CHAPTER 2

Airfield Demand Capacity and Facility Requirements

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Missoula International Airport Master Plan Update

Prepared for

Missoula County Airport Authority

August 2008

CH2MHILL

Contents

Exhibits

CHAPTER 2

Demand Capacity and Facility Requirements

2.1 Introduction

Federal Aviation Regulations (FAR) Part 139, *Airport Certification,* governs the certification and operation of federally funded airports served by air carrier aircraft, such as Missoula International Airport. These regulations specifically address aircraft rescue and firefighting operations, aircraft refueling, snow and ice control, pavement maintenance, and required runway and taxiway marking, signage, and lighting. In addition to FAR Part 139 operational and safety requirements, this chapter incorporates FAA Advisory Circular (AC) 150/5300-13, *Airport Design* and FAR Part 77 to determine existing facility deficiencies and to identify facilities required to accommodate the forecast demand. Lastly, FAA AC 150/5200-37, *Introduction to Safety Management Systems (SMS) for Airport Operators*, is also reviewed.

In the previous chapter, *Aviation Forecast*, aviation activity demand forecasts were developed for MSO through 2028. These results will be used to determine the airport's ability to accommodate the forecast aviation demand and to identify the facilities that will be required to meet forecast demand through the 2028 planning period. The full range of options available to remedy identified deficiencies is considered in *Airfield Alternatives Analysis*.

The facility requirements analysis is presented for the major elements of land use at MSO:

- Airfield Facilities
- General Aviation (GA) Facilities
- Surface Transportation and Parking
- Support Facilities

Terminal facilities are evaluated separately in Chapter 3, *Passenger Terminal Demand Capacity and Facility Requirements*. The full range of options available to remedy identified deficiencies is considered in Chapter 5, *Passenger Terminal Alternatives Analysis*.

2.1.1 Airport Reference Code

The FAA has established a set of airport design classifications, known as the airport reference code (ARC), that applies to airport runway and taxiway components. The primary determinants of these classifications are the operational and physical characteristics of the most demanding types of aircraft expected to use the runway and taxiway system, and the instrument approach minimums applicable to a particular runway end. To be considered as the basis for planning, an aircraft or group of aircraft must operate regularly, defined as 500 or more annual operations (equivalent to 250 departures and 250 landings). Each ARC consists of two components relating to aircraft design and performance. The first runway length component, depicted by a letter, is the aircraft approach category, as determined by the approach speed of the design aircraft. The second component, depicted by a Roman numeral, is the Airplane Design Group (ADG), as determined by the design aircraft's wingspan and tail height. **Table 2-1** summarizes the FAA aircraft classifications as listed in AC 150/5300-13, Change 13, *Airport Design*. Typical aircraft in each aircraft approach category and ADG are shown in **Exhibit 2-1 and Exhibit 2-2.**

TABLE 2-1
FAA Aircraft Classifications

Aircraft Approach Category		Airplane Design Group		
Category	Approach Speed (knots)	Design Group	Tail Height (ft)	Wingspan (ft)
A	< 91	I	< 20	< 49
B	91 < 121	II	20 < 30	49 < 79
C	121 <141	III	30 < 45	79 < 118
D	141 < 166	IV	45 < 60	118 < 171
E	> 166	V	60 < 66	171 < 214
		VI	66 < 80	214 < 262

Source: FAA AC 150/5300-13, Change 13, *Airport Design.*

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Prior to the development of the *Aviation Forecast*, the ARC for Runway 11/29 was C-IV, and Runway 7/25 was identified as B-I, Small aircraft only. As discussed previously, ARCs are defined for runways based on the forecasted design aircraft, which can change over time. This is the case with MSO, as shown in Exhibit 1-34 in the *Aviation Forecast* chapter, where the critical aircraft for Runway 11/29 has changed. **Based on the FAA-approved forecast fleet mix, the ARC for MSO through 2028 is C-III for Runway 11/29 and B-I, Small-aircraft-only for Runway 7/25. Although the forecast justifies a C-III ARC, existing separation safety standards which are designed to C-IV specifications should be maintained. Additionally, Runway 7/25 fulfills B-I design standards, and therefore should be maintained.** This is consistent with the FAA's Northwest Mountain ADO recommendation that air carrier airports should not have small-aircraft-only runways, regardless of Regular Use.[1]

2.1.2 Airfield Capacity

The purpose of this analysis is to determine the level of aviation activity that can be accommodated by the existing airfield system, and identify the need for additional capacity based on forecast demand outlined in Chapter 1.

[1] Meeting Summary: Discussions with FAA's Northwest Mountain Region representative, October 29, 2008.

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Aircraft Approach Category	Representative Aircraft		
A			• Cessna 150 • Dassault 941 • DC 3 • Dash 8
B			• Embraer 326 • Cessna Citation III • BAE 146 - 100 • DC 7
C			• Learjet 25 • Gulfstream G III • MD 88 • Boeing 707 - 320
D			• Gulfstream IV • BAE RJ 100 • Airbus 310 • Boeing 777
E			• SR 71

Source: F.A.R. PART 77.25 "Civilian Airport Imaginary Surfaces"

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Airplane Design Group	Representative Aircraft		
I			• Cessna 150 • Embraer 121 • Piper 400 LS • Learjet 25
II			• Embraer 110 - Bandeirante • Saab SF 340 • Cessna Citation VI • Grumman Gulfstream II
III			• McDonnell Douglas DC 3 • BAE 146 - 200 • Boeing 737 - BBJ • MD 88
IV			• McDonnell Douglas DC 7 • Airbus 310 • Boeing 777 • Boeing 767 - ER
V			• Boeing 747 - SP • Boeing 747 - 200 • Airbus 330 - 200 • Airbus 340 - 500
VI			• Antonov 124 • Lockheed C - 5B

Source: F.A.R. PART 77.25 "Civilian Airport Imaginary Surfaces"

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Methodology

Airfield capacity is defined as the maximum number of aircraft operations that an airfield can accommodate during a specific period of time and operating condition. The FAA methodology for assessing airfield capacity is defined in AC 150/5060-5, *Airport Capacity and Delay*. This and the FAA's Airport Capacity Model software are used to analyze the airfield requirements by computing hourly capacity, annual service volume (ASV), and average aircraft delays. The FAA Capacity Model uses general assumptions for the purposes of computing hourly capacity and average delays including: (1) arrivals equal departures, (2) touch-and-go operations are less than 20 percent[2], (3) a full-length parallel taxiway is in place, (4) ample runway entrance/exit taxiways exist, (5) airspace is not constrained, (6) at least one runway is equipped with an ILS, (7) IFR weather occurs approximately ten percent of the time, (8) and approximately 80 percent of the time the airport is operated with the runway-use configuration that produces the greatest hourly capacity.

Factors Affecting Capacity

The capacity of an airfield system, including the runways and associated taxiways, is not constant over time. The following factors affect airfield capacity and were considered in the analysis.

- **Runway configuration in use**

MSO's runway configuration is one of the most significant factors affecting airfield capacity, as aircraft operations on either runway are considered dependent on operations on the other runway. Airports with intersecting runways may in some cases improve airfield capacity through the use of Land-and-hold-short-operations (LAHSO). LAHSO allows for an arrival and/or departure to occur on one runway independent of aircraft arrivals on the intersecting runway, where sufficient landing distance exists. However, LAHSO operations are not utilized at MSO. Due to the dependency between the runways, the single-runway configuration was used for this analysis.

- **Number and location of runway exits (or exit taxiways)**

MSO's airfield is equipped with a full-length parallel taxiway, ample runway entrances and exits, and no taxiway crossing problems. Taxiway layout is discussed later in this chapter, however for capacity purposes, the taxiway system does not have shortcomings that significantly reduce the capacity of the airfield.

- **Weather conditions (i.e. the percentage of time the airport experiences poor weather conditions with low cloud ceilings and low visibility conditions)**

MSO experiences below Category I minimums approximately 1.2 percent of the time on an annual basis.[3] This is not significant enough to decrease the capacity of the airfield.

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[2] Based on a Mix Index [%(C+3D)] of 51 to 80.

[3] MSO Airport Layout Plan Update, 2004.

- **Aircraft fleet mix**

From the forecast, it was determined that approximately one percent of MSO's aircraft operations were performed by Class D aircraft while approximately 48 percent of aircraft operations were performed by Class C aircraft. The remaining 51 percent of operations were performed by a combination of Class A and Class B aircraft. The FAA provides a means of determining a Fleet Mix Index as a way of reflecting fleet diversity. Typically, a higher mix index results in a greater separation between aircraft, therefore lessening the overall airfield capacity. Based on the forecast fleet mix, MSO's fleet mix index of 51 is calculated as follows:

Mix Index = %(C+3D)

therefore:

MSO Mix Index= %(48+3*1)

MSO Mix Index= 51%

- **Touch and go operations**

Touch and go operations account for approximately less five percent of total operations.[4]

The estimated peak hour capacities for the existing airfield given current demand and the operating conditions and assumptions listed above are shown in **Table 2-2**.

TABLE 2-2
Capacity and Delay Calculations for Long-range Planning

	2007	2013	2018	2028
C & D Mix Index	51%	51%	51%	51%
VFR Hourly Capacity	63	63	63	63
IFR Hourly Capacity	56	56	56	56
ASV	**205,000**	**205,000**	**205,000**	**205,000**
Annual Demand	53,174	62,555	67,495	77,852
Percent ASV	26%	31%	33%	38%
Average Delay Per Aircraft	Less than one minute			

Note: Single runway configuration was assumed for this analysis (#1 from FAA AC 5060-5).
Prepared by: CH2M HILL, 2008.

As shown, without any capacity improvements to the existing airfield, the projected annual aircraft activity by 2028 will represent 38 percent of the MSO ASV. The FAA recommends that airports plan for runway capacity improvements at between 60 and 75 percent of ASV; **therefore capacity improvements are not required at MSO within the planning period of this MPU.**

Peak Hour Demand

Peak month, peak month average day (PMAD), and PMAD peak hour for passenger aircraft operations and total aircraft operations as determined from the Forecast are shown in **Table 2-3**. These projections are used to determine facility requirements within this chapter.

[4] MSO Tower Interview, 2008.

TABLE 2-3
Peak Daily Demand and Capacity

Passenger Aircraft					Total Aircraft Operations			
Year	Passenger Operations	Peak Month	PMAD	PMAD Peak Hour	Total Operations	Peak Month	PMAD	PMAD Peak Hour
2007	14,041	1,391	45	7	67,216	5,822	185	15
2013	16,072	1,516	49	8	62,555	5,390	174	15
2018	17,833	1,682	54	9	67,495	5,820	188	16
2028	21,709	2,048	66	11	77,852	6,726	217	19

Source: MSO Forecast, 2008.

Prepared by: CH2M HILL, January 2008.

2.2 Airfield Facility Requirements

2.2.1 Evaluation of MSO Design Standards

The FAA promulgates design standards which are published in FAA AC 150/5300-13. **Table 2-4** shows the FAA required dimensions and the existing dimensions at MSO. This section discusses the design criteria in more detail and identifies existing nonstandard conditions. In some cases, recommendations for correcting any nonstandard conditions are made, and remaining remedies are identified in the alternatives chapter.

TABLE 2-4
Runway Dimensional Standards

		Existing Dims.			Existing Dims.	
Design Criteria (feet)	C-III Dims.	11	29	B-I Dims.	7	25
Runway Width	150’ 1/	150’		60’	75’	
Runway Safety Area						
- Width	500’	500’	500’	120’	120’	120’
- Length Beyond Runway End	1,000’	1,000’	1,000’	240’	240’	240’
Runway Object Free Area						
- Width	800’	800’	800’	250’	250’	250’
- Length Beyond Runway End	1,000’	1,000’	350’	240’	240’	240’
Runway Protection Zone						
- Inner Width	1,000’	1,000’	1,000’	250’	250’	250’
- Outer Width	1,750’	1,750’	1,750’	450’	450’	450’
- Length	2,500’	2,500’	2,500’	1,000’	1,000’	1,000’
Runway Obstacle Free Zone						
- Width	400’	400’	400’	250’	250’	250’
- Length Beyond Runway End	200’	200’	200’	200’	200’	200’

Source for Existing Dimensions: 2004 Airport Layout Plan.

Source for Standard Dimensions: FAA AC 5300-13, Change 11, *Airport Design.*

1/ The FAA recommended runway width for DG III is 100 feet, except for runways serving aircraft with a maximum certificated takeoff weight greater than 150,000 pounds, in which case the recommended runway width is 150 feet.

Prepared by: CH2M HILL, 2008.

Runway Safety Area (RSA)

The RSA is the FAA’s most restrictive protection surface associated with the runway and is defined as land surrounding the runway that serves to reduce the risk of death or injury to aircraft occupants in the event of an undershoot, overshoot, or excursion from the runway. The RSA is centered on the runway centerline and must be:

- Capable of supporting airport rescue and firefighting equipment, snow removal equipment, and aircraft under dry conditions
- Free of objects, except those fixed by function and mounted on low-impact-resistant supports
- Cleared, graded, and free of hazardous surface violations
- Properly drained

FAA Order 5200.8, "*Runway Safety Area Program*", established the objective that all federally obligated and Part 139 certificated[5] airports (such as Missoula International Airport) shall have RSAs that conform to the standards contained in AC 150/5300-13, *Airport Design,* to the extent practicable. **The RSAs for both runways meet FAA standards.**

Runway Obstacle Free Zone (OFZ)

The OFZ is the volume of airspace along the runway and the extended runway centerline that is required to be clear of objects in order to provide clearance protection for aircraft takeoff and landing. The OFZ clearing standards preclude taxiing and parked airplanes and object penetrations, except for frangible NAVAIDs that are fixed by function. **The OFZs for both runways meet FAA standards.**

Precision Object Free Zones (POFZ)

The POFZ is defined as a volume of airspace above an area at the end of the runway threshold elevation and aligned with the runway centerline. The POFZ is 800 feet wide (400 feet from centerline) and extends 200 feet beginning at the runway threshold. **Currently Runway 11 is equipped with precision approaches and meets the FAA's POFZ requirements. Runway 29 does not currently require a POFZ; however the addition of a POFZ, as recommended in the NAVAIDs section, would not impact surrounding facilities.**

Inner-Approach OFZ

An Inner-Approach OFZ exists when a runway is equipped with an approach lighting system. The inner approach OFZ is at the same elevation as the OFZ, but starts 200 feet away from the runway threshold. The Inner-Approach OFZ retains the same width as the OFZ and slopes upward at a rate of 50 to 1 before terminating 200 feet beyond the last light in the approach lighting system. **The Inner-Approach OFZ on Runway 11 meets FAA standards.**

Runway Object Free Area (OFA)

The purpose of the OFA is to enhance the safety of aircraft operations by maintaining the area free of objects. The OFA is centered on the runway centerline and must be cleared of all above-ground objects, except those fixed by function (such as taxiway signs, aircraft in movement) that protrude above the OFA edge elevation. Unlike the RSA, the OFA is a

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[5] 14CFR Part 139, *Airport Certification,* establishes certification requirements for airports serving scheduled air carrier operations.

geometrical plane and may overlie open water or rough terrain and need not be able to support the weight of an aircraft or other airport vehicles. **The OFAs for both runways meet FAA standards.**

Extended OFA

The FAA encourages airports to extend the OFA to the maximum extent feasible. The extended OFA begins at the end of the OFA, and terminates at the end of the RPZ or the end of the airport property line, whichever comes first. The extended OFA should be clear of all objects, including buildings, parking facilities, and automobiles. **The Extended OFAs for both runways at MSO meet FAA standards.**

Runway Protection Zone (RPZ)

The RPZ is an area on the ground or the surface of water that is trapezoidal in shape and centered on the extended runway centerline. The purpose of the RPZ is to protect people and property on the ground rather than to protect aviation, and as such should be free of land uses that would house or attract large numbers of people within its boundaries such as churches, schools and hospitals. RPZ dimensions are contingent on the size of the design aircraft currently ARC C-III and ARC B-I as well as the type of approach capability of the runway.

The FAA also recommends that airports acquire the land within the RPZ so that land uses can be controlled. **With the exception of the Runway 25 end, where an easement is in place, MSO fully owns all RPZs.**

The following facilities or land uses are within the RPZs:

- **Highway 10 West crosses through the Runway 25 RPZ.**
- **A controlled airport access road traverses the entire width of the Runway 7 RPZ.**
- **The Runway 11 RPZ has multiple controlled airport access roads, as well as a firing range shelters located within it. These facilities should be removed out of the RPZ.**
- **The Runway 29 RPZ also has controlled airport access roads located within it.**

Taxiway Safety Area

The main function of the taxiway safety area is to support airport rescue, fire fighting, and snow removal equipment, and the occasional passage of aircraft, without causing structural damage. Similar to the RSA, the taxiway safety area must be:

- Cleared and graded and have no potentially hazardous ruts, humps, depressions, or other surface violations
- Drained by grading or storm sewers to prevent accumulation of water
- Free of objects not fixed by function

Runway 11/29 has a complete parallel taxiway system in place consisting of Taxiway A. Other important taxiways include: Taxiway G which provides access to the approach end of Runway 7 and a direct route for Aircraft Rescue and Fire Fighting (ARFF) to access the airfield; Taxiway F connects the terminal apron with Taxiway A; Taxiway E connects the center of the terminal apron area with Taxiway A. **The taxiway safety areas meet standards.**

Taxiway Object Free Area

Taxiway and taxilane OFA clearing standards prohibit service vehicle roads, parked airplanes, and above-ground objects, except those fixed by function within its parameters. The taxiway object free areas have the following infringements:

- An electrical vault off Taxiway D meets the applicable Group III standards (186 feet wide); however should the airport ever upgrade to Group IV (259 feet wide), the electrical vault would be an infringement.
- A service road off Taxiway A near the end of Runway 11 is in the Group III Taxiway OFA.

It is recommended that this service road is moved outside of the taxiway OFA.

2.2.2 Runway Line of Sight

FAA AC 150/5300-13 requires that an unobstructed line of sight exist from along any two points on half of a runway, if the runway is equipped with a parallel taxiway. This criterion applies to Runway 11/29 at MSO. An analysis of the runway centerline profile found that the five-foot line of sight is violated by approximately 0.78 feet. This will noted in the ALP as a violation. **It is recommended that the violation is remedied at the time of a future full-depth reconstruction of Runway 11/29.**

2.2.3 FAR Part 77 – Objects Affecting Navigable Airspace

FAR Part 77, *Objects Affecting Navigable Airspace,* establishes standards for determining obstructions to navigable airspace, sets forth the requirements for notice to the FAA for certain proposed construction or alteration activities, and provides for the identification of obstructions to air navigation. These standards apply to existing and manufactured objects, objects of natural growth (trees), and terrain. If an object is an obstruction to Part 77 it should be removed, but this is not always achievable or feasible. Part 77 obstructions that cannot be removed are subject to an FAA airspace study using the *Terminal Procedures Order* (TERPS) to determine if the object is a Hazard to Air Navigation and the appropriate action to be taken. Hazards that cannot be removed usually are lighted and sometimes result in restrictions on the instrument approach procedures at an airport (such as night approach minimums). As the airport sponsor, MCAA has the responsibility of clearing and protecting the runway approaches. Additionally, it is recommended that the airport coordinate with local agencies to place reasonable restrictions on the land uses in the immediate vicinity of the airport through the use of such measures as the adoption of zoning ordinances.

Several "imaginary" surfaces are established under Part 77 with relation to the airport and to each end of a runway to help determine whether an object is a potential obstruction to air navigation. These include the primary, horizontal, conical, approach, and transitional surfaces, all of which are depicted in **Exhibit 2-3**. The dimensions of these imaginary surfaces are relative to the type of approach and weight of the aircraft that is forecast to use the runway.[6] The dimensions for the imaginary surfaces related to Runway 11/29 at Missoula International Airport are based on a Precision Instrument (PIR) approach with visibility minimums lower than 3/4 statute mile, and aircraft that are heavier than 12,500 pounds. The dimensions of Runway 7/25 are based on a Visual approach, Category A (Utility Runways).

Descriptions of each Part 77 surface include:

- *Primary Surface:* The primary surface is the most restrictive surface and exists on the ground that surrounds a runway. The primary surface for Runway 11/29 measures 1,000 feet in width (500 feet from the runway centerline) and extends 200 feet beyond the runway ends. Runway 7/25 primary surface measures 250 feet in width (125 feet from the runway centerline) and extends 200 feet beyond the runway ends.

  Primary Surface obstructions at MSO:

  - **The Runway 29 end has a fence in the primary surface, as shown in Exhibit 2-4. It is recommended that the fence is relocated outside of the primary surface.**

- *Approach Surface:* The precision instrument approach surfaces begin off the ends of the runway at the end of the primary surfaces. The inner width is the same width as the primary surface and increases to 4,000 feet wide at an upward slope of 50 to 1 as it extends for 10,000 feet along the extended runway centerline. The Precision Instrument approach surface on Runway 29 extends an additional 40,000 feet beyond the initial 10,000 approach segment at a 40 to 1 slope increasing to a width of 16,000 feet. The Visual-A approach surface for Runway 7/25 begins at the ends of the runway where the primary surface end. The inner width is the same as the primary surface and increases to a width of 1,250 feet at a 20 to 1 slope as it extends for 5,000 feet along the extended runway centerline.

  Approach Surfaces obstructions at MSO:

  - Runway 11 end has two obstructions in the approach surface, as shown in **Exhibit 2-5**. **It is recommended that these obstructions are relocated outside of the Part 77 surface.**
  - Runway 7 has a road below the approach surface. **This road clears the 20:1 Part 77 approach by a minimum of 10 feet, therefore no actions are recommended.**
  - Runway 11 has a road below the approach surface. This road clears the Part 77 surfaces by the required 10 feet, so no actions are necessary. This road is also marked by signs. **No actions are recommended.**
  - Runway 29 has a road below the approach surface. This road clears the Part 77 surfaces by the required 10 feet, and the road is also marked by signs. **No actions are recommended.**
  - The Wye Mullan West Comprehensive Area Plan, discussed later in this chapter, is proposed to traverse airport property, but outside of the RPZ. Assuming the

[6] Note: Part 77 is not associated with AC 150/5300-13, Change 12 and therefore does not use the ARC system to identify standards.

proposed road location does not change, it clears the Part 77 surfaces by the required 15 feet for a public roadway that is not an Interstate Highway. **Therefore no actions are recommended.**

- *Transitional Surface:* The transitional surface extends outward and upward along the side of the runway starting at the edge of the primary and approach surfaces at a slope of 7 to 1 up to the horizontal surface.
  - **No objects penetrate the transitional surface.**
- *Horizontal Surface*: The horizontal surface is an imaginary plane that overlies the Airport at 150 feet. The perimeter of the horizontal surface is constructed by swinging arcs from the end of the primary surface of each runway, and connecting each arc by lines tangent to them.
- *Conical Surface*: The conical surface extends outward and upward from the edge of the horizontal surface at a slope of 20 to 1 for 4,000 feet.

  Obstructions to the Horizontal and Conical Surface
  - **The high mountain terrain surrounding the airport creates multiple obstructions to the horizontal and conical surfaces. No action is recommended.**

Airport Topography

Complete topography information for the airport is unavailable, and the NGS official terrain information is significantly different from actual surveyed elevations from recent work on Runway 11/29. The variation ranges from one foot, up to 17 feet, therefore NGS contours cannot be adjusted to match the surveyed information. Additionally, reflecting the NGS contour elevations in this analysis for road clearance elevations and in the ALP creates false information in areas of important spot elevations. **Therefore, it is recommended that complete topographic information is updated for the airport and adjacent areas.**

2.2.4 Navigational Aids

Runway approaches/instrumentation, lighting, and other navigational aids (NAVAIDs) provide pilots with the necessary means to navigate their aircraft safely and efficiently in most weather conditions. Since the FAA plans to duplicate or replace ILS procedures with new technologies by 2020, and minimize the role of ILS, this section provides an overview of new NAVAID technologies. Additionally, this section reviews existing and programmed precision, nonprecision, and visual approaches at MSO, and makes recommendations to optimize airport accessibility during lower weather minimums.

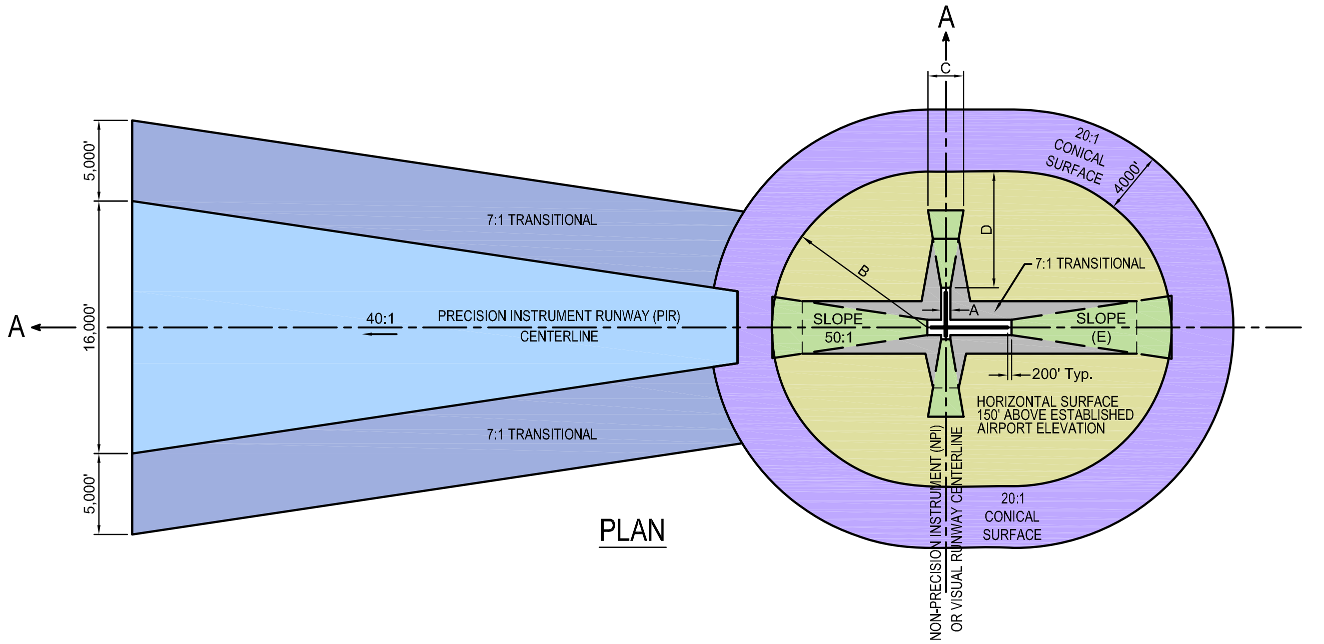
Navigational Aids Technologies

The FAA's Next Generation (NextGen) program provides a combination of technologies to produce a GPS-based navigation system. Wide Area Augmentation System (WAAS) is a backbone of the NextGen program, which is comprised of three elements: a constellation of GPS satellites emitting signals and navigational data, a ground control network monitoring and enhancing the accuracy or integrity of the signal, and user equipment receiving the signal. WAAS provides refined position, velocity, and time data for most of North America, and eliminates the need for pilots to fly from one ground NAVAID to another, allowing flexible navigation, and increasing airport capacity and accessibility.

RNAV, or Area Navigation, is a component of the NextGen system that pertains to in-flight navigation as well as approach and departure navigation. RNAV approaches increase accessibility to airports by allowing lower minima and by providing instrument approaches to airports that could not support such procedures previously. RNAV approaches can provide:

- Nonprecision guidance through WAAS-enabled lateral navigation (LNAV)
- Approaches with Vertical guidance (APV[7]) through lateral and vertical guidance comparable to a conventional precision approach, such as ISL.

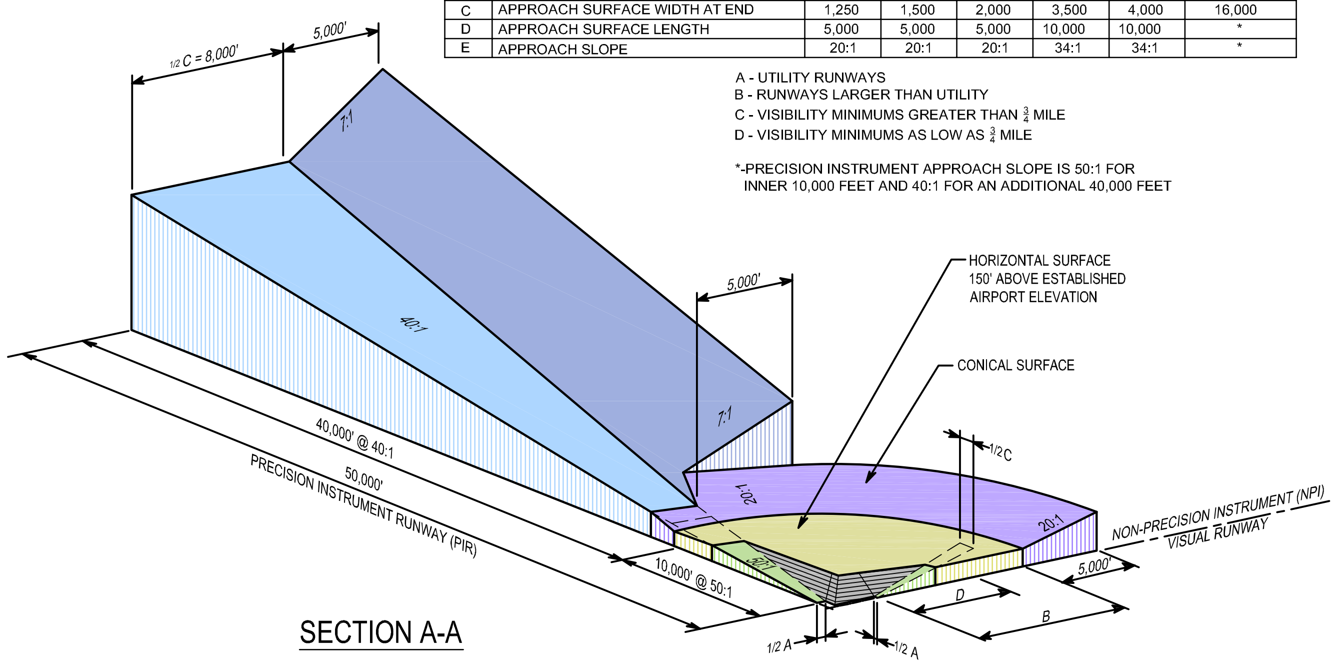
[7] Approach with Vertical guidance, defined in AIM 5-4-5(7-b), does not currently meet the international standards set by the ICAO for precision approach, yet its accuracy and attainable minimums meet FAA standards and merit categorical separation from nonprecision approaches.



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

A - UTILITY RUNWAYS
B - RUNWAYS LARGER THAN UTILITY
C - VISIBILITY MINIMUMS GREATER THAN $\frac{3}{4}$ MILE
D - VISIBILITY MINIMUMS AS LOW AS $\frac{3}{4}$ MILE

*-PRECISION INSTRUMENT APPROACH SLOPE IS 50:1 FOR INNER 10,000 FEET AND 40:1 FOR AN ADDITIONAL 40,000 FEET



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F.A.R. PART 77 IMAGINARY SURFACES

Exhibit 2-3

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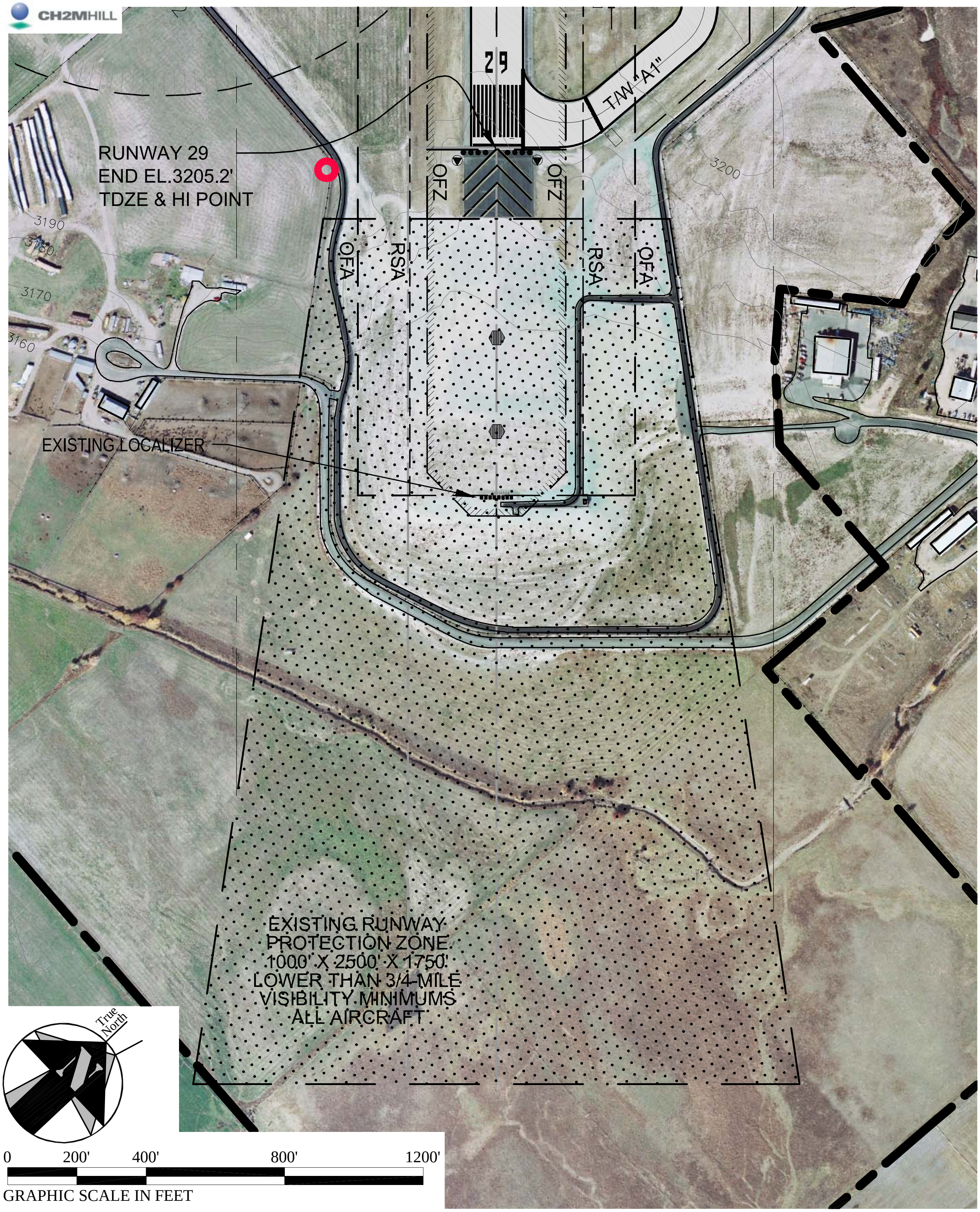

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Missoula Airport
Master Plan Update

Existing Obstructions
Runway 29

Exhibit

2-4

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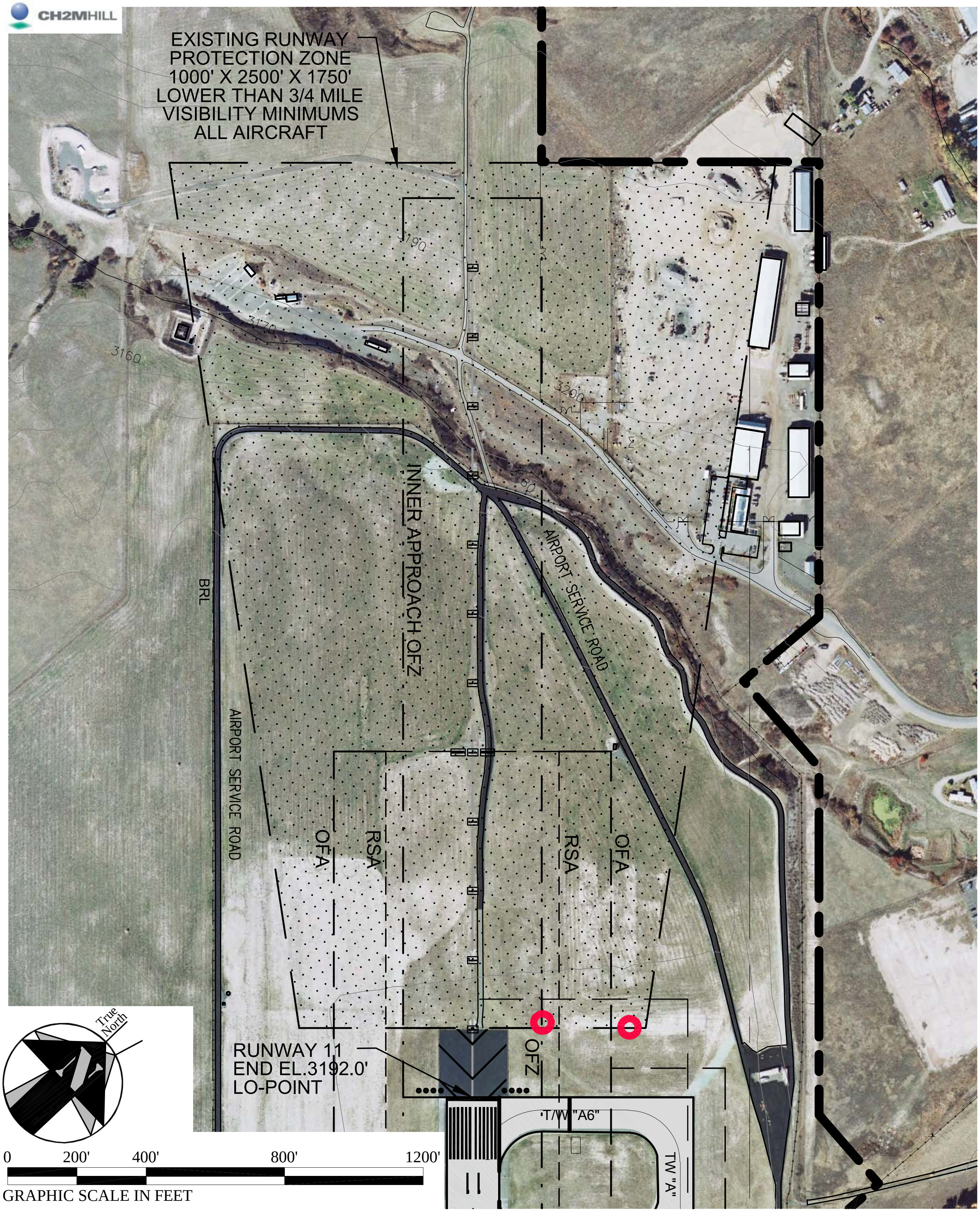

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Missoula Airport
Master Plan Update

Existing Obstructions
Runway 11

Exhibit

2-5

Unlike an ILS, certain APVs are able to provide Category I approaches without the need for any equipment located at the airport. The types of RNAV approaches currently available are shown below in **Table 2-5.**

TABLE 2-5
RNAV Approaches

Approach	Type	Visibility Minimum (Mile)
LNAV	Nonprecision	WAAS lateral guidance only
LNAV/VNAV	APV[2]	WAAS lateral guidance, airport localizer for vertical guidance
LPV[1]	APV	WAAS lateral and vertical guidance
RNAV/RNP	APV	Required Navigation Performance. WAAS lateral and vertical guidance with onboard performance and alert-capable navigation equipment. May include aircrew certification.

Source: FAA
1/ The term RNAV is occasionally used interchangeably with LPV (Localizer Performance with Vertical Guidance), although RNAV encompasses a variety of approaches.
2/ Approaches with Vertical guidance (APV) provide lateral and vertical guidance comparable to a precision approach.

Prepared by: CH2M HILL, 2008

Another NAVAID technology is the Local Area Augmentation System (LAAS), which is under development and will provide very high accuracy approach guidance via a VHF signal broadcast. Research and development continues to refine LAAS so that it can provide Category II and Category III approaches, and inadequate information is available to recommend improvements. It is likely, however, that RNAV approaches using WAAS will be sufficient for MSO and that a LAAS will not be needed.

Precision/APV Approach Capability at MSO

Precision approach NAVAIDs assist aircraft performing precision instrument approach procedures by providing course and glide slope information to a point just beyond the approach end of the runway. Existing and programmed precision approaches are outlined in **Table 2-6**. The Special ILS on Runway 11 is available to pilots who have been granted permission by the FAA to use it. To use the programmed RNAV (RNP) approach, aircraft will need to be equipped with performance monitoring and alert-capable navigation equipment, and depending on the complexity of the approach, aircrew may be required to hold certain flight performance qualifications. The airspace survey required to define the RNAV (RNP) for MSO has already been conducted. The results of the obstruction survey are summarized in the FAR Part 77 section of this chapter.

TABLE 2-6
MSO Precision Approach Procedures

Approach	Ceiling Minimum (AGL)	Visibility Minimum (Mile)
Existing Approaches		
Runway 11 ILS (SPECIAL)[1]	200'	1/2
Runway 11 ILS[2]	1,350'	5
Programmed Approaches		
Runway 11 RNAV/RNP[2]	TBD	TBD
Runway 29 RNAV/RNP[2]	TBD	TBD

1/ Source: FAA MSO Tower
2/ Source: FAA - AVN: Instrument Flight Procedures (IFP) Production Plan, November 2008
Prepared by: CH2M HILL, 2008

With the programmed approaches shown in Table 2-6, the precision capability of MSO is adequate. It is important these procedures are finalized and published to provide redundant capability on Runway 11. An additional instrument approach is recommended on Runway 29 for the following reasons:

Weather Patterns – Fog

According to the air traffic control tower (ATCT), the approach to Runway 11/29 can quickly become covered in a low-lying fog, changing conditions from VFR to IFR within minutes. The fog usually rolls in on the Runway 11 (ILS) side of the runway, creating a low runway visual range (RVR), often making the instrument approach unusable. **An additional precision approach on the Runway 29 side would help to maintain airport access during low-visibility weather.**

Runway Utilization

As shown in **Table 2-6**, Runway 29 is used some 85 to 90 percent of the time during all weather conditions, followed by Runway 11, at 7-10 percent of the time. These data support the requirement for introducing an instrument approach to Runway 29. Strictly during IFR conditions, Runway 11 has a higher utilization rate than Runway 29.

TABLE 2-7
Runway Utilization

Runway	Use
29	85-90%
11	7-10%
25	3%
7	-

Source: MSO Tower, Interview

Prepared by: CH2M HILL, 2008

The smaller demand for Runway 7/25 suggests that another instrument approach to this runway would not be a significant benefit. Discussions with ATCT confirm this. In addition, the mountainous terrain on the Runway 25 end impacts nonprecision approach surfaces, and would most likely result in high minimums that would further limit the potential benefit.

Wind Coverage

As shown in **Table 2-8**, Runway 29 provides slightly better wind coverage than Runway 11.

TABLE 2-8
IFR Runway Wind Coverage

Runway	10.5 knots	13 knots	16 knots	20 knots
Runway 11	89.14%	89.40%	89.67%	89.71%
Runway 29	91.47%	91.89%	92.32%	92.59%

Source: 2004 ALP Update; NOAA National Climatic Data Center; Station 72773, Missoula International Airport, Montana; Period of Record 1990-1999.

Prepared by: CH2M HILL, 2008.

Nonprecision Approaches

Nonprecision approach NAVAIDs assist aircraft performing instrument approach procedures by providing course bearing guidance to a point near the runway environment. MSO currently has a Very High Frequency Omnidirectional Range (VOR) facility located on the field. This facility provides support for nonprecision VOR instrument approaches as well as enroute and terminal navigation support. MSO's VOR is equipped with distance measuring equipment (DME) for Runway ends 11 and 29. In addition to VOR facilities, MSO maintains a nonprecision GPS approach for Runway 29, and a RNAV (GPS) for Runway 11, as displayed in **Table 2-9** below.

TABLE 2-9
Nonprecision Approach Procedures

Approach	Ceiling Minimum (feet AGL)	Visibility Minimum (Mile)
Existing Approaches		
Runway 11 RNAV (GPS)[1]	2,220	1 1/4
Programmed Approaches		
Runway 11 RNAV (GPS)	TBD	TBD
Circling Approaches		
GPS-D	1,915	1 1/4
VOR/DME or GPS-A	1,859	1 1/4
VOR/DME or GPS-B	1,299	1 1/4

Source: NACO: Digital Terminal Procedures Publication, November 2008

Source: FAA - AVN: Instrument Flight Procedures (IFP) Production Plan, November 2008
Prepared by: CH2M HILL, 2008

An additional RNAV (GPS) approach for Runway 11 is scheduled to be released August 2009. **The nonprecision approaches at MSO are adequate to support the airport's mission; however satellite-based technology should be explored as options to duplicate older technology.**

Visual Approach Aids

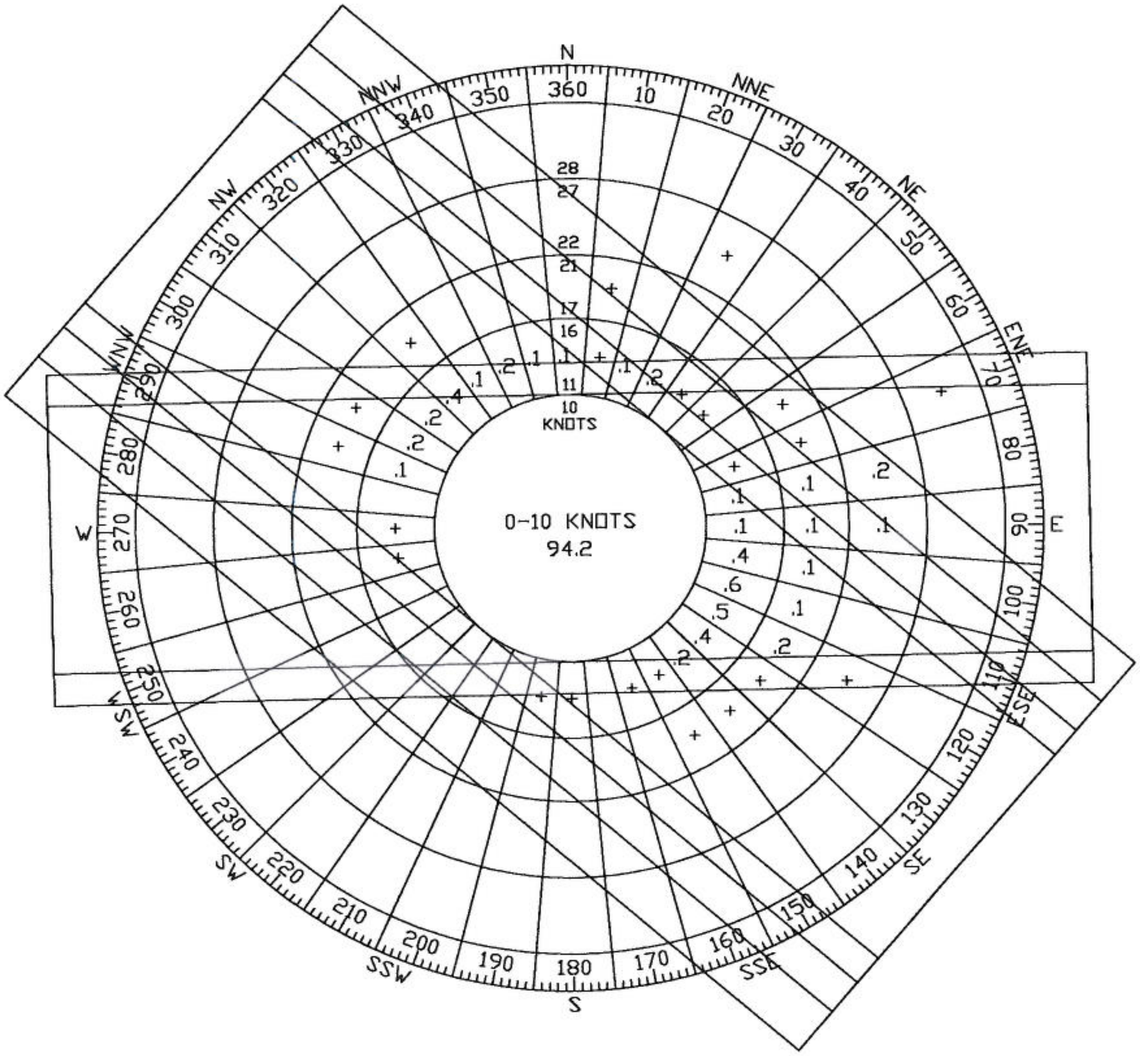
Visual approach NAVAIDs provide aircraft guidance once an aircraft is within sight of an airport and aid in the transition from flight to approach, and to landing. Runway 11 is equipped with a precision approach path indicator (PAPI) and Medium-Intensity Approach Lights (MALSR) with sequenced flashers. Runway 29 is also equipped with a PAPI and runway end identifier lights (REILs). **With the implementation of new approach procedures on Runway 29, adding approach lighting would attain lower minimums, and therefore should be considered. The remaining lighting systems are adequate to support MSO's mission.**

Airfield Lighting

The lighting system aids in the transition from the instrument approach to touch-down, the most critical point of landing. Runway 11/29 is equipped with high intensity runway lights (HIRL) and Runway 7/25 is equipped with medium intensity runway lights (MIRL). The edge lights, runway end identifier lights, signs, and airfield lighting control system associated with Runway 11/29 were replaced in 2007, and the lead in (LDIN) approach lights were demolished. Additionally, the lights and signs associated with Runway 7/25 are scheduled for replacement in 2008. **Beyond these improvements, no action is recommended.**

Prepared by:

CH2MHILL



SOURCE: 2004 ALP update

NOTE: National Oceanic and Atmospheric Administration, National Climatic Data Center, Station 72773, Missoula International Airport, Montana. Period of Record: 1990-1999.

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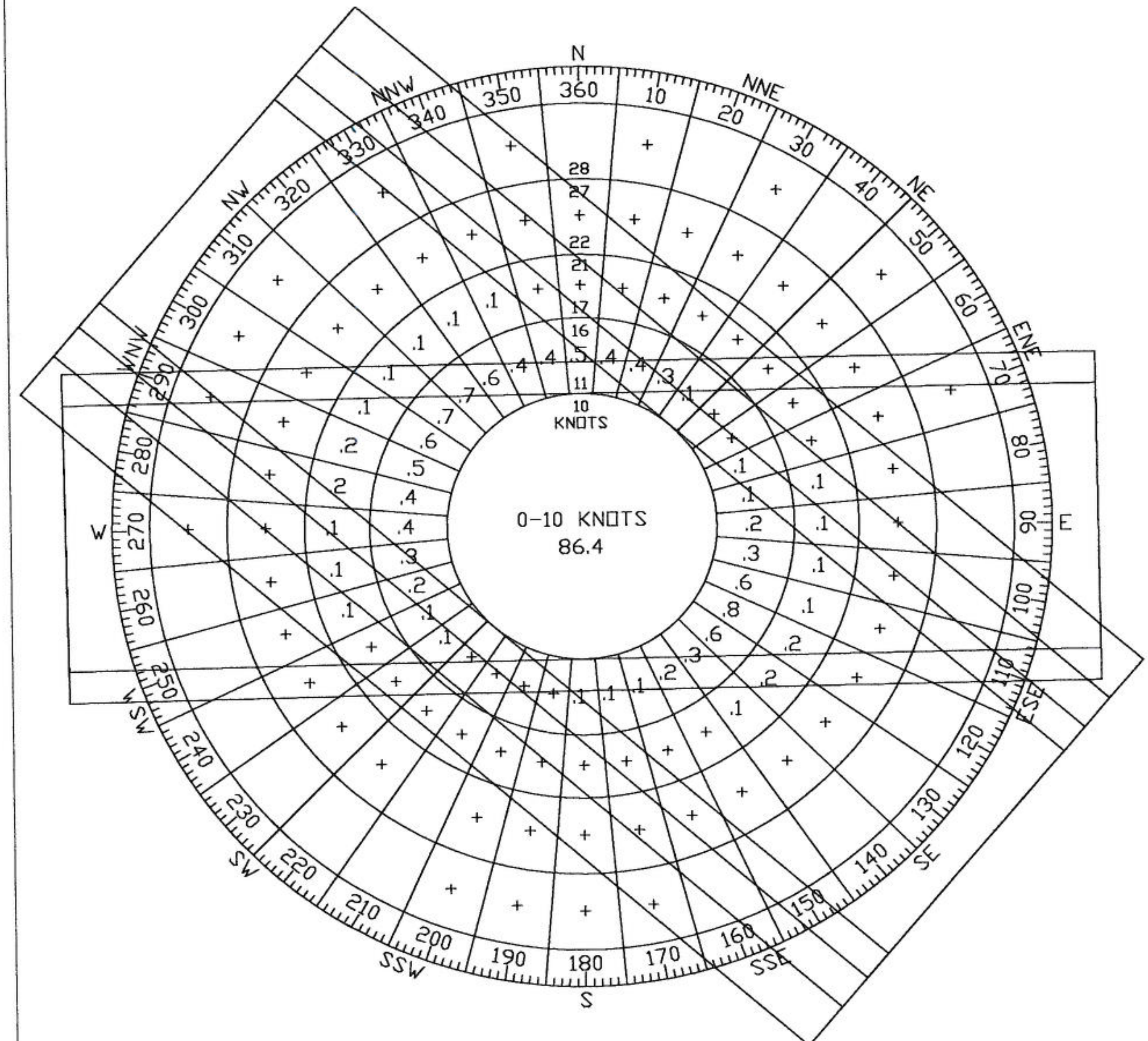
Missoula Airport Master Plan Update	IFR Windrose	Exhibit 2-6

Prepared by:

CH2MHILL



SOURCE: 2004 ALP update

NOTE: National Oceanic and Atmospheric Administration, National Climatic Data Center, Station 72773, Missoula International Airport, Montana. Period of Record: 1990-1999.

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Missoula Airport Master Plan Update		All Weather Windrose	Exhibit 2-7

2.2.5 Runway Length

The length of Runway 11/29 is 9,501 feet and the runway length of Runway 7/25 is 4,612 feet.

Methodology

FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design* provides guidance on determining runway lengths. For airports serving aircraft over 60,000 pounds, such as MSO, runway length is calculated for the most demanding aircraft that regularly operates at the airport, known as the critical aircraft[8]. The FAA defines a "regular use" as a minimum of 500 annual operations, or 250 departures.

The MSO Aviation Forecast identifies the top short-range, mid range, and long-range air service markets for MSO, in addition to identifying the fleet mix and historic load factors. The forecast results reflect new aircraft orders by various airlines serving the airport, local trends observed at MSO, industry trends and publications, aircraft retirements and planned acquisitions, and projected trends defined by Boeing and Airbus aircraft manufacturers. Finally, the future fleet mix aircraft types were also verified with current airline flight schedules for MSO's top markets, and include:

- MD 80
- MD 90-30
- CRJ 700
- Airbus 320
- Airbus 319
- De Havilland Q 400 Dash 8Q
- 737-500
- 737-300
- B 737-700

At high temperatures, the relative density of the air decreases, which causes a decrease in aircraft performance and corresponding increase in required runway length. The average high temperature at MSO is 87.7 degrees Fahrenheit during months of July and August[9]. Therefore, runway length requirements for MSO were evaluated according to "hot day" conditions.

Additionally, airport elevation affects required runway length in that the higher the elevation, the longer the distance required. The relative density of the air decreases as elevation increases. MSO's airport elevation of approximately 3,200 feet was used in this analysis.

[8] Landing length requirements for GA aircraft are generally shorter and therefore are not included
[9] Source: NOAA Comparative Climatic Data Publication, 2005.

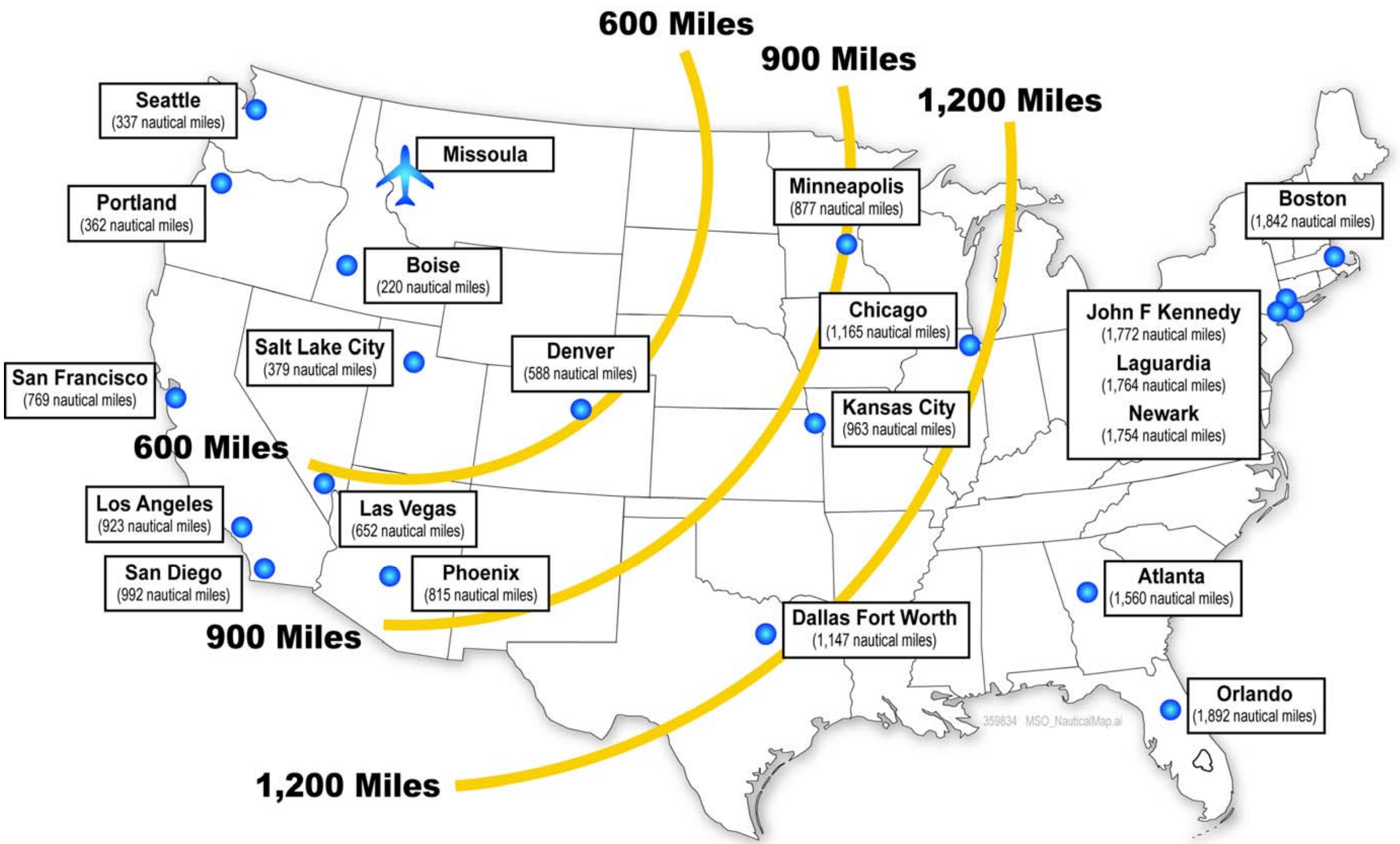
Take-Off Runway Length Requirements

Aircraft Stage Lengths

Take-off runway length requirements were calculated based on the distances representative of existing and likely future nonstop markets obtained from the Forecast. Aircraft flight distance is important because the required fuel load can make up a significant portion of aircraft weight and therefore affect the takeoff length needed. Three distances were selected as representative for the purposes of the calculations in this analysis: 600 nautical miles, 900 nautical miles, and 1,200 nautical miles as summarized below. Representative distances are shown in **Exhibit 2-8**.

- ✈ Short-range stage length (up to 600 nautical miles), encompasses the majority of existing nonstop destinations, including the following markets:
  - Boise (BOI)
  - Seattle (SEA)
  - Portland (PDX)
  - Salt Lake City (SLC)
  - San Francisco (SFO)
  - Denver (DEN)
- ✈ Medium-range stage length (between 600 nautical miles and 900 nautical miles), representative of existing nonstop market destinations including:
  - Las Vegas (LAS)
  - Phoenix (PHX)
  - Los Angeles (LAX)
  - San Diego (SAN)
  - Minneapolis (MSP)
- ✈ Long-range stage length (greater than 900 nautical miles), representative of existing nonstop markets being served from MSO:
  - Atlanta (ATL)
  - Chicago (MDW)

EXHIBIT 2-8
Stage Lengths



Prepared by: CH2M HILL, 2008

Take-off Length Requirements

The take-off length requirements for air carrier and regional jet aircraft with destinations of 600, 900, and 1,200 nautical miles under hot day conditions are shown in **Exhibit 2-9**. The take-off runway length requirements for serving these markets are: [10]

- 8,800 feet for short-range stage lengths up to 600 nautical miles, driven by aircraft such as the 737-900
- 9,300 feet for medium-range stage lengths up to 900 nautical miles, driven by aircraft such as 737-900
- 10,250 feet for mid- to long-range stage lengths up to 1,200 nautical miles, driven by aircraft such as the MD-80

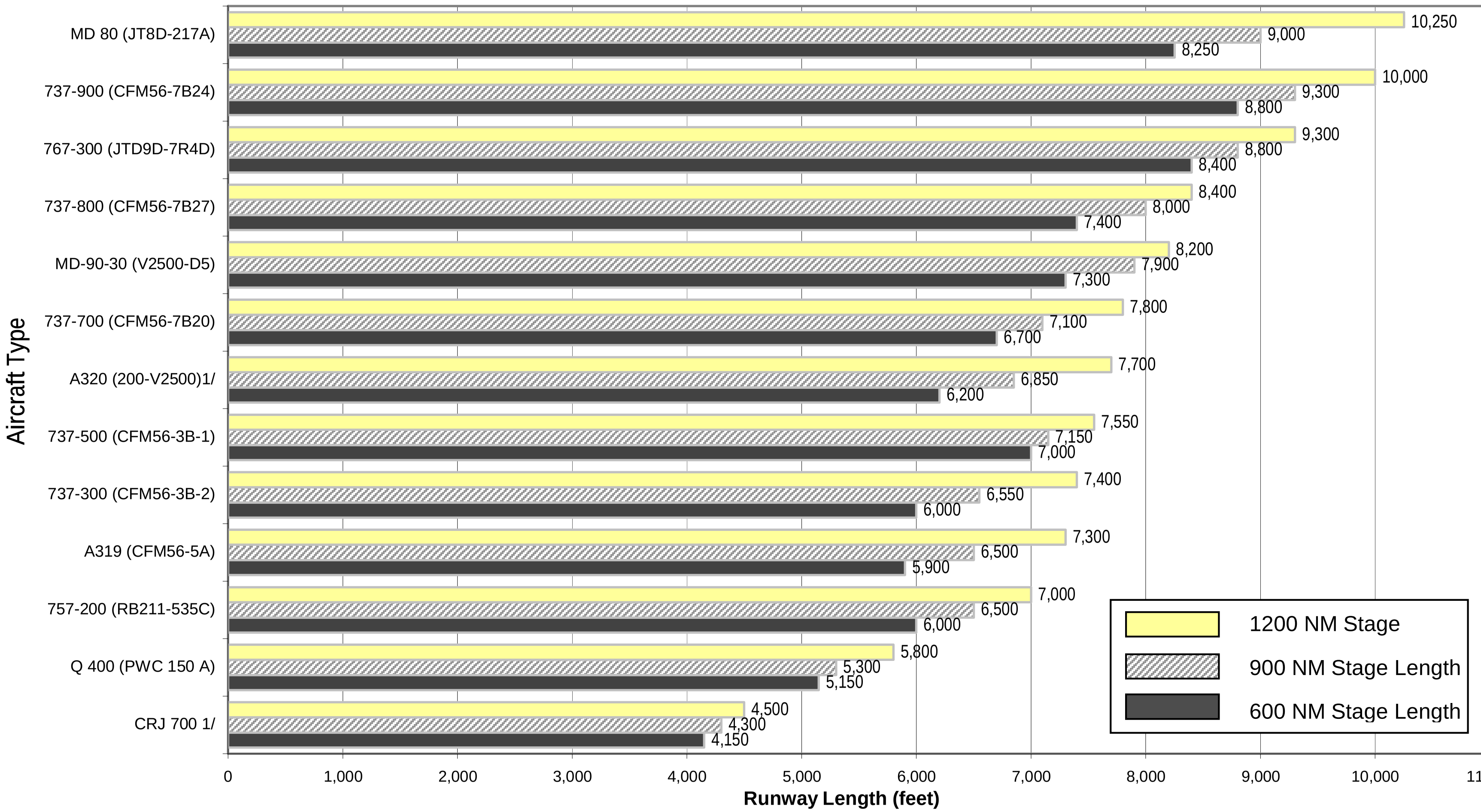
As shown, the existing runway length at MSO (9,501 feet) is adequate to accommodate the forecast aircraft under most conditions. Under the most stringent conditions, hot day and long destination range, the MD-80 and 737-900 may be required to reduce payload to depart from MSO. **An increase in runway length is not recommended.**

Landing Runway Length Requirements

Runway length requirements for landing operations were derived based on the maximum aircraft landing weight and least stringent flap settings for both wet and dry pavement conditions. The MD-80 is the most demanding aircraft requiring 6,300 feet because the aircraft is projected to operate more than 500 times per year by 2028. Additionally, the A320, 737-800, and 737-900 require between 6,400 to 6,900 feet when landing during wet conditions, however these aircraft are not projected to perform 500 or more operations per year at MSO. **Exhibit 2-10** shows the landing length requirements for air carrier and regional jet aircraft. Other aircraft types are not included because they require similar or shorter lengths to land. **The runway length at MSO is adequate to accommodate landing aircraft forecast in the fleet mix over the 20-year planning period.**

[10] *MSO Aviation Forecast*, April, 2008 (approved by the FAA on June 25, 2008).

EXHIBIT 2-9
Aircraft Take-off Runway Length Requirements



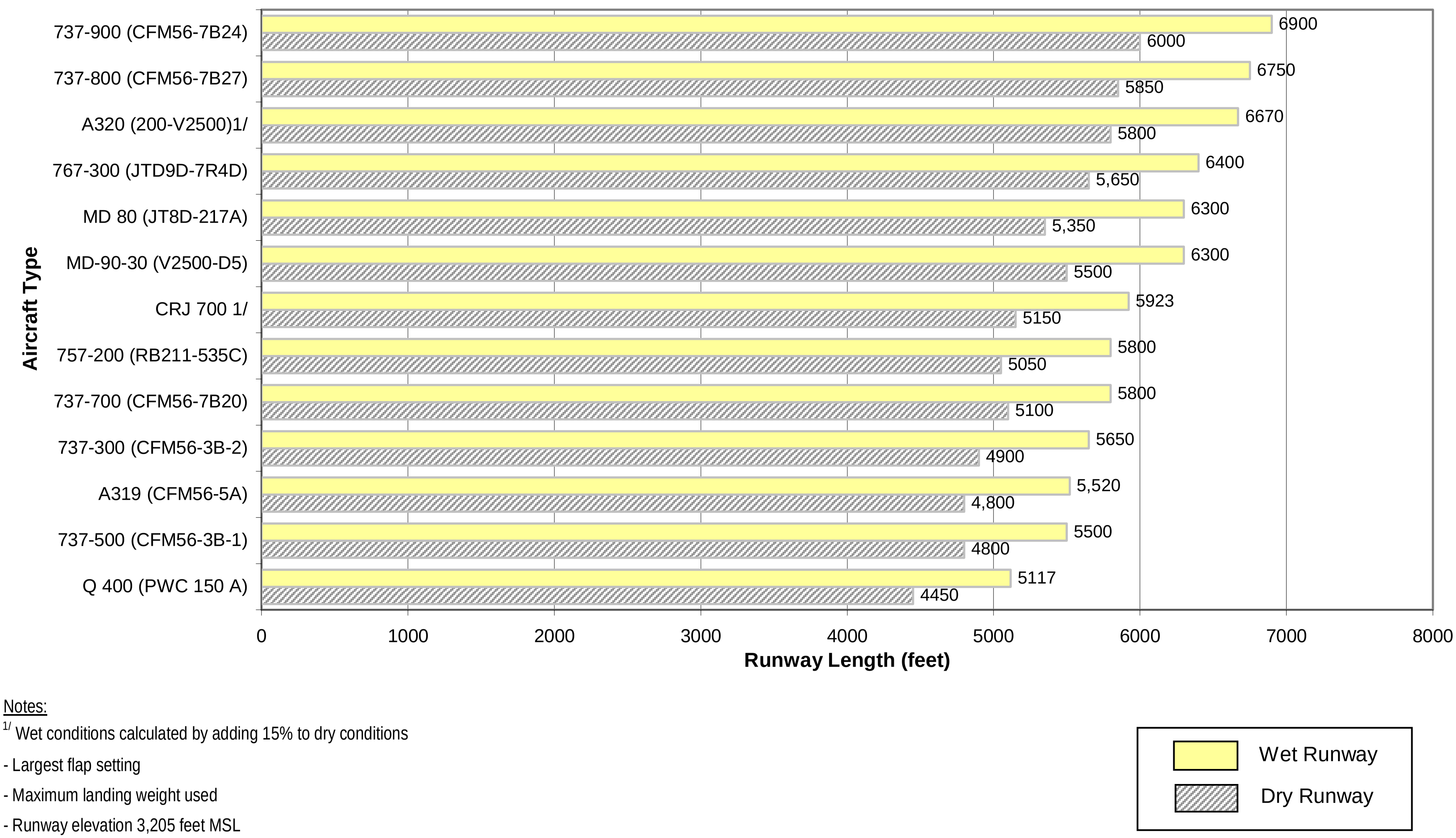
Notes:
[1/] Takeoff weight assumes 92% MTOW for 1200 NM, 89% MTOW for 900 NM and 86% MTOW for 600 NM

Runway elevation 3205.2 feet MSL
Aircraft manufacturers data
Standard day + 27 degrees (F)

757-200 Standard day + 25 degrees (F)
767-300 standard day + 33 degrees (F)
Q 400 Takeoff flaps set at 5 degrees

Source: Aircraft Manufacturer's Characteristics Manuals
Prepared by: CH2M HILL, 2008

EXHIBIT 2-10
Aircraft Landing Runway Lengths in Wet and Dry Conditions



Notes:
[1/] Wet conditions calculated by adding 15% to dry conditions
- Largest flap setting
- Maximum landing weight used
- Runway elevation 3,205 feet MSL
- Source: Aircraft Manufacturer's Characteristics Manuals

Source: Aircraft Manufacturer's Characteristics Manuals
Prepared by: CH2M HILL, 2008

2.2.6 Airfield Pavement Evaluation

Refer to **Appendix D** of the Master Plan Update for a complete aircraft pavement analysis, including a recommended short term (0 to 5 years) and medium term (5 to 10 years) pavement rehabilitation schedule.

2.2.7 Taxiway System

Runway exits and taxiways connect aircraft movement and nonmovement areas and therefore are important components of the efficient flow of traffic on the ground. The need for additional supporting taxiway infrastructure and the location of existing taxiways is evaluated in this section.

Parallel Taxiways

Runway 11/29 is supported by full parallel Taxiway A, located 600 feet from centerline to centerline. **This taxiway separation distance exceeds the minimum separation by 200 feet and is adequate to serve the largest fleet of aircraft that use MSO.** This separation should be maintained because it is also an adequate separation distance to accommodate future high-speed taxiway exits.

Runway 7/25 is not supported by a parallel taxiway; however, sufficient routing around to the runway ends does exist. **Development of a future parallel runway, however, is not recommended for this runway due to the low utilization rate of approximately 3-5 percent.**

Taxiway Exit Location

Seven existing taxiway connectors join Taxiway A to Runway 11/29. The distances of all exit taxiways from the Runway 11 and 29 ends are shown in **Table 2-11**, along with the percentage of Category C aircraft accommodated. **As shown, existing exit taxiway layouts are adequately spaced to accommodate existing and projected C-III aircraft.**

TABLE 2-10
Approximate Taxiway Exit Location

Taxiway Exit	Distance From 29 End (ft) 1/	Percent of C Aircraft Accommodated 2/ 3/	Distance From 11 End (ft) 1/	Percent of C Aircraft Accommodated 2/ 3/
A1	-	-	9,400	100
A2	540	0	8,950	100
A3	2,550	0	6,950	88
E (future extension)	3,800	1	5,700	37
F (future extension)	4,750	8	4,740	8
G (extension)	5,500	27	3,520	0
A4	7,200	93	2,180	0
A5	9,160	100	330	0
A6	9,460	100	-	-

1/ Distance to center of taxiway.
2/ Percentages are approximate.
3/ Wet runway conditions.
Prepared by: CH2M HILL, 2008.

High-speed Exit

High-speed (acute-angled) exits aid in the quick exit of aircraft from the runway. These exits contribute to increased capacity of the runway system by allowing aircraft to exit the runway at a faster pace, which reduces runway occupancy time.

A design peak hour flow of 30 operations or more is the minimum recommended by the FAA in AC 5300-13 before considering the use of high speed (acute angle) exit taxiways to improve traffic flows**. MSO does not have a forecast peak hour activity of 30 operations, however acute angled taxiways are recommended toward the end of the planning period to facilitate tanker aircraft operations.**

Taxiway System Layout – Opportunities to Enhance Safety

The FAA has issued guidelines designed to reduce the number of runway incursions by avoiding airfield layouts that do not discourage incursions. Following the guidelines in *Engineering Brief No. 75: Incorporation of Runway Incursion Prevention into Taxiway and Apron Design* (EB-75)[11], potential areas of improvement at MSO include:

1. **Taxiway E intersection at Runway 7/25.** Conduits that form a straight line to an active runway increase the risk for a runway incursion. This is also the intersection of three pavements-- Taxiway E, Parallel Taxiway A, and Runway 7/25.
2. **Taxiway crossing of Runway 7/25.** The intersection of this taxiway across Runway 7/25 increases the risk for pilots to inadvertently cross an active runway.
3. **Runway 7/25 intersection to Runway 11/29**. The active Runway 7/25 can be confused as a high-speed exit.
4. **Taxiway A-3 and Taxiway G access to Runway 11/29.** The straight access that Taxiway A-3 and Taxiway G provide to Runway 11/29 increase the risk for pilots to taxi across Taxiway A and onto the active runway.
5. **Taxiway E access to the terminal apron.** With connection through Runway 7/25, Taxiway E provides direct, unimpeded access to the terminal area from Runway 11/29.

Taxiway Flow

The proposed GA/FBO expansion area located near the Minuteman facility requires landside access. The recommended landside access in this chapter transverses Taxiway G and prevents aircraft from accessing anything east of Taxiway G, and vice versa. This requires that two-way traffic, consisting of high-speed critical tanker operations and slower GA aircraft share the taxiway, calling for increased coordination by pilots and the MSO ATCT. In addition, it may result in the delay of tanker operations. **To segregate this traffic and provide two-way access to the USFS, it is recommended that dual access is provided along Taxiway G.**

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[11] EB-75 was released by the FAA on November 19th, 2007 to inform the aviation community of changes forthcoming with the new comprehensive revisions to Advisory Circular 150/5300-13, which is hoped to be completed within 18 months of EB-75's release date.

Taxiway Width

The MSO airfield was designed to ARC C-IV standards. The MSO Aviation Forecast projects smaller, C-III aircraft as the design aircraft. Even with detailed analysis to investigate the latest data available, there remains a high degree of uncertainty and volatility in the airline industry. Therefore, in order to afford MSO the highest level of flexibility and to account for the possibility of larger C-IV aircraft driving the standards in the future, it is recommended that taxiways continue to be designed with a Group IV separation. However, taxiway widths should be designed to Group III specifications. With the exception of the following taxiways, all taxiways meet the Group IV separation requirement and the Group III width requirement:

- Taxiway G segment between Runway 11/29 and Taxiway A does not meet Group III width requirements at approximately 40 feet.
- Taxiway G segment between Runway 7/25 and Runway 11/29 does not meet Group III width requirements at approximately 40 feet.
- Taxiway leading to the Metro Aviation hangar off Taxiway G does not meet Group III width requirements at approximately 40 feet.

With the exception of the taxiway segment between Runway 7/25 and Runway 11/29, these taxiways should be widened to Group III standards (50 feet).

EXHIBIT 2-11
EB-75 Taxiway Focus Areas

KEY
Existing pavement
Proposed pavement

Note: Drawing not to scale.
Source: Aerial Photography, October 2007.
Prepared by: CH2M HILL, 2008

2.3 General Aviation Facility Requirements

This section assesses and makes recommendations for GA facilities, including FBO facilities, vehicle parking, corporate hangars, and T-hangars. Apron requirements for both FBOs are evaluated in the Apron section of this chapter.

2.3.1 Fixed Base Operators

MSO is served by two full-service fixed base operators (FBOs), Minuteman and Northstar/Neptune, located in opposite areas of the airfield. Minuteman's main facilities are located on the west side of the terminal, but Minuteman also has additional hangars on the east side of the terminal. Northstar/Neptune is located in the far northeast corner of the airfield, near the fuel farm. Both FBOs have expressed the need for additional facilities to meet their 20-year requirements. This section projects requirements based on a comparison with the Aviation Forecast and FBO input, specifically:

Minuteman:

- Add a helicopter refueling, parking, and maneuvering area
- Replace a maintenance hangar to be demolished as part of the landside access improvements
- Replace tie downs lost as part of the landside access improvements
- Add a maintenance hangar to accommodate anticipated demand
- Replace T-hangars to be demolished as part of the landside access improvement
- Replace and increase apron size (evaluated in Apron section)

Northstar/Neptune:

- Add multiple hangars to house future tanker aircraft
- Double the size of the existing maintenance facility
- Increase apron size (evaluated in Apron section)

In addition to these requirements, Homestead Helicopters, Inc. is projected to need one additional hangar of the same size as the existing hangar.

Rotary Wing

Minuteman has expressed the need for a designated area to park, fuel, and maneuver rotary-wing aircraft. Helicopters include the Bell Jet Ranger, Long Ranger, and Coast Guard helicopters. The location should be based on the largest helicopter serviced which is a Coast Guard aircraft. **Based on conversations with the FBO, a pad that accommodates two helicopters is sufficient to satisfy demand. This pad should be sited to accommodate a Bell 210, which has a main rotor diameter of 48 feet.**

Tie-downs

Minuteman will be losing approximately 14 aircraft tie-down positions due to the future landside access improvements. In addition to replacing these, Minuteman has expressed that additional tie-downs are needed to accommodate based and transient aircraft. **The need for additional tie-down apron space will be included in the analysis of based and transient aircraft in the apron requirements section.**

Maintenance Hangars

Due to the landside access improvement project, Minuteman will need to replace an existing 180 by 200-foot maintenance hangar which will be demolished. Additionally, the FBO forecasts the need for another 180 by 200-foot maintenance hangar within the planning period to satisfy their business plan.

Northstar/Neptune also anticipates multiple 200 by 200-foot hangars that are capable of housing future aircraft models.. **It is anticipated that approximately four 200 by 200-foot hangars would accommodate the future aircraft, allowing for pull through parking. Additionally, Northstar/Neptune anticipates demand to double the existing maintenance facility – an additional hangar of approximately 200 by 160 feet.**

Corporate and T-hangars

The addition of the landside access improvement requires the demolishing of approximately 32 of Minuteman's T-hangars which are located west of the public and employee parking lots. These hangars need to be replaced. The *Long-term Concept Sketch Plan* was completed in January 2008 to identify locations for GA development. The GA Steering Committee is responsible for implementing the plans detailed in this document and designs are underway for the plot of land located off the end of Runway 29. The design accommodates 17 hangars that will be available for occupancy during the winter of 2008. In addition to replacing the remaining 15 T-hangars, there is demand for T-hangars and corporate hangars forecast throughout the planning period. **An initial survey conducted by the GA Steering Committee reveal the need for 39 additional T-hangars, nine corporate stand-alone hangars that house one aircraft, and six corporate stand-alone hangars that house two to four aircraft, as shown in Table 2-12.**

TABLE 2-11
Hangar Survey Results

	T-hangar	Stand Alone Hangar - 1 Aircraft	Stand Alone Hangar - 2-4 Aircraft
Own for private use	14	9	3
Own & lease to others	8		3
Lease for private use	4		
Replace lost	13		
Total:	**39**	**9**	**6**

Source: Gary Matson, April 2007 survey results.
Notes: This chart does not include the 17 T-hangars presently under development.
Prepared by: CH2M HILL, 2008.

Automobile Parking

Both FBOs have adequate parking for existing facilities. Operationally, the Minuteman parking facility is segregated from the airside, and is segregated so that it does not infringe on future development. The parking for the Northstar/Neptune facility is also segregated from airside access, but at a higher inconvenience. A large amount of fencing is required to keep the landside and airside segregated, and the location of the parking area in the middle of the facility makes expansion of the lot and surrounding apron and hangar areas difficult.

The Northstar/Neptune facility parking area should be evaluated to determine the most operationally efficient location.

Third FBO

Local conditions dictate the need for additional FBOs; however given the MSO forecast of almost 48,000 operations in 2028, consideration for a third FBO within the planning period is unlikely.

TABLE 2-12
FBO and General Aviation Aircraft Operations Summary

Airport	FBOs	General Aviation Operations (2006) 1/
Missoula International Airport (MSO)	Minuteman	31,123
	Northstar	
Glacier Park International (GPI)	Glacier Jet Center	35,788
Tampa International Airport (TPA)	Raytheon	40,307
	Jet Center	
Baton Rouge (BTR)	Executive Aviation	63,516
	PAI Aero	
	Louisiana Aircraft	
Page Field Airport (FMY)	Page Field Aviation Center	73,540
Boca Raton Airport (BCT)	Boca Aviation	81,003
	Avitat Boca Raton	
White Plains (HPN)	Panorama Flight Service	120,113
	Million Air	
	Signature Flight Support	
	Avitat Westchester	
	Landmark Aviation	
Newport News (PHF)	Rick Aviation	144,641
	Atlantic	

1/ Source of GA Operations: FAA TAF, February 2006.
Prepared by: CH2M HILL, 2008.

2.3.2 Apron Requirements

Apron requirements include areas used for access and parking of based and itinerant aircraft not stored in hangars. Existing ramp area for the two FBOs is shown in **Table 2-13 and Exhibit 2-14.** This accounts for the 19,000 square yards of apron that will be lost upon construction of the long-term parking access layout (21,350 total square yards, less building areas). The locations evaluated in the remaining sections total approximately70,000 square yards. A separate apron analysis will be completed for Minuteman area and Northstar/Neptune area due to the variations in based aircraft.

TABLE 2-13
Existing Apron Area

Location	Total Area (square yards)
Minuteman - Area One [1/]	22,000
Minuteman - Area Two	17,000
Northstar/Neptune - Area Three	48,555
Total Area	**87,555**

1/ Does not include approximately 19,000 square yards lost through parking.
Prepared by: CH2M HILL, 2008

The total requirements were determined through the forecast type and quantity of aircraft, compared to existing ramp space. Aircraft demand was determined for the ramps during a busy day of the peak month, as recommended in FAA AC 150/5300-13, Change 13, to reflect real "busy day" conditions.

Based Aircraft Ramp Needs

Based aircraft ramp requirements were determined based on the Forecast and supplemented by the based GA fleet mix described in the July 2005 Part 150 Update, and through discussions with airport tenants. However, it was necessary to determine how many based aircraft were not stored in hangars, as based aircraft not stored in hangars are typically accommodated on the ramp. A conservative estimate is approximately 65-70 percent of the based aircraft at Minuteman, and 75 percent of the Northstar/Neptune aircraft are not stored in hangars.

Aircraft space requirements reflect square yardage that includes area for ingress and egress of aircraft, circulation area, and a separation of 10 feet between aircraft. The weighted average of all aircraft types for Minuteman is approximately 1,100 square yards (shown in **Table 2-15**), and 2,000 square yards for Northstar/Neptune. The space requirement for Northstar/Neptune is larger due to the larger based aircraft, such as the P-2.

TABLE 2-14
GA Operations by Type

Aircraft	Percent Operations	2028 Apron Space Requirements (square yards)
Single-Engine	65%	870
Multiengine	15%	960
Turboprop	16%	1,730
Business Jet	5%	2,540
Weighted average:		**1,097**

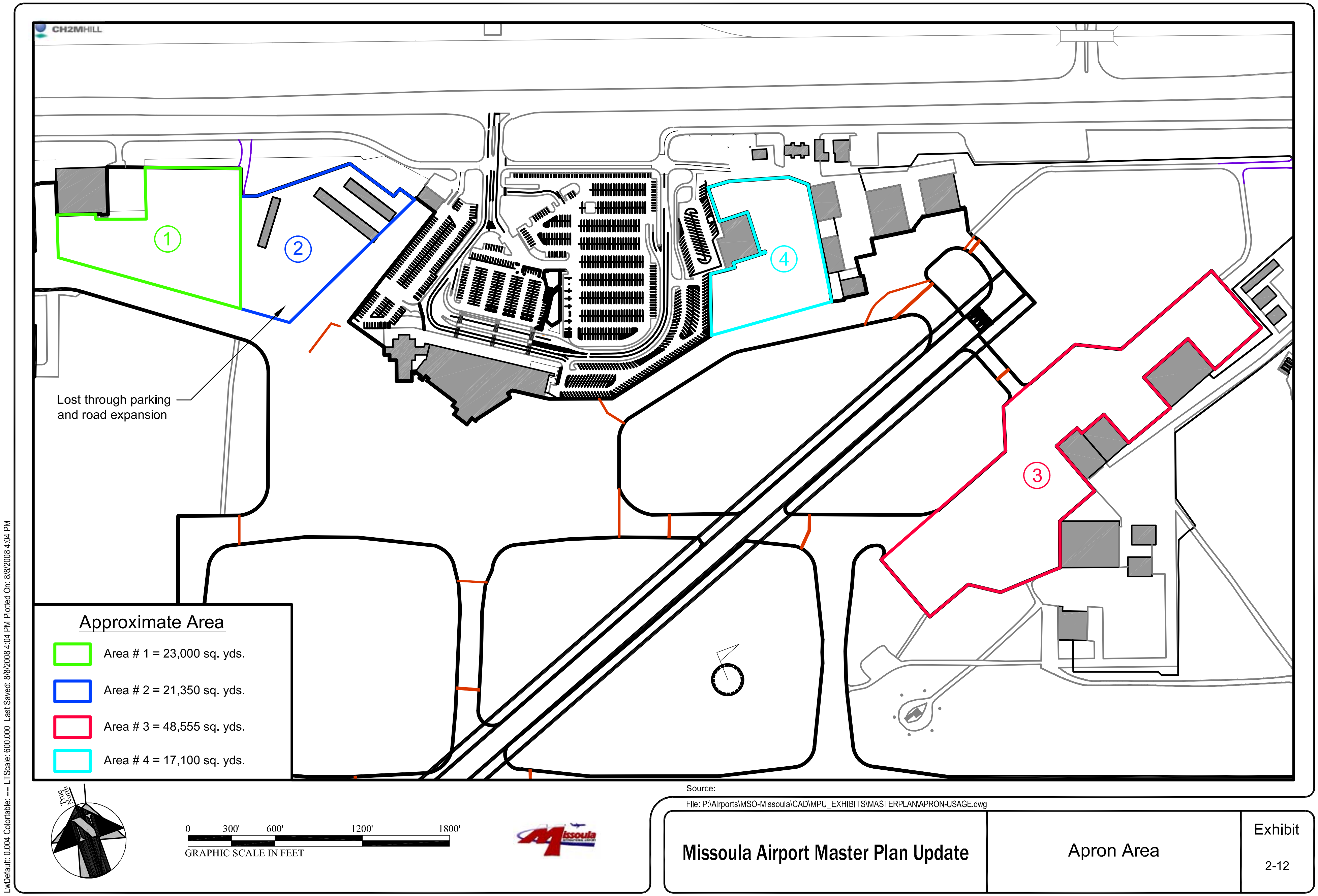
Source: MSO FAR Part 150 Update, July 2005.
Notes: Percentages may not add to 100 due to rounding.
Prepared by: CH2M HILL, 2008.

Based aircraft ramp requirements are summarized in **Table 2-15**.

TABLE 2-15
Based Aircraft Ramp Requirements

	2007	2013	2018	2028
Total Forecast Based Aircraft	101	141	151	172
Minuteman Based Aircraft	65	92	98	112
Total aircraft not stored in hangars (70 percent)	46	64	69	78
Approximate Area per Aircraft (sq. yards):	1,100			
Ramp Required (square yards)	**50,361**	**70,767**	**75,782**	**86,032**
Northstar/Neptune Base Aircraft	35	49	53	60
Total aircraft not stored in hangars (75 percent)	26	37	40	45
Approximate Area per Aircraft (square yards.):	2,000			
Ramp Required (square yards)	**52,826**	**74,231**	**79,492**	**90,243**

Prepared by: CH2M HILL, August 2007.


CH2MHILL
1
2
3
4
Lost through parking
and road expansion
Approximate Area
Area # 1 = 23,000 sq. yds.
Area # 2 = 21,350 sq. yds.
Area # 3 = 48,555 sq. yds.
Area # 4 = 17,100 sq. yds.
True North
0 300' 600' 1200' 1800'
GRAPHIC SCALE IN FEET
Source:
File: P:\Airports\MSO-Missoula\CAD\MPU_EXHIBITS\MASTERPLAN\APRON-USAGE.dwg
Missoula Airport Master Plan Update
Apron Area
Exhibit
2-12
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Transient Aircraft Ramp Needs

Transient ramp requirements for both FBOs were based on the fleet mix and assumed apron space requirements per aircraft as specified above in **Table 2-17,** a weighted average of approximately 1,100 square yards**.**

Historically, MSO GA operations are approximately 65 percent itinerant. It is assumed that a busy day would be 10 percent more active than the average day. Finally, a conservative estimate is that 50 percent of these aircraft would be on the ground at once. As shown in **Table X-X,** a busy day has 99 operations, representing approximately 50 aircraft.

TABLE 2-16
Transient Aircraft Ramp Requirements

	2007	2013	2018	2028
Annual GA and Military Operations	32,891	39,898	42,683	48,375
Daily Operations [1/]	90	109	117	133
Busy Day [2/]	99	120	129	146
Aircraft using Ramp [3/]	50	60	64	73
Transient A/C [4/]	32	39	42	47
Maximum Transient A/C [5/]	16	17	19	20
Transient Ramp Required (square yards)	17,550	18,647	20,841	21,938
Minuteman Ramp Deficiency (70 percent)	**12,285**	**13,053**	**14,589**	**15,357**
Northstar/Neptune Ramp Deficiency (30 percent)	**5,265**	**5,594**	**6,252**	**6,581**

1/ Annual operations divided by 365.
2/ Daily operations multiplied by 10 percent to account for busy day conditions.
3/ Assumes 50 percent of busy day aircraft are on ground at one time
4/ Assumes 65 percent of the operations are transient.
5/ Operations divided by two equates to the number of aircraft.
Prepared by: CH2M HILL, 2008.

Total Aircraft Ramp Needs (Transient and Based)

As shown in the following tables, MSO has an overall ramp deficiency today. By the end of the planning period, Minuteman is expected to need just over 43,000 square yards of total apron, which does not include the need to replace approximately 19,000 square yards of apron lost through the landside access improvements. Currently, it shows that on the busiest days, Minuteman is about 4,500 square yards deficient. These requirements are shown in **Table 2-17**. Northstar/Neptune will need over an additional 48,000 square yards of ramp, as shown in **Table 2-18.** Currently on the busiest day, Northstar/Neptune is approximately 9,500 square yards deficient.

TABLE 2-17
Minuteman Total Aircraft Ramp Deficiencies (square yards)

	2007	2013	2018	2028
Based Ramp Requirements	50,361	70,767	75,782	86,032
Transient Ramp Requirements	12,285	13,053	14,589	15,357
Total Requirements	**62,646**	**83,820**	**90,371**	**101,388**
Total Existing Ramp	*39,000*			
Ramp Deficiency	**-23,646**	**-44,820**	**-51,371**	**-62,388**

Prepared by: CH2M HILL, 2008.

TABLE 2-18
Northstar/Neptune Total Aircraft Ramp Deficiencies (square yards)

	2007	2013	2018	2028
Based Ramp Requirements	52,826	74,231	79,492	90,243
Transient Ramp Requirements	5,265	5,594	6,252	6,581
Total Requirements	**58,091**	**79,825**	**85,744**	**96,824**
Total Existing Ramp	*48,555*			
Ramp Deficiency	**-9,536**	**-31,270**	**-37,189**	**-48,269**

Prepared by: CH2M HILL, 2008.

In addition to the ramp needs identified above, Homestead Helicopters Inc., located near the Northstar/Neptune development area, will require a ramp expansion of approximately 1,000 square yards to provide additional safety clearance, landing, parking, and maneuvering area for helicopters.

2.4 Surface Transportation and Parking Facility Requirements

2.4.1 Airport Service Roads

Service roads are used by airport staff and rescue personnel either performing safety, security, or foreign object debris (FOD) checks on the airfield, or responding to airport emergencies. This section describes service roads and provides recommendations for areas where airside access could be improved, or where service roads infringe on operational areas at MSO.

MSO's service roads were built-up and resurfaced in 2007 with the aggregate asphalt milled from resurfacing Runway 11/29, therefore these service roads are in good shape.

From the west side of the airfield to the east, one continuous service road starts near Taxiway G, by the USFS property, curves around each runway end, and ends in the Northstar/Neptune area. Several smaller service roads connect this road to facilities such as the localizer, VOR, and supplemental wind sock.

Overall, the service roads provide adequate connection to all sides of the airfield and provide separation from aircraft pavement. As discussed in the Design Standards and Part 77 sections, multiple service roads traverse through the RPZs and under the approach and departure surfaces. **Each of these roads are marked by signage and clear the Part 77 surfaces by the recommended 10 feet. Finally, the service road north of Taxiway A near the USFS facility violates standards, specifically the OFA.**

2.4.2 Landside Access Roadways

A Landside Master Plan Study was conducted for MSO in May 2008 as part of the Airport Master Plan Update. The purpose of this study was to address landside circulation and access. See **Appendix C** for the Landside Master Plan Study.

Airport access is provided to the airport via a main public airport entrance from U.S. Highway 10 which runs alongside the northeast side of the airport. Running parallel to the highway on airport property is Aviation Way, which connects the main access to multiple gated airside access points and additional public airport access roadways which do not all lead to the terminal. This service road ends in the USFS property on the west side, and the fuel farm road on the east side. As part of an airport security initiative, secured access points and security gates are being updated alongside this road that connects public access to the airside.

Access to the terminal is also provided from of Aviation Way. **The Landside Master Plan Study completed as part of the Master Plan effort recommends that this road is reconfigured to a one-way all-inclusive system which includes Aviation Way, so that vehicles do not stop until reaching U.S. 10. This would eliminate queuing at Aviation Way prior to reaching Highway 10. Also, creating one access road to the terminal would lessen confusion for passengers picking up, dropping off, or parking.**

Wye Mullan West Comprehensive Area Plan

The Missoula City-County Office of Planning and Grants (OPG), Transportation Planning Division, adopted a grid system in 2005 that includes the area on the eastern side of the airport. Part of this plan, The Wye Mullan West Comprehensive Area Plan, shown in Exhibit 2-13, includes a general alignment public roadway that passes partially through airport property, but stays just outside of the RPZ on the Runway 29 end. The Wye Mullan West Road is not planned until the end of the MPU planning period or beyond. The connection will provide access opportunities to new areas of the airport property, particularly south of Runway 11/29. The alternatives analysis will consider these opportunities.

2.4.3 Landside Automobile Parking

The Landside Master Plan also determined landside parking requirements. The purpose of this study was to address the layout, capacity, and circulation issues associated with public parking, employee parking, and rental cars. This study determined facility requirements through 2026, and years 2027 and 2028 have been extrapolated based on the enplanement growth rate.

Public Parking

There are a total of 756 public parking spaces: 157 short-term and 599 long-term, in addition to 170 rental car spaces and 131 employee spaces.[12] 2006 occupancy was determined using the midday occupancy of the peak month, 522 long-term parkers, and 48 short-term parkers. This number was increased by 10 percent to account for the difficulty of finding the last few parking spots (574 long-term and 53 short-term). The increase parking demand through 2028 was determined by the average increase in enplanements. This demand and the surplus or shortfall for the planning period is shown in **Table 2-19.**

[12] Since the completion of this chapter, the employee parking lot was converted into a credit card lot. Currently the employee lot is 145 spaces and the credit card lot is 130 spaces.

EXHIBIT 2-13
Wye Mullan West Plan Area

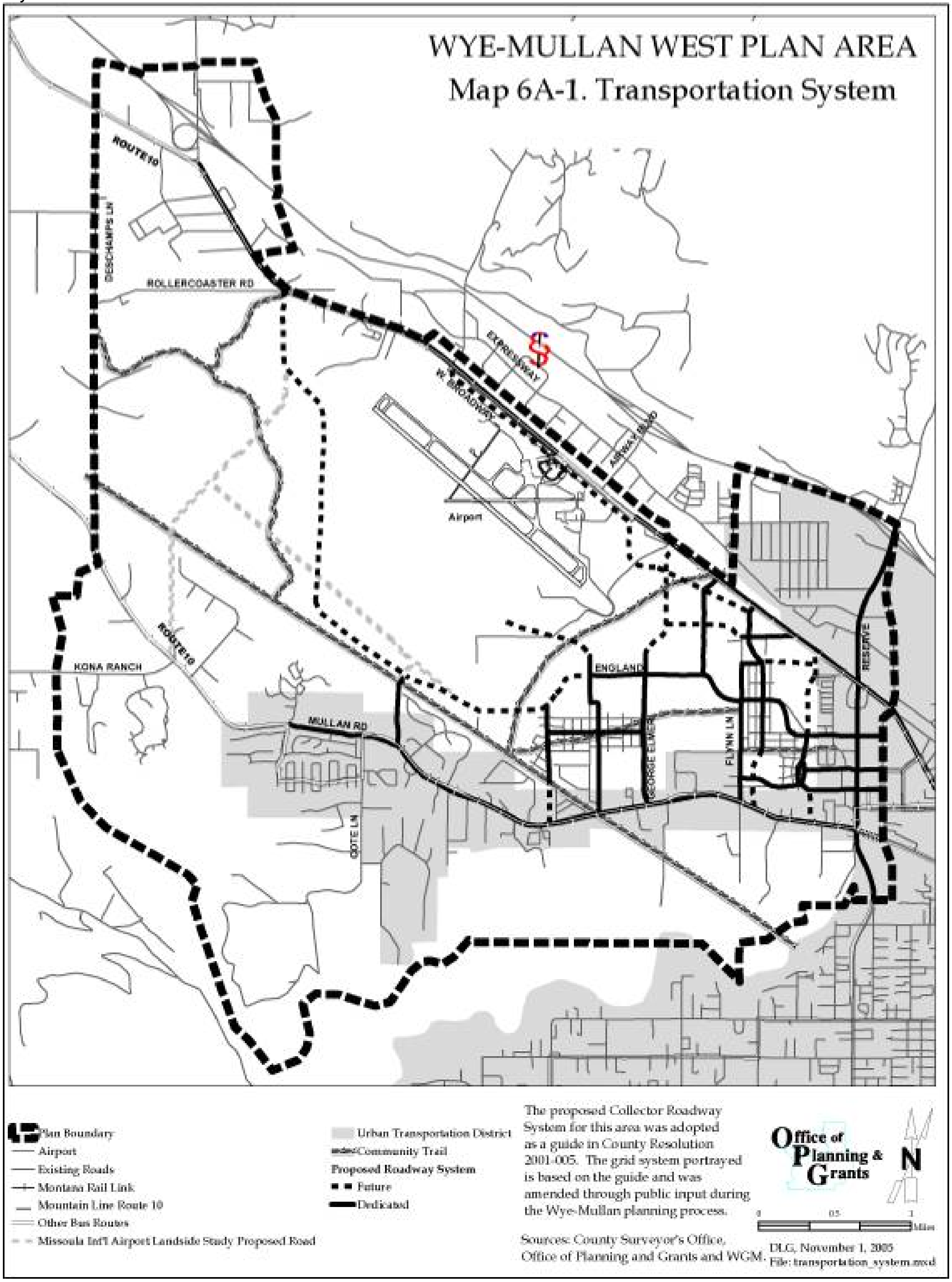

TABLE 2-19
Parking Requirements

Year	Enplanements	Parking Demand [1/]	Total Surplus/ Deficit
Long-term Parking - 599 spots			
2006	275,125	574	25
2016	362,352	756	-157
2026	457,730	955	-356
2028	473,518	987	-388
Short-term Parking - 157 spots			
2006	275,125	53	104
2016	362,352	70	87
2026	457,730	88	69
2028	473,518	91	66
Long-term plus short-term combined - 756 spots			
2006	275,125	618	138
2016	362,352	814	-58
2026	457,730	1,029	-273
2028	473,518	1,078	-322

1/ Calculated based on a 110 percent occupancy.
Source: Landside Master Plan Study
Prepared by: CH2M HILL, 2008.

As shown in the table, in 2028 MSO will have a deficit of 388 parking spots in the long-term lot and a surplus of 66 in the short-term lot. **The MSO Landside Master Plan recommends that the long-term and short-term parking areas are combined since the heavy demand for long-term can be partially accommodated by the availability of spaces in the short-term lot.**

Employee Parking

Existing employee parking has 145 spaces. **Based on airports of comparable size to MSO, the recommended parking lot size should be approximately 200 spaces.**

Rental Car

Eight rental car companies serve MSO. Four companies operate on-airport: Avis, Budget, Hertz and National/Alamo, and four are located off-airport and pick up passengers by van: Dollar, Enterprise, Rent-a-Wreck, and Thrifty. **Based on airports of comparable size to MSO, the recommended parking lot size should also be 200 spaces, an increase from the existing 170 spaces.**

Recommended Access and Parking Layout

The layout identified as the preferred alternative is shown in **Exhibit 2-14**. The interim development option leading up to the ultimate build out is shown in **Exhibit 2-15.** These layouts were selected because this alternative fulfills the following functions:

- Incorporates all functions inside the ring road to improve traffic flow.

- Provides a single access point to lessen confusion.
- Collocates short- and long-term parking, employee and rental car lot to allow movable barriers so the airport can accommodate changing demand.
- Parking bays are oriented at a 90 degree angle to the terminal to allow better access to the terminal for foot-traffic.

EXHIBIT 2-14
Proposed Long-Term Parking Layout

Source: MSO Landside Master Plan Study, CH2M HILL in association with Albersman & Armstrong, LTD. 2008.
Prepared by: CH2M HILL, 2008.

EXHIBIT 2-15
Proposed Interim Parking Layout

Source: MSO Landside Master Plan Study, CH2M HILL in association with Albersman & Armstrong, LTD. 2008.
Prepared by: CH2M HILL, 2008.

2.5 Support Facility Requirements

This section identifies the facilities that support airfield operations which are vital to the overall operability and maintenance of MSO. Support facilities that will be analyzed in this section include the following:

- ARFF
- Aircraft deicing locations
- Aircraft run-up areas
- Airfield maintenance buildings
- Air Traffic Control Tower
- Fuel farm location
- Air cargo facilities

2.5.1 Airport Rescue and Firefighting

Requirements for aircraft rescue and firefighting (ARFF) services at an airport are established under FAR Part 139, under which Missoula International Airport is certificated. 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 is currently an Index B airport, which includes aircraft between 90 and 126 feet long. **As shown in Table 2-20, MSO meets the required five daily departures by Index B aircraft throughout the planning period and therefore the ARFF is adequate.**

TABLE 2-20
ARFF Index

Aircraft	Length (ft.)	ARFF Index	2007 Daily Departures	2013 Daily Departures	2018 Daily Departures	2028 Daily Departures
McDonnell Douglas MD80	148	C	0.00	0.01	0.01	0.01
Total C			**0.00**	**0.01**	**0.01**	**0.01**
Boeing 737-300	110	B	0.00	0.17	0.20	0.24
Boeing 737-500	102	B	0.00	0.01	0.01	0.01
Airbus Industrie A320	123	B	0.05	0.54	0.61	0.75
Airbus Industrie A319	111	B	1.14	0.58	0.65	0.80
Embraer 175	98	B	0.65	1.59	1.79	2.21
Embraer 170	93	B	0.00	1.36	1.52	1.88
Bombardier Q400	108	B	3.56	4.10	4.57	5.63
Canadair Regional Jet 700	106	B	1.48	1.35	2.08	3.90
Total B			**6.88**	**9.70**	**11.42**	**15.42**

Source: MSO Aviation Forecast, 2008.
Prepared by: CH2M HILL, 2008.

Equipment

Equipment required for an Index B is specified in FAR Part 139. The required equipment for MSO includes either:

- One vehicle carrying at least 500 pounds of sodium-based dry chemical or halon, and 1,500 gallons of water, and the corresponding quantity of AFFF for foam production, or

- Two vehicles which carry the required agents stated above.

The equipment owned by the airport meets the requirements and therefore change is not recommended.

Response Times

MSO is served by two ARFF facilities located in adjacent corners on the northern side of the airport. The largest facility is collocated with airport snow removal and maintenance operations. Its location at the end of Taxiway G provides direct access to the airfield and Runway 11/29. Rescue teams also have direct access to the terminal via an eastern route across the Minuteman apron. The second location is a single-bay ARFF facility adjacent to the eastern side of the terminal. This satellite location also provides access to the airfield and terminal. Both locations have direct access to the airfield and terminal.

Both ARRF facilities are equipped with the required rescue equipment. Each of the ARRF stations has the ability to respond to an emergency within three minutes with a rescue firefighting vehicle and team. **For these reasons, no additional ARFF facilities are recommended.**

2.5.2 Aircraft Deicing Facilities

Deicing is conducted on the deicing ramp located west of the terminal. The deicing pad is sized to accommodate two Group III aircraft. Demand based on peak hour departures is shown in **Table 2-21**. As shown, existing peak hour demand is four departures. This increases to six departures within the planning period. GA aircraft deice on the FBO ramps and therefore are not considered in this analysis.

TABLE 2-21
Peak Demand

Year	Total Hour Demand[1/]	Peak Hour Departures
2007	7	4
2013	8	4
2018	9	5
2028	11	6

Source: 2007 MSO Aviation Forecast
Notes:
1/ Based on the forecast peak passenger aircraft demand.
2/ GA aircraft are assumed to deice on individual ramps, therefore not included in this analysis.

Deicing facility requirements are based on the throughput rate of aircraft per hour, per deicing position. As outlined in FAA AC 150/5300-14A, *Design of Aircraft Deicing Facilities,* throughput rate is influenced by many factors, including:

- One step or two step deicing procedure used
- Variations in meteorological conditions
- Type of aircraft receiving treatment

Considering these factors, as shown in **Table 2-22**, the weighted average throughput per deicing position for purposes of this long-term analysis is 4.1 aircraft per hour.

TABLE 2-22
Average Aircraft Deicing Throughput

Aircraft	Minutes to Deice 1/	Deicing Pad Hourly Aircraft Capacity (Aircraft per Hour)	Average Throughput by Fleet Mix Type
Mainline			
McDonnell Douglas MD80	20	3	
Boeing 737-300	18	3.3	
Boeing 737-500	18	3.3	**3.3**
Airbus Industrie A320	17	3.5	
Airbus Industrie A319	17	3.5	
Regional			
Embraer 175	14	4.3	
Embraer 170	14	4.3	
Bombardier Q400	16	3.8	**4.2**
Canadair Regional Jet 700	14	4.3	
Canadair Regional Jet	14	4.3	
Beechcraft 1900 Airliner	14	4.3	
		Weighted Average: 2/	**4.1**

1/ Approximation.
2/ Based on the forecast fleet mix of approximately 10% mainline aircraft and 90% regional
Prepared By: CH2M HILL, 2008

By comparing forecast peak-hour departures to deicing throughput, deicing requirements are determined, as shown in **Table 2-23**.

TABLE 2-23
Deicing Facility Requirements

	Actual	Forecast		
	2007	2013	2018	2028
PMAD Peak Hour Departures 1/	4	4	5	6
Deicing Throughput (Aircraft per Hour) 2/		8		
Surplus/ (Deficit)	**4**	**4**	**3**	**2**

1/ Commercial aircraft operations forecast divided by two to represent departures.
2/ Calculated based on the existing deicing requirement (4.1 aircraft per hour per deicing spot).
Prepared By: CH2M HILL, 2008

The analysis concludes that the Airport is expected to have sufficient aircraft deicing positions through the end of the planning period.

2.5.3 Aircraft Run-Up Areas

Aircraft run-up areas are designated aircraft movement areas on the airfield, and are generally used by two groups; maintenance technicians, and pilots testing their power plants prior to departure. Run-ups are conducted in three areas at MSO; air carrier run-ups are conducted on the western side of the terminal, Forest Service aircraft run up on Taxiway

A-3 prior to parallel Taxiway A, and GA aircraft generally run-up on the FBO aprons. **Run-ups do not impact operational flow. However, as demand increases, a designated run-up pad is recommended near Taxiway A-3 in order to separate stationary aircraft from the active taxiway. The pad should be sized to accommodate the C-III design aircraft. Additionally, as residential and commercial property encroaches on the airport, designated run-up pads are recommended in the other two locations to contain the noise to designated areas on the airfield.**

2.5.4 Airport Maintenance/Snow Removal Equipment 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 located in the northwest corner of the airfield at the end of Taxiway G. This facility also houses ARFF equipment and an emergency operations center (EOC).

Based on interviews with airport operations staff, it was determined that this multiuse facility currently is deficient. The SRE building was constructed in 1989 and at the time held seven pieces of SRE equipment. MSO's airfield surface area and aircraft operations have increased and so has the amount of maintenance equipment and SRE. Additionally, equipment has increased in size. With eleven pieces of larger equipment in the limited space, there is also no interior space for staging equipment, leading to lengthened response times. A 12,750 square foot expansion is planned for this facility which will accommodate the immediate need for additional storage. **For planning purposes, future storage requirements should be planned based on growth of airport operational area over the planning period. However, due to the lack of significant new airfield pavement, none beyond the 12,750 square foot expansion is anticipated throughout the 20-year period.**

2.5.5 Air Traffic Control Tower

The existing air traffic control tower is located on top of the terminal building, and stands approximately eight stories above the apron. Survey results reveal that the existing eye height is approximately 62 feet. At this elevation, the controllers have two published line of sight (LOS) issues:

- Approximately 50 feet of Golf taxiway behind the Metro Aviation hangar
- Runway 7/25 end near Charlie One taxiway

These two areas are published and have not caused any conflicts to date. However, any future development on the airfield should be evaluated under a LOS study prior to implementation.

No remedial actions are recommended for the two LOS issues due to the ongoing plan to construct a new tower. The *MSO Airport Traffic Control Tower Site Selection Report*, published by the FAA in October 2005, selected a preferred location designated as Prairie Site 1A, located 1,400 feet south of the Runway 11/29 centerline, directly in line with the existing tower. Upon implementation of this new facility, possibly within the next five years, no known LOS issues will exist.

2.5.6 Fueling Facilities

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. All aircraft are fueled by tanker trucks. In addition to this, MCAA operates a fuel farm for its own use, located in the northwest corner of the airfield, near the ARFF/SRE facility.

Both fuel providers note that fuel storage tanks are adequately sized to serve existing operations; therefore capacity in 2007 was used as a base year to project future requirements. **Table 2-24** shows the capacities of each tank, and projects needs based on the following growth rates estimated in the Forecast:

- 2007-2013: 2.74 percent
- 2013-2018: 1.53 percent
- 2018-2028: 1.44 percent

TABLE 2-24
Fuel Tank Requirements (gallons)

	Jet-A	100LL	80 Octane	Diesel	Unleaded	Super Unleaded
Northstar 2007 Capacity	(2) 10,000 (1) 9,000	(1) 20,000	-	-	-	-
2013	33,713	23,251				
2018	36,342	25,063				
2028	41,918	28,909	-	-	-	-
Planning period total deficiency:	**12,918**	**8,909**	**-**	**-**	**-**	**-**
Minuteman 2007 Capacity	(2) 20,000	(2) 12,000	(2) 12,000	-	-	-
2013	46,501	27,901	27,901	-	-	-
2018	50,127	30,076	30,076	-	-	-
2028	57,819	34,691	34,691	-	-	-
Planning period total deficiency:	**17,819**	**10,691**	**10,691**	**-**	**-**	**-**
MCAA 2007 Capacity	-	-	-	(1) 4,000	(1) 2,000 (1) 10,000*	(1) 1,000

* Serves the rental car facility.
Prepared by: CH2M HILL, 2008

As shown, Northstar/Neptune and Minuteman are projected to need an increase in fuel storage capacity of approximately 45 percent over the planning period. In addition to the expansion of the Minuteman and Northstar/Neptune areas, meetings with Homestead Helicopters has reveled the need for an additional fuel tank of approximately 20,000 gallons.

2.5.7 Air Cargo

Reporting air cargo carriers at MSO include scheduled passenger airlines carrying belly cargo, and FedEx and Empire Airlines. DHL also operates out of MSO, but they do not report to the U.S. Bureau of Transportation Statistics. The only all-cargo facilities are operated by DHL and FedEx. As forecast, all-cargo aircraft operations are projected to decrease initially from 1,245 in 2007 to 1,142 in 2013, and then increase to 1,151 in 2019, and remain at that level through 2028. **Due to the lack of increase in projected demand, the need for additional cargo facilities is not anticipated throughout the 20-year planning period.**

2.6 Summary of Facility Requirements

Findings and facility recommendations made within this chapter are summarized in **Table 2-25**.

TABLE 2-25
MSO Facility Requirements Summary of Findings and Recommendations

Airfield Facility	Finding or Concern	Recommendation
Airport Reference Code	The forecast fleet mix determined a reduction in ARC for Runway 11/29, from C-IV to C-III.	Maintain the current ARC C-IV separation between facilities, but design future facilities to ARC C-III standards.
	The forecast fleet mix determined an increased ARC for Runway 7/25, from B-I, Small aircraft only, to B-I. Additionally, the FAA's Northwest Mountain ADO recommends that air carrier airports should not have small-aircraft-only runways, regardless of Regular Use.	Runway 7/25 should be maintained as a B-I Standard runway capable of handling B-I Standard aircraft.
Airfield Capacity	2028 operations activity is forecast to represent a 38 percent ASV.	An additional runway is not recommended within the planning period. Although Runway 7/25 does not add capacity, it is recommended that this runway is maintained to serve small GA aircraft during strong crosswind conditions.
Airport Design Standards	The RSAs for both runways meet FAA standards.	No action.
	The OFZs for both runways meet FAA standards.	No action.
	Runway 11 meets POFZ requirements. Runway 29 does not currently require a POFZ, however the addition of a POFZ would not impact surrounding facilities.	No action.
	The OFAs for both runways meet FAA standards.	No action.
	The extended OFA for both runways meet FAA standards.	No action.

TABLE 2-25
MSO Facility Requirements Summary of Findings and Recommendations

Airfield Facility	Finding or Concern	Recommendation
Airport Design Standards (Continued)	MSO leases but does not own the entire RPZ on the Runway 25 approach end. Rather, it leases the portion of the RPZ which crosses over Interstate Route 10.	Should the property within the RPZ ever become available, acquire the property.
	Multiple airport service roads infringe on the RPZs.	Address the nonstandard conditions discussed in the Design Standards section.
	A firing range with a shed exists in the RPZ on the Runway 11 approach end.	Remove structure and firing range.
	The taxiway safety areas meet FAA standards.	No Action.
	The taxiway OFA has two infringements: an electrical vault off Taxiway D, and a service road off Taxiway A. The electrical vault meets Group III standards, however should the airport ever upgrade to Group IV, the electrical vault would be an infringement.	Relocate the service road outside of the taxiway OFA.
Runway Line of Sight	An analysis of the runway centerline profile found that the five-foot line of sight is violated by approximately 0.78 feet.	It is recommended that the violation is remedied at the time of a future full-depth reconstruction of Runway 11/29.
FAR Part 77 Surfaces	Runway 29 end has a fence in the primary surface. Runway 11 end has two obstructions in the approach surface.	It is recommended that these obstructions are relocated outside of the Part 77 surface.
	The high mountain terrain surrounding the airport creates multiple obstructions to the horizontal and conical surfaces.	No action.
	Complete topography information for the airport is unavailable, and the NGS official terrain information is significantly different from actual surveyed elevations from recent work on Runway 11/29.	It is recommended that complete topographic information is updated for the airport and adjacent areas.

TABLE 2-25
MSO Facility Requirements Summary of Findings and Recommendations

Airfield Facility	Finding or Concern	Recommendation
Navigational Aids	The FAA has an initiative to phase out ILS approaches by 2020.	New satellite-based technology, RNAV RNP, planned for implementation on Runway 11 and Runway 29 is recommended.
Lighting	When combined with new satellite-based approach technology, an approach lighting system lowers the minimums.	Approach lighting is recommended for Runway 29.
Runway Length	The existing runway length is adequate to accommodate the forecast aircraft under most conditions. Under the most stringent conditions, hot day and long destination range, the MD-80 and 737-900 may be required to reduce payload to depart from MSO.	No action.
Runway Orientation	Runway 11/29 provides more than the 95 percent coverage recommended by FAA for the 16-knot crosswind component for all conditions.	No action.
	Although Runway 7/25 is not technically required to meet the predominant wind direction minimum coverage, the runway plays an important role for MSO: small aircraft during strong crosswind conditions.	No action.
Airfield Pavement Evaluation	Pavement condition is being evaluated.	Refer to Appendix D of the Master Plan Update for a complete aircraft pavement analysis.
Parallel Taxiway System	Runway 11/29 parallel taxiway separation distance is adequate to serve the largest fleet of aircraft that use MSO, including high-speed taxiway exits.	No action.
	A taxiway is not recommended for Runway 7/25 due to the low utilization rate of approximately 3-5 percent.	No action.

TABLE 2-25
MSO Facility Requirements Summary of Findings and Recommendations

Airfield Facility	Finding or Concern	Recommendation
Taxiway Exits	Acute-angled (high speed) taxiways are recommended to accommodate critical high-speed tanker operations during peak period months in the long-term.	Acute angled exits in addition to the existing taxiway connectors are recommended and will be evaluated in the Airfield Alternatives chapter.
Engineering Brief 75 Taxiway Evaluation and Taxiway Flow	For MSO to comply with newly released guidelines, taxiway enhancements and realignments are recommended.	The following intersections will be reviewed in the Airfield Alternatives chapter: - Taxiway E intersection along Runway 7/25 - Taxiway crossing of Runway 7/25 - Runway 7/25 intersection to Runway 11/29 - Taxiway A-3 and G access to Runway 11/29 - Taxiway E access to the terminal apron
	The proposed area for GA/FBO development segregates traffic on Taxiway G and impedes two-way taxiway flow by both critical tanker operations and slower-moving GA aircraft.	An additional access point to the GA area and the U.S. Forest Service is recommended.
Taxiway Width	- Taxiway G segment between Runway 11/29 and Taxiway A does not meet width requirements at approximately 40 feet. - Taxiway G segment between Runway 7/25 and Runway 11/29 does not meet width requirements at approximately 40 feet. - Taxiway leading to the Metro Aviation hangar off Taxiway G does not meet Group IV width requirements at approximately 40 feet.	These taxiways should be widened to Group III standards (50 feet).
Apron Requirements	Minuteman, Northstar/Neptune, and Homestead Helicopters have a ramp deficiency.	Increase the ramp size by approximately: - 43,288 square yards for Minuteman in 2028, in addition to the 19,000 square yards lost through parking expansion. - 48,000 square yards for Northstar/Neptune in 2028. - 1,000 square yards for Homestead Helicopters, Inc.

TABLE 2-25
MSO Facility Requirements Summary of Findings and Recommendations

Airfield Facility	Finding or Concern	Recommendation
Fixed Base Operators	Minuteman, Northstar/Neptune, and Homestead Helicopters report the need for facilities as part of their business plans.	Minuteman: - Helicopter refueling, parking, and maneuvering area - Maintenance hangar to accommodate anticipated demand - Replace T-hangars, maintenance hangars, and tie-downs lost as part of the landside access improvement Northstar/Neptune - Add four hangars to house future aircraft - Double the existing maintenance facility - Evaluate parking area to determine the most operationally efficient location Homestead Helicopters: One additional hangar.
Airport Service Roads	MSO's service roads were built-up and resurfaced in 2007 with the aggregate asphalt milled from resurfacing Runway 11/29.	No action.
	Overall, the service roads provide adequate connection to all sides of the airfield. However, multiple service roads infringe on the RPZs and a service road infringes the OFA of Taxiway A, as discussed in the Airport Design Standards section of this table.	Address the nonstandard conditions discussed in the Design Standards section.
Landside Access Roadways	The Landside Master Plan Study found that queuing occurs along Aviation Way and that some passengers experience confusion in the pickup, drop-off, and parking areas.	The Landside Master Plan Study recommends that Aviation Way is reconfigured to an all-inclusive terminal and parking access system with one-way traffic flow. Additionally, Aviation Way should serve as the only access road to the terminal.
Landside Automobile Parking	Parking facilities are inadequate.	The following parking areas should be increased: - Employee parking area, from 145 spaces to 200 spaces. - Rental car parking area, from 170 spaces to 200 spaces. The long-term and short-term visitor parking areas should be combined and enhanced with an additional 322 spaces.

TABLE 2-25
MSO Facility Requirements Summary of Findings and Recommendations

Airfield Facility	Finding or Concern	Recommendation
Airport Rescue and Firefighting	MSO meets the required five daily departures by Index B aircraft throughout the planning period. MSO also meets response times required by this index.	No action.
Aircraft Deicing Facilities	Deicing facilities are adequate to accommodate demand throughout the planning period.	No action.
Aircraft Run-up Areas	The ATCT reports that run-up's do not impact operations; however as demand increases, Taxiway A-3 may become constrained.	The construction of a run-up pad, capable of accommodating C-IV design aircraft, is recommended to remove stationary aircraft from Taxiway A-3 as demand increases.
Airport Maintenance/Snow Removal Equipment Facilities	A 12,750 square foot expansion is planned for this facility which will accommodate the immediate need for additional storage.	Future storage requirements should be planned based on growth of the airport movement area over the planning period; however none is anticipated throughout the planning period other than the planned expansion shown in the ACIP.
Air Traffic Control Tower	The existing tower has two line of sight issues.	No remedial actions are recommended due to the ongoing plan to construct a new tower.
Fueling Facilities	The Northstar/Neptune and Minuteman fuel farm is projected to be deficient over the planning period. Homestead Helicopters projects the need for fueling facilities.	Increase Northstar/Neptune's Jet-A and 100LL to 5,300 gallons, and resolve Minuteman's Jet-A, 100LL, and 80 Octane deficiency of almost 11,000 gallons. It is recommended that the available space on the fuel farm road be reserved for these additional fueling facilities. Homestead Helicopters has revealed the need for an additional fuel tank of approximately 20,000 gallons.
Air Cargo	Cargo operations are forecast to stay relatively the same.	No action.

Prepared by: CH2M HILL, 2008.