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*Chapter 4*

# Airfield Alternatives Analysis

## Missoula International Airport
## Master Plan Update

Prepared for

**Missoula County Airport Authority**

OCTOBER 2008

CH2MHILL

# Contents

CHAPTER 4

# Airfield Alternatives Analysis

This chapter identifies and evaluates feasible airport development alternatives that allow Missoula International Airport (MSO) to accommodate projected aviation demand through 2028. Airside and landside needs were determined in the previous chapter, *Demand/Capacity and Facility Requirements*, based on the projection of aviation demand in the forecast chapter[1].

This chapter: 1) identifies various alternatives, or airfield alternatives, that remedy identified needs, 2) develops evaluation criteria based on the airport's goals and needs, 3) evaluates the alternatives, and 4) recommends preferred alternatives that best reflect the needs. Terminal facility alternatives are evaluated in Chapter 5, *Terminal Alternatives*.

The preferred facilities development alternatives generated within this chapter serves as the basis for the future Airport Layout Plan (ALP) by establishing future property uses.

## 4.1 Long-term Concept Sketch Plan

A *Long-term Concept Sketch Plan* (Sketch Plan) was completed early in the Master Plan Update (MPU) process to allow the Missoula County Airport Authority (MCAA) to make early decisions to accommodate immediate short-term general aviation (GA) needs. By projecting what property might be needed for various aviation uses over the next several decades, the Sketch Plan identified properties that would be available for GA development. The Sketch Plan was conducted before the preparation of the Forecast and used the general assumption that demand would approximately double from existing conditions. This represented a more aggressive average annual growth rate than the FAA Terminal Area Forecast (TAF). This chapter revisits the same airport focus areas in more detail, with the benefit of an updated Forecast.

## 4.2 Summary of Facility Requirements

This section summarizes the key requirements through 2028 as identified in the *Demand/Capacity and Facility Requirements* chapter.

### 4.2.1 Airfield Facilities

#### Airfield Capacity

- The airfield capacity of the existing runway system will adequately accommodate demand through 2028, and therefore no new runway alternatives are justified.
- Crosswind Runway 7/25 adds no capacity but serves the needs of small general aviation (GA) aircraft; therefore it should stay in service.

[1] *Aviation Forecast* chapter, approved by the Federal Aviation Administration (FAA) on June 25, 2008. See Appendix H..

### Taxiway System

- Based on FAA guidance, as directed in the recently published *Engineering Brief No. 75: Incorporation of Runway Incursion Prevention into Taxiway and Apron Design* (EB-75)[2], MSO's areas of opportunity to enhance safety include: [3]

  1. Taxiway E intersection of Runway 7/25
  2. Taxiway crossing of Runway 7/25
  3. Runway 7/25 intersection to Runway 11/29
  4. Taxiway A-3 and G access to Runway 11/29
  5. Taxiway E access to the terminal apron

- The location of existing and potential future right-angled exits is evaluated to further improve airfield flow. High-speed exits are also evaluated to increase the efficiency of future tanker operations.

- Taxiway G does not meet Group III width standards.

### Aircraft Aprons

- Minuteman will likely require an additional 43,000 square yards of apron in the long-term, in addition to the immediate-term need to replace 19,000 square yards of apron lost due to the planned near-term terminal parking lot expansion. Northstar/Neptune is projected to require 48,000 square yards of apron to account for growth and aircraft fleet changes. These projected needs approximately double the existing apron area for both fixed base operators (FBOs).

### Navigational Aids

- There is a need for improved weather minima on Runway 29 end.

- Satellite-based technology is explored to replace or augment older technology.

## 4.2.2 Surface Transportation and Parking Alternatives

### Landside Parking and Access Study

- To satisfy the need for immediate and future parking improvements, a separate analysis was conducted. Refer to **Appendix C** of this Master Plan for the *Landside Master Plan*, developed in May, 2008. The recommendations of the plan have been adopted by MSO and are reflected on the Airport Layout Plan.

## 4.2.3 General Aviation/FBO Facilities

The GA/FBO Facilities section examines the needs and demands on MSO's GA community and FBOs and proposes airfield alternatives to support their continued operations and viability.

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[2] Published November 8, 2007.

[3] The Northwest Mountain Region conducted a runway safety evaluation for MSO on July 28-29, 2008. The findings in the Runway Safety Action Team (RSAT) Evaluation are consistent with these safety enhancements.

#### Minuteman

- There is a need to accommodate helicopter refueling, parking, and maneuvering area
- Replace a maintenance hangar to be demolished as part of the landside access improvements as described in the Landside Master Plan Study.
- Replace aircraft tie-downs lost because of the landside access improvements.
- Add an additional maintenance hangar to accommodate anticipated demand.
- Replace T-hangars to be demolished because of the landside access improvement.

#### Neptune

- Add multiple hangars to house future aircraft used for tanker operations.
- Double the existing maintenance facility.

#### Potential Third FBO:

- There is no current demand or interest for a third FBO. Should a new entrant express interest in establishing operations at MSO, however the airport needs to have a plan to respond. As such, placement alternatives are explored.

### 4.2.4 Other Support Facilities

#### Fuel Farm

- Both fuel farms operated by the FBOs require an approximate 45 percent increase in total capacity within the next 20 years.

## 4.3 Airfield Alternatives

This section develops and evaluates alternatives for supplemental navigational aid (NAVAID) capability, taxiway system, and GA and FBO facilities. Runway alternatives are not evaluated in this section because additional airfield capacity is not recommended within the planning period.

### 4.3.1 Navigational Aids

Runway approach instrumentation, lighting, and other NAVAIDs provide pilots with the means to navigate and land aircraft safely and efficiently in most weather conditions. This section recommends lighting system upgrades to the planned Wide Area Augmentation System (WAAS)-enabled approach, or Area Navigation (RNAV) RNP approach on Runway 29. As discussed in the *Airfield Demand Capacity and Facility Requirements Chapter*, Runway 11 is already equipped with an approach lighting system. The planned RNP approaches will provide lower weather minima on Runway 29 and redundant capability to the ILS and

Special ILS on Runway 11.[4] Combining these approaches on Runway 29 with an approach light system achieves the lowest minima, as shown in **Table 4-1**.

With the introduction of the WAAS and other GPS-based technologies, the FAA is in the process of phasing out ground-based navigational aids, including VORs, NDBs, and instrument landing system (ILS). ILS's will eventually be surpassed by satellite-based technology, but the FAA will continue to maintain existing ILS facilities and necessary ground navigation devices into the near future to provide a backup navigation system and accommodate the needs of the flying public because not all pilots and businesses have attained WAAS-capable navigation systems.

These approaches are beneficial to MSO because they offer increased navigation accuracy that can be accessed at a distance farther from the airport than most current ground NAVAID approach systems. Also, they are not affected by radio operations on the ground. Finally, since it is a satellite-based system, there is no ground equipment to install and maintain at the airport.

### Lighting System Upgrades

An Omni-Directional Airport Lighting System (ODALS), while not always able to attain the same low minimums as a Medium-Intensity Approach Lights (MALSR), is less expensive and requires less maintenance compared to a MALSR. However, TERPS lists an ODALS as only to be used for nonprecision approaches.

A MALSR is recommended for Runway 29 to obtain the lowest minima and offer the most precise approach. Runway 11 is equipped with a MALSR with sequenced flashers, and no additional lighting recommendations are recommended to achieve lower minimums.

### Design Standards and Approach Slopes

The addition of a precision approach on Runway 29 requires an RPZ with dimensions of 1,000 feet x 2,500 feet x 1,750 feet. This is larger than the existing RPZ dimensions of 500 feet x 1,010 feet x 1,700 feet. Also, due to the use of vertical guidance and less than ¾ mile visibility obtained with the approach, a Precision Obstacle Free Zone (POFZ) is required. **Exhibit 4-1** illustrates the RPZ and POFZ for Runway 29. As shown, there is no impact to existing facilities by adding the RPZ and POFZ. Since Runway 11 is already equipped with a precision approach, the RPZ and POFZ are adequate to support the new approach.

As shown in **Exhibit 4-2**, the 50:1 slope associated with the new approach is not obstructed; however, the 40:1 portion of the approach surface associated with the typical ILS is obstructed by the mountains.

[4] In addition to the ILS on Runway 11, Runway 11 is equipped with a Special ILS (with ceiling minimums of 200 feet and visibility minimums of ½ mile); however it is only available for pilots who have been granted permission by the FAA to use it.

TABLE 4-1
Runway 29 Minimums with and without Lighting

| Alternative | Evaluation Criteria | Runway 29 Existing [5/] | APV Approach | Change from Existing |
|---|---|---|---|---|
| LNAV/VNAV without Lighting | Visibility | Visual | < 3/4 Mile minimum | Lower minimum |
| | HATh | N/A | 350' | Lower minimum |
| | RPZ | 500' x 1,010' x 1,700' | 1,000' x 2,500' x 1,750' | Enlarged RPZ, No Effect [3/] |
| | Part 77 App. Surfaces | 20:1 [1/] | 50:1 | **Less Steep/Longer Approach Obstructed by terrain [2/, 4/]** |
| | POFZ | N/A | 200' x 800' | No Obstructions [3/] |
| | Approach Lights | N/A | N/A | N/A |
| | Vertical Guidance | N/A | Glideslope | **Implementation of Glideslope** |
| LNAV/VNAV with Lighting | Visibility | Visual | < 3/4 Mile minimum | Lower minimum |
| | HATh | N/A | 350' | Lower minimum |
| | RPZ | 500' x 1,010' x 1,700' | 1,000' x 2,500' x 1,750' | Enlarged RPZ, No Effect [3/] |
| | Part 77 App. Surfaces | 20:1 | 50:1 | **Less Steep/Longer Approach Obstructed by terrain [2/, 4/]** |
| | POFZ | N/A | 200' x 800' | No Obstructions [3/] |
| | Approach Lights | N/A | MALSR or SSALR/ALSF-2 | **Implementation of Approach Lights** |
| | Vertical Guidance | N/A | Glideslope | **Implementation of Glideslope** |
| LPV without Lighting | Visibility | Visual | < 3/4 Mile minimum | Lower minimum |
| | HATh | N/A | 250' | Lower minimum |
| | RPZ | 500' x 1,010' x 1,700' | 1,000' x 2,500' x 1,750' | Enlarged RPZ, No Effect [3/] |
| | Part 77 App. Surfaces | 20:1 | 50:1 | **Less Steep/Longer Approach Obstructed by terrain [2/, 4/]** |
| | POFZ | N/A | 200' x 800' | No Obstructions [3/] |
| | Approach Lights | N/A | N/A | N/A |
| | Vertical Guidance | N/A | N/A | N/A |
| LPV with Lighting | Visibility | Visual | 1/2 Mile minimum | Lowest minimum |
| | HATh | N/A | 200' | Lowest minimum |
| | RPZ | 500' x 1,010' x 1,700' | 1,000' x 2,500' x 1,750' | Enlarged RPZ, No Effect [3/] |
| | Part 77 App. Surfaces | 20:1 | 50:1 | **Less Steep/Longer Approach Obstructed by terrain [2/, 4/]** |
| | POFZ | N/A | 200' x 800' | No Obstructions [3/] |
| | Approach Lights | N/A | MALSR or SSALR/ALSF-2 | **Implementation of Approach Lights** |
| | Vertical Guidance | N/A | N/A | N/A |

Notes:
N/A - not applicable current runway has no published procedures for this approach
1 - Runway 29 is published with a 50:1 approach slope, however visual runways have a 20:1 approach slope. See Exhibit 4-1.
2 - See Exhibit 4-1.
3 - See Exhibit 4-2.
4 - The lowest minimums are reported, however surface penetrations such as the mountainous terrain, would most likely result in higher minimums.
5 - The RNAV (RNP) approach for Runway 29 is not published and minimums are unknown, therefore existing visual approach criteria is shown.
Sources: GCR & Associates, Inc. Airport Master Record Forms (5010-1 and 5010-2). FAA AC 150/5300-13, Change 13, *Airport Design*
Prepared By: CH2M HILL, 2008

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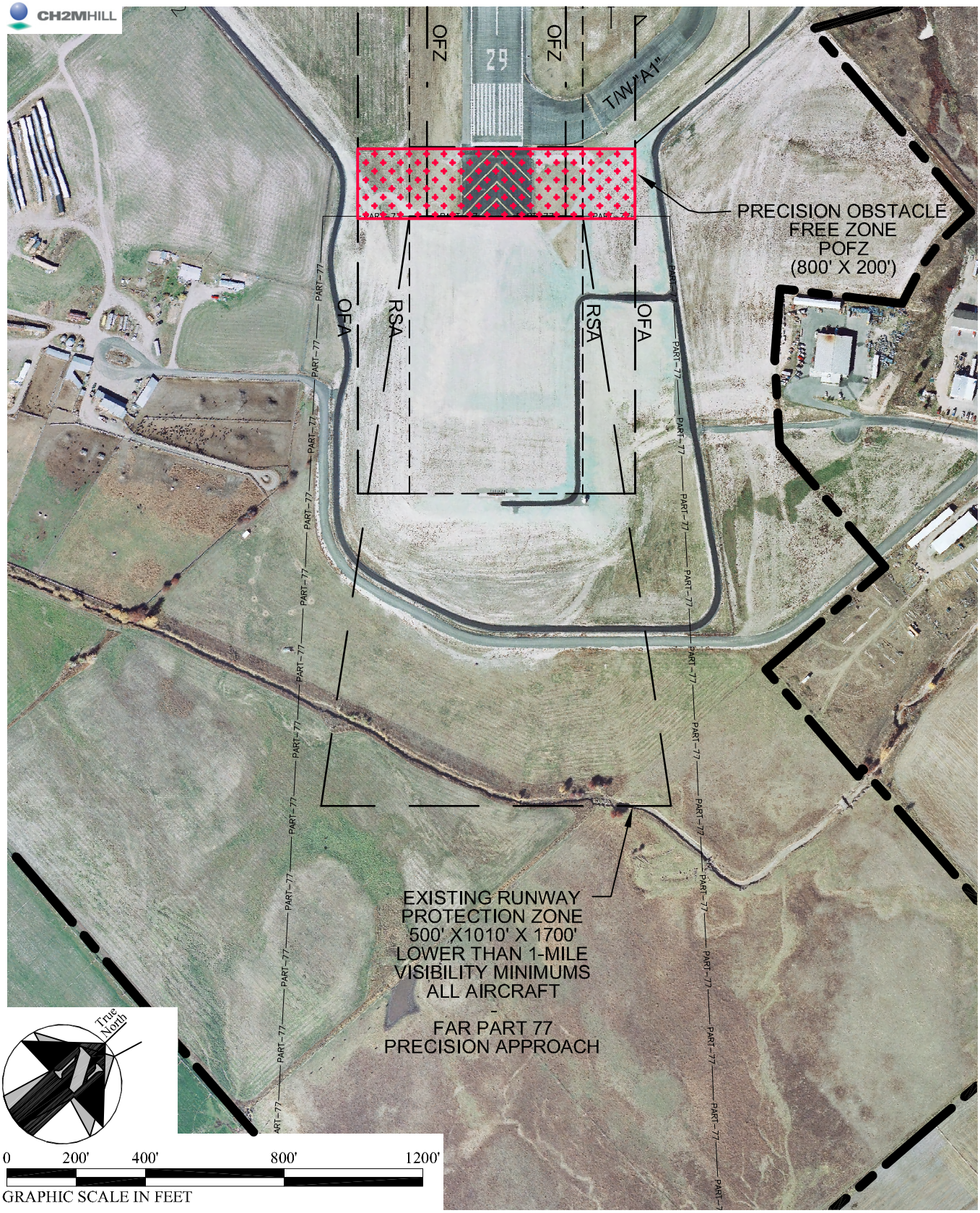
CH2MHILL

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|---|---|---|
| **Missoula Airport Master Plan Update** | Runway 29 Precision Approach RPZ and POFZ | Exhibit 4-1 |

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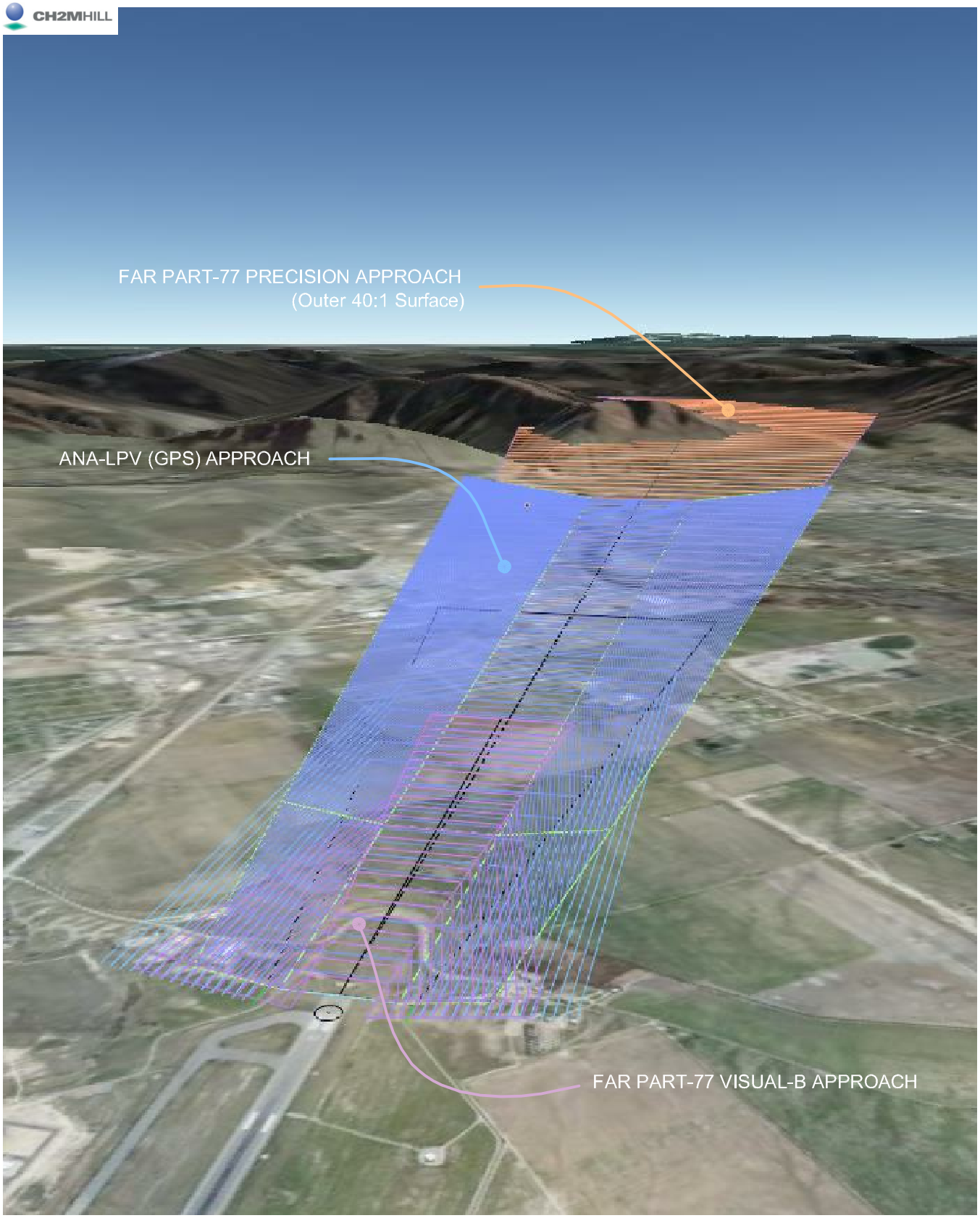


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# Missoula Airport Master Plan Update

RW-29 Precision Approach Surfaces - ILS and LPV

Exhibit 4-2

## 4.3.2 Taxiway Alternatives

This section evaluates and recommends taxiway system improvements to address the deficiencies identified in Chapter 2. The purpose of this section is to develop taxiway layouts that are operationally efficient, and that enhance safety, circulation, and capacity.

As stated in Chapter 2, MSO does not have the minimum 30 peak hour operations to be eligible for high-speed (acute-angled) exits. Air Traffic Control Tower (ATCT) staff confirmed that the hourly peaking characteristics do not require a high-speed exit. Additionally, ATCT does not anticipate the hourly peaking characteristics to rise significantly over the planning period. However, acute-angled taxiways would be beneficial to critical firefighting operations and therefore will be considered in the long-term.

Per FAA planning guidance, all aircraft are grouped into an Aircraft Approach Category based on approach speed. Understanding the Aircraft Approach Category of the aircraft operating at MSO provides a basis for determining taxiway requirements. As defined in FAA AC 150/5300-13, approach Category B aircraft have an approach speed of 91 knots or more, but less than 121 knots. MSO's design aircraft category is Category C, with a speed of 121 knots or more, but less than 141 knots. Included in this category are the regional jets, Boeing 737, and corporate jets.

The FAA's Engineering Brief 75, released in November 2007, offers guidance on the design of taxiways and apron areas in order to prevent runway incursions. Existing taxiways and taxiway intersections that are incompatible with EB-75 guidelines are evaluated for optimal placement. The distance of these exit taxiways from the runway ends effect the runway occupancy time of both Category B and Category C aircraft.

### Runway Exit Taxiway Location

Optimal placement of future taxiway exits is based on an analysis of taxiway exit utilization percentages for Category B and C aircraft. **Table 4-2** and **Table 4-3**, *Exit Taxiway Cumulative Utilization Percentages*, shows the percentages of Category B and C aircraft that are accommodated at various taxiway locations from the landing threshold. The location of taxiway exits is important because runway occupancy time is decreased by appropriately placed taxiways that allow aircraft to exit as soon as decelerated to a safe maneuvering speed.

As shown in Table 4-2 and Table 4-3, the percentage of aircraft that can be accommodated at each taxiway exit location depends on the angle of the exit and the condition of the pavement, along with the approach speed of the aircraft. An interview with the ATCT was conducted to adjust for local conditions.

TABLE 4-2
Exit Taxiway Cumulative Utilization Percentages[1/]
*Percent of Category B aircraft that will be able to turn at a taxiway exit upon landing.*

| | Wet Runways | Dry Runways | |
|---|---|---|---|
| **Distance from Threshold to Exit** | **Right and Acute Angled Exits** | **Right Angled Exits** | **Acute Angled Exits** |
| 0 ft | 0 | 0 | 0 |
| 500 ft | 0 | 0 | 0 |
| 1,000 ft | 0 | 0 | 0 |
| 1,500 ft | 0 | 0 | 0 |
| 2,000 ft | 0 | 1 | 1 |
| 2,500 ft | 1 | 10 | 10 |
| 3,000 ft | 10 | 39 | 40 |
| 3,500 ft | 41 | 81 | 82 |
| 4,000 ft | 80 | 98 | 98 |
| 4,500 ft | 97 | 100 | 100 |
| 5,000 ft | 100 | 100 | 100 |
| 5,500 ft | 100 | 100 | 100 |
| 6,000 ft | 100 | 100 | 100 |
| 6,500 ft | 100 | 100 | 100 |
| 7,000 ft | 100 | 100 | 100 |
| 7,500 ft | 100 | 100 | 100 |
| 8,000 ft | 100 | 100 | 100 |
| 8,500 ft | 100 | 100 | 100 |
| 9,000 ft | 100 | 100 | 100 |

Source: FAA AC 150/5300-13, Change 12, *Airport Design*
Prepared By: CH2M HILL, 2008
[1/]Category B - Small twin-engine -12,500 lbs or less.

TABLE 4-3
Exit Taxiway Cumulative Utilization Percentages1/
*Percent of Category C aircraft that will be able to turn at a taxiway exit upon landing.*

| Distance from Threshold to Exit | Wet Runways | Dry Runways | |
|---|---|---|---|
| | Right and Acute Angled Exits | Right Angled Exits | Acute Angled Exits |
| 0 ft | 0 | 0 | 0 |
| 500 ft | 0 | 0 | 0 |
| 1,000 ft | 0 | 0 | 0 |
| 1,500 ft | 0 | 0 | 0 |
| 2,000 ft | 0 | 0 | 0 |
| 2,500 ft | 0 | 0 | 0 |
| 3,000 ft | 0 | 0 | 0 |
| 3,500 ft | 0 | 2 | 9 |
| 4,000 ft | 1 | 8 | 26 |
| 4,500 ft | 4 | 24 | 51 |
| 5,000 ft | 12 | 49 | 76 |
| 5,500 ft | 27 | 75 | 92 |
| 6,000 ft | 48 | 92 | 98 |
| 6,500 ft | 71 | 98 | 100 |
| 7,000 ft | 88 | 100 | 100 |
| 7,500 ft | 97 | 100 | 100 |
| 8,000 ft | 100 | 100 | 100 |
| 8,500 ft | 100 | 100 | 100 |
| 9,000 ft | 100 | 100 | 100 |

Source: FAA AC 150/5300-13, Change 12, *Airport Design*
Prepared By: CH2M HILL, 2008
1/Category C - Large Aircraft -12,500 lbs to 300,000 lbs.

### *Taxiway G*

Given that Runway 29 is the primary runway, used 85 to 90 percent of the time, Taxiway G is a very important exit as it is located approximately 5,500 feet from the Runway 29 threshold. In its current location along the runway, Taxiway G accommodates a majority of the fleet mix, including all of Category B aircraft and between 75 and 92 percent of Category C aircraft, with an acute-angled and right-angled taxiway. Along Runway 11, Taxiway G is approximately 4,000 feet from the threshold and is therefore in a good location to accommodate most approach Category B aircraft, approximately 98 percent in dry conditions. However, due to the slight angle and inadequate width of Taxiway G, it is underutilized. Therefore, in the near-term, it is recommended that the portion of Taxiway G between Runway 11/29 and Taxiway A is widened and realigned to a right-angled taxiway. The width expansion needs to accommodate Airplane Design Group (ADG) III aircraft, and most Category C aircraft. Aircraft that are unable to make Taxiway G from the Runway 11 direction must travel an additional 3,000 feet on the runway to reach the next exit (Taxiway A-3).

To eliminate the remaining EB-75 inconsistency on Taxiway G, the northern section of Taxiway G from Taxiway A to the Minuteman/USFS apron should also be widened.

### *Proposed Taxiway H*

Users of Taxiway G include both high-speed critical tanker operations and slower-moving GA aircraft. Over the planning period, the amount of GA traffic on Taxiway G is expected to increase, along with the build out of the Minuteman GA area discussed in Section 4.2.3. The proposed Minuteman GA development area requires landside access that traverses Taxiway G and prevents tanker aircraft and GA aircraft on Taxiway G from accessing the terminal area, creating more two-way traffic on Taxiway G. Three alternatives are available to create two-way flow:

- Alternative 1 – Construct a parallel taxiway west of Taxiway G.
- Alternative 2 - Construct a parallel taxiway east of Taxiway G.
- Alternative 3 – Construct a holding pad on Taxiway G.

#### *Evaluation Criteria*

The evaluation criteria used for this analysis includes:

- Two-way access – The alternative allows two-way flow.
- Landuse compatibility – The level of infringement on existing or proposed land uses.

#### *Evaluation*

Two-way access - All the alternatives allow a two-way flow and allow aircraft to pass on the taxiways. Alternative 3 involves the most coordination by aircraft and the ATCT.

Landuse compatibility –Alternative 2 would reduce the amount of developable land available for GA/FBO expansion between the taxiway and the deicing pad/Taxiway F. This would reduce the ability to keep Minuteman GA/FBO development together. In contrast, Alternatives 1 and 3 do not infringe on proposed development within the planning period.

#### *Preferred Alternative*

In parallel with the Minuteman GA/FBO expansion discussed in this chapter, Alternative 1 is the preferred alternative to provide two-way access because it reduces the level of coordination by pilots and the ATCT and it also is consistent with the GA/FBO development proposed in this chapter.

### *Taxiway E*

Taxiway E is inconsistent with EB-75 because it intersects with Taxiway A and Runway 7/25, creating a five-way intersection. Taxiways A-3, E, and F provide access to and from the terminal apron during all conditions, including occasions when access on one taxiway is blocked by snow removal or emergency equipment. Because unobstructed access to and from the terminal apron is important for airfield flow, Taxiway E should remain in service, but be relocated to eliminate the EB-75 inconsistency.

A teleconference was held between the RSAT team, the Helena Airport Districts Office (ADO), the MSO ATCT, and MSO staff to discuss Taxiway E relocation alternatives.[5]

[5] A record of the teleconference, "telerecordmso12809.doc" is on file at the Airport.

Following the teleconference, multiple taxiway alternatives were presented and reviewed which resulted in an alternative that was mutually acceptable by all teleconference participants. The preferred relocated Taxiway E layout begins at the mouth of the existing Taxiway E, crosses Runway 7/25 at a 90-degree angle, and ends at Taxiway A. This layout, shown in **Exhibit 4-3,** is more consistent with EB-75 guidelines because it eliminates multiple taxiway intersections, minimizes expanses of pavement at intersections, and provides good pilot visibility with a 90 degree taxiway-runway intersection. The new layout also expedites operational flow by providing a more direct route to the departure end, Runway 29.

As shown in Exhibit 4-3, the preferred angled portion of Taxiway E should be constructed in the near term. As such, the design is currently underway for near-term construction.

### *Taxiway A-3*

Taxiway A-3 is used mostly by aircraft landing on Runway 11 and is located approximately 7,000 feet from the threshold. According to FAA AC 150/5300-13, this right-angled taxiway accommodates approximately 88 to 100 percent of Category C aircraft and all Category B aircraft.

Taxiway A-3 is inconsistent with EB-75 because of the straight-through runway access across parallel Taxiway A, and potential solutions to alleviate the EB-75 inconsistency also affect the runway exit location. In the long-term, the straight access across parallel Taxiway A should be eliminated. Four alternatives are available:

- Alternative 1 - Shift the portion of Taxiway A-3 between Taxiway A and Runway 7/25 to the west, so the centerline correlates with the preferred layout of Taxiway E.
- Alternative 2 - Shift Taxiway D one taxiway width to the west.
- Alternative 3 - Shift Taxiway D one taxiway width to the east.
- Alternative 4 - Create a jog in Taxiway D to the west a half taxiway width.

#### *Evaluation Criteria*

The evaluation criteria used for this analysis includes:

- Runway exit and airfield flow – The new location of the taxiway is placed to accommodate the exit of aircraft off of Runway 11/29 and maintain or enhance airfield flow.
- Impact to surrounding facilities – The facilities that must be relocated due to the new taxiway layout.
- Infringement to future development – The ability to expand future aprons around the taxiway.

#### *Evaluation*

Runway exit and airfield flow - All four taxiway alternatives provide adequate taxiway exit capability. Alternative 1, which shifts the taxiway location closer to Runway 11, allows most aircraft to exit sooner. It also provides a closer alternative to aircraft currently using Runway 7/25 as a high-speed exit. Additionally, by tying into the preferred layout of Taxiway E, it provides direct access to and from the terminal apron. When aircraft land on Runway 29,

Alternative 1 accommodates almost no Category C aircraft and only 25 to 55 percent of Category B aircraft in wet and dry conditions. When aircraft land on Runway 11, Alternative 1 accommodates all Category B aircraft and approximately 70 percent and 96 percent of Category C aircraft in wet and dry conditions. Alternatives 2 through 4 do not change the taxiway exit location because Taxiway A-3 remains in its existing position, and Taxiway D is moved.

Impact to surrounding facilities – Shifting Taxiway A-3 to the west (Alternative 1) does not affect existing facilities. Implementing Alternative 2 would require that the wind cone is removed and relocated. It would also line up the top of Taxiway D with Runway 7/25, creating an EB-75 inconsistency. Implementing Alternative 3 would affect the FAA transmitter and electrical vault, and require that they are relocated. Alternative 4 does not impact any known facilities.

Infringement to future development – Alternatives 1, 2, and 4 would not be constructed in an area where the taxiways would infringe on future apron development. Implementing Alternative 2 would allow the most room for apron expansion to the east of the taxiway. On the other hand, Alternative 3 would move the taxiway into the Northstar/Neptune development area, and aircraft using Taxiway D would taxi through the apron area.

***Preferred Alternative***

Alternative 2 is not a viable option because of the EB-75 inconsistency it creates with Runway 7/25. Also, Alternative 3 should be eliminated from consideration because it would require the removal and relocation of the most facilities and because its location near the Northstar/Neptune ramp would cause the most interruption to operations. Alternatives 1 and 4 are both viable alternatives to remove the EB-75 inconsistency. However, Alternative 1 is the preferred option because its location provides adequate exit capability for aircraft landing on Runway 11 and it would possibly replace the use of Runway 7/25 as a taxiway. The location also does not infringe on existing or future development.

### *Acute-angled Exits*

Although existing and projected peaking characteristics do not justify acute-angled exits, to benefit critical fire fighting tanker operations and as operations increase beyond the planning period, acute-angled exit placement should be considered. In the long-term, a high-speed exit is recommended just beyond Taxiway G to serve Runway 29. A high-speed exit is not recommended to serve Runway 11 due to the relatively low utilization of Runway 11.

## Preferred Taxiway Layout

Based on this analysis, the following taxiway improvements are proposed to enhance overall airfield capacity, operability, and reduce runway occupancy times:

***Near-Term***

- Relocate Taxiway E at an angle toward Taxiway A, crossing Runway 7/25 at a right angle.
- Widen Taxiway G to accommodate C-III aircraft, and straighten the portion of Taxiway G from Taxiway A to Runway 11/29 to a 90 degree angle with the runway.

*Mid- to Long-Term*

- Shift Taxiway A-3 to the west.
- Construct Taxiway H parallel to, and west of, Taxiway G.

*Long-term*

- A high speed exit is recommended on Runway 29, just beyond Taxiway G to increase the efficiency of future tanker operations.

The locations of these taxiway improvements are shown in **Exhibit 4-3**.

750'

LEGEND

- Near Term Development
- Mid-Long Term Development
- Long Term Development

True North

1" = 800'

400' 0 800'

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# Missoula Airport Master Plan Update

Preferred Taxiway Layout

Exhibit 4-3

### 4.3.3 General Aviation/FBO Alternatives

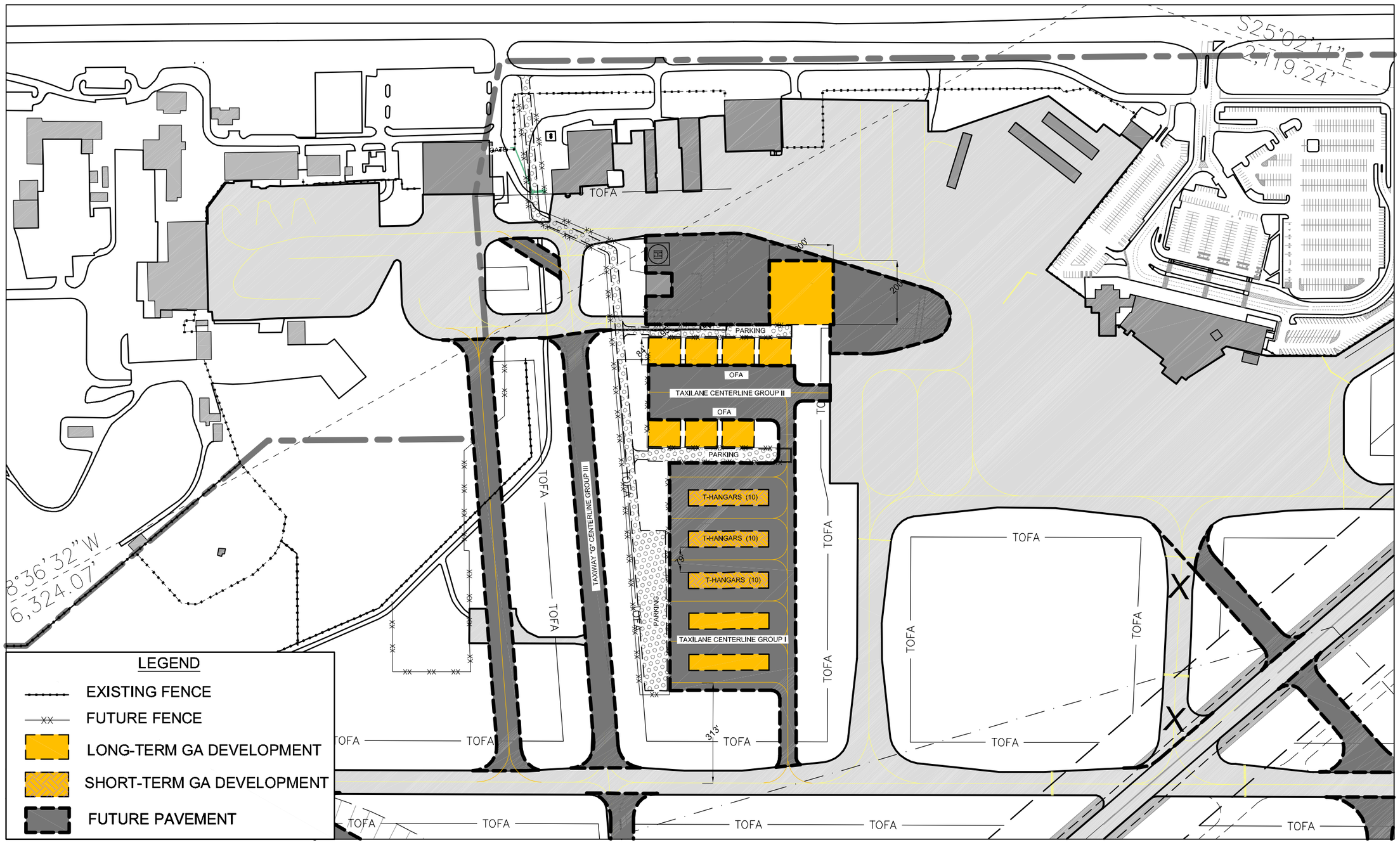
The following conceptual layouts were developed to meet the 2028 facility needs projected for Minuteman and Northstar/Neptune. The layouts identified in this section are typical layouts that would accommodate the projected needs, but they do not represent the actual business plans of the FBOs. The FBOs will work with the airport on specific proposals as demand materializes.

#### Minuteman

Minuteman is expected to require additional 43,000 square yards of apron in the long-term, in addition to the immediate-term need to replace 19,000 square yards of apron lost due to the terminal parking lot expansion. The layout of the Minuteman area is shown in **Exhibit 4-4**. The proposed apron layout, plus the additional T-hangar and apron development near the end of Runway 25 (shown in **Exhibit 4-6)** is approximately 62,000 square yards. As additional T-hangars are needed, an ideal location for T-hangars is between Taxiway G and Taxiway F.

The replacement maintenance hangar should be located close to the existing maintenance hangar to provide operational efficiencies for the FBO and also avoid ATCT line of sight issues (LOS) on Taxiway G (the replacement ATCT will remain in its existing location for some five years).

Additionally, the helicopter refueling, parking, and maneuvering area should be located to minimize impact to fixed-wing operations and minimize foreign object debris (FOD) to surrounding aircraft and vehicles. The area shown in **Exhibit 4-5** would be an ideal location for the helicopter parking, refueling, and maneuvering area. In the long-term, it provides the greatest distance from fixed-wing aircraft, and would reduce the risk of damage associated with any FOD. This location was confirmed with the FBO representative.

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**Missoula Airport Master Plan Update**

Minuteman GA Development

Exhibit 4-4

EXHIBIT 4-5
Preferred Helipad Location


## Neptune

Northstar/Neptune is expected to require approximately 48,000 square yards of apron to account for growth over the planning period. The potential future layout of the Northstar/Neptune area is shown in **Exhibit 4-6**. This layout includes large hangars to house potential future aircraft and maintenance operations. Additionally, the automobile parking area was segregated from airside operations. No specific alternatives are considered here because different options for their area were analyzed and reviewed with the Airport Board, Study Resource Committee (SRC), and others during the preparation of the *Long-term Concept Sketch Plan* (see Appendix B).

## GA Expansion and Potential Third FBO

Missoula is served by two full-service and well-managed FBOs. Both are located north of Runway 11/29. Should a new FBO express interest in MSO, the airport needs to have a plan to respond. As such, placement alternatives are explored in this section.

Seven placement alternatives were explored, and are shown in **Exhibit 4-7**:

- Alternative 1 - Near Minuteman, east of Taxiway G
- Alternative 2 - Near Minuteman, west of Taxiway G
- Alternative 3 - Near Northstar/Neptune
- Alternative 4 - East of existing terminal area
- Alternative 5 - South of Runway 11/29, near Runway 29 end
- Alternative 6 - South of Runway 11/29, near Runway 11 end
- Alternative 7 - South airport property

RPZ VISUAL (250'X450'X1000')

20FT BRL

T-HANGARS (17) *

F-OFA

TOFA

PRIMARY SURFACE

FUTURE FBO AREA

ZONE X

OFZ

TAXIWAY CENTERLINE "A" (GROUP-III)

## LEGEND

- EXISTING FENCE
- FUTURE FENCE
- LONG-TERM GA DEVELOPMENT
- SHORT-TERM GA DEVELOPMENT
- FUTURE PAVEMENT

TRUE NORTH

1" = 300'

150' 0 300'

* Under Construction (2008)

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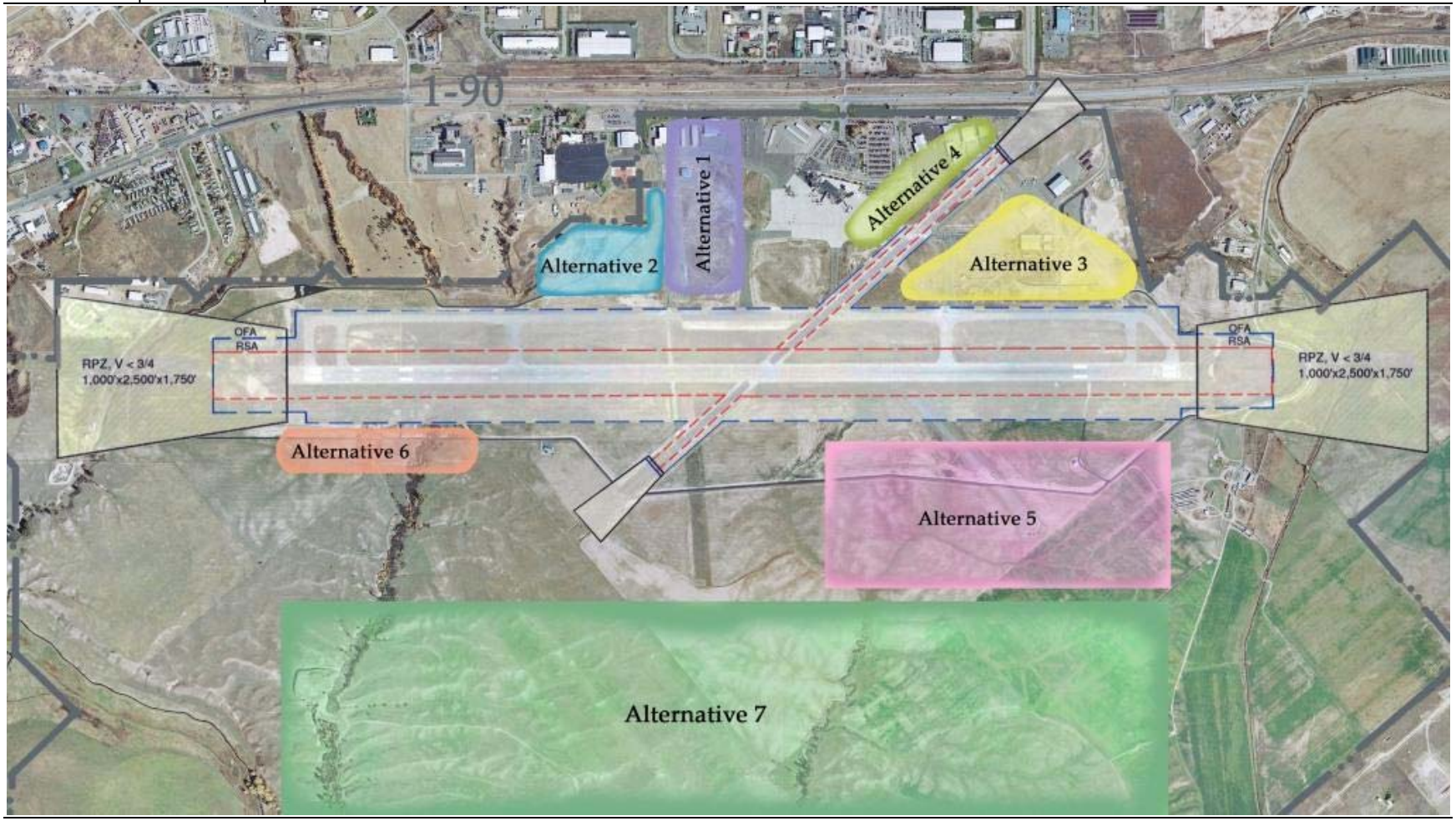
# Missoula Airport Master Plan Update

Northstar/Neptune GA Development

Exhibit 4-7

EXHIBIT 4-7
FBO and GA Expansion Development Alternatives




Prepared by: CH2M HILL, 2008

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### *Evaluation Criteria*

Three evaluation criteria were identified based on the objectives and needs of MSO. The evaluation criteria include:

- Long-term development – The alternative supports long-term development of other airfield facilities such as runways, terminals, existing FBOs, etc.
- Part 77 and LOS issues – The alternative does not cause safety or line of sight issues.
- Supporting infrastructure – The area has supporting infrastructure including taxiways, security fences, utilities, etc.

### *Evaluation*

**Table 4-4** compares the seven alternatives by comparing the established evaluation criteria outlined above.

TABLE 4-4
Alternative Locations for Additional General Aviation and / or FBOs

| Alternative Locations | Long-term Development | Part 77 and LOS Issues | Supporting Infrastructure |
|---|---|---|---|
| Alternative 1. Near Minuteman, east of Taxiway G | - Highest value is continued FBO use<br>- Possible competition with existing FBO<br>- Consolidation with ongoing GA operations<br>- Large enough for long-term development | - LOS issues in the near term on Taxiway G and possibly Taxiway A<br>- No LOS issues when the ATCT is relocated south of Runway 11/29 | - Landside access requires crossing active taxiways<br>- Landside access needs improvement if traffic to this area is increased<br>- Requires upgrades of utilities<br>- Requires some supporting taxiways<br>- Requires upgrades in security fencing around landside access points |
| Alternative 2. Near Minuteman, west of Taxiway G | - Highest value is continued FBO use<br>- Possible interruption of long-term existing FBO expansion<br>- Consolidation with ongoing GA operations<br>- Limited long-term expansion potential due to environmental and airport property boundary constraints | - No LOS issues in the near term<br>- No LOS issues when the ATCT is relocated south of Runway 11/29<br>- Part 77 limits building height | - Landside access requires crossing of active taxiways<br>- Landside access needs improvement if traffic to this area is increased<br>- Requires upgrades of utilities<br>- Requires some supporting taxiways<br>- Requires upgrades in security fencing around landside access points |
| Alternative 3. Near Northstar/Neptune | - Highest value is continued FBO use<br>- Possible competition with existing FBO<br>- Consolidation with ongoing GA operations<br>- Large enough for long-term development | - LOS issues in the near term preclude large hangar development in some areas<br>- No LOS issues when the ATCT is relocated south of Runway 11/29 | - Requires upgrades of utilities<br>- Requires upgrades in security fencing around landside access points |

TABLE 4-4
Alternative Locations for Additional General Aviation and / or FBOs

| Alternative Locations | Long-term Development | Part 77 and LOS Issues | Supporting Infrastructure |
|---|---|---|---|
| Alternative 4. East of existing terminal area | - Possible interruption of long-term existing FBO expansion<br>- Consolidation with ongoing GA operations<br>- Little room for development | - Development limited by LOS issues in the near term<br>- No LOS issues when the ATCT is relocated south of Runway 11/29<br>- Part 77 limits building height | - Most supporting infrastructure exists in the area |
| Alternative 5. South of Runway 11/29, near Runway 29 end | - Creates a new location for GA operations<br>- Collocates development with ATCT in the mid- to long-term<br>- GA expansion limited by possible terminal facilities in the long-term, however it is large enough for long-term development<br>- Possible interference with NAVAIDs in near-term<br>- Ability to tie into ATCT construction (landside access and utilities) makes this alternative more ideal for long-term development | - No LOS issues in the near term<br>- No LOS issues when the ATCT is relocated south of Runway 11/29 | - Less suitable for near-term development, until tower is constructed, due to lack of utilities<br>- Requires supporting taxiways<br>- May require some additional security fencing to tie into the ATCT fencing<br>- May require some landside access improvements to tie into the ATCT roadways |
| Alternative 6. South of Runway 11/29, near Runway 11 end | - Creates a new location for GA operations<br>- Possible interference with NAVAIDs in near-term<br>- Large enough for long-term development | - No LOS issues in the near term<br>- No LOS issues when the ATCT is relocated south of Runway 11/29 | - Lack of utilities, with no plan for utilities<br>- Requires a large improvement to supporting taxiways<br>- Requires security fencing<br>- Requires a large improvement to landside access |
| Alternative 7. South airport property | - Creates a new location for GA operations<br>- Large enough for long-term development<br>- Distance from the airfield makes this alternative unsuitable for development within the planning period<br>- Possible interruption of nonaviation development and future aviation development post-planning period | - No LOS issues in the near term<br>- No LOS issues when the ATCT is relocated south of Runway 11/29 | - Lack of utilities, with no plan for utilities<br>- Requires the most supporting taxiways<br>- Requires security fencing<br>- Requires the most improvement to landside access |

Prepared By: CH2M HILL, 2008

***Preferred Alternative***

In the near-term, organic or incremental expansion by the existing FBOs would best be accommodated within their respective land areas—Alternative 1 and Alternative 3. However in the long-term, Alternative 5 is an ideal location for future GA development because development in this area will be the least restricted by line of sight and Part 77 surfaces. Additionally, GA development in this area can potentially tie into the infrastructure being constructed for the ATCT, such as landside access roads, utilities, and security fencing. Development in this area relies on the expected future decommissioning of the airport VOR.

## 4.4 Support Facilities Alternatives

This section develops and evaluates alternatives for fuel farm expansion. The capacity of other support facilities was considered adequate.

### 4.4.1 Fuel Farm

Three alternatives were explored to accommodate fuel farm expansion to meet both Northstar/Neptune's and Minuteman's long-term requirement. Both FBOs will require approximately a 45 percent increase in fuel storage capability. The following alternatives were reviewed:

- Alternative 1 - Expand in existing location
- Alternative 2 - Relocate all storage facilities to a location east of Taxiway G
- Alternative 3 - Construct additional fuel storage facilities east of Taxiway G, and maintain two fuel farms

**Exhibit 4-8** shows the locations of these alternatives.

EXHIBIT 4-8

Fuel Farm Alternatives


Prepared by: CH2M HILL, 2008.

### *Evaluation Criteria*

Four criteria were identified based on the objectives and needs of MSO. The evaluation criteria include:

- Airfield Operability and Access – Minimize runway and taxiway crossings; Aircraft will continue to be fueled by trucks, and the fuel farm will require truck access. Landside access is also required.
- LOS - Line of sight issues with the existing and future tower location.
- Fuel Farm Expansion – The ability to expand the fuel farm as demand grows beyond current projections.
- Impact on Aviation Development – The level of impact on the potential growth of aviation facilities.
- Environmental – Potential environmental issues.

### *Evaluation*

**Table 4-5** compares the three alternatives against the established evaluation criteria outlined above.

TABLE 4-5
Fuel Farm Alternatives

| Evaluation Criteria | Alternative 1 Expand in Existing Location | Alternative 2 Relocate all Fuel Facilities off of Taxiway G | Alternative 2 Construct Additional Fuel Facilities off of Taxiway G |
|---|---|---|---|
| Airfield Operability and Access | - Trucks cross the airfield in front of the terminal area to access aircraft on the other side of the airfield. | - Trucks must cross the airfield in front of the terminal area to access aircraft on the other side of the airfield. | - With fuel farms on both sides of the airfield, most runway and taxiway crossings can be eliminated. |
| | - Adequate access roads exist to landside. | - Dedicated access road does not exist. | - Dedicated access road does not exist. |
| LOS | - No LOS issues with existing or future tower location. | - Possible LOS issues with both tower locations. | - Possible LOS issues with both tower locations. |
| Fuel Farm Expansion | - Room exists to expand fuel farm facilities within the planning period. | - Room exists to expand fuel farm facilities within the planning period. | - Room exists to expand fuel farm facilities within the planning period. |
| Impact to Aviation Development | - Location does not affect future aviation development due to its location on the edge of airport property. | - Central location on airport property is prime real estate for GA or terminal development. | - Central location on airport property is prime real estate for GA or terminal development. |
| **Environmental** | - Requires upkeep of one location. | - Requires upkeep of one location. | - Requires upkeep of two locations. |

Prepared By: CH2M HILL, 2008

***Preferred Alternative***

Alternative 1, the existing location is adequate to accommodate expansion of both the fuel farms for Minuteman and Northstar/Neptune throughout the planning horizon. This area will not pose any LOS issues, has adequate landside access roads, has the smallest impact on other aviation development, and appears to have the least environmental impacts; therefore it is the recommended alternative.

## 4.5 Nonaviation Development Plan

This chapter and the post-20-year *Long-term Concept Sketch Plan* identified the footprint necessary to accommodate aviation activity through and beyond the 20-year planning period. The purpose of identifying this aviation land was to reflect on the ALP the property available that might be available for nonaviation development. Hence, the focus of Chapter 7, *Nonaviation Development,* will be on the land south of the aviation-use areas and within airport boundaries. Chapter 7 includes a review of relative economic and real estate trends in the Missoula area, suggests business uses for the property, and develops a conceptual layout of a business park.

## 4.6 Environmental Overview

Proposed facility locations identified in this chapter are not expected to trigger environmental concerns, including:

- Water
- Flood plains
- Historic properties

However, prior to implementation of any project identified in this chapter, the proper environmental approvals are required. Refer to **Appendix F** of the Master Plan for an overview of known environmental features on and around the vicinity of the airport.