BOULDER CITY
MUNICIPAL AIRPORT

CHAPTER THREE

Facility Requirements

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FACILITY REQUIREMENTS

This chapter will evaluate the existing capacities of the Boulder City Municipal Airport (BVU or Airport) and outline any new facilities needed to accommodate projected forecast levels. The existing capacity is compared to the forecast activity levels prepared in Chapter Two to determine the adequacy of existing facilities as well as to identify if deficiencies currently exist or may be expected to materialize in the future. The chapter will cover:

- Planning Horizon Activity Levels
- Airfield Capacity
- Airport Physical Planning Criteria
- Airside and Landside Facility Requirements

As indicated in Chapter One, airport facilities include both airside and landside components. Airside facilities include those that are related to the arrival, departure, and ground movement of aircraft. These components include:

- Runways
- Taxiways
- Navigational Approach Aids
- Airfield Lighting, Marking, and Signage

Landside facilities are needed for the interface between air and ground transportation modes. At Boulder City Municipal Airport, this includes components for commercial service and general aviation needs such as:

- Terminal Facilities
- Aircraft Hangars
- Aircraft Parking Aprons
- Automobile Parking
- Airport Support Facilities

As noted above, the overall objective of this effort is to identify, in general terms, the adequacy of existing airport facilities and outline what new facilities may be needed and when these may be needed to accommodate forecast demands. Having established these facility requirements, alternatives for providing these facilities will be evaluated in Chapter Four to determine the most practical, cost-effective, and efficient direction for future development.

PLANNING HORIZONS

In Chapter Two, an updated set of aviation demand forecasts for BVU was established. The activity forecasts include air tour operator enplanements, based aircraft, fleet mix, annual operations, peaking characteristics, and annual instrument approaches (AIAs). With this information, specific components of the airside and landside systems can be evaluated to determine their capacity to accommodate future demand.

Cost-effective, safe, efficient, and orderly development of an airport should rely more upon actual demand at an airport than a time-based forecast figure.

Cost-effective, safe, efficient, and orderly development of an airport should rely more upon actual demand at an airport than a time-based forecast figure. In order to develop a Master Plan that is "demand-based" rather than "time-based," a series of planning horizon milestones has been established for the Airport that takes into consideration the reasonable range of aviation demand projections prepared in Chapter Two. It is important to consider that the actual activity at any given time at the Airport may be higher or lower than projected activity levels. By planning according to activity milestones, the resulting plan can accommodate unexpected shifts or changes in the Airport's aviation demand.

The most important reason for utilizing milestones is that they allow the airport to develop facilities according to need generated by actual demand levels. The demand-based schedule provides flexibility in development, as schedules can either be slowed or expedited according to actual demand at any given time over the planning period. The resultant plan provides airport management with a financially responsible and needs-based program. **Table 3A** presents the planning horizon milestones of short, intermediate, and long term for each aircraft activity category for the Airport. These milestones generally correlate to the five, ten, and 20-year periods used in Chapter Two.

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TABLE 3A
Planning Horizon Activity Summary
Boulder City Municipal Airport

	Base Year (2015)	Short Term (1-5 Years)	Intermediate Term (6-10 Years)	Long Term (11-20 Years)
ENPLANED PASSENGERS	**211,648**	**240,000**	**275,000**	**350,000**
BASED AIRCRAFT				
Single Engine Piston	171	184	194	216
Multi-Engine Piston	8	9	10	10
Turboprop	23	29	32	41
Jet	0	1	3	7
Helicopter	43	47	51	56
Total Based Aircraft	**245**	**270**	**290**	**330**
ANNUAL OPERATIONS				
Itinerant				
Air Taxi/Commuter	57,496	63,158	72,368	84,848
General Aviation	6,570	8,000	10,000	13,500
“Other” Air Taxi	14,100	15,650	16,350	19,000
Military	496	300	300	300
Total Itinerant	**78,662**	**87,108**	**99,018**	**117,648**
Local				
General Aviation	20,100	23,000	24,000	27,000
Total Local	**20,100**	**23,000**	**24,000**	**27,000**
TOTAL OPERATIONS	**98,762**	**109,108**	**123,018**	**144,648**

AIRFIELD CAPACITY

An airfield’s capacity is expressed in terms of its annual service volume (ASV). ASV is a reasonable estimate of the maximum level of aircraft operations that can be accommodated in a year without incurring significant delay factors. As aircraft operations near or surpass

ASV is a reasonable estimate of the maximum level of aircraft operations that can be accommodated in a year without incurring significant delay factors.

the ASV, delay factors increase exponentially. The airport's ASV was examined utilizing the Federal Aviation Administration's (FAA) Advisory Circular (AC) 150/5060-5, *Airport Capacity and Delay*.

FACTORS AFFECTING ANNUAL SERVICE VOLUME

This analysis takes into account specific factors about the airfield in order to calculate the airport's ASV. These various factors are depicted in **Exhibit 3A**. The following describes the input factors as they relate to Boulder City Municipal Airport and include airfield layout, weather conditions, aircraft mix, and operations.

- **Runway Configuration –** Primary Runway 9-27 is 4,803 feet long and 75 feet wide. Runway 15-33, the crosswind runway, is 3,852 feet long and 75 feet wide. Both runways intersect near the midpoint of each runway. The existing airfield configuration also consists of a series of taxiways serving each runway.

- **Runway Use –** Runway use in capacity conditions will be controlled by wind and/or airspace conditions. For BVU, the direction of takeoffs and landings is generally determined by the speed and direction of the wind. It is generally safest for aircraft to takeoff and land into the wind, avoiding a crosswind (wind that is blowing perpendicular to the travel of the aircraft) or tailwind components during these operations. Runway 9-27 is the primary runway and is capable of accommodating all types of aircraft operating at the airport, day and night. Runway 15-33 can also accommodate a large majority of aircraft utilizing the airport. Similar to primary Runway 9-27, this runway is capable of handling operations during daytime and nighttime conditions.

  Based upon aircraft type and characteristics, the intersecting configuration of Runways 9-27 and 15-33 is utilized most often. It should be noted that the air tour helicopter operations are analogous to fixed wing operations occurring on Runway 15-33 due to the agreed operational usage which has helicopters departing south and arriving from the south so as to avoid the City of Boulder City to the greatest extent possible.

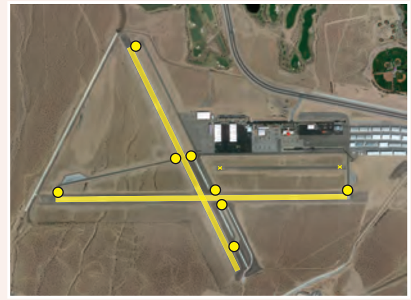
- **Exit Taxiways –** Exit taxiways have a significant impact on airfield capacity since the number and location of exits directly determine the occupancy time of an aircraft on the runway. The airfield capacity analysis gives credit to taxiway exits located within the prescribed range from a runway's threshold. This range is based upon the mix index of the aircraft that use the runways. Based upon mix, only exit taxiways between 2,000 feet and 4,000 feet from the landing threshold count in the exit rating at Boulder City Municipal Airport. The exits must be at least 750 feet apart to count as separate exit taxiways. Utilizing these standards, the airport is generally provided two exit taxiways on each runway.

AIRFIELD LAYOUT

Runway Configuration

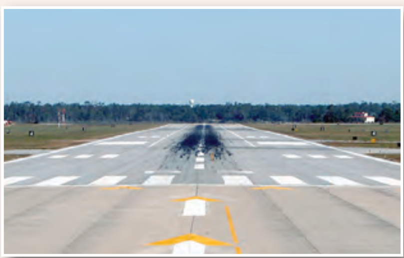
Runway Use

Number of Exits

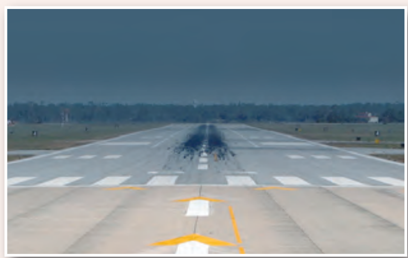


WEATHER CONDITIONS

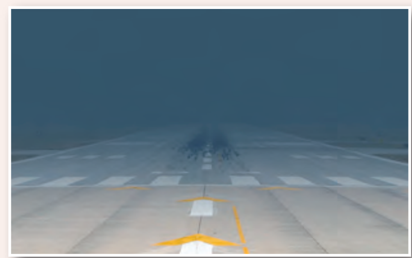
VMC
Visual Meteorological Conditions



IMC
Instrument Meteorological Conditions



PVC
Poor Visibility Conditions



AIRCRAFT MIX

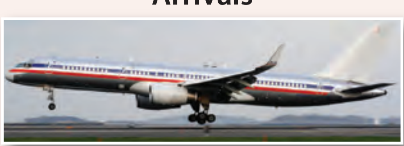
Category A & B Aircraft

Category C Aircraft

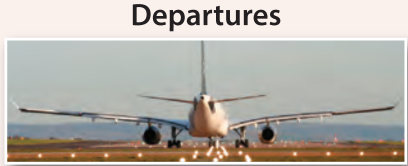
Category D Aircraft

OPERATIONS

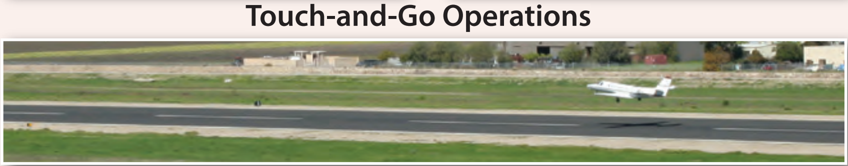
Arrivals



Departures



Touch-and-Go Operations



Total Annual Operations

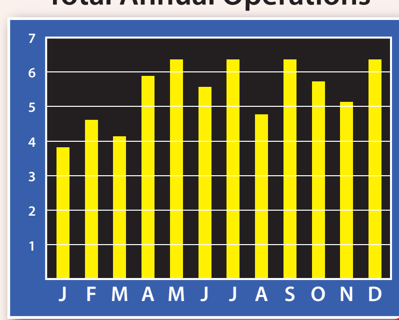


Exhibit 3A
AIRFIELD CAPACITY FACTORS

- **Weather Conditions –** Weather conditions can have a significant impact on airfield capacity. Airport capacity is usually highest in clear weather, when flight visibility is at its best. Airfield capacity is diminished as weather conditions deteriorate and cloud ceilings and visibility are reduced. As weather conditions deteriorate, the spacing of aircraft must increase to provide allowable margins of safety and air traffic vectoring. The increased distance between aircraft reduces the number of aircraft which can operate at the airport during any given period, thus reducing overall airfield capacity.

According to meteorological data collected from the on-airport automated weather observation system (AWOS), the airport operates under visual meteorological conditions (VMC) approximately 99.83 percent of the time. VMC exist whenever the cloud ceiling is greater than 1,000 feet above ground level (AGL) and visibility is greater than three statute miles. Instrument meteorological conditions (IMC) are defined when cloud ceilings are between 500 and 1,000 feet AGL or visibility is between one and three miles. According to the weather observations, IMC prevailed approximately 0.11 percent of the time. Poor visibility conditions (PVC) apply for cloud ceilings below 500 feet and visibility minimums below one mile. PVC conditions occur approximately 0.06 percent of the year. **Table 3B** summarizes the weather conditions experienced at the airport over a 7-year period of time.

TABLE 3B
Weather Conditions
Boulder City Municipal Airport

Condition	Cloud Ceiling	Visibility	Percent of Total
VMC	> 1,000' AGL	> 3 statute miles	99.83%
IMC	≥ 500' AGL and ≤ 1,000' AGL	1-3 statute miles	0.11%
PVC	< 500' AGL	< 1 statute mile	0.06%

VMC - Visual Meteorological Conditions
IMC - Instrument Meteorological Conditions
PVC - Poor Visibility Conditions
AGL - Above Ground Level

Source: National Oceanic and Atmospheric Administration (NOAA) - National Climatic Data Center. Airport observations from June 2010 – December 2015.

- **Aircraft Mix -** Aircraft mix for the capacity analysis is defined in terms of four aircraft classes. Classes A and B consist of small- and medium-sized propeller and some jet aircraft, all weighing 12,500 pounds or less. These aircraft are associated primarily with general aviation activity. A large majority of aircraft operations at Boulder City Municipal Airport are those in Classes A and B. Class C consists of aircraft weighing between 12,500 pounds and 300,000 pounds. These aircraft include most business jets and some turboprop aircraft. The turboprop Beechcraft Super King Air 350 and the larger Cessna Citation jets being operated at the airport are examples of Class C aircraft. Class D aircraft consists of large aircraft weighing more than 300,000 pounds. The airport does not experience operations by Class D aircraft.

- **Percent Arrivals –** The percentage of arrivals as they relate to total operations of the airport is important in determining airfield capacity. Under most circumstances, the lower the percentage of arrivals, the higher the hourly capacity. The aircraft arrival-departure percentage split is typically 50/50, which is the case at Boulder City Municipal Airport.

- **Touch-And-Go Activity –** A touch-and-go operation involves an aircraft making a landing and then an immediate takeoff without coming to a full stop or exiting the runway. As previously discussed in Chapter Two, these operations are normally associated with general aviation training activity and classified as a local operation. A high percentage of touch-and-go traffic normally results in a higher operational capacity because one landing and one takeoff occurs within a shorter time period than individual operations. Touch-and-go operations at Boulder City Municipal Airport account for approximately 20.4 percent of total annual operations. A similar ratio is expected in the future.

- **Peak Period Operations –** For the airfield capacity analysis, average daily operations and average peak hour operations during the peak month are utilized. Typical operations activity is important in the calculation of an airport's ASV as "peak demand" levels occur sporadically. The peak periods used in the capacity analysis are representative of normal operational activity and can be exceeded at various times throughout the year.

CAPACITY ANALYSIS CONCLUSIONS

Given the factors outlined above, the BVU airfield ASV will range between 219,000 and 245,000 annual operations. The ASV does not indicate a point of absolute gridlock for the airfield; however, it does represent the point at which operational delay for each aircraft operation will increase exponentially. The current estimated operational level for the airport represents approximately 45 percent of the airfield's ASV, if the ASV is considered at the low end of the typical range of 219,000 annual operations. By the end of the planning period, total annual operations are expected to represent approximately 59 percent of the airfield's ASV.

While no significant capacity improvements will be necessary, options to improve airfield efficiency will still be considered in the Master Plan.

FAA Order 5090.3B, *Field Formulation of the National Plan of Integrated Airport Systems* (NPIAS), indicates that improvements for airfield capacity purposes should begin to be considered once operations reach 60 to 75 percent of the annual service volume. This is an approximate level to begin the detailed planning of capacity improvements. At the 80 percent level, the planned improvements should be made. While no significant capacity improvements will be necessary, options to improve airfield efficiency will still be considered in the Master Plan.

AIRSIDE FACILITY REQUIREMENTS

As indicated earlier, airport facilities include both airside and landside components. Airside facilities include those that are related to the arrival, departure, and ground movement of aircraft. These components include:

- Runway Configuration
- Safety Area Design Standards
- Runways
- Taxiways
- Navigational and Approach Aids
- Lighting, Marking, and Signage

RUNWAY CONFIGURATION

The airport is currently served by a two-runway system. Primary Runway 9-27 is orientated in an east-west manner. Crosswind Runway 15-33 is orientated in a northwest-southeast manner.

For the operational safety and efficiency of an airport, it is desirable for the primary runway to be oriented as close as possible to the direction of the prevailing wind. This reduces the impact of wind components perpendicular to the direction of travel of an aircraft that is landing or taking off.

FAA AC 150/5300-13A, *Airport Design,* recommends that a crosswind runway be made available when the primary runway orientation provides for less than 95 percent wind coverage for specific crosswind components. The 95 percent wind coverage is computed on the basis of not exceeding a 10.5 knot (12 mph) component for RDC A-I and B-I, 13 knot (15 mph) component for RDC A-II and B-II, and 16 knot (18 mph) component for RDC A-III, B-III, C-I through C-III, and D-I through D-III.

Weather data specific to the airport was obtained from the National Oceanic Atmospheric Administration (NOAA) National Climatic Data Center. This data was collected from the AWOS located on the airfield over a continuous 4.5-year period from June 2010 through December 2015. A total of 136,243 observations of wind direction and other data points were made.

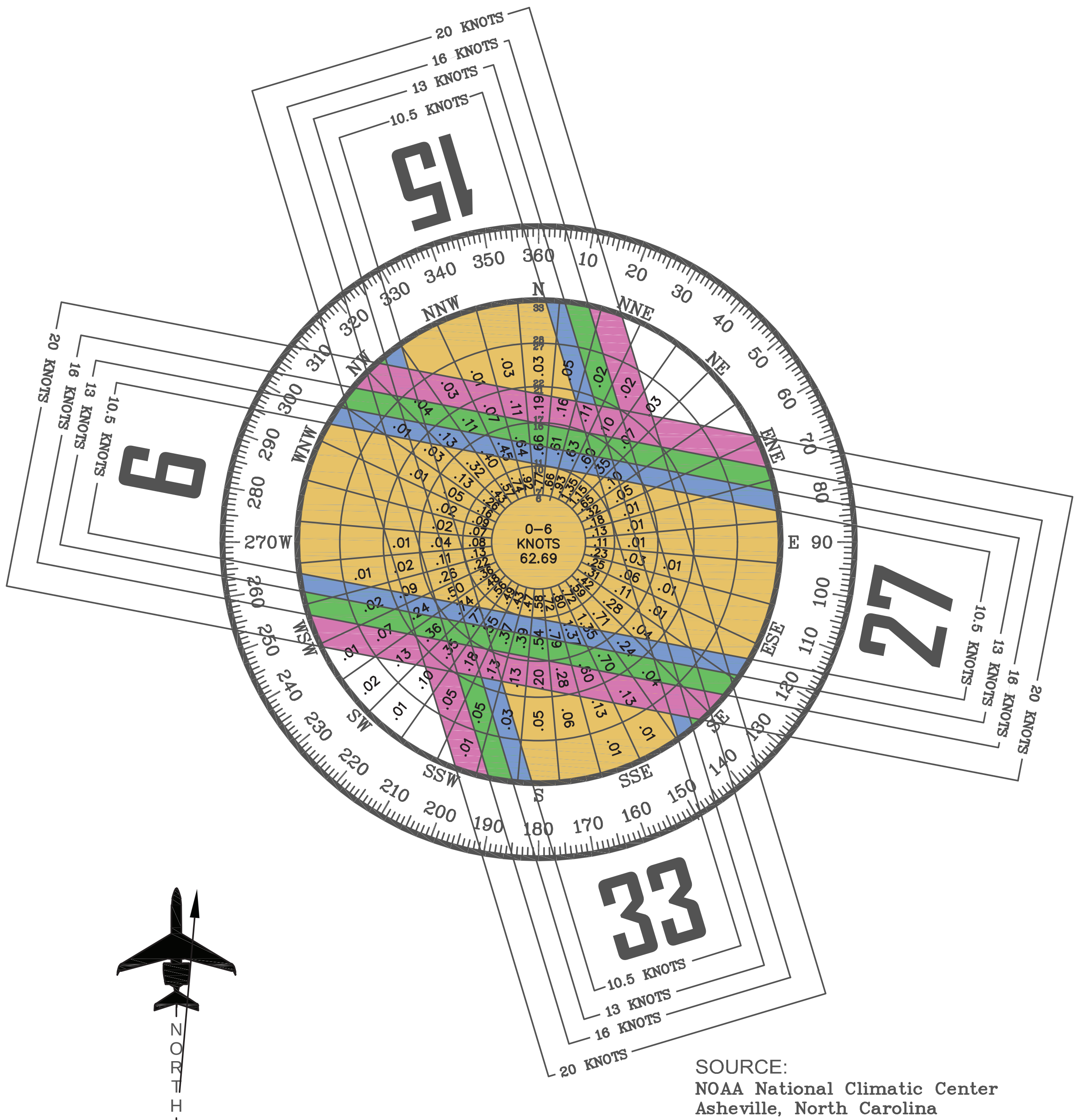
Exhibit 3B presents an all-weather wind rose. A wind rose is a graphic tool that gives a succinct view of how wind speed and direction are historically distributed at a particular location. The table at the top of each wind rose indicates the percent of wind coverage for each runway and specific wind intensity.

No single runway can provide sufficient wind coverage at 10.5 knots. Therefore, a crosswind runway is justified by FAA standards.

As presented on the exhibit, no single runway orientation provides the sufficient 95 percent wind coverage at 10.5 knots. Therefore, a crosswind runway is justified by FAA standards. In all-weather conditions, Runway 9-27 provides 85.08 percent wind coverage for 10.5 knot crosswinds, 90.78 percent coverage at 13 knots, 96.31 percent at 16 knots, and

ALL WEATHER WIND COVERAGE

Runways	10.5 Knots	13 Knots	16 Knots	20 Knots
Runway 9–27	85.08%	90.78%	96.31%	98.95%
Runway 15–33	94.63%	96.87%	98.58%	99.54%
All Runways	96.21%	98.27%	99.34%	99.84%

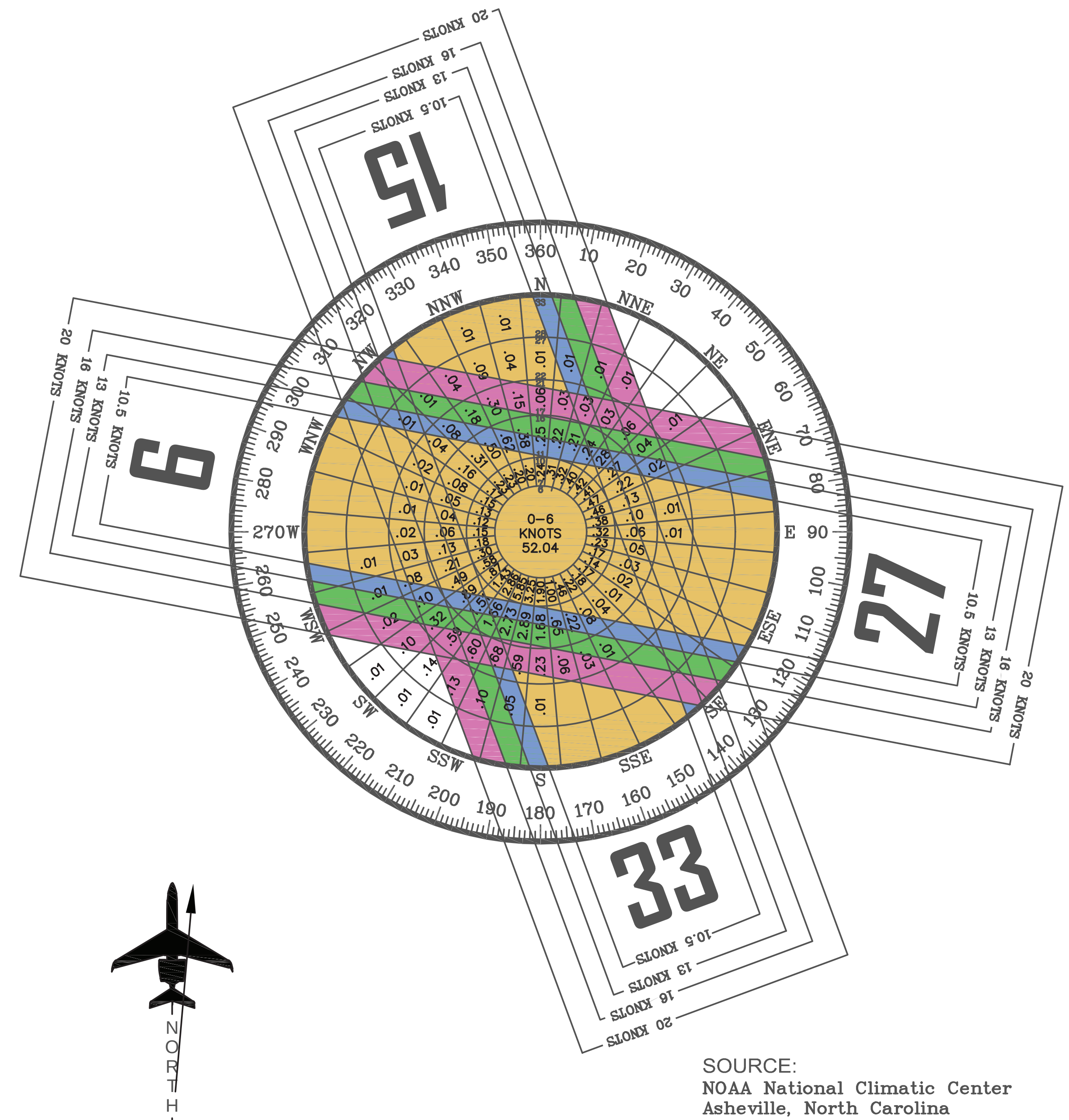


Magnetic Declination
11° 44' East (Dec. 2015)
Annual Rate of Change
00° 6' West (Dec. 2015)

SOURCE:
NOAA National Climatic Center
Asheville, North Carolina
Boulder City Municipal Airport
Boulder City, Nevada
OBSERVATIONS:
136,243 All Weather Observations
June 2010–December 2015

ALL WEATHER WIND COVERAGE

Runways	10.5 Knots	13 Knots	16 Knots	20 Knots
Runway 9–27	81.37%	88.01%	95.56%	98.85%
Runway 15–33	92.38%	95.93%	98.55%	99.65%
All Runways	94.53%	97.70%	99.22%	99.86%



Magnetic Declination
11° 44' East (Jan. 2016)
Annual Rate of Change
00° 6' West (Jan. 2016)

SOURCE:
NOAA National Climatic Center
Asheville, North Carolina
McCarran Intl. Airport
Las Vegas, Nevada
OBSERVATIONS:
95,750 All Weather Observations
2006–2015

Exhibit 3B
WINDROSE

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98.95 percent at 20 knots. Crosswind Runway 15-33 provides 94.63 percent wind coverage at 10.5 knots, 96.87 percent at 13 knots, 98.58 percent at 16 knots, and 99.54 percent coverage at 20 knots.

The combined wind coverage for both runways provides 96.21 percent wind coverage at 10.5 knots, 98.27 percent at 13 knots, 99.34 percent at 16 knots, and 99.84 percent coverage at 20 knots. The wind analysis indicates that the dual runway system at BVU satisfies the 95 percent wind coverage recommendation and that no new runways are necessary for crosswind purposes.

SAFETY AREA DESIGN STANDARDS

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

The entire RSA, ROFA, and ROFZ must be under the direct ownership of the airport sponsor to ensure these areas remain free of obstacles and can be readily accessed by maintenance and emergency personnel. The RPZ should also be under airport ownership. An alternative to outright ownership of the RPZ is the purchase of avigation easements (acquiring control of designated airspace within the RPZ) or having sufficient land use control measures in place which ensure the RPZ remains free of incompatible development. The airport safety areas are depicted on **Exhibit 3C**.

The entire RSA, ROFA, and ROFZ must be under the direct ownership of the airport sponsor to ensure these areas remain free of obstacles and can be readily accessed by maintenance and emergency personnel.

Analysis in Chapter Two indicated that Runway 9-27 currently conform and be maintained to accommodate aircraft in RDC B-II, while Runway 15-33 is currently designated as a RDC A-I. The long term plan includes ensuring that crosswind Runway 15-33 can meet RDC B-II standards. Dimensional standards for the safety areas associated with the runways are a function of the type of aircraft expected to use the runways as well as the instrument approach capability. **Table 3C** presents the FAA design standards as they apply to the runways at BVU per the detailed analysis conducted at the end of Chapter Two.

Runway Safety Area

The RSA is defined in FAA AC 150/5300-13A, Change 1, *Airport Design,* as a "surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of undershoot, overshoot, or excursion from the runway." The RSA is centered on the runway and dimensioned in accordance to the approach speed of the critical design aircraft using the runway. The FAA requires the RSA to be cleared and graded, drained by grading or storm sewers, capable of accommodating the design aircraft and fire and rescue vehicles, and free of obstacles not fixed by navigational purpose such as runway edge lights or approach lights.

TABLE 3C
Runway Design Standards
Boulder City Municipal Airport

	RUNWAY 9-27		RUNWAY 15-33	
	Existing	Ultimate	Existing	Ultimate
Runway Design Code	B-II	B-II	A-I	B-II
Visibility Minimums	Visual	1-mile - Rwy 27	Visual	Visual
Runway Design				
Runway Width	75	75	60	75
Blast Pad Length x Width	95 x 150	95 x 150	95 x 250	95 x 150
Runway Protection				
Runway Safety Area				
Width	150	150	120	150
Length Beyond Departure End	300	300	240	300
Length Prior to Threshold	300	300	240	300
Runway Object Free Area				
Width	500	500	400	500
Length Beyond Departure End	300	300	240	300
Length Prior to Threshold	300	300	240	300
Runway Obstacle Free Zone				
Width	400	400	400	400
Length Beyond Runway End	200	200	200	200
Approach Runway Protection Zone				
Inner Width	500	500	500	500
Outer Width	700	700	700	700
Length	1,000	1,000	1,000	1,000
Departure Runway Protection Zone				
Inner Width	500	500	500	500
Outer Width	700	700	700	700
Length	1,000	1,000	1,000	1,000
Runway Separation				
Runway Centerline to:				
Holding Position	200	200	200	200
Parallel Taxiway	240	240	225	240
Aircraft Parking Apron	250	250	200	250

Note: All dimensions in feet unless otherwise noted.
Source: FAA AC 150/5300-13A, Airport Design

The FAA has placed a higher significance on maintaining adequate RSA at all airports. Under Order 5200.8, effective October 1, 1999, the FAA established the *Runway Safety Area Program.* The Order states, "The objective of the Runway Safety Area Program is that all RSAs at federally-obligated air-ports…shall conform to the standards contained in AC 150/5300-13, Change 1, *Airport Design*, to the

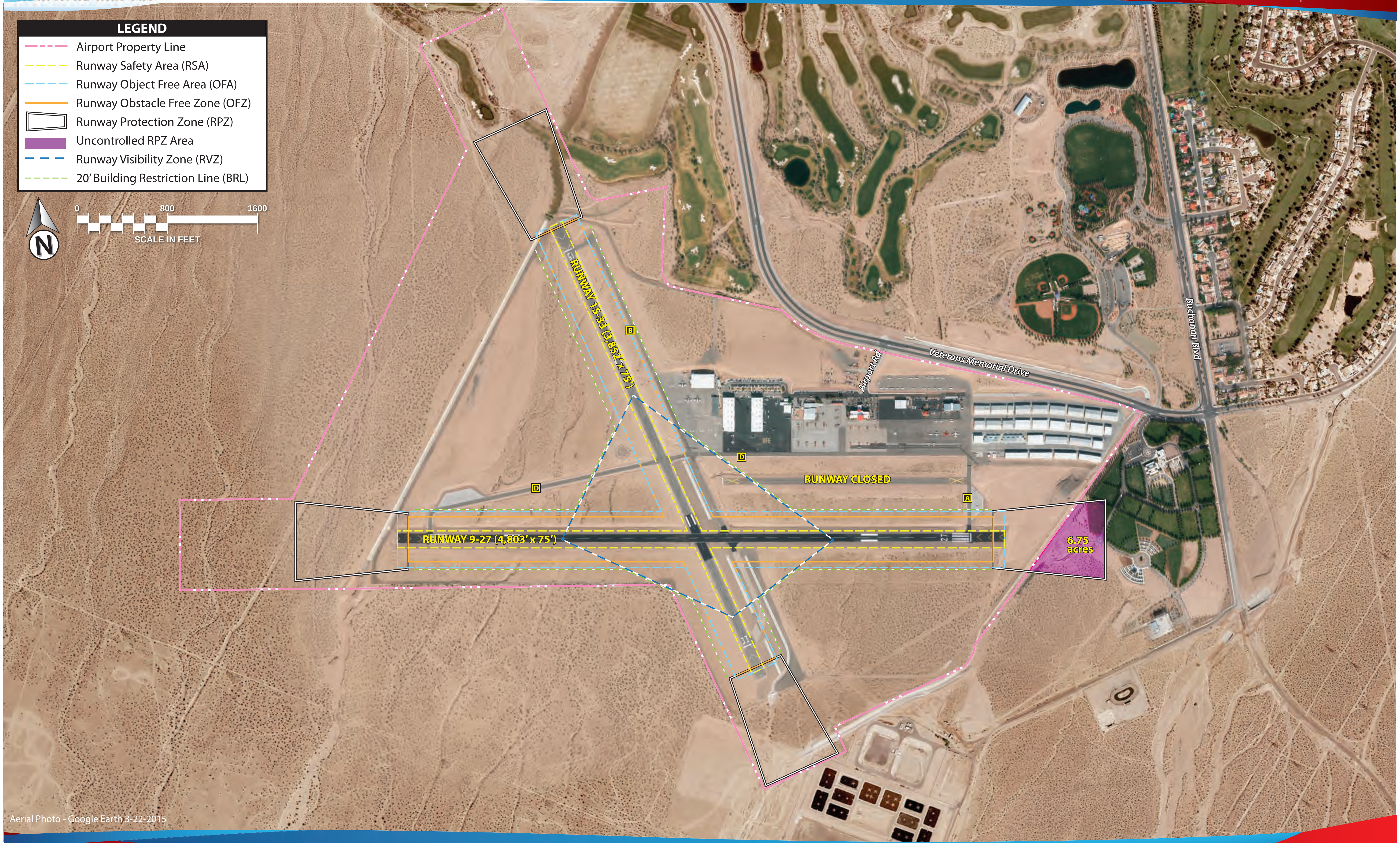

Exhibit 3C
SAFETY AREAS

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All RSAs at federally-obligated airports…shall conform to the standards contained in AC 150/5300-13, Change 1, Airport Design, to the extent practicable."

extent practicable." Each Regional Airports Division of the FAA is obligated to collect and maintain data on the RSA for each runway at the airport and perform airport inspections.

As depicted on **Exhibit 3C**, the current RSAs associated with each runway meet the FAA standards associated with the designated RDCs. As such, there are currently no objects that would be considered obstructions, and grading within the RSA meets the designated FAA standards.

Runway Object Free Area

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

Exhibit 3C depicts the ROFA for both runways at BVU. Currently, the Runway 9-27 ROFA is penetrated by the perimeter service road and overgrown vegetation located beyond the west end of the runway. The northwest end of the Runway 15-33 ROFA is also obstructed by the perimeter service road and overgrown vegetation. While the perimeter service road is considered an obstruction to the ROFA, access is restricted to authorized airport personnel and is not open for public use. In addition, windcones located near each runway end are also considered obstructions to the ROFA as the FAA does not specify windcones as fixed by function. Consideration should be given to relocating the perimeter service road, while windcones inside of the ROFA and overgrown vegetation should be removed.

Runway Obstacle Free Zone

The ROFZ is an imaginary volume of airspace which precludes object penetrations, including taxiing and parked aircraft. The only allowance for ROFZ obstructions is navigational aids mounted on frangible bases which are fixed in their location by function, such as airfield signs. The ROFZ is established to ensure the safety of aircraft operations. If the ROFZ is obstructed, the airport's approaches could be removed or approach minimums could be increased. **Exhibit 3C** presents the current ROFZ dimensions associated with each runway.

Windcones in close proximity to each runway end are located within the ROFZ for both runways and are obstructions. Consideration should be given to relocating the windcones outside of the ROFZ.

Runway Protection Zone

The RPZ is a trapezoidal area centered on the runway, typically beginning 200 feet beyond the runway end. The RPZ has been established by the FAA to provide an area clear of obstructions and incompatible land uses, in order to enhance the protection of people and property on the ground. The RPZ is comprised of the central portion of the RPZ and the controlled activity area. The central portion of the RPZ extends from the beginning to the end of the RPZ, is centered on the runway, and is the width of the ROFA. The controlled activity area is any remaining portions of the RPZ. The dimensions of the RPZ vary according to the visibility minimums serving the runway and the type of aircraft (design aircraft) operating on the runway.

While the RPZ is intended to be clear of incompatible objects or land uses, some uses are permitted with conditions and other land uses are prohibited. According to AC 150/5300-13A, the following land uses are permissible within the RPZ:

- Farming that meets the minimum buffer requirements,
- Irrigation channels as long as they do not attract birds,
- Airport service roads, as long as they are not public roads and are directly controlled by the airport operator,
- Underground facilities, as long as they meet other design criteria, such as RSA requirements, as applicable, and
- Unstaffed navigational aids (NAVAIDs) and facilities, such as required for airport facilities that are fixed by function in regard to the RPZ.

Any other land uses considered within RPZ land owned by the airport sponsor must be evaluated and approved by the FAA Office of Airports. The FAA has published *Interim Guidance on Land Uses within a Runway Protection Zone* (9.27.2012), which identifies several potential land uses that must be evaluated and approved prior to implementation. The specific land uses requiring FAA evaluation and approval include:

- Buildings and structures (examples include, but are not limited to: residences, schools, churches, hospitals or other medical care facilities, commercial/industrial buildings, etc.)
- Recreational land use (examples include, but are not limited to: golf courses, sports fields, amusement parks, other places of public assembly, etc.)
- Transportation facilities. Examples include, but are not limited to:
  - Rail facilities - light or heavy, passenger or freight
  - Public roads/highways
  - Vehicular parking facilities
- Fuel storage facilities (above and below ground)
- Hazardous material storage (above and below ground)
- Wastewater treatment facilities
- Above-ground utility infrastructure (i.e., electrical substations), including any type of solar panel installations.

The *Interim Guidance on Land within a Runway Protection Zone* states, "RPZ land use compatibility also is often complicated by ownership considerations. Airport owner control over the RPZ land is emphasized to achieve the desired protection of people and property on the ground. Although the FAA recognizes that in certain situations the airport sponsor may not fully control land within the RPZ, the FAA expects airport sponsors to take all possible measures to protect against and remove or mitigate incompatible land uses."

Currently, the RPZ review standards are applicable to any new or modified RPZ. The following actions or events could alter the size of an RPZ, potentially introducing an incompatibility:

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

Since the interim guidance only addresses a new or modified RPZ, existing incompatibilities are generally (but not always) grandfathered under certain circumstances. While it is still necessary for the airport sponsor to take all reasonable actions to meet the RPZ design standard, FAA funding priority for certain actions, such as relocating existing roads in the RPZ, will be determined on a case-by-case basis.

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

Whenever possible, the airport should maintain positive control over the RPZs through fee simple acquisition; however, avigation easements and/or positive land uses controls such as zoning measures can be pursued if fee simple acquisition is not feasible. Currently, the RPZs serving Runways 9, 15, and 33 are contained entirely on airport property, as depicted on **Exhibit 3C**.

Whenever possible, the airport should maintain positive control over the RPZs through fee simple acquisition.

Approximately 6.75 acres of the Runway 27 RPZ is located beyond Airport property. The Airport should consider alternatives to gain positive control over the entire Runway 27 RPZ through fee simple acquisition or avigation easement. A perimeter service road located on airport property traverses each RPZ, which is a private road and is not accessible to the public. Therefore, the perimeter service road does not require mitigation. A portion of the Boulder Creek Golf Club located on airport property is also contained within the RPZ serving Runway 15. This use may be allowable as being grandfathered; however, any changes made to Runway 15 may require that the FAA make an official determination on the RPZ.

Further examination of the RPZs associated with each runway end will be undertaken later in this study. The potential for improved instrument approach procedures and their effects on RPZ dimensions will also be considered.

Runway Visibility Zone

The Runway Visibility Zone (RVZ) is an area formed by imaginary lines connecting the line-of-sight points of intersecting runways. The purpose of the RVZ is to facilitate coordination among aircraft, and between aircraft and vehicles that are operating on active runways. Having a clear line of sight allows departing aircraft and arriving aircraft to verify the location and actions of other aircraft and vehicles on the ground that could create a conflict. Within the RVZ, any point five feet above the runway centerline must be mutually visible with any other point five feet above the centerline of the crossing runway. The RVZ at BVU is depicted on **Exhibit 3C**. Currently, there are no known obstructions to the line of sight within the RVZ.

Building Restriction Line

The Building Restriction Line (BRL) identifies suitable building area locations on the airport. The BRL encompasses the RPZs, the OFA, navigational aid critical areas, areas required for terminal instrument procedures, and other areas necessary for meeting airport line-of-sight criteria, such as the RVZ.

Two primary factors contribute to the determination of the BRL: type of runway (utility or other-than-utility) and the type of approach available for the runway. Runways 9-27 and 15-33 are both considered "visual" runways.

The BRL is the product of CFR Part 77 transitional surface clearance requirements. These requirements stipulate that no object be located in the primary surface, defined as being 250 feet wide for visual runways. From the primary surface, the transitional surface extends outward at a slope of one vertical foot to every seven horizontal feet. For Runways 9-27 and 15-33, the 20-foot BRL is set at 265 feet from the runway centerline. The BRL is depicted on **Exhibit 3C**, and it appears all landside facilities are located beyond the 20-foot BRL.

Runway/Taxiway Separation

The design standards for the separation between runways and parallel taxiways are a function of the critical design aircraft and the instrument approach visibility minimums. The runway to taxiway separation standard for RDC B-II with not lower than ¾-mile visibility minimums is 240 feet. Partial-parallel Taxiway D, which services Runway 9-27, is located at a runway/taxiway centerline separation distance of 230 feet at its nearest point and gradually increases in distance to 740 feet. The airport should consider relocating the portion of Taxiway D serving Runway 9 approximately 10 feet to the north in order to comply with FAA standards. Aside from the portion of Taxiway D serving Runway 9, its current location is more than adequate for visibility minimums of one mile and greater (visual).

The runway/taxiway centerline separation standard for RDC A-I with not lower than ¾-mile visibility minimums is 225 feet. Full-length parallel Taxiway B, which serves Runway 15-33, has a runway/taxiway centerline separation distance of 240 feet, which exceeds the existing (RDC A-I) FAA design standard and meets the ultimate (RDC B-II) FAA design standard. **Exhibit 3D** presents runway/taxiway separation standards applicable to each runway.

Hold Line Separation

Hold lines are markings on taxiways leading to runways, which provide for adequate runway clearance for holding aircraft. At uncontrolled airports like BVU, flight crews must visually confirm no traffic prior to crossing into the active runway environment. For Runway 9-27, hold line position markings are not uniformly set as they range from 230 to 275 feet from the runway centerline. Hold line positions serving Runway 15-33 also range in separation distances from 180 to 200 feet from the Runway 15-33 centerline. The hold position located on Taxiway B serving Runway 33 is currently 180 feet from the Runway 15-33 centerline. Thus, Runway 15-33 is deficient of the FAA hold line separation standards. The holding positions for each runway should be uniformly applied to minimize the chance for confusion. **Exhibit 3D** presents the hold line separation standards as they apply to each runway.

Aircraft Parking Apron Separation

For Runway 9-27, aircraft parking areas should be at least 250 feet from the runway centerline for RDC B-II. For RDC A-I, parking aprons should be located 200 feet from the runway centerline. All aircraft parking aprons at least meet or exceed this standard.

RUNWAYS

The adequacy of the existing runway system at Boulder City Municipal Airport has been analyzed from a number of perspectives, including runway orientation and adherence to safety area design standards. From this information, requirements for runway improvements were determined for the airport. Runway elements such as length, width, and strength are now presented.

Runway Length

AC 150/5325-4B, *Runway Length Requirements for Airport Design*, provides guidance for determining runway length needs. A draft revision to this AC is currently available (150/5325-4C) and the FAA is utilizing the draft revision in most cases when evaluating runway length needs for airports.

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

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

Aircraft performance declines as elevations, temperature, and runway gradient factors increase.

Aircraft performance declines as elevations, temperature, and runway gradient factors increase. For Boulder City Municipal Airport, the mean maximum daily temperature of the hottest month is 104.2 degrees Fahrenheit (F), which occurs in July. The airport elevation is 2,203 feet MSL. The runway elevation difference is 29 feet for Runway 9-27, and 105 feet for Runway 15-33. The gradient for Runway 9-27 conforms to FAA design standards; however, Runway 15-33 contains a gradient of 0.7 percent greater than the maximum FAA design standard, which is two percent. **Exhibit 3E** presents the operating characteristics of business jets and turboprop aircraft at BVU.

Airplanes are capable of operating on a wide variety of available runway lengths. Many factors will govern the suitability of those runway lengths for aircraft, such as elevation, temperature, wind, aircraft weight, wing flap settings, runway condition (wet or dry), runway gradient, vicinity airspace obstructions, and any special operating procedures. Airport operators can pursue policies that can maximize the suitability of the runway length. Policies, such as area zoning and height and hazard restrictions can protect an airport's runway length. Airport ownership (fee simple or easement) of land leading to the runway ends can reduce the possibility of natural growth or man-made obstructions. Planning of runways should include an evaluation of aircraft types expected to use the airport, or a particular runway now and in the future. Future plans should be realistic and supported by the FAA approved forecasts and should be based on the critical design aircraft (or family of aircraft).

Air Tour Commercial Service Aircraft

Runway length needs for commercial service aircraft must factor the local airport conditions described above and the load carried. The aircraft load is dependent upon the payload of passengers and/or cargo, plus the amount of fuel carried. For departures, the amount of fuel varies depending upon the length of trip.

As previously detailed, commercial service aircraft operating at the airport include the Cessna 208B and De Havilland Twin-Otter turboprop aircraft. The Cessna 208B is configured to accommodate nine passenger seats, while the Twin-Otters operated by the air tour service providers have been configured to accommodate 19 passenger seats. Forecasts anticipate the size and category of aircraft currently being utilized by the air tour service providers to remain largely the same. **Table 3E** presents the takeoff weight

Aerial Photo - Martinez Geospacial 11/18/2015

Exhibit 3D
FAA DESIGN STANDARDS FOR: RDC A1 and B-II
WITH VISIBILITY MINIMUMS = NOT LOWER THAN ONE MILE

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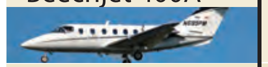
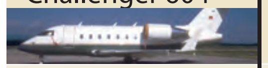
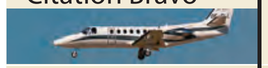
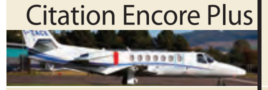
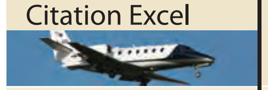
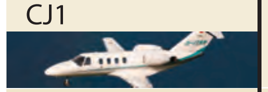
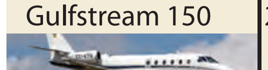
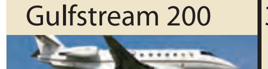
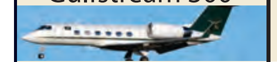
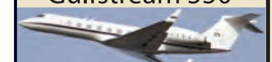
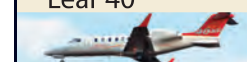
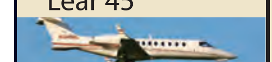
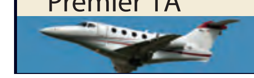
Aircraft Name	% Useful Load for 4,803' Runway		Take-off Length Required at Max Takeoff Weight		Landing Length Required for: C.F.R. Part 25		C.F.R. Part 135		C.F.R. Part 91k	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
BUSINESS JETS										
Beechjet 400A 	66.9%	OL	6,172	7,846	3,633	5,319	6,055	8,865	4,541	6,649
Challenger 604 	31.9%	OL	9,481	10,144	2,948	4,708	4,913	7,847	3,685	5,885
Citation Bravo 	58.4%	56.8%	6,820	6,812	3,931	6,188	6,552	10,313	4,914	7,735
Citation Encore 	75.9%	69.3%	6,177	6,575	3,214	4,823	5,357	8,038	4,018	6,029
Citation Encore Plus 	76.8%	67.1%	6,135	6,709	3,214	4,865	5,357	8,108	4,018	6,081
Citation Excel 	60.0%	60.0%	6,195	6,195	3,602	5,751	6,003	9,585	4,503	7,189
Citation II 	70.6%	30.5%	6,475	8,931	2,720	6,574	4,533	10,957	3,400	8,218
Citation Isp 	69.6%	69.6%	3,958	4,552	2,540	2,921	4,233	4,868	3,175	3,651
Citation Sovereign 	83.9%	75.9%	5,625	5,673	2,974	3,809	4,957	6,348	3,718	4,761
Citation V 	92.9%	26.8%	5,077	8,297	3,280	4,863	5,467	8,105	4,100	6,079
Citation VII 	34.8%	28.3%	6,851	6,929	3,347	4,550	5,578	7,583	4,184	5,688
Citation X 	34.7%	OL	7,442	8,286	4,135	5,892	6,892	9,820	5,169	7,365
CJ1 	42.2%	68.4%	8,019	5,335	3,086	4,179	5,143	6,965	3,858	5,224
CJ2 	76.8%	71.0%	5,479	5,678	3,338	4,822	5,563	8,037	4,173	6,028
Gulfstream 150 	25.5%	9.1%	6,456	7,248	3,129	4,469	5,215	7,448	3,911	5,586
Gulfstream 200 	31.9%	OL	9,027	9,220	3,587	4,125	5,978	6,875	4,484	5,156

Aircraft Name	% Useful Load for 4,803' Runway		Take-off Length Required at Max Takeoff Weight		Landing Length Required for: C.F.R. Part 25		C.F.R. Part 135		C.F.R. Part 91k	
	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
BUSINESS JETS										
Gulfstream 300 	42.0%	OL	7,596	8,643	3,300	3,795	5,500	6,325	4,125	4,744
Gulfstream 550 	42.0%	19.9%	10,052	9,933	2,901	4,945	4,835	8,242	3,626	6,181
Hawker 4000 	48.7%	44.3%	8,324	9,138	3,378	3,884	5,630	6,473	4,223	4,855
Hawker 800XP 	45.6%	OL	6,451	7,446	2,785	4,237	4,642	7,062	3,481	5,296
Lear 31A 	49.1%	OL	8,216	9,859	3,178	4,449	5,297	7,415	3,973	5,561
Lear 35A 	36.1%	OL	8,748	10,497	3,409	4,773	5,682	7,955	4,261	5,966
Lear 40 	33.7%	OL	10,151	9,930	3,027	3,924	5,045	6,540	3,784	4,905
Lear 45 	33.1%	OL	10,541	10,275	3,028	3,924	5,047	6,540	3,785	4,905
Premier 1A 	41.1%	31.0%	8,933	8,382	3,599	4,606	5,998	7,677	4,499	5,758
TURBOPROP										
King Air C90GTi 	82.7%	82.7%	5,380	5,380	1,637	1,637	2,728	2,728	2,046	2,046
King Air C90B 	26.5%	26.5%	7,604	7,604	1,475	1,475	2,458	2,458	1,844	1,844
King Air 200GT 	22.8%	22.8%	9,825	9,825	2,058	2,058	3,430	3,430	2,573	2,573
King Air 350 	75.7%	63.5%	5,694	5,882	2,827	3,251	4,712	5,418	3,534	4,064
Beech 1900D 	60.7%	60.7%	6,310	6,310	2,942	3,383	4,903	5,638	3,678	4,229
Pilatus PC 12 	100.0%	100.0%	3,542	3,542	2,962	2,962	4,937	4,937	3,703	3,703

O/L: Out of aircraft operational limits
Note: Field Elevation 2203'; Mean Max Temp 40.1 C

Source: Ultranav Flight Software based on aircraft operating manuals
Note: Part 135 is 60% Factored and Part 91k 80% Factored

Exhibit 3E
BUSINESS AIRCRAFT RUNWAY LENGTH ANALYSIS

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limits for several common turboprop and business jet aircraft utilizing conditions specific to Boulder City Municipal Airport.

TABLE 3E
Takeoff Weight Limits
Boulder City Municipal Airport

Aircraft	Maximum Takeoff Weight (pounds)	Takeoff Runway Length (feet)	Maximum Allowable Takeoff Weight (pounds)
King Air 200GT	12,500	4,803	9,630
		5,300	10,032
		5,800	10,398
King Air 350	15,000	4,803	13,758
		5,300	14,530
		5,800	15,000
Citation Bravo	14,800	4,803	12,524
		5,300	13,195
		5,800	13,771
Citation Encore	16,630	4,803	15,158
		5,300	15,768
		5,800	16,280

Current Runway 9-27 Length - 4,803 feet
Design Criteria: Elevation – 2,203 feet MSL; Temperature – 104.2 degrees F
Source: Aircraft Operating Manuals; Coffman Associates analysis

The current length of 4,803 feet on Runway 9-27 is capable of accommodating existing operations by the Beechcraft King Air 200GT and King Air 350; however, these aircraft will often be weight-restricted, especially during times when warm temperatures and high density altitudes prevail at the airport. Small and mid-sized business jets, such as the Citation Bravo and the Citation Encore, are also capable of operating on the existing runway length, but are also subject to weight restrictions. As noted in **Table 3E**, increased runway length will allow weight-restricted aircraft to operate at a greater maximum allowable takeoff weight (MTOW). This will ultimately increase the operational safety of the runway or the amount of fuel or payload allowed on board the aircraft currently operating under weight restrictions. Additional runway length should also be considered to better accommodate fixed-wing aircraft that are routinely utilized for commercial operations at BVU. Extending the runway to accommodate full payloads for turboprops and small- to mid-sized business jets will require significant capital funding, as well as the appropriate environmental review.

General Aviation Aircraft

The majority of operations conducted by fixed-wing aircraft at Boulder City Municipal Airport are conducted by smaller single engine piston-powered aircraft weighing less than 12,500 pounds. Following guidance from AC 150/5325-4B, to accommodate 100 percent of these small aircraft, a runway length of 4,800 feet is recommended.

The airport is also utilized by aircraft weighing more than 12,500 pounds, including small- to mid-sized business jet aircraft. AC 150/5325-4B stipulates that runway length determination for business jets consider a grouping of airplanes with similar operating characteristics. The AC provides two separate “family groupings of airplanes,” each based upon their representative percentage of aircraft in the national fleet. The first group is those business jets that make up 75 percent of the national fleet, and the second group is those making up 100 percent of the national fleet. **Table 3F** presents a partial list of common aircraft in each aircraft group. A third group considers business jets weighing more than 60,000 pounds. Runway length determination for these aircraft must be based on the performance characteristics of the individual aircraft.

TABLE 3F
Business Jet Categories for Runway Length Determination

75 percent of the national fleet	MTOW	75-100 percent of the national fleet	MTOW	Greater than 60,000 pounds	MTOW
Lear 35	20,350	Lear 55	21,500	Gulfstream II	65,500
Lear 45	20,500	Lear 60	23,500	Gulfstream IV	73,200
Cessna 550	14,100	Hawker 800XP	28,000	Gulfstream V	90,500
Cessna 560XL	20,000	Hawker 1000	31,000	Global Express	98,000
Cessna 650 (VII)	22,000	Cessna 650 (III/IV)	22,000		
IAI Westwind	23,500	Cessna 750 (X)	36,100		
Beechjet 400	15,800	Challenger 604	47,600		
Falcon 50	18,500	IAI Astra	23,500		

MTOW: Maximum Take Off Weight
Source: FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*

Runway length calculations for business jet aircraft take into consideration the runway gradient and landing length requirements for contaminated (wet) runways. Business jets tend to need greater runway length when landing on a wet surface because of their increased approach speeds. **Table 3G** presents the results of the runway length analysis for business jets developed following the guidance provided in AC 150/5325-4B. To accommodate 75 percent of the business jet fleet at 60 percent useful load, a runway length of 5,800 feet is recommended. This length is derived from a raw length of 5,458 feet that is adjusted, as recommended, for runway gradient and consideration of landing length needs on a contaminated runway (wet and slippery). To accommodate 100 percent of the business jet fleet at 60 percent useful load, a runway length of 11,300 feet is recommended.

Utilization of the 90 percent category for runway length determination is generally not allowed by the FAA unless there is a demonstrated need at the airport. This could be documented activity by a business jet operator that flies out frequently with heavy loads. To accommodate 75 percent of the business jet fleet at 90 percent useful load, a runway length of 9,800 feet is recommended. To accommodate 100 percent of business jets at 90 percent useful load, a runway length of 11,800 feet is recommended.

TABLE 3G Runway Length Requirements Boulder City Municipal Airport				
Airport Elevation	2,203 feet above mean sea level			
Average High Monthly Temp.	104.2 degrees (July)			
Runway Gradient	29' Runway 9-27			
Fleet Mix Category	Raw Runway Length from FAA AC	Runway Length with Gradient Adjustment	Wet Surface Landing Length for Jets*	Final Runway Length
100% of small airplanes	4,800’	N/A	N/A	N/A
Small airplanes with 10 or more passenger seats	4,800’	N/A	N/A	N/A
75% of fleet at 60% useful load	5,458’	5,748’	5,500'	5,800’
100% of fleet at 60% useful load	7,363’	7,653’	5,500’	7,700’
75% of fleet at 90% useful load	8,129’	8,419’	7,000’	8,400’
100% of fleet at 90% useful load	11,000’	11,290’	7,000'	11,300’

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

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

Runway Length Summary

Many factors are considered when determining appropriate runway length for safe and efficient operations of aircraft at BVU. The airport should strive to accommodate commercial service aircraft and business jets to the greatest extent possible. It should be noted that the FAA will not support extending a runway unless specific aircraft operational needs dictate. The analysis here is not meant to suggest that an extension should be considered as a means to attract demand, only as a measure to adequately support current existing demand.

Runway 9-27, with a length of 4,803 feet, can accommodate most small- and mid-sized business jets in the fleet under moderate loading conditions, especially with shorter trip lengths and during cool to warm temperatures. Likewise, Runway 9-27 accommodates the air tour commercial service turboprop aircraft that currently utilize the airport; however, based upon aircraft flight planning manuals, these aircraft are often weight-restricted when combining operational factors, such as temperature and density altitude. Increased operations by large turboprop or business jets could support an even longer runway, but specific users and aircraft types would first need to be identified and confirmed to conduct a minimum of 500 annual itinerant operations before the FAA would agree to participate in funding a runway extension. The existing runway length presents loading limitations, as well as departure climb limitations, which are a climb rate limitation imposed on aircraft when high temperatures and density altitude are present.

The previous Airport Layout Plan Update recommended a 1,000-foot extension for Runway 9-27 for a length of 5,800 feet to address the needs of turboprop and business jet aircraft weighing more than 12,500 pounds. The Alternatives analysis to follow in the next chapter will consider runway extension possibilities for Runway 9-27.

Secondary or crosswind runways should be designed for the lower crosswind capable aircraft using the primary runway. In the case of BVU, Runway 15-33, with a length of 3,852 feet, does not meet the length recommended for all small general aviation aircraft (4,800 feet). However, due to development of the golf course and water treatment facility that has occurred on both ends of the runway, an extension to Runway 15-33 may not be economically or politically feasible. While the existing length does not meet the FAA recommendation for 100 percent of the small aircraft fleet, small aircraft at BVU operate routinely on the crosswind runway without incident. In addition, Runway 15-33 has supported air tour commercial service operations in the occasion that the primary runway is closed for maintenance and emergencies or as strong crosswinds dictate. The analysis presented in the next chapter will analyze extension options; however, options on Runway 15-33 may be limited or impractical.

Runway Width

Runway width design standards are primarily based on the critical aircraft, but can also be influenced by the visibility minimums of published instrument approach procedures. Both runways at BVU are currently 75 feet wide. RDC B-II design criteria, which applies to the existing and ultimate Runway 9-27 conditions, stipulates a runway width of 75 feet. Runway 9-27 satisfies the existing and ultimate runway width design standard and should, therefore, be maintained at its current width. Runway 15-33 exceeds the current design standard of 60 feet for RDC A-I runways; however, the additional runway width is beneficial for smaller aircraft operating under higher crosswind conditions, improving overall operational safety or for the occasional use by larger commercial aircraft. Ultimately, Runway 15-33 is planned to be upgraded to meet RDC B-II design criteria and, therefore, the existing runway width should be maintained through the planning period of this Master Plan.

Runway Strength

An important feature of airfield pavement is its ability to withstand repeated use by aircraft. The FAA reports the pavement strength for Runways 9-27 and 15-33 at 12,500 pounds single wheel loading (SWL). Strength ratings refer to the configuration of the aircraft landing gear. For example, SWL indicates an aircraft with a single wheel on each landing gear.

The strength rating of a runway does not preclude aircraft weighing more than the published strength rating from using the runway. All federally obligated airports must remain open to the public, and it is typically up to the pilot of the aircraft to determine if a runway can support their aircraft safely. An airport sponsor cannot restrict an aircraft from using the runway

An airport sponsor cannot restrict an aircraft from using the runway simply because its weight exceeds the published strength rating. On the other hand, the airport sponsor has an obligation to properly maintain the runway and protect the useful life of the runway, typically for 20 years.

simply because its weight exceeds the published strength rating. On the other hand, the airport sponsor has an obligation to properly maintain the runway and protect the useful life of the runway, typically for 20 years.

According to the FAA publication, *Airport/Facility Directory*, "Runway strength rating is not intended as a maximum allowable weight or as an operating limitation. Many airport pavements are capable of supporting limited operations with gross weights in excess of the published figures." The directory goes on to say that those aircraft exceeding the pavement strength should contact the airport sponsor for permission to operate at the airport.

The strength rating of a runway can change over time. Regular usage by heavier aircraft can decrease the strength rating, while periodic runway resurfacing can increase the strength rating. The current runway strength rating is adequate to accommodate a large majority of aircraft that operate at Boulder City Municipal Airport; however, in the event that large business jets operate at the airport more regularly, the runway should be strengthened. As such, future consideration should be given to increasing the pavement strength of Runway 9-27 to approximately 30,000 pounds SWL. This strength would better situate the runway for regular use by small- to medium-sized business jets, such as the Citation VII, Citation X, Gulfstream G-150, and Lear 40, if demand warrants.

Runway 15-33 is strength-rated at 12,500 pounds SWL. This weight capacity is capable of handling all small general aviation aircraft and the majority of the small- and mid-sized commercial aircraft currently operating at the airport. The Runway 15-33 pavement strength is adequate for the existing and ultimate condition and should be maintained through the long term planning period.

TAXIWAYS

The design standards associated with taxiways are determined by the Taxiway Design Group (TDG) or the Airplane Design Group (ADG) of the critical design aircraft. As determined previously, the applicable ADG for primary Runway 9-27 currently is ADG II, and crosswind Runway 15-33 is currently ADG I. Ultimate planning should maintain ADG II for Runway 9-27, while Runway 15-33 should be improved to ADG II. **Table 3H** presents the various taxiway design standards related to ADG II.

The table also shows those taxiway design standards related to TDG. The TDG standards are based on the Main Gear Width (MGW) and Cockpit to Main Gear (CMG) distance of the critical design aircraft expected to use those taxiways. Different taxiway and taxilane pavements can and should be planned to the most appropriate TDG design standards based on usage.

The current taxiway system is composed of varying taxiway widths. The taxiways associated with Runway 9-27 are currently 35 feet wide and meet the standards for TDG 2 design. Taxiways serving Runway 15-33 currently range in width from 35 to 50 feet and also meet TDG 2 design criteria. As such, the current taxiway widths are sufficient to meet existing and ultimate aircraft TDG design criteria.

TABLE 3H
Taxiway Dimensions and Standards
Boulder City Municipal Airport

STANDARDS BASED ON WINGSPAN	***ADG I***		***ADG II***
Taxiway Protection			
Taxiway Safety Area width (feet)	49'		79'
Taxiway Object Free Area width (feet)	89'		131'
Taxilane Object Free Area width (feet)	79'		115'
Taxiway Separation			
Taxiway Centerline to:			
Fixed or Movable Object (feet)	44.5'		65.5'
Parallel Taxiway/Taxilane (feet)	70'		105'
Taxilane Centerline to:			
Fixed or Movable Object (feet)	39.5'		57.5'
Parallel Taxilane (feet)	64'		97'
Wingtip Clearance			
Taxiway Wingtip Clearance (feet)	20'		26'
Taxilane Wingtip Clearance (feet)	15'		18'
STANDARDS BASED ON TDG	***TDG 1A***	***TDG 1B***	***TDG 2***
Taxiway Width Standard (feet)	25'	25'	35'
Taxiway Edge Safety Margin (feet)	5'	5'	7.5'
Taxiway Shoulder Width (feet)	10'	10'	10'

ADG: Airplane Design Group
TDG: Taxiway Design Group
Source: FAA AC 150/5300-13A, Change 1, *Airport Design*

Taxiway Design Considerations

FAA AC 150/5300-13A, Change 1, *Airport Design*, provides guidance on recommended taxiway and taxilane layouts to enhance safety by avoiding runway incursions. A runway incursion is defined as "any occurrence at an airport involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and takeoff of aircraft."

The taxiway system at Boulder City Municipal Airport generally provides for the efficient movement of aircraft; however, recently published AC 150/5300-13A, Change 1, *Airport Design*, provides recommendations for taxiway design. The following is a list of the taxiway design guidelines and the basic rationale behind each recommendation:

1. **Taxi Method**: Taxiways are designed for "cockpit over centerline" taxiing with pavement being sufficiently wide to allow a certain amount of wander. On turns, sufficient pavement should be provided to maintain the edge safety margin from the landing gear. When constructing new taxiways, upgrading existing intersections should be undertaken to eliminate "judgmental oversteering," which is

where the pilot must intentionally steer the cockpit outside the marked centerline in order to assure the aircraft remains on the taxiway pavement.

2. **Steering Angle**: Taxiways should be designed such that the nose gear steering angle is no more than 50 degrees, the generally accepted value to prevent excessive tire scrubbing.

3. **Three-Node Concept**: To maintain pilot situational awareness, taxiway intersections should provide a pilot a maximum of three choices of travel. Ideally, these are right and left angle turns and a continuation straight ahead.

4. **Intersection Angles**: Design turns to be 90 degrees wherever possible. For acute angle intersections, standard angles of 30, 45, 60, 120, 135, and 150 degrees are preferred.

5. **Runway Incursions**: Design taxiways to reduce the probability of runway incursions.
   - *Increase Pilot Situational Awareness*: A pilot who knows where he/she is on the airport is less likely to enter a runway improperly. Complexity leads to confusion. Keep taxiway systems simple using the "three node" concept.
   - *Avoid Wide Expanses of Pavement*: Wide pavements require placement of signs far from a pilot's eye. This is especially critical at runway entrance points. Where a wide expanse of pavement is necessary, avoid direct access to a runway.
   - *Limit Runway Crossings*: The taxiway layout can reduce the opportunity for human error. The benefits are twofold – through simple reduction in the number of occurrences, and through a reduction in air traffic controller workload.
   - *Avoid "High Energy" Intersections*: These are intersections in the middle third of runways. By limiting runway crossings to the first and last thirds of the runway, the portion of the runway where a pilot can least maneuver to avoid a collision is kept clear.
   - *Increase Visibility*: Right angle intersections, both between taxiways and runways, provide the best visibility. Acute angle runway exits provide for greater efficiency in runway usage, but should not be used as runway entrance or crossing points. A right angle turn at the end of a parallel taxiway is a clear indication of approaching a runway.
   - *Avoid "Dual Purpose" Pavements*: Runways used as taxiways and taxiways used as runways can lead to confusion. A runway should always be clearly identified as a runway and only a runway.
   - *Indirect Access*: Do not design taxiways to lead directly from an apron to a runway. Such configurations can lead to confusion when a pilot typically expects to encounter a parallel taxiway.
   - *Hot Spots*: Confusing intersections near runways are more likely to contribute to runway incursions. These intersections must be redesigned when the associated runway is subject to reconstruction or rehabilitation. Other hot spots should be corrected as soon as practicable.

6. **Runway/Taxiway Intersections**:
   - *Right Angle*: Right angle intersections are the standard for all runway/taxiway intersections, except where there is a need for a high-speed exit. Right angle taxiways provide the best visual

perspective to a pilot approaching an intersection with the runway to observe aircraft in both the left and right directions. They also provide optimal orientation of the runway holding position signs so they are visible to pilots.

- *Acute Angle*: Acute angles should not be larger than 45 degrees from the runway centerline. A 30-degree taxiway layout should be reserved for high speed exits. The use of multiple intersecting taxiways with acute angles creates pilot confusion and improper positioning of taxiway signage.
- *Large Expanses of Pavement*: Taxiways must never coincide with the intersection of two runways. Taxiway configurations with multiple taxiway and runway intersections in a single area create large expanses of pavement, making it difficult to provide proper signage, marking, and lighting.

7. **Taxiway/Runway/Apron Incursion Prevention**: Apron locations that allow direct access onto a runway should be avoided. Increase pilot situational awareness by designing taxiways in such a manner that forces pilots to consciously make turns. Taxiways originating from aprons and forming a straight line across runways at mid-span should be avoided.
   - *Wide Throat Taxiways*: Wide throat taxiway entrances should be avoided. Such large expanses of pavement may cause pilot confusion and makes lighting and marking more difficult.
   - *Direct Access from Apron to a Runway*: Avoid taxiway connectors that cross over a parallel taxiway and directly onto a runway. Consider a staggered taxiway layout that forces pilots to make a conscious decision to turn.
   - *Apron to Parallel Taxiway End*: Avoid direct connection from an apron to a parallel taxiway at the end of a runway.

Taxiway geometry at BVU presented in **Exhibit 3F** includes multiple incompatibilities with the current FAA design standards including:

- Taxiway A provides direct access from the easternmost portion of the aircraft ramp to Runway 27;
- Direct access to Runway 15-33 is provided between the westernmost portion of the aircraft ramp and the intersection of Taxiways B and D;
- Taxiways B and D intersect the high energy areas of Runways 9-27 and 15-33;
- The holding position markings for Runway 27 are not parallel the runway due to the angular nature of Taxiway D which does not conform to standards; and
- Taxiway B serving Runway 33 is also situated as an acute angle, not allowing for pilots to have full field of vision on the runway.

Analysis in the next chapter will consider improvements which could be implemented on the airfield to minimize runway incursion potential, improve efficiency, and conform to FAA standards for taxiway design. Any future taxiways planned will also take into consideration the taxiway design standards.

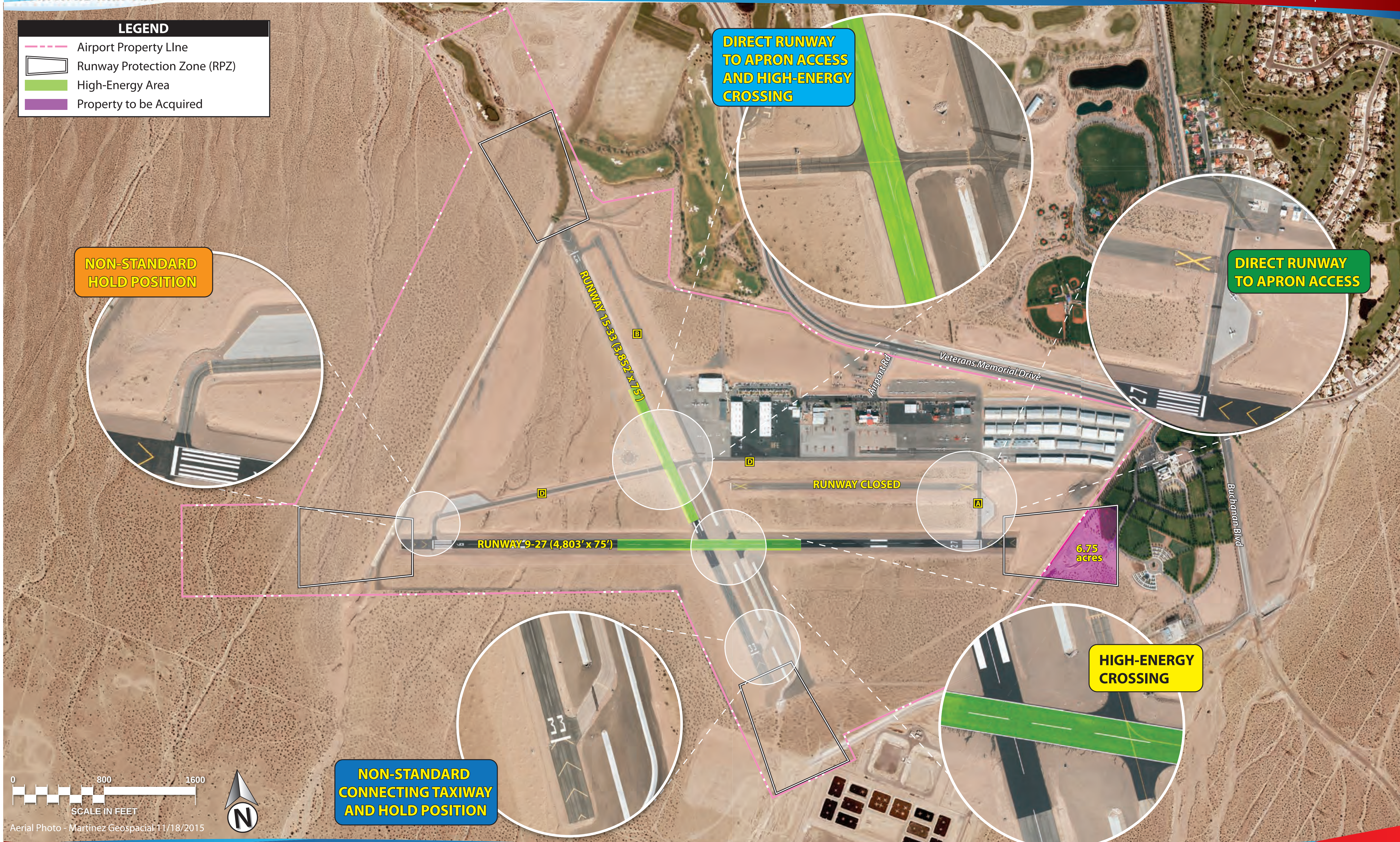

Exhibit 3F
AIRFIELD DESIGN GEOMETRY

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Taxilane Design Considerations

Taxilanes are distinguished from taxiways in that they do not provide access to or from the runway system directly. Taxilanes typically provide access to hangar areas. As a result, taxilanes can be planned to varying design standards depending on the type of aircraft utilizing the taxilane. For example, a taxilane leading to a T-hangar area only needs to be designed to accommodate those aircraft typically accessing the T-hangar. The Alternatives chapter will consider various designs for improving the safe movement of aircraft via taxilanes as hangar and apron facilities expand over time.

NAVIGATIONAL AND APPROACH AIDS

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

Instrument Approach Aids

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

BVU does not currently have published instrument approach procedures. As previously mentioned, the airport does contain published STAR procedures; however, these differ from instrument approach procedures in that instrument approaches are specific to the airport. At the time of writing this document, the airport is seeking approval for a GPS-based localizer performance with a vertical guidance (LPV) precision approach to Runway 27.

Analysis in the next chapter will consider improvements necessary for additional instrument approach procedures to the Airport.

Analysis in the next chapter will consider improvements necessary for enhancing instrument approaches to the runway system.

Visual Approach Aids

In most instances, the landing phase of any flight must be conducted in visual conditions. To provide pilots with visual guidance information during landings to the runway, electronic visual approach aids are commonly provided at airports. The most common visual approach aids at airports include the visual approach slope indicator (VASI) and precision approach path indicator (PAPI). Currently, each end of Runway 9-27 and Runway 33 are served by a two-light PAPI-2. Future planning should consider a four-light PAPI system on Runway 9-27 and maintain the two-light PAPI system serving Runway 33. In addition, a two-light PAPI system could be recommended for Runway 15.

Runway end identification lights (REILs) are flashing lights located at the runway threshold end that facilitate rapid identification of the runway end at night and during poor visibility conditions. REILs provide pilots with the ability to identify the runway thresholds and distinguish the runway end lighting from other lighting on the airport and in the approach areas. The FAA indicates that REILs should be considered for all lighted runway ends not planned for a more sophisticated ALS. REILs are installed on each end of Runways 9-27 and 15-33. The current REIL system should be maintained throughout the planning horizon.

Weather Reporting Aids

Boulder City Municipal Airport has a lighted windcone and segmented circle, as well as additional supplemental windcones serving each runway end. The windcones provide information to pilots regarding wind speed and direction. The segmented circle consists of a system of visual indicators designed to provide traffic pattern information to pilots. These should be maintained throughout the planning period.

The airport is equipped with an AWOS III which provides weather observations 24 hours per day. The system updates weather observations every minute, continuously reporting significant weather changes as they occur. This information is then transmitted at regular intervals (usually once per hour) on the airport's automated terminal information service (ATIS) or via a local telephone number (702-293-1532). Aircraft in the vicinity can receive this information if they have their radio tuned to the correct frequency (118.475 MHz). This system should be maintained through the planning period.

Communication Facilities

BVU does not have an operational airport traffic control tower (ATCT) at this time. Papillon Grand Canyon Helicopters, an air tour operator currently utilizing the airport does, however, operate a small dispatch tower designated for advisory purposes only. The Papillon dispatch tower is located on the southwest corner of the second level of the air tour terminal building. Justification for the development of an ATCT is typically determined by a benefit-cost analysis which takes into consideration the operational levels of the airport and the fleet mix of aircraft utilizing the airport facilities. A 2011 ATCT justification study states that federal approval under the FAA Federal Contract Tower program could be likely. Future planning should consider the addition of an ATCT, and will be further explored in the next chapter, Alternatives Analysis.

AIRFIELD LIGHTING, MARKING, AND SIGNAGE

There are a number of lighting and pavement marking aids serving pilots using the Airport. These aids assist pilots in locating an airport and runway at night or in poor visibility conditions. They also assist in guiding the ground movement of aircraft.

Airport Identification Lighting

The location of the airport at night is universally indicated by a rotating beacon. For civil airports, a rotating beacon projects two beams of light, one white and one green, 180 degrees apart. The existing beacon, located on top of a tower directly to the east of the Airport Administration building, should be maintained through the planning period.

Runway and Taxiway Lighting

Runway pavement edge lighting provides the pilot with positive identification of the runway and its alignment. Runways 9-27 and 15-33 are served by medium intensity runway lighting (MIRL). Edge lighting on both runways should be maintained through the planning period and expanded along with any potential runway extensions.

Medium intensity taxiway lighting (MITL) is provided on all active taxiways serving the two-runway system. Elevated runway guard lights are also placed at each hold position prior to a runway crossing. This system is vital for safe and efficient ground movements and should be maintained in the future.

Over time, the airport should consider removing incandescent airfield signage and runway and taxiway edge lighting systems, and replacing them with light emitting diode (LED) technology. LEDs have many advantages, including lower energy consumption, longer lifetime, tougher construction, reduced size, greater reliability, and faster switching. While a substantial initial investment is required upfront, the energy savings and reduced maintenance costs outweigh any additional costs in the long run.

Pavement Markings

Runway markings are typically designed to the type of instrument approach available on the runway. FAA AC 150/5340-1K, *Standards for Airport Markings*, provides guidance necessary to design airport markings.

Runway 9-27 is served by non-precision markings. This aids in accommodating the potential instrument approach to Runway 27 and provides enhanced identification for both ends of the primary runway at the airport. Runway 15-33 has basic markings. All runway markings should be maintained through the long term planning period.

Airfield Signs

Airfield identification signs assist pilots in identifying their location on the airfield and directing them to their desired location. Signs are installed on both the runway and taxiway systems on the airfield. The signage system includes runway and taxiway designations, holding positions, routing/directional, runway distance remaining, and runway exits. It should be noted that any lighted signs should be upgraded with LED lights when airfield lights are upgraded. All signs should be maintained throughout the planning period.

AIRSIDE FACILITY REQUIREMENTS SUMMARY

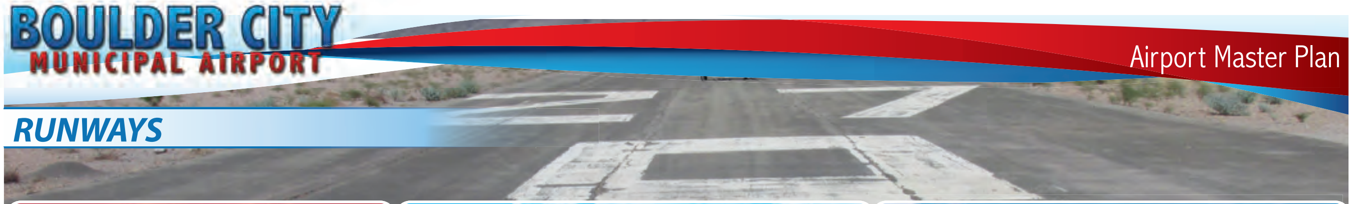
A summary of the airside facilities previously discussed at Boulder City Municipal Airport is presented on **Exhibit 3G**.

LANDSIDE FACILITY REQUIREMENTS

Landside facilities are those necessary for the handling of aircraft and passengers while on the ground. These facilities provide the essential interface between the air and ground transportation modes. The capacity of the various components of each element was examined in relation to projected demand to identify future landside facility needs. At Boulder City Municipal Airport, this includes components for commercial service and general aviation needs such as:

- Passenger Terminal Complex
- General Aviation Terminal Facilities
- Aircraft Hangars
- Aircraft Parking Aprons
- Airport Support Facilities

RUNWAYS



CATEGORY	EXISTING		RECOMMENDED IMPROVEMENTS OVER PLANNING PERIOD	
	Runway 9-27	**Runway 15-33**	**Runway 9-27**	**Runway 15-33**
Runway Design Code (RDC)	RDC B-II-VIS	RDC A-I-VIS	RDC B-II-5000	RDC B-II-VIS
Length x Width (in feet)	4,803 x 75	3,852 x 75	5,800	Same
Pavement Strength (in pounds)				
Single Wheel Loading (S)	12,500	12,500	30,000	Same
Runway Protection Zones	500 x 700 x 1,000	500 x 700 x 1,000	Same	Same
Owned	Mostly	Yes	Yes	Same
Incompatible Uses	None	None	Same	Same

TAXIWAYS

Taxiway Design Code (TDG)	2	2	Same	Same
Parallel Taxiway	Full Length	Full Length	Same	Same
Number of Entrance/Exits	Three	Three	Same	Same
Taxiway Widths (in feet)	35	35 and 50	Same	Same

AIRFIELD GEOMETRY

Hot Spots Identified	None	None	
High Energy Runway Crossings	Yes (Taxiway B)	Yes (Taxiway D)	Consider Alternatives to Mitigate
Direct Access Runway/Apron	Yes (Taxiway A)	Yes (Taxiway D)	Consider Alternatives to Mitigate

NAVIGATION & WEATHER AIDS

	AWOS, Five Lighted Wincones, Beacon		Same	
Instrument Approach Procedures	**Runway 9-27**	**Runway 15-33**	**Runway 9-27**	**Runway 15-33**
GPS LPV	None	None	Not lower than 1-mile	Same

LIGHTING AND MARKING

Runway Lighting	MIRL	MIRL	Same	Same
Centerline Lighting	No	No	Same	Same
Touchdown Zone Lights	No	No	Same	Same
Runway Marking	Non-Precision	Basic	Same	Same
Taxiway Lighting	MITL	MITL	Same	Same
Approach Lighting System	REIL	REIL	Same	Same
Visual Approach Aids	PAPI-2L	PAPI-2L (Rwy 33)	PAPI-4L	PAPI-2L

Exhibit 3G
AIRSIDE FACILITY REQUIREMENTS

AIR TOUR TERMINAL FACILITY

Components of the passenger terminal complex include the terminal building, gate positions, and apron area. This section identifies the facilities required to meet the airport's needs through the planning period.

The review of the capacity and requirements for various terminal complex functional areas was performed with guidance from FAA AC 150/5360-13, *Planning and Design Guidelines for Airport Terminal Facilities*. Facility requirements were updated to reflect the short, intermediate, and long term planning horizons for enplanement milestones. This included the levels of 240,000, 275,000, and 350,000 annual enplaned passengers.

It should be clearly stated and understood from the outset that the air tour operators utilize privately owned terminal facilities and that the analysis here is not intended to direct their development. The purpose here is to determine if future spaces may be required so as to properly plan for such spaces. In short, this analysis is intended for advisory purposes and planning purposes only. In addition, operational characteristics of the air tour service providers are fundamentally different from the traditional air carrier airlines. Air tours have much greater scheduling flexibilities and respond to demand even in the moment. Traditional airlines are bound by specific schedules and fleet limitations. As such, square footage allotments for the air tour terminal operator facilities may differ significantly from required square footage allotments pertaining to a passenger terminal facility serving air carriers.

The following functional areas for the air tour terminal are discussed:

- Airline ticketing and operations
- Departure facilities
- Terminal services
- Public use areas
- Administration/Support

Ticketing and Airline Operations

The first destination for enplaning passengers in the terminal building is usually the airline ticket counter. The ticketing area consists of the ticket counters, queuing area for passengers in line at the counters, and the ticket lobby which provides circulation.

The ticket lobby should be arranged so that the enplaning passenger has immediate access and clear visibility to the individual airline ticket counters upon entering the building. Circulation patterns should allow the option of bypassing the counters with minimum interference. Provisions for seating should be minimal to avoid congestion and to encourage passengers to proceed to the gate area.

Departure Gates and Hold Areas

Ground level loading and unloading of passengers is appropriate for Boulder City Municipal Airport as smaller turboprops and helicopters are the primary aircraft serving the airport. The number of gates required to accommodate the combined peak hour activity and the aircraft seating capacities determine passenger hold area capacity requirements. Hold areas should be sized to provide adequate space and area for the largest group of people that can use each gate.

Terminal Services

Currently, there are dedicated food and beverage services in the terminal facilities that include a restaurant and souvenir vending area in the largest facility. Additional space for food and beverages could be planned through the long term that could accommodate an increase in passenger enplanements as well as the general public. Thought could be given to providing additional space for the general public, as well as bathroom space in the hold room area for departing passengers.

Public-Use Area

The public lobby is where passengers or visitors may comfortably relax while waiting for arrivals or departures. Typically, visitors must remain out of secure departure areas at terminal facilities serving air carriers, so a public lobby is important. The air tour operators at BVU operate under federal regulations which do not require security via the Transportation Security Agency (TSA). Thus, a secure area is not required for BVU operations as conducted today. Passengers and visitors alike may utilize the same public-use area. Additional space could be considered during the planning period to accommodate both passenger and visitor activity levels.

Building Support and Administration

Building support facilities include all miscellaneous spaces at the airport, including mechanical, telephone, business centers, walls/structures, and general circulation. As other components of the airport increase in size, so will supporting spaces.

The administrative offices are separate from the passenger service areas in the large air tour terminal building. These offices include space for airport and airline management and operations personnel. Heating, ventilating, and air conditioning (HVAC) mechanical spaces are provided, but may be undersized to meet demands on the facility. As enplanement levels increase, stresses could be placed on the building, necessitating expansion of HVAC facilities.

Terminal Building Requirements Summary

As presented in **Table 3J**, considerations for the gross terminal building area offered for air tour operations appear to be undersized for existing and projected passenger service demand. As a reminder, however, the terminal space requirements for terminal facilities serving traditional air carriers and the terminal facilities serving the air tour operators can be significantly different given the nature of each operation. Thus, the recommendations presented in **Table 3J** are advisory in nature. Each air tour operator will determine their space allotments as based on the individualized business model. If the City of Boulder City were to construct a centralized facility, the space allotments offered in Table 3J would satisfy projected demand.

TABLE 3J
Air Tour Terminal Facilities
Boulder City Municipal Airport

	Available	Short Term	Intermediate Term	Long Term
Enplanements	211,648	240,000	275,000	350,000
Design Hour Enplanements	102	116	133	169
Multiplier (s.f.)	-	150	150	150
Air Tour Terminal Building Space (s.f.)	+-20,000	17,400	19,950	25,350

Commercial Service Apron Requirements

Commercial service aircraft apron is typically allocated and analyzed according to the number of passenger gates offered and type of aircraft serving the gate(s). At BVU, three specific aircraft types are utilized, helicopters (varies but similar sizes) and two fixed-wing aircraft, the single engine Cessna Caravan and Twin Otter. The existing apron areas on the airport support 45 paved commercial parking spaces with 21 of those designated for fixed-wing aircraft. Long term passenger demands could require an additional ten to 15 parking spaces, or up to 12,000 square yards of apron area, for fixed-wing and rotorcraft commercial service aircraft. Analysis in the next chapter will consider options for additional commercial apron spaces.

Terminal Access Roadway

The capacity of the airport access and terminal area roadways is commonly determined as the maximum number of vehicles that can pass over a given section of a lane or roadway during a given time period. It is normally preferred that a roadway operate below capacity to provide reasonable flow and minimize delay to the vehicles using it. For commercial service airports, the terminal roadways should be developed so as to facilitate efficient passenger movements into and out of the facility.

Access to the commercial service terminal complex at BVU is provided by Airport Road which extends south from Veterans Memorial Drive and then continues in an east-west fashion along the landside facilities. The road also leads directly to on-airport terminal facilities, including the airport's largest terminal building curb. It should be noted that road is typically utilized by shuttles to drop off air tour passengers. As such, nearby terminal parking is also provided for passengers. The existing terminal roadway is sufficiently designed and built to accommodate existing and ultimate passenger loads. Peak passenger periods may tax the roadway but not to a point where significant changes would be required.

Terminal Curb Frontage and Vehicle Parking

The curb element is the interface between the terminal building and the ground transportation system. The length of curb required for the loading and unloading of passengers is determined by the type and volume of ground vehicles anticipated in the peak period on the design day.

A typical problem for terminal curb capacity is the length of dwell time for vehicles utilizing the curb. At airports where the curb front has not been strictly patrolled, vehicles have been known to be parked at the curb while the driver and/or riders are inside the terminal checking in. Since most curbs are not designed for vehicles to remain curbside for more than two to three minutes, capacity problems can ensue.

At BVU, the terminal roadway provides one lane for loading and unloading of passengers. The curb frontage totals approximately 220 feet in length, connected to the entrance road in a loop configuration. As presented in **Table 3K**, curb length is recommended to be held constant as a result of the significant amount of passengers that arrive at the air tour terminal facility via bus or shuttle. The curb is not necessarily as important at BVU since the majority of passengers are on-demand and either arrive via shuttle services or by private automobile. The air tour also does not generally have any significant drop-offs or pick-ups, as those using the services will arrive and leave within a period of a few hours. Finally, the curb length is generally important when considering arriving passengers who collect baggage at a claim facility, which is not the case at BVU for air tour operations.

TABLE 3K
Airline Terminal Vehicle Requirements
Boulder City Municipal Airport

	Existing	Short Term	Intermediate Term	Long Term
Terminal Curb				
Total Curb (ft)	220	220	220	220
Auto Parking				
Peak Hour Enplanements	102	116	133	169
Multiplier	-	1.5	1.5	1.5
Passengers	**184**	**174**	**200**	**254**
Employees	**NA**	**20**	**25**	**38**
Total Public Parking Spaces	**184**	**194**	**225**	**292**

Vehicle parking in the air tour passenger terminal area of the airport includes those spaces utilized by passengers, visitors, and employees of the air tour terminal facilities. Vehicle parking demand for commercial passengers is based upon the industry standard of 1.5 parking spaces per peak hour passenger. Employee parking was figured as 15 percent of the commercial passenger totals.

Public parking is located in surface lots near the air tour terminal areas. Several areas are paved and capable of accommodating parking needs but the paved areas are also utilized for other general aviation purposes. As such, the analysis allotted 184 of the 271 spaces for commercial service operations. The remaining 87 spaces are assigned for general aviation auto parking.

It should also be clearly stated that vehicle parking demand guidance provided by the FAA may not be representative of the air tour industry given the amount of shuttles and buses utilized by air tour operators to transport passengers. Additional parking is available in unpaved areas north of the existing paved parking lots and includes approximately 230 unmarked parking spaces. Future consideration will be given to providing additional paved vehicle parking areas to support the air tour passenger terminal area as the analysis indicates that more than 100 additional paved parking spaces should be provided to meet passenger demands.

GENERAL AVIATION TERMINAL FACILITIES

The general aviation facilities at the airport are often the first impression of the community that corporate officials and other visitors will encounter. General aviation terminal facilities at an airport provide space for passenger waiting, pilots' lounge, pilot flight planning, concessions, management, storage, and various other needs. This space is not necessarily limited to a single, separate terminal building, but can include space offered by FBOs and other specialty operators for these functions and services. At BVU, general aviation terminal services are primarily provided by the BFE FBO located west of the large primary air tour terminal building complex area.

The methodology typically used in estimating general aviation terminal facility needs is based upon the number of airport users expected to utilize general aviation facilities during the design hour. Space requirements for terminal facilities were based on providing 125 square feet per design hour itinerant passenger. A multiplier of 2.6 in the short term, increasing to 3.0 in the long term, was also applied to terminal facility needs in order to better determine the number of passengers associated with each itinerant aircraft operation. This increasing multiplier indicates an expected growth in business and recreational operations through the long term. These operations often support larger turboprop and jet aircraft which accommodate an increasing passenger load factor. Such may be the case at Boulder City Municipal Airport, as the facility is expected to experience an increasing amount of itinerant aircraft activity.

Table 3L outlines the space requirements for general aviation terminal services at Boulder City Municipal Airport through the long term planning period. As shown in the table, up to 12,500 square feet of space could be needed in the long term for general aviation passengers. The amount of space currently offered by the BFE FBO on the airfield is approximately 5,000 square feet. The existing terminal facility offered includes designated areas for passenger waiting lobbies, flight planning, pilots' lounges, restroom facilities, and other amenities. Similar to the commercial terminal building facilities, general aviation spaces are provided by a private entity at BVU. As such, the space projections offered here are just a guide as the FBO will elect to offer such spaces unless the City of Boulder City elects to erect a stand-alone general aviation terminal building.

TABLE 3L
General Aviation Terminal Area Facilities
Boulder City Municipal Airport

	Available	Short Term	Intermediate Term	Long Term
Design Hour Operations	48	53	60	70
Design Hour Itinerant Operations	36	40	43	50
Multiplier	1.8	1.9	2	2.1
Total Design Hour Itinerant Passengers	65	75	87	104
General Aviation Building Spaces (s.f.)	5,250	9,000	10,400	12,500

Source: Coffman Associates analysis

General aviation vehicular parking demands have also been determined for BVU and are presented in **Table 3M**. Space determinations for itinerant passengers were based on an evaluation of existing airport uses, as well as standards set forth to help calculate projected terminal facility needs.

TABLE 3M
General Aviation Automobile Parking Requirements
Boulder City Municipal Airport

	Future Requirements		
	Short Term	Intermediate Term	Long Term
Design Hour Itinerant Passengers	***4***	***5***	***8***
GA Itinerant Parking Spaces	75	87	104
Local Based Aircraft Parking Spaces	81	87	99
Total GA Parking Area (s.f.)	**49,200**	**54,800**	**64,100**
Total Parking Spaces	**156**	**174**	**203**

Source: Coffman Associates analysis

The parking requirements of based aircraft owners should also be considered. Although some owners prefer to park their vehicles in their hangar, safety can be compromised when automobile and aircraft movements are intermixed. For this reason, separate parking requirements, which consider 30 percent of based aircraft at the airport, were applied to general aviation automobile parking space requirements. Utilizing this methodology, parking requirements for general aviation activity call for approximately 156 spaces in the short term, increasing to approximately 203 spaces in the long term planning horizon.

It is estimated that there are approximately 271 marked, paved parking spaces at Boulder City Municipal Airport currently serving various airport activities, including air tour passenger terminal services, the FBOs, rental car parking, and other aviation functions. Furthermore, additional unmarked parking area serving the terminal area, as well as more remote locations adjacent to landside hangar facilities, is located on the airport. Analysis here indicates that approximately 87 of the total spaces are utilized and/or available for general aviation activities. As previously detailed, future consideration in the Master Plan will be given to providing more paved vehicle parking in order to provide adequate space for air tour passenger service and general aviation activities.

AIRCRAFT HANGARS

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

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

Hangar development should be based upon actual demand trends and financial investment conditions.

While the majority of aircraft owners prefer enclosed aircraft storage, a number of based aircraft will still use outdoor tiedown spaces (due to lack of hangar availability, hangar rental rates, and/or operational needs). Therefore, enclosed hangar facilities do not necessarily need to be planned for each based aircraft. At BVU, it is estimated that approximately 20 percent of aircraft are currently based on aircraft parking aprons, with the remainder housed in hangar spaces.

Hangar types vary in size and function. T-hangars and port-a-port hangars are popular with aircraft owners having only one small aircraft. These hangars provide individual spaces within a larger structure. Aircraft owners are allowed privacy and individual access to their space. There is an estimated 243,025 square feet of storage space at the Airport comprised of Linear Box, T-hangars, and port-a-port hangars. For determining future aircraft storage needs, a planning standard of 1,200 square feet per aircraft is utilized.

Executive hangars are open-space facilities with no interior supporting structure. These hangars can vary in size and typically house multi-engine, turboprop, or jet aircraft, in addition to helicopters. Executive hangar space at BVU is estimated at 37,000 square feet. For future planning, a standard of 1,750 square feet per aircraft is utilized for executive hangars.

Conventional hangars are open space facilities with no supporting structure interference that can store several aircraft. Often, other airport services are offered from the conventional hangars, such as FBO activities. Conventional hangars are estimated to encompass 98,225 square feet of space at BVU. For future planning needs, 2,500 square feet per aircraft is utilized for conventional hangars.

In total, there is approximately 378,250 square feet of hangar, maintenance, and office space provided on the airport for general aviation activities.

Future hangar requirements for the Airport are summarized in **Table 3N**. While some based aircraft will continue to utilize aircraft parking apron space instead of hangar facilities, the overall percentage of aircraft seeking hangar space is projected to increase during the long term planning period. Since portions of the hangars are known to be used for aircraft maintenance servicing, requirements for maintenance/service hangar area was estimated using a planning standard of ten percent of total storage space requirements.

TABLE 3N
Aircraft Hangar Requirements
Boulder City Municipal Airport

	Currently Available	Short Term Need	Intermediate Term Need	Long Term Need
Total Based Aircraft	245	270	290	330
Aircraft To Be Hangared	-	210	230	270
Hangar Area Requirements				
Linear Box/T-Hangar/Port-A-Port (s.f.)	243,025	174,000	186,000	212,400
Executive Hangar Area (s.f.)	37,000	37,500	40,000	45,000
Conventional Hangar Area (s.f.)	98,225	140,000	150,000	172,500
Maintenance Area (s.f.)		40,500	43,500	49,500
Total Hangar Area (s.f.)	**378,250***	**392,000**	**419,500**	**479,400**

Note: * Includes total hangar and maintenance area currently at the airport
Source: Coffman Associates analysis

The analysis shows that future hangar requirements indicate that there is a potential need for over 100,000 square feet of hangar storage space to be offered through the long term planning period. This includes a mixture of hangar and maintenance areas. Due to the projected increase in based aircraft, annual general aviation operations, and hangar storage needs, facility planning will consider additional hangars at the airport. It is expected that the aircraft storage hangar requirements will continue to be met through a combination of hangar types.

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

GENERAL AVIATION AIRCRAFT PARKING APRONS

The aircraft parking apron is an expanse of paved area intended for aircraft parking and circulation. Typically, a main apron is centrally located near the airside entry point, such as the terminal building or FBO facilities. Ideally, the main apron is large enough to accommodate transient airport users, as well as a portion of locally based aircraft. Often, smaller aprons are available adjacent to FBO hangars and at other locations around the airport. The apron layout at Boulder City Municipal Airport includes parking aprons adjacent to the FBO facilities, as well as additional apron space for the parking and circulation of aircraft. The parking apron located immediately adjacent to the passenger terminal building is utilized for commercial service aircraft operations.

The total aircraft parking apron area dedicated for general aviation activities at BVU is approximately 32,700 square yards and includes those spaces on the east side of the airfield. A planning criterion of 800 square yards was used for single and multi-engine itinerant aircraft, while a planning criterion of 1,600 square yards was used to determine the area for itinerant turboprop aircraft.

A parking apron should also provide space for the number of locally based aircraft that are not stored in hangars. Locally based tiedowns typically will be utilized by smaller single engine aircraft; thus, a planning standard of 650 square yards per position is utilized. Maintenance activities would include the movement of aircraft into and out of hangar facilities and temporary storage of aircraft on the apron.

The total apron parking requirements are presented in **Table 3P**. Currently, there are approximately 94 marked positions available for based and itinerant general aviation aircraft at BVU. A large majority of these positions are for small single and multi-engine aircraft. As shown in the table, it appears that there are adequate marked tiedown positions available through the planning period of this study. The airport does experience higher volumes of traffic associated with air tour operations that often requires additional parking apron space for these peak period activities. As a result, future facility planning will consider the potential for additional parking apron space to accommodate the mix of aviation activity that occurs at the airport. It should be noted that the total apron area exceeds the long term planning horizon as a result of stricter apron area requirements being applied to aircraft position needs.

TABLE 3P General Aviation Aircraft Parking Apron Requirements Boulder City Municipal Airport				
	Available	Short Term	Intermedi-ate Term	Long Term
Single, Multi-engine Transient Aircraft Positions		15	15	16
Apron Area (s.y.)		9,750	9,750	10,400
Transient Business Turboprop/Jet Positions		3	4	6
Apron Area (s.y.)		4,900	7,000	10,000
Locally-Based Aircraft Positions		45	45	45
Apron Area (s.y.)		22,500	22,500	22,500
Total Positions	83	63	64	67
Total Apron Area (s.y.)	32,700	37,150	39,250	42,900

In addition to fixed-wing aircraft parking, areas should also be dedicated for helicopter parking. Helicopters also operate on various apron areas shared by fixed-wing aircraft at BVU. Helicopter operations should be segregated to the extent practicable to increase safety and efficiency of aircraft parking aprons. Long term facility planning will consider dedicated helicopter activity areas at the airport.

A summary of the general aviation landside facilities previously discussed at Boulder City Municipal Airport is presented on **Exhibit 3H**.

AIRPORT SUPPORT FACILITIES

Various other landside facilities that play a supporting role in overall airport operations have also been identified. These support facilities include:

- Aircraft Rescue and Firefighting (ARFF)
- Aviation Fuel Storage
- Maintenance Facilities
- Perimeter Fencing and Gates

Aircraft Rescue and Firefighting

Requirements for aircraft rescue and firefighting (ARFF) services at an airport are established under Title 14 CFR Part 139, which applies to the certification and operation of airports served by any scheduled or unscheduled passenger operation of an air carrier using an aircraft with more than 30 passenger seats, or scheduled passenger operation of an air carrier using an aircraft with more than nine passenger seats but less than 31. Paragraph 139.315 establishes ARFF Index ratings based on the length of the largest aircraft with an average of five or more daily departures.

COMMERCIAL TERMINAL COMPLEX

	AVAILABLE	SHORT TERM NEED	INTERMEDIATE TERM NEED	LONG TERM NEED
Building Space (s.f.)	20,000	17,400	19,950	25,350
Apron Space (s.y.)	46,900	N/A	N/A	58,900
Total Public Parking Spaces	184	194	225	292

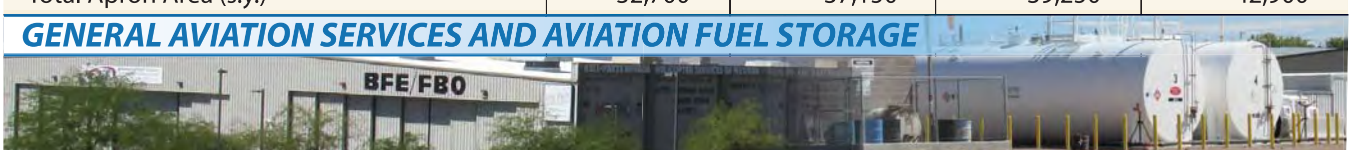
AIRCRAFT STORAGE

	AVAILABLE	SHORT TERM NEED	INTERMEDIATE TERM NEED	LONG TERM NEED
Linear Box/T-Hangar/Port-A-Port Area (s.f)	243,025	174,000	186,000	212,400
Executive Hangar Area (s.f.)	37,000	37,500	40,000	45,000
Conventional Hangar Area (s.f)	98,225	140,000	150,000	172,500
Maintenance Area (s.f.)	N/A	40,500	43,500	49,500
Total Hangar Area (s.f.)	378,250	392,000	419,500	479,400

GENERAL AVIATION AIRCRAFT APRON

	AVAILABLE	SHORT TERM NEED	INTERMEDIATE TERM NEED	LONG TERM NEED
Single, Multi-engine Transient Aircraft Positions	N/A	15	15	16
Apron Area (s.y.)	N/A	9,750	9,750	10,400
Transient Business Jet Positions	N/A	3	4	6
Apron Area (s.y.)	N/A	4,900	7,000	10,000
Locally-Based Aircraft Positions	N/A	45	45	45
Apron Area (s.y.)	N/A	22,500	22,500	22,500
Total Positions	83	63	64	67
Total Apron Area (s.y.)	32,700	37,150	39,250	42,900

GENERAL AVIATION SERVICES AND AVIATION FUEL STORAGE



	AVAILABLE	SHORT TERM NEED	INTERMEDIATE TERM NEED	LONG TERM NEED
GA Building Space (s.f.)	5,250	9,000	10,400	12,500
Based Aircraft Auto Spaces	N/A	81	87	99
Total GA Auto Parking Spaces	N/A	156	174	203
Total Parking Area (s.f.)	N/A	49,200	54,800	64,100
AVIATION FUEL STORAGE				
14 Day-Fuel Storage Capacity (gal.) - AvGas	12,000	3,011	3,395	3,992
14 Day-Fuel Storage Capacity (gal.) - Jet A	52,000	67,906	76,563	90,025

Exhibit 3H
LANDSIDE FACILITY REQUIREMENTS

The following indicates the requirements for each ARFF Index and the associated equipment requirements:

Index A - Includes aircraft less than 90 feet in length (Saab 340, Embraer ERJ-135).
Index B - Includes aircraft at least 90 feet but less than 126 feet in length (Embraer ERJ-145, Boeing 737).
Index C - Includes aircraft at least 126 feet but less than 159 feet in length (MD-83, Boeing 757).
Index D - Includes aircraft at least 159 feet but less than 200 feet in length (Boeing 767).
Index E - Includes aircraft at least 200 feet in length (Boeing 747).

Boulder City Municipal Airport is not currently certificated under Title 14 CFR Part 139, so the airport is not required to maintain an ARFF facility; however, recent concern has been expressed by commercial tenants operating at the airport. At this time, the nearest fire and rescue services provided are approximately 2.5 miles away, which translates to a response time of, at best, five minutes. Given the current and forecast levels of air tour operations, an ARFF facility should be considered. In order for the ARFF facility to qualify for federal funding, the Airport must establish itself as a Part 139 certificated airport and meet minimum requirements. Without this certification, the Airport would need to provide ARFF services without federal funding. **Table 3Q** presents the vehicle requirements and capacities for each index level.

TABLE 3Q
ARFF Index Requirements

Index	Aircraft Length	Requirements
Index A	<90'	1. One ARFF vehicle with 500 lbs. of sodium-based dry chemical or
		2. One vehicle with 450 lbs. of potassium-based dry chemical and 100 lbs. of water and AFFF for simultaneous water and foam application
Index B	90'-126'	1. One vehicle with 500 lbs. of sodium-based dry chemical and 1,500 gallons of water and AFFF or
		2. Two vehicles, one with the requirements for Index A and the other with enough water and AFFF for a total quantity of 1,500 gallons
Index C	126'-159'	1. Three vehicles, one having Index A, and two with enough water and AFFF for all three vehicles to combine for at least 3,000 gallons of agent or
		2. Two vehicles, one with Index B and one with enough water and AFFF for both vehicles to total 3,000 gallons
Index D	159'-200'	1. One vehicle carrying agents required for Index A and
		2. Two vehicles carrying enough water and AFFF for a total quantity by the three vehicles of at least 4,000 gallons
Index E	>200'	1. One vehicle with Index A and
		2. Two vehicles with enough water and AFFF for a total quantity of the three vehicles of 6,000 gallons

AFFF: Aqueous Film-Forming Foam
ARFF: Aircraft Rescue and Firefighting
Source: Title 14 Code of Federal Regulations Part 139

Aviation Fuel Storage

As previously discussed in Chapter One, there is currently one fuel farm located on airport property that stores aviation fuel. The fuel farm is operated by the BFE FBO and consists of two aboveground storage tanks that provide 40,000 gallons of Jet A fuel storage and two underground fuel storage tanks that provide 12,000 gallons of 100LL storage. The fuel farm is accessible from Taxiway A and is located near the entrance to the GA hangars.

As presented in **Table 3R**, there is 64,000 gallons of fuel storage capacity on airport property. Approximately 63 percent of the storage capacity is dedicated to Jet A fuel.

TABLE 3R
Fuel Storage Requirements
Boulder City Municipal Airport

	Available	Current Need	Short Term	Intermediate Term	Long Term
100LL Requirements Two-Week Storage (gallons)	12,000*	2,726	3,011	3,395	3,992
Jet A Requirements Two-Week Storage (gallons)	52,000*	61,467	67,906	76,563	90,025

* On-airport fuel storage (fuel tanks)
Source: Coffman Associates analysis

Fuel storage requirements are typically based upon keeping a two-week supply of fuel during an average month; however, more frequent deliveries can reduce the fuel storage capacity requirements. Generally, fuel tanks should be of adequate capacity to accept a full refueling tanker, which is approximately 8,000 gallons, while maintaining a reasonable level of fuel in the storage tank. Future fueling demand experienced by the FBOs on airport property will determine the need for additional fuel storage capacity. It is important that airport personnel work with the FBOs to plan for adequate levels of fuel storage capacity through the long term planning period of this study.

Maintenance Facilities

The airport does not currently have a building dedicated to maintenance or storage. The airport should consider the development of a building specifically dedicated to the storage of airport maintenance equipment. The alternatives analysis will consider several potential locations for a dedicated airport maintenance facility.

Perimeter Fencing and Gates

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

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

Boulder City Municipal Airport's perimeter contains a service road and is enclosed with six-foot tall chain-link fence topped by three-strand barbed-wire. Several controlled-access and manual gates associated with the fencing lead to different areas on the airfield. This existing fencing should be maintained and expanded as landside facilities develop on the Airport. In addition, it is recommended that perimeter fencing adhere to Transportation Security Administration (TSA) guidelines.

Aircraft Wash Rack

Currently, there is not a designated aircraft wash rack at BVU. Consideration should be given to establishing such a facility at the Airport. This would provide for the collection of used aircraft oil and other hazardous materials, as well as provide a covered area for aircraft washing and light maintenance.

SUMMARY

This chapter has outlined the safety design standards and facilities required to meet potential aviation demand projected at Boulder City Municipal Airport for the next 20 years. In an effort to provide a more flexible Master Plan, the yearly forecasts from Chapter Two have been converted to planning horizon levels. The short term roughly corresponds to a five-year timeframe, the intermediate term is approximately ten years, and the long term is 20 years. By utilizing planning horizons, airport management can focus on demand indicators for initiating projects and grant requests rather than on specific dates in the future.

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

BOULDER CITY
MUNICIPAL AIRPORT

CHAPTER FOUR

Airport Alternatives

BOULDER CITY
MUNICIPAL AIRPORT

CHAPTER FOUR
AIRPORT ALTERNATIVES

The previous chapter outlined airside and landside facilities at Boulder City Municipal Airport (BVU or Airport) required to satisfy aviation demand through the long range planning period of the Master Plan. The next step in the planning process is to evaluate reasonable and practical ways these facilities can be provided. The purpose of this chapter is to formulate and examine rational airport development alternatives that can address the short, intermediate, and long term planning horizon levels. Because there are a multitude of possibilities and combinations, it is necessary to focus on those opportunities which have the greatest potential for success. Each of the proposed alternative options provides a differing approach to meet existing and future facility needs and/or FAA design standard.

Some airports become constrained due to limited space availability, while others may become constrained due to adjacent land use development. One very important component of the master planning process is a deliberate and purposeful analysis aimed at ensuring that the airport is properly developed to meet long term demand. Careful consideration should be given to the layout of future facilities and impacts to potential airfield improvements at the Airport, especially those related to the runway and taxiway system. Proper planning at this time can ensure the long term viability of the airport to ensure it can meet aviation demand and achieve economic growth. This goal is important to preserve BVU's role serving as a vital economic engine for Boulder City and the region as a whole.

The primary goal of this planning process is to develop a viable plan for meeting the needs resulting from the projected market demand over the next 20 years. The plan of action should be developed in a manner that is consistent with the future goals and objectives of the City of Boulder City, airport users, and citizens of Boulder City, who have a vested interest in the development and operation of BVU.

The ultimate goal is to develop the underlying rationale which supports the final recommended development concept. Through this process, an evaluation of the highest and best uses of airport property will be made while also weighing local development goals, physical and environmental constraints, and appropriate airport design standards.

NON-DEVELOPMENT ALTERNATIVES

Prior to presenting development alternatives for the Airport, non-development alternatives were considered. Non-development alternatives include the “no-build” or “no-action” alternative, or the transfer of services to another existing airport or development of a new airport.

BVU plays a critical role in the economic development of the City of Boulder City and the surrounding region. There is significant public and private investment at the airport. The pursuit of a non-development alternative would slowly devalue these investments and lead to infrastructure deterioration and potentially the loss of significant levels of federal and state funding for airport improvements. If facilities are not maintained and improved so that the airport provides a pleasant experience for airport users, then these individuals may consider doing business elsewhere. Ultimately, the safety of aircraft, pilots, and persons on the ground could be jeopardized if improvements are no longer undertaken. Furthermore, non-development alternatives are inconsistent with the long term goals of the Federal Aviation Administration (FAA) and the Nevada Department of Transportation – Aviation Planning Section (NDOT), which are to enhance local and interstate commerce. Therefore, the “no-build” or “no-action” alternative will not be considered further.

The alternative of shifting aviation services to another existing airport or development of a new airport site was found to be an undesirable alternative. The development of a new airport is a very complex and expensive alternative. A new site will require substantial land area, duplication of investment in airport facilities, installation of supporting infrastructure that is already available, and significant environmental impacts. Furthermore, the City of Boulder City, FAA, and NDOT have all contributed to significant improvements at the airport in recent years. The continuing growth expected in the area demonstrates the need for a highly functional and convenient airport. As a result, the transfer of aviation services is not a viable option for the Airport.

The primary goal for the Master Plan is to define a future concept which positions the airport to be marketed, developed, and safely operated for the betterment of its users and the community as a whole.

AIRPORT DEVELOPMENT OBJECTIVES

It is the overall objective of this Master Plan to produce a balanced aviation facility to serve forecast demands. Before defining and evaluating specific alternatives, airport development objectives should be established. As owner and operator, the City of Boulder City provides the overall guidance for the operation and development of the airport. The primary goal for the Master Plan is to define a future concept which positions the airport to be marketed, developed, and safely operated for the betterment of its users and the community as a whole. With this in mind, the following development objectives have been defined for this planning effort.

- Conform to FAA and NDOT design and safety standards, wherever practical, for the mix of aircraft that could potentially use the airport during the 20-year planning period.
- Develop a safe, attractive, and efficient aviation facility in accordance with applicable federal, state, and local regulations.
- Provide sufficient airport capacity which will meet the long term planning horizon demand levels.
- Reflect and support the long term planning efforts currently applicable to the region.
- Develop facilities to safely and efficiently serve aviation users and support future growth.
- Identify any future land acquisition needs.
- Develop a facility with a focus on self-sufficiency in both operational and development cost recovery.
- Ensure that future development is environmentally compatible.

REVIEW OF PREVIOUS AIRPORT PLANS

An Airport Layout Plan (ALP) and Narrative Update for Boulder City Municipal Airport was completed in 2013. The Airport Layout Drawing and associated Airport Data Sheet are shown on **Exhibit 4A**. The Airport Data Sheet, detailed on the front of the exhibit, provides information on existing and ultimate conditions at BVU, including:

- Airport data related to service level, Airport Reference Code (ARC), elevation, wind conditions, temperature, and navigational aids located at the Airport.
- Runway data related to the critical design aircraft, safety areas, markings, lighting, and visual and navigational aids associated with the runway and taxiway system.

On the back of the exhibit, the Airport Layout Drawing graphically depicts information contained on the Airport Data Sheet and further outlines airside and landside recommendations based upon previous airport planning that include:

- Meeting ultimate ARC B-II design standards for Runways 9-27 and 15-33.
- Enhanced visual approach aids in the form of precision approach path indicators (PAPIs) and runway end identification lights (REILs) serving various runway ends.
- Ultimate parcel layout in various areas on airport property that could support future development.

The analysis presented in this chapter will revisit the recommendations presented on the Airport Layout Drawing. Since completion of the last plan, the FAA has made some significant modifications to airport design standards as outlined in the previous chapter. As such, some of the previous plan's elements may be carried over to this Master Plan and others may be changed and/or removed from further consideration.

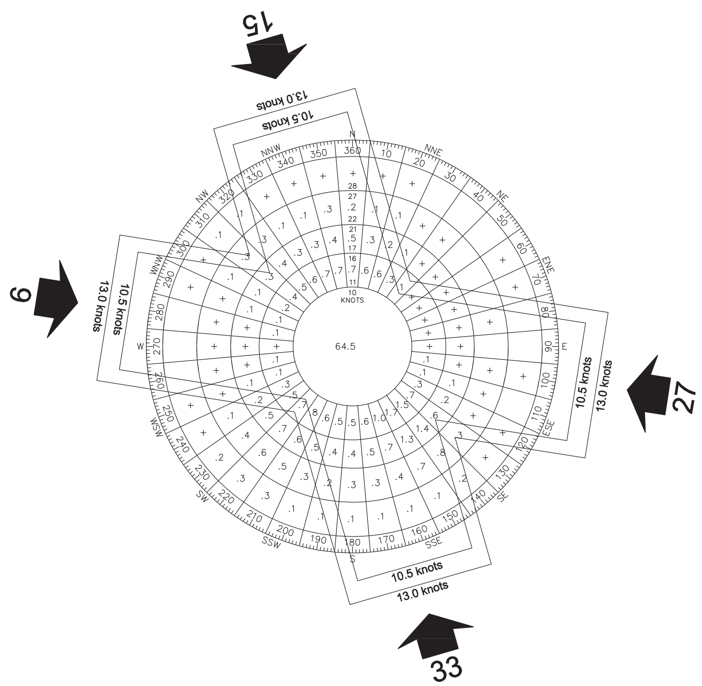
AIRPORT ALTERNATIVE CONSIDERATIONS

The development alternatives are categorized into two functional areas: airside and landside. Airside considerations relate to runways, taxiways, navigational aids, lighting and marking aids, etc. and require the greatest commitment of land area to meet the physical layout of the airport, as well as the required airfield safety standards. The design of the airfield also defines minimum set-back distances from the runway and object clearance standards. These criteria are defined first to ensure that the fundamental needs of the airport are met. Landside considerations include hangars, aircraft parking aprons, terminal services, as well as utilization of remaining property to provide revenue support for the airport and to benefit the economic development and well-being of the regional area.

Each functional area interrelates and affects the development potential of the others. Therefore, all areas must be examined individually and then coordinated as a whole to ensure the final plan is functional, efficient, and cost-effective. The total impact of all these factors must be evaluated to determine if the investment in the Airport will meet the needs of the surrounding area, both during and beyond the planning period of this study.

Exhibit 4B presents both airside and landside alternative considerations that will be specifically addressed in this analysis. These issues are the result of the findings of the aviation demand forecasts and facility requirements evaluations, as well as input from the Planning Advisory Committee (PAC), airport management, and general public.

The remainder of this chapter will describe various development alternatives for airside and landside facilities. Although each area is treated separately, ultimate planning will integrate the individual requirements so that they can complement one another.



All Weather Wind Rose				
Runway(s)	Crosswind Component (knots)			
	10.5	13.0	16.0	20.0
9-27	72.49%	79.74%	87.47%	94.05%
15-33	89.11%	93.05%	96.02%	98.20%
9-27 & 15-33	91.48%	94.91%	97.21%	98.84%

Source: Boulder City Municipal Airport, AWOS Data
August 26, 2009 - August 26, 2010

RUNWAY DATA

ITEM		RUNWAY 9R-27L				RUNWAY 9L-27R			RUNWAY 15-33			
		EXISTING		FUTURE		EXISTING		FUTURE	EXISTING		FUTURE	
AIRPORT REFERENCE CODE		B-II		SAME		A-I (SMALL AIRCRAFT)		RUNWAY TO BE CLOSED TO ENHANCE SAFETY	A-I		B-II	
CRITICAL AIRCRAFT	AIRCRAFT	CESSNA CITATION II/SP		SAME		CESSNA 182			CESSNA 182		CESSNA CITATION II/SP	
	WINGSPAN (FEET)	51.8		SAME		36			36		51.8	
	UNDERCARRIAGE WIDTH (FEET)	12.6		SAME		8			8		12.6	
	APPROACH SPEED (KNOTS)	108		SAME		64			64		108	
	MAXIMUM TAKEOFF WEIGHT (LBS)	12,500		SAME		3,100			3,100		SAME	
% EFFECTIVE GRADIENT		0.610%		SAME		0.591%			2.712%		SAME	
% MAXIMUM GRADIENT		0.810%		SAME		2.24%			3.00%		SAME	
% WIND COVERAGE		79.74% (13.0 KNOTS)		SAME		72.49% (10.5 KNOTS)			93.05% (13 KNOTS)		SAME	
PAVEMENT DESIGN STRENGTH		12,500 - SW		SAME		12,500 - SW			12,500 - SW		SAME	
RUNWAY SAFETY AREA WIDTH X LENGTH BEYOND RUNWAY END (BRE)		150 X 300		SAME		120 X 240			120 X 240		150 X 300	
OBJECT FREE AREA (OFA) WIDTH X LENGTH BRE		500 X 300		SAME		250 X 240			400 X 240		500 X 300	
OBJECT FREE ZONE (OFZ) WIDTH X LENGTH BRE		400 X 200		SAME		250 X 200			400 X 200		SAME	
DISTANCE FROM RW CENTERLINE TO HOLD BARS (FT)		247 - 275		SAME		137 - 150			197 - 203		SAME	
DISTANCE FROM RW CENTERLINE TO PARALLEL TW (FT)		240		SAME		240			240		SAME	
DISTANCE FROM TW CENTERLINE TO FIXED OR MOVEABLE OBJECT (FT)		151		SAME		> 44.5			> 65.5		SAME	
TAXIWAY OFA WIDTH (FT)		131		SAME		89			89		131	
TAXIWAY SAFETY AREA WIDTH (FT)		79		SAME		49			49		79	
TAXIWAY WINGTIP CLEARANCE (FT)		26		SAME		20			20		26	
RUNWAY HIGH POINT ELEVATION (FT AMSL)		2138.1		SAME		2153.6			2203.5		SAME	
RUNWAY LOW POINT ELEVATION (FT AMSL)		2108.7		SAME		2144.2			2099.0		SAME	
VERTICAL LINE OF SIGHT PROVIDED		YES		SAME		YES			YES		SAME	
RUNWAY LENGTH X WIDTH (FT)		4800 X 75		SAME		2200 X 60			3850 X 75		SAME	
RUNWAY SURFACE TYPE		ASPHALT		SAME		ASPHALT			ASPHALT		SAME	
TAXIWAY SURFACE TYPE		ASPHALT		SAME		ASPHALT			ASPHALT		SAME	
RUNWAY LIGHTING		MIRL		SAME		NONE			MIRL		SAME	
RUNWAY ENDS		9R	27L	9	27	9L	27R		15	33	15	33
APPROACH VISIBILITY MINIMUMS		VISUAL	VISUAL	VISUAL AND NOT LESS THAN 1 MILE	VISUAL AND NOT LESS THAN 1 MILE	VISUAL	VISUAL		VISUAL	VISUAL	SAME	SAME
RUNWAY MARKINGS		NON-PRECISION	NON-PRECISION	SAME	SAME	BASIC	BASIC		BASIC	BASIC	SAME	SAME
APPROACH TYPE/FAR PART 77 CATEGORY		VISUAL A(V)	VISUAL A(V)	NON-PRECISION A(NP)	NON-PRECISION A(NP)	VISUAL A(V)	VISUAL A(V)		VISUAL A(V)	VISUAL A(V)	SAME	SAME
RUNWAY END ELEVATION (FT AMSL)		2108.7	2138.1	SAME	SAME	2144.2	2153.6		2203.5	2099.0	SAME	SAME
RUNWAY TOUCHDOWN ZONE ELEVATION (FT AMSL)		2130.4	2138.1	SAME	SAME	2144.2	2153.6		2203.5	2179.7	SAME	SAME
APPROACH SLOPE		20:1	20:1	SAME	SAME	20:1	20:1		20:1	20:1	SAME	SAME
NAVIGATIONAL AIDS		NONE	NONE	GPS/LPV	GPS/LPV	NONE	NONE		NONE	NONE	SAME	SAME
VISUAL AIDS		PAPI-2, REIL	PAPI-2, REIL	SAME	SAME	NONE	NONE		REIL	PAPI-2, REIL	PAPI-2, REIL	SAME

BUILDING/ FACILITIES LIST

EXISTING BUILDINGS					
NUMBER	USE/ TENANT	ELEVATION	NUMBER	USE/ TENANT	ELEVATION
1	BFE	2165.0	26	HANGAR	2164.9
2	BFE	2162.5	27	HANGAR	2165.3
3	BFE	2160.0	28	HANGAR	2165.4
4	BFE	2160.0	29	HANGAR	2165.3
5	OFFICE	2163.0	30	HANGAR	2165.0
6	OFFICE	2165.5	31	HANGAR	2165.1
7	HANGAR	2165.0	32	HANGAR	2165.5
8	TERMINAL	2164.5	33	HANGAR	2163.1
9	HANGER	2167.1	34	HANGAR	2163.2
10	OFFICE	2167.1	35	HANGAR	2163.2
11	OFFICE	2167.1	36	HANGAR	2164.0
12	OFFICE	2167.2	37	HANGAR	2163.7
13	ADMINISTRATION	2165.9	38	HANGAR	2163.7
14	HANGAR	2166.8	39	HANGAR	2164.2
15	HANGAR	2166.9	40	FUEL ISLAND	2160.5
16	HANGAR	2167.0	41	HANGAR	2161.5
17	HANGAR	2167.1	42	HANGAR	2161.7
18	HANGAR	2167.1	43	HANGAR	2162.5
19	HANGAR	2167.2	44	HANGAR	2163.0
20	HANGAR	2167.2			
21	HANGAR	2167.1			
22	HANGAR	2167.1			
23	HANGAR	2167.0			
24	HANGAR	2164.9			
25	HANGAR	2164.9			

RUNWAY END COORDINATES (NAD83)

	RUNWAY 9R-27L				RUNWAY 9L-27R			RUNWAY 15-33			
	EXISTING		FUTURE		EXISTING		FUTURE	EXISTING		FUTURE	
LATITUDE	9R	35° 56' 50.86" N	9	35° 56' 52.52" N	9L	35° 56' 51.40" N	NONE - RUNWAY REMOVED	15	35° 57' 13.66" N	15	SAME
LONGITUDE		114° 52' 08.51" W		114° 52' 20.49" W		114° 51' 36.30" W			114° 51' 48.41" W		SAME
LATITUDE	27L	35° 56' 42.83" N	27	SAME	27R	35° 56' 47.78" N		33	35° 56' 36.81" N	33	SAME
LONGITUDE		114° 51' 10.94" W		SAME		114° 51' 10.34" W			114° 51' 36.63" W		SAME

AIRPORT DATA

ITEM		EXISTING	FUTURE
AIRPORT REFERENCE CODE		B-II	SAME
AIRPORT SERVICE LEVEL		NON-HUB COMMERCIAL SERVICE-PRIMARY	SAME
AIRPORT ELEVATION (NAVD88)		2203'	SAME
AIRPORT REFERENCE POINT COORDINATES (NAD `83)	LATITUDE	35° 56' 50.4" N	35° 56' 50.7" N
	LONGITUDE	114° 51' 37.4" W	114° 51' 44.4" W
MAX. TEMPERATURE - HOTTEST MONTH		99.4° F - JULY	SAME
AIRPORT & TERMINAL NAVAIDS		BEACON	SAME
GPS APPROACH		NO	SAME
AIRPORT ACREAGE	FEE SIMPLE	525 AC	SAME
	AVIGATION EASEMENT	0 AC	6.5 AC

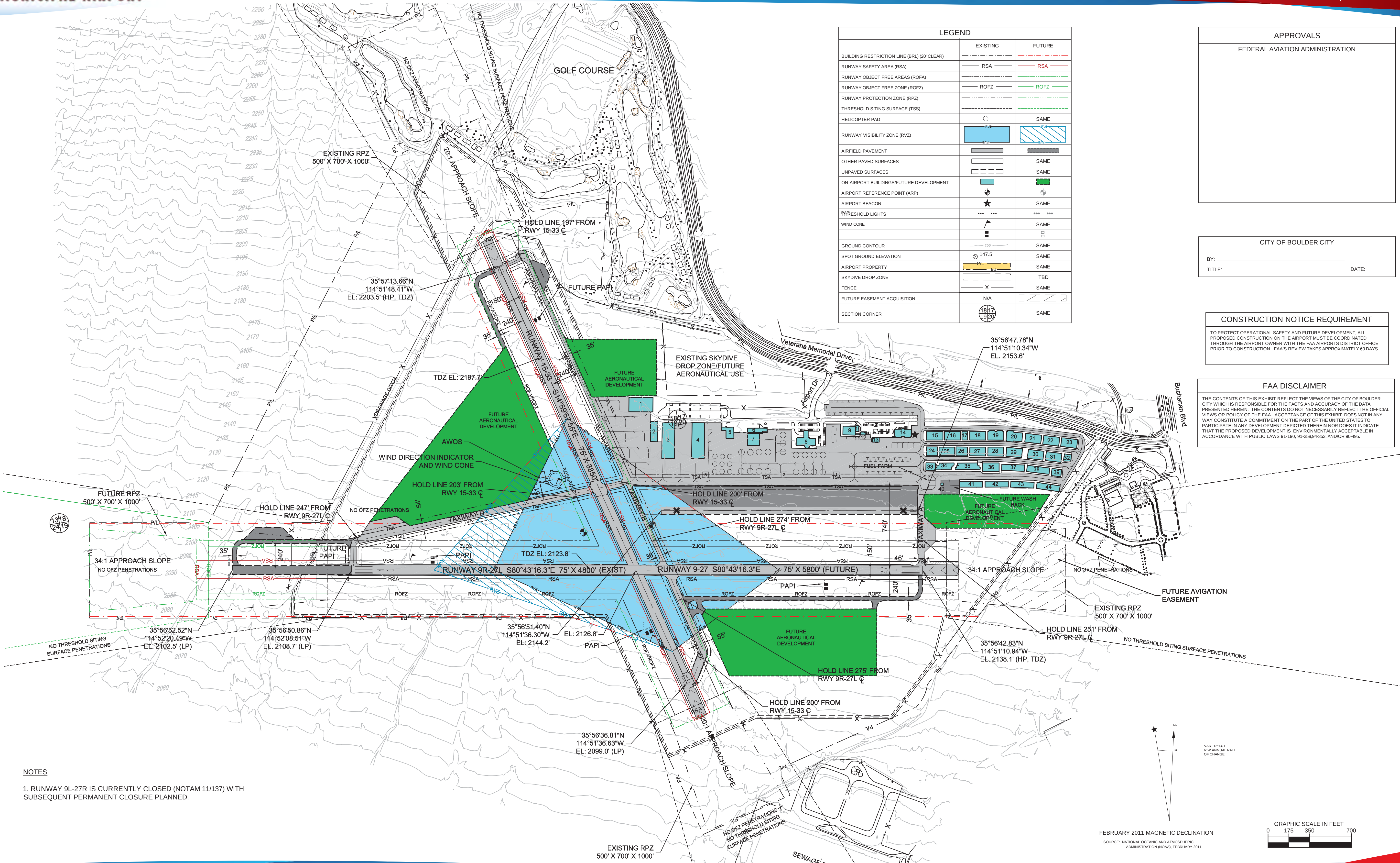
NOTES

1) TOPOGRAPHY SOURCE IS 2005 SURVEY.

2) PAVEMENTS ARE ASPHALTIC CONCRETE. ALL STRENGTHS ARE ESTIMATED.

3) GEOGRAPHICAL COORDINATES: HORIZONTAL DATUM - NAD83, VERTICAL DATUM - NAVD88.

Exhibit 4A
AIRPORT DATA SHEET



LEGEND

	EXISTING	FUTURE
BUILDING RESTRICTION LINE (BRL) (20' CLEAR)		
RUNWAY SAFETY AREA (RSA)	RSA	RSA
RUNWAY OBJECT FREE AREAS (ROFA)		
RUNWAY OBJECT FREE ZONE (ROFZ)	ROFZ	ROFZ
RUNWAY PROTECTION ZONE (RPZ)		
THRESHOLD SITING SURFACE (TSS)		
HELICOPTER PAD		SAME
RUNWAY VISIBILITY ZONE (RVZ)	RVZ	RVZ
AIRFIELD PAVEMENT		
OTHER PAVED SURFACES		SAME
UNPAVED SURFACES		SAME
ON-AIRPORT BUILDINGS/FUTURE DEVELOPMENT		
AIRPORT REFERENCE POINT (ARP)		
AIRPORT BEACON		SAME
PAPI THRESHOLD LIGHTS		
WIND CONE		SAME
GROUND CONTOUR	150	SAME
SPOT GROUND ELEVATION	147.5	SAME
AIRPORT PROPERTY	P/L	SAME
SKYDIVE DROP ZONE		TBD
FENCE	X	SAME
FUTURE EASEMENT ACQUISITION	N/A	
SECTION CORNER	18 17 19 20	SAME

APPROVALS

FEDERAL AVIATION ADMINISTRATION

CITY OF BOULDER CITY

BY: ______

TITLE: ______ DATE: ______

CONSTRUCTION NOTICE REQUIREMENT

TO PROTECT OPERATIONAL SAFETY AND FUTURE DEVELOPMENT, ALL PROPOSED CONSTRUCTION ON THE AIRPORT MUST BE COORDINATED THROUGH THE AIRPORT OWNER WITH THE FAA AIRPORTS DISTRICT OFFICE PRIOR TO CONSTRUCTION. FAA'S REVIEW TAKES APPROXIMATELY 60 DAYS.

FAA DISCLAIMER

THE CONTENTS OF THIS EXHIBIT REFLECT THE VIEWS OF THE CITY OF BOULDER CITY WHICH IS RESPONSIBLE FOR THE FACTS AND ACCURACY OF THE DATA PRESENTED HEREIN. THE CONTENTS DO NOT NECESSARILY REFLECT THE OFFICIAL VIEWS OR POLICY OF THE FAA. ACCEPTANCE OF THIS EXHIBIT DOES NOT IN ANY WAY CONSTITUTE A COMMITMENT ON THE PART OF THE UNITED STATES TO PARTICIPATE IN ANY DEVELOPMENT DEPICTED THEREIN NOR DOES IT INDICATE THAT THE PROPOSED DEVELOPMENT IS ENVIRONMENTALLY ACCEPTABLE IN ACCORDANCE WITH PUBLIC LAWS 91-190, 91-258,94-353, AND/OR 90-495.

NOTES

1. RUNWAY 9L-27R IS CURRENTLY CLOSED (NOTAM 11/137) WITH SUBSEQUENT PERMANENT CLOSURE PLANNED.

Exhibit 4A
AIRPORT LAYOUT DRAWING

Airside Considerations

- Evaluate improvements necessary to meet the appropriate existing and ultimate Federal Aviation Administration (FAA) design standards for each runway.
- Examine potential extensions to Runways 15-33 and 9-27 to meet aircraft operational requirements.
- Consider a pavement design strength increase on Runway 9-27 to better support forecast aviation demands.
- Evaluate the taxiway system in meeting airfield safety, design and geometry standards.
- Locate runway/taxiway hold lines per FAA standards.
- Analyze improved instrument approach considerations.
- Identify land acquisition needed to accommodate safety areas associated with existing/ultimate conditions on the airfield.

Landside Considerations

- Determine efficient land used that allow the airport to meet the needs of aviation users and promote non-aviation uses where possible.
- Identify locations for additional hangar development to meet projected demand.
- Identify areas for additional aircraft apron space to meet the activity demands on the airfield.
- Evaluate the air tour and general aviation terminal facility needs.
- Evaluate options to enhance support facilities needed for aviation activities.
- Examine options for additional vehicle parking access while best segregating aircraft and vehicle traffic on airport movement areas.

Exhibit 4B
AIR AND LANDSIDE ALTERNATIVE SUMMARY

ANALYSIS OF AIRSIDE DEVELOPMENT CONSIDERATIONS

This section identifies and evaluates various airside development factors at BVU to meet the requirements set forth in Chapter Three. Airside facilities are, by nature, the focal point of an airport complex. Because of their primary role and the fact that they physically dominate airport land use, airfield facility needs are often the most critical factor in the determination of viable development options.

Airside facilities are, by nature, the focal point of an airport complex.

AIRPORT DESIGN CRITERIA

Applicable standards for airport design are outlined in FAA Advisory Circular (AC) 150/5300-13A, *Airport Design*, Change 1. The design of airfield facilities is primarily based on the physical and operational characteristics of the critical design aircraft using the airport.

The design of airfield facilities is primarily based on the physical and operational characteristics of aircraft using the airport. As discussed in Chapter Three, a Runway Design Code (RDC) is applied to each runway at an airport in order to identify the appropriate design standards for the runway and associated taxiway system. The RDC is made up of the Aircraft Approach Category (AAC), the Airplane Design Group (ADG), and the approach visibility minimums expressed in runway visual range (RVR) values. It relates to the largest and fastest aircraft that regularly operates at the airport. The FAA has historically defined regular use as at least 500 annual operations at the airport. While this can, at times, be represented by one specific make and model of aircraft, most of the runways' RDC values are represented by several different aircraft, which collectively operate at the airport.

Analysis in the previous chapter indicated that the RDC for Runway 9-27 at BVU is currently B-II-VIS. The airfield should continue to be planned for the most demanding fixed-wing air tour commercial service aircraft and general aviation business jet aircraft utilizing the airport. Runway 9-27 provides the greatest runway length. Furthermore, the airport achieving a non-precision instrument approach with enhanced visibility approach minimums serving Runway 27 would be advantageous. Alternative analysis will evaluate facility development that could meet ultimate RDC standards for B-II-5000 on primary Runway 9-27.

Alternative analysis will evaluate facility development that could meet ultimate RDC standards for B-II-5000 on primary Runway 9-27.

BVU is also served by crosswind Runway 15-33. Similar to Runway 9-27, Runway 15-33 can accommodate air tour commercial service aircraft operations as well as a large majority of the aircraft mix that utilizes the airport. This runway can also provide an important role in serving aircraft operations when the primary runway is closed for maintenance or emergencies and when strong crosswinds dictate its use. Currently, this runway is served by visual approaches. As such, the RDC for Runway 15-33 is ultimately planned for B-II-VIS.

Table 4A summarizes the existing and planned RDCs for each runway at BVU.

TABLE 4A
Runway Design Codes
Boulder City Municipal Airport

Runway	Existing Runway Design Code	Planned Runway Design Code
9-27	B-II-VIS	B-II-5000
15-33	A-I-VIS	B-II-VIS

SAFETY AREAS

The design of airfield facilities includes the pavement areas to accommodate landing and ground operations of aircraft, as well as the required safety areas to protect aircraft operational areas and keep them free of obstructions that could affect the safe operation of aircraft at the airport. The safety areas include the runway safety area (RSA), runway object free area (ROFA), runway obstacle free zone (ROFZ), and runway protection zone (RPZ). The applicable design standards for the runway system were previously outlined in Chapter Three. As depicted on **Exhibit 4C**, there are areas on the airfield that do not conform to current safety design standards related to the RSA, ROFA, and ROFZ.

Runway Safety Area

As discussed in Chapter Three, the RSA associated with Runway 9-27 does not contain any deficiencies according to AC 150/5300-13A. Given that the existing and ultimate RDC associated with the runway is designated as B-II, the ultimate RSA dimensions should remain clear of any obstructions.

Identified in the previous chapter, Runway 15-33 is designated as a RDC A-I. As such, the FAA calls for the RSA to be 120 feet wide and extend 240 feet beyond each runway end for the existing RDC. Long-term planning suggests that Runway 15-33 should be upgraded from RDC A-I to B-II design standards. For RDC B-II design, the RSA should be widened to 150 feet and extended 300 feet beyond each runway end. Under ultimate conditions, the RSA extending to the northwest of Runway 15-33 would encompass a drainage ditch and private perimeter service road beginning approximately 240 feet beyond the runway end. As detailed in Chapter Three, 300 feet of RSA is needed prior to the landing threshold on each runway end under RDC B-II standards.

In the event the airport were to allow the existing penetrations to remain, an alternative would be the implementation of a displaced landing threshold on Runway 15 and decreased runway length declared available for takeoff on Runway 33. The landing distance would need to be decreased by approximately 60 feet to allow 300 feet of RSA prior to the landing threshold. Declared distances would need to be implemented on Runway 15, necessitating a decrease in the amount of runway length available for take-off on Runway 33 by approximately 60 feet as well. This would allow for a full 300 feet of RSA beyond the runway end. This alternative, however, would negatively impact the operational capacity of Runway 15-33, especially since it is designated as being able to accommodate air tour commercial service aircraft when needed and serves as the crosswind runway for the airport.

As a result, future planning should include the mitigation of RSA deficiencies due to drainage accommodations and portions of the airport perimeter service road. In doing so, the full length of Runway 15-33 can continue to be utilized for takeoffs and landings.

Runway Object Free Area

The FAA calls for the ROFA to be 500 feet wide, extending 300 feet beyond each runway end for the existing RDC B-II, applicable to Runway 9-27. Similar to the RSA, 300 feet is needed prior to the landing threshold. For RDC A-I standards associated with Runway 15-33, the ROFA encompasses an area 400 feet wide and 240 feet beyond each runway end.

Runway 9-27 is currently deficient of ROFA standards pertaining to existing and future RDCs. The Runway is obstructed on the northwest side by vegetation and a windcone. Furthermore, the eastern portion of the ROFA adjacent to the north and south sides of the runway include vegetation, and the southeastern portion of the ROFA also includes a windcone. It is recommended that the ROFA be cleared of obstructing vegetation and the windcones removed at the same time of the proposed RSA improvements.

The existing ROFA for Runway 15-33 is obstructed by overgrown vegetation as well as an airport perimeter service road. In addition, the implementation of the ultimate ROFA conditions will also yield obstructions to Runway 15-33 ROFA dimensional standards. ROFA deficiencies pertaining to Runway 15-33 under the ultimate condition also include overgrown vegetation and the airport perimeter service road. It is recommended that the airport clear the ROFA for Runway 15-33 under existing and ultimate conditions. Given that the drainage ditch located on the northern end of Runway 15-33 will need to be addressed to comply with RSA standards, it is recommended that deficiencies associated with the drainage ditch be mitigated for the ROFA at this time as well.

The ROFA extending beyond the west end of Runway 9-27 is obstructed by the airport perimeter service roadway. Similar to the ROFA associated with Runway 9-27, it would be ideal for the airport to clear the ROFA adjacent to the northern end of Runway 15-33. It should be noted that this road is restricted to authorized airport personnel only and is not open for public use.

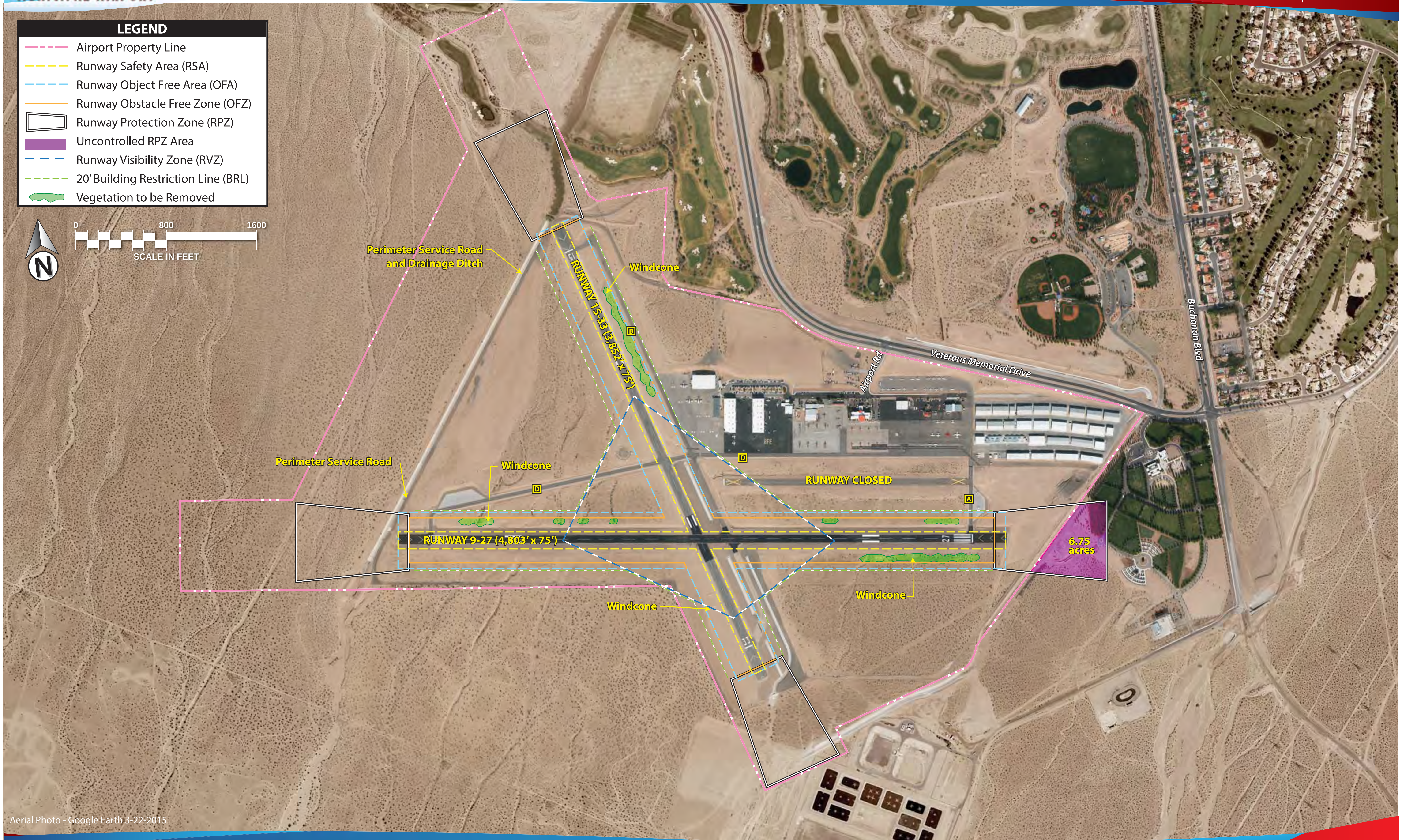


Exhibit 4C
AIRFIELD SAFETY AREAS

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Runway Obstacle Free Zone

The ROFZ serving Runway 9-27 is currently 400 feet in width and extends 200 feet beyond each end of the runway. These ROFZ dimensions are required for a runway utilized by aircraft weighing 12,500 pounds or more, as are the existing and ultimate ROFZ dimensions planned for Runway 9-27. As such, the ROFZ associated with Runway 9-27 is obstructed by overgrown vegetation along the sides of the runway as well as windcones serving each runway end.

In addition, Runway 15-33 is also served by ROFZ dimensions that are 400 feet in width and extend 200 feet beyond each end of the runway under existing and ultimate conditions. The ROFZ accommodating Runway 15-33 is currently obstructed by overgrown vegetation and windcones at each end of the runway. The ROFZ at the northern end of Runway 15-33 is also obstructed by an airport perimeter service road.

As detailed in Chapter Three, the only allowance for ROFZ obstructions are navigational aids mounted on frangible bases which are fixed by function in their location. Windcones are not categorized as a fixed by function navigational aid. In addition, the Modification to Standard process does not apply to the ROFZ. As such, the windcones and overgrown vegetation should be removed from the ROFZ serving each runway. Ideally, the small portion of the roadway that currently penetrates the ROFZ serving Runway 15-33 could be relocated slightly north to remain clear of the safety area. As previously discussed, this road is restricted to authorized airport personnel only and is not open for public use.

Runway Protection Zone

FAA AC 150/5300-13A, Change 1, defines the RPZ as *"An area at ground level prior to the threshold or beyond the runway end to enhance the safety and protection of people and property on the ground."* The goal of the RPZ standard is to increase safety for both pilots and people on the ground by maintaining the RPZ free of items that attract groupings of people or property.

The FAA recommends that an airport have ownership of the RPZ lands where feasible.

The disposition of RPZs for each runway end should be considered individually. The FAA recommends that an airport have ownership of the RPZ lands where feasible. If outright ownership is not feasible, then easements can be acceptable. Easements in the RPZ should allow an airport to positively limit the height of structures. A third option for protection of the RPZs that extend beyond airport property is implementation of strict land use zoning that, at a minimum, prohibits residential development or other development that could serve as a congregating point for people and restricts structure heights.

All runway ends have two RPZs: an approach RPZ and a departure RPZ. The size of each is dependent upon the type of aircraft or RDC for which the runway is being designed. The approach RPZ is also sized according to the lowest visibility minimums provided by the approved instrument approach procedure(s). For runways without a displaced threshold, it is common for the approach and departure RPZs to be in the same location. This is currently the case for the approach and departure RPZs beyond each end of Runways 9-27 and 15-33. FAA's RPZ criterion applies to both the approach and departure RPZ.

In the past, FAA guidance did not clearly identify all objects which could be located inside the RPZ except to qualify that the object could not be an attractant to a congregation of people. In newer guidance, however, the FAA stipulates that certain land uses are permissible without further evaluation and other land uses will require further evaluation and ultimate FAA approval. Chapter Three outlined the updated guidance provided in AC 150/5300-13A, Change 1, and *Interim Guidance on Land Uses within a Runway Protection Zone* (9.27.2012)

If an airport cannot fully control the entirety of the RPZ, the RPZ land use standards have recommendation status for that portion of the RPZ not controlled by the airport owner. In essence, this means that the FAA can require a change to the runway environment so as to properly secure the entirety of the RPZ. The FAA has always held that residences, businesses, and similar uses should be excluded from the RPZ, although this objective was not uniformly enforced. Objects such as public roads, however, have always been allowed under previous guidance unless it posed an airspace obstruction. FAA's current guidance does not readily allow for public roads in the RPZ.

As shown on **Exhibit 4C**, a portion of the RPZ associated with Runway 9-27 extends beyond the airport property line. Approximately 6.75 acres of the RPZ serving Runway 27 extends east of the existing airport property line. The unowned portion of the RPZ is located atop a public cemetery. It should be noted that the airport does not have an existing avigation easement over the unowned portion of the RPZ, which is the minimal preferred option to ensure airspace protection for the runway.

The airport perimeter service road traverses all RPZs associated with Runways 9-27 and 15-33. However, the road is not open to the public and is restricted to private use only. As such, the perimeter road is should not be considered incompatible with the BVU RPZs.

As previously discussed in Chapter Three, since the new RPZ guidance addresses new or modified RPZs, existing incompatibilities may be grandfathered under certain conditions. For example, roads that are in the current RPZ are typically allowed to remain grandfathered unless the runway environment changes. The airport sponsor should take reasonable actions to meet RPZ design standards, which could include purchasing or obtaining an easement over the unowned property within the RPZ to the east of Runway 9-27. Any change to the RPZ could require full compliance. Alternatives discussed later in this chapter will evaluate the effects of the RPZs when considering improvements associated with runways on the airfield.

INSTRUMENT APPROACH CONSIDERATIONS

Approach minimums should be as low as practical considering possible safety and financial constraints. The best approach minimums practical will ultimately allow aircraft to operate in reduced visibility conditions, while increasing operational safety and airport capacity.

As previously discussed, BVU currently does not have any published instrument approach procedures serving the runway system. However, the airport is anticipating approval (at the time of this writing) for a non-precision localizer performance with vertical guidance (LPV) approach to Runway 27.

The following analysis considers the potential for improved visibility minimums for Runway 27 at BVU. As previously discussed, this particular runway serves a large majority of aircraft operating at the airport and is capable of accommodating air tour commercial service operations. The dimensions of the RPZ will change in size if there are improvements to the instrument approach capabilities. **Table 4B** presents the dimensions of the RPZs based upon the approach visibility minimums that currently, or have the potential to, apply to Runway 27.

TABLE 4B
Runway Protection Zones
Boulder City Municipal Airport

	Instrument Approach Capabilities		
Visibility Minimum	Visual	>= 1-Mile	>=3/4-Mile
Approach Runway Protection Zone			
Inner Width	500	500	1,000
Outer Width	700	700	1,510
Length	1,000	1,000	1,700
Departure Runway Protection Zone			
Inner Width	500	500	500
Outer Width	700	700	700
Length	1,000	1,000	1,000

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

Granted that the airport is currently served only by visual approach minimums, the implementation of 1-mile non-precision approach minimums would result in no change to approach or departure RPZ requirements. On the other hand, the installation of a non-precision approach with visibility minimums of not less than ¾-mile would ultimately result in increased approach RPZ requirements, while the departure RPZ requirements would remain the same.

RUNWAY WIDTH

Runway 9-27 is currently 75 feet wide. FAA standards call for a width of 75 feet to meet RDC B-II standards with approach visibility minimums of not less than ¾-mile. As such, the width of Runway 9-27 should be maintained at 75 feet.

Runway 15-33 is also 75 feet wide. Given that Runway 15-33 is currently designated as a RDC A-I runway, its current width exceeds the FAA standard. However, the runway is occasionally utilized by commercial service air tour aircraft and is the Airport's primary crosswind runway. Thus, the runway width of 75 feet provides added safety. In addition, the ultimate RDC for Runway 15-33 is B-II. The runway width of 75 feet will meet this standard when upgraded. As a result, the width of Runway 15-33 should be maintained.

RUNWAY STRENGTH

The pavement strength for Runways 9-27 and 15-33 is reported at 12,500 pounds single wheel loading (SWL). While aircraft weighing more than the certified strength can operate on the runways, the life span of the pavements can be shortened due to the utilization of these heavier loads over time.

Future consideration should be given to increasing the pavement strength to 30,000 pounds SWL on Runway 9-27. This strength rating will better accommodate operations by larger business jets that are forecast to operate at the airport in addition to the possibility of larger air tour service aircraft utilizing the airport in the future.

Future consideration should be given to increasing the pavement strength to 30,000 pounds SWL on Runway 9-27.

VISUAL APPROACH AIDS

Certain approach aids provide information to pilots to indicate if they are on the correct glide path to the runway for landing. Visual approach aids are typically provided for instrument-capable runway ends that do not already have an approach lighting system.

A PAPI system is commonly installed to enhance safety by providing pilots with visual guidance information during landings to the runway. Future planning considers the implementation of a four-box PAPI serving Runway 9-27 and a two-box PAPI system serving each end of Runway 15-33. The PAPI must be sited and aimed so it defines an approach path with sufficient clearance over obstacle and minimum threshold crossing heights. The two-box PAPI system is normally installed on a runway that generally serves smaller general aviation aircraft.

REILs currently serve each end of Runways 9-27 and 15-33 and should be maintained throughout the planning horizon.

AIRFIELD LIGHTING

The airport should consider removing the incandescent airfield lighting and signage systems, and replacing them with light emitting diode (LED) technology.

During the course of the planning period, medium intensity runway lighting (MIRL) should be maintained on Runways 9-27 and 15-33. Medium intensity taxiway lighting (MITL) should be provided on all existing and proposed taxiways serving the runway system. In addition, the airport should consider removing the incandescent airfield lighting and signage systems and replacing them with light emitting diode (LED) technology. These lighting upgrades could be undertaken in the event of a reconstruction/rehabilitation pavement project associated with various pavements on the runway and taxiway system. LED lighting has many advantages, including lower energy consumption and longer lifetimes.

TAXIWAY DESIGN

Taxiway design has historically followed the critical aircraft utilizing the runway and taxiway system. Common design issues have included parallel taxiway separation from the runway, taxiway width, and overall system efficiency. FAA AC 150/5300-13A, Change 1, *Airport Design*, instituted new design standards for taxiways, some of which impact planning for BVU. Most of the new or updated standards were enacted to mitigate the potential for runway incursion events. Changes were aimed at improving pilot situational awareness. The FAA has indicated that all airfields should be planned to meet these standards. Actual changes will be made over time as grant funding is made available.

FAA AC 150/5300-13A, Change 1, Airport Design, instituted new design standards for taxiways, some of which impact planning for Boulder City Municipal Airport.

A new taxiway design standard put into place under AC 150/5300-13A, Change 1, is the prohibition of direct access between an aircraft parking area and a runway. At BVU, Taxiway A extends south of the apron area and provides a direct pavement connection to Runway 27. In addition, Taxiway D extends west of the apron area and provides a direct connection to Runway 15-33. Taxiway routing markings are not considered sufficient per FAA guidance. As such, the FAA recommends constructing "No Taxi Islands" or re-routing or removing the taxiways and replacing them in a location that does not provide direct access. No Taxi Islands can be developed using markings around the island, green paint to identify the island, and lighting around the island; or, the islands can be developed by removing the pavement altogether. Either option will present an obstruction which will require a pilot to navigate a turn prior to entering a runway environment. The FAA has found that requiring a turn prior to entering a runway can minimize runway incursion events.

FAA design standards also present a new concept of a runway's "high energy area." The high energy area is defined as the middle third of a runway and is typically the location where aircraft are moving rapidly for takeoff or landing. It is this area that aircraft are more vulnerable to accidents with aircraft crossing through as they cannot readily slow or stop to avoid impacts. FAA guidance highly discourages the location of taxiways which route aircraft across a runway through the high energy area.

In addition to taxiway geometry concerns, the location of holding positions and hold aprons associated with each taxiway are also discussed within this section. The airfield contains several holding positions that are oriented in what is considered to be a non-standard configuration. As such, a holding position located prior to a runway crossing or runway access point should be oriented at 90 degrees, or perpendicular, to the respective runway in order to maximize visibility of the runway environment. Furthermore, there are multiple holding aprons located on the airfield that extend beyond the threshold of the corresponding runway, which is considered to be a non-standard configuration. This is due to the possibility for aircraft utilizing the holding apron to create an obstruction to the threshold siting surface (TSS).

BVU is served by a taxiway system which includes parallel, entrance/exit, and connector taxiways serving the two runways on the airfield. While the existing taxiway system meets certain standards outlined in the AC, there are some aspects of the taxiway system that should be addressed.

AIRFIELD GEOMETRY ALTERNATIVES

The first step in in the alternative evaluation will be to consider alternatives aimed at meeting FAA airfield geometry design standards. As previously noted above and in the previous chapter, the FAA has revised airfield geometry design standards to minimize opportunities for runway incursion events. BVU has several airfield geometry configurations, primarily related to the taxiway system, that are no longer standard and which should be evaluated for change opportunities. The following sections detail those areas where options exist to potentially improve airfield geometry and overall airfield safety conditions at BVU.

TAXIWAY A RECONFIGURATION ALTERNATIVES

Taxiway A provides direct access to Runway 27 from the paved aircraft parking aprons and hangar units to the north. The FAA has expressed concern regarding the linkage as a direct access route between runway and apron which should be considered for modification as discussed earlier in this chapter. Another concern regarding Taxiway A is the location and design of the hold apron for Runway 27. The current location of the hold apron serving Runway 27 is now considered non-standard as it extends beyond the runway threshold and could cause an obstruction to the TSS of the runway. Alternatives aimed at improving the Taxiway A design issues are graphically presented on **Exhibit 4D**.

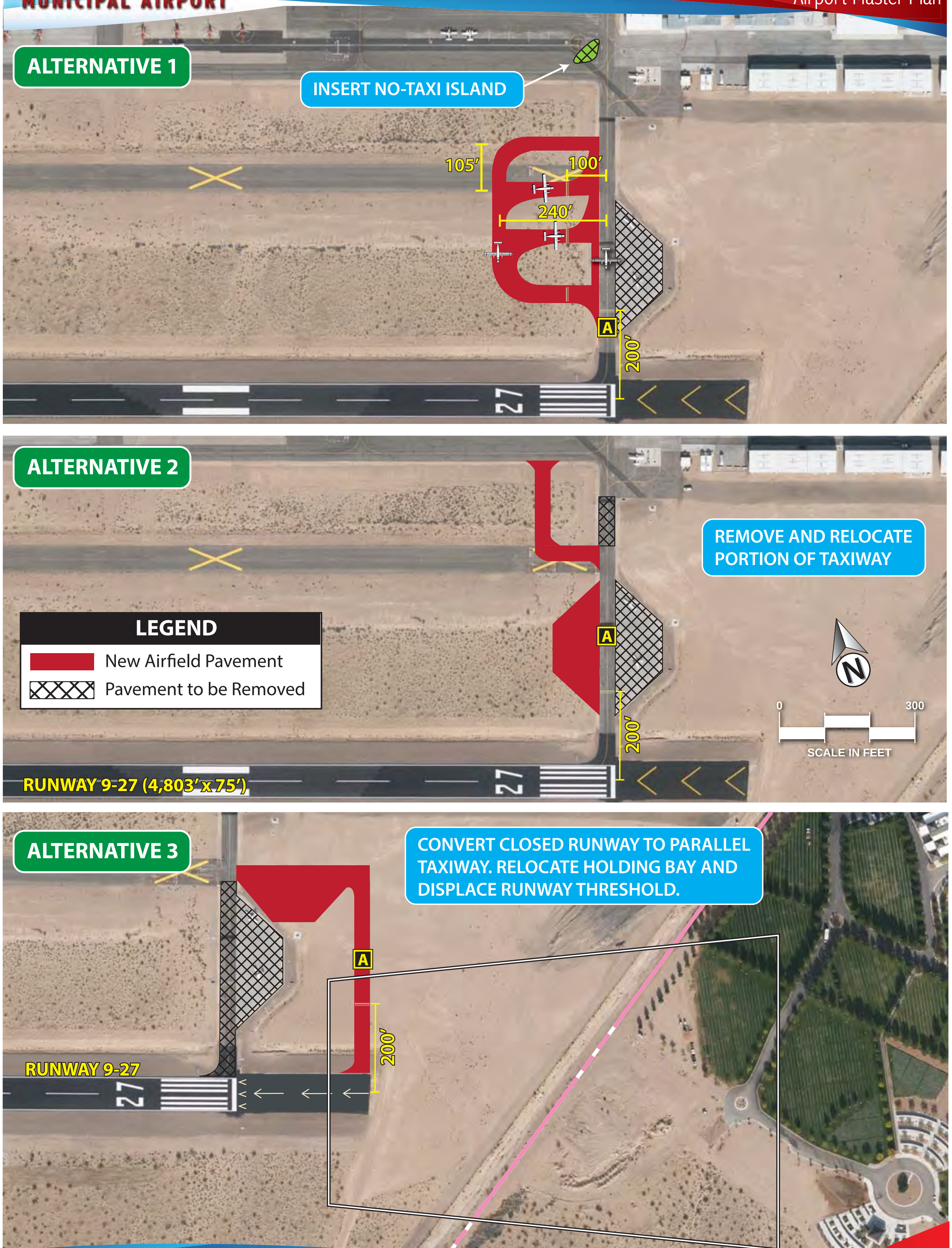

Exhibit 4D
TAXIWAY A ALTERNATIVES

Alternative 1

The first alternative option depicts the implementation of a No Taxi Island that could be implemented to prevent direct access from a diagonal taxi movement from the parking apron to the runway via Taxiway A. This alternative also explores the construction of the FAA's new hold apron design standard located on the eastern side of Taxiway A so as to avoid any potential TSS obstructions. The standard holding apron design allows use by multiple aircraft hold positions and provides additional cues for pilots by providing designated taxilanes and markings to ensure aircraft separation.

Alternative 2

In an effort to mitigate the direct access linking the apron and Runway 27 associated with Taxiway A, Alterative 2 proposes the closure of a portion of Taxiway A with access replaced by an "elbow" shaped link between Taxiway D and Taxiway A. The elbow would utilize a portion of the now closed parallel runway pavement as shown on **Exhibit 4D**. Moreover, the alternative suggests that a new hold apron could be mirrored, or flipped, to be located on the west side of Taxiway A This option would position the hold apron in a manner that does not allow the potential for TSS obstruction. It should be noted that the holding position design shown in this alternative no longer meets FAA design standard and would require approval prior to implementation.

Alternative 3

The third alternative also includes the modification of existing Taxiway A. As shown on **Exhibit 4D**, Alternative 3 presents the concept of closing the portion of taxiway between the closed parallel runway and existing Runway 27 threshold. The existing portion of taxiway pavement would need to be removed so that a new linkage could be constructed, as shown on the exhibit. The new Taxiway A alignment would be routed to the existing eastern end of Runway 9-27 currently utilized for blast pad/RSA. Under this alternative, the existing runway pavement now used as blast pad, marked with yellow chevrons, could be reconditioned and utilized for take-off operations to the west only. The runway threshold would need to be displaced in its current location. This option would increase the usable runway for departures taking place on Runway 27 by approximately 300 feet, while the landing distance available for both runways and take-off distance for Runway 9 would all remain the same.

With this particular configuration being utilized, a hold apron could then be placed on the southern side of the east-west portion of Taxiway A. This option would allow a holding apron to serve Runway 27 that meets TSS requirements and would allow for wash rack development (to be discussed later). In addition, the hold position serving Runway 27 could be located at 200 feet from runway centerline.

TAXIWAY B RECONFIGURATION ALTERNATIVES

Taxiway B is currently positioned in a manner that allows an opportunity for an angled crossing within the high energy area of Runway 9-27. Furthermore, the connecting taxiway serving Runway 33 is positioned acutely to the corresponding runway. In turn, the hold position located on the connecting taxiway is oriented at less than 90 degrees perpendicular to the runway. Six alternatives addressing the current airfield geometry design deficiencies associated with Taxiway B are presented on **Exhibit 4E** and described below.

Alternative 1

This alternative option proposes an extension of Taxiway B to the threshold of Runway 33 in a manner producing a 90-degree angle entrance taxiway. Extending the taxiway would allow the holding position marking to be oriented in a standard parallel to the runway centerline; however, this minimalist option does not address the angled runway crossing through the high energy area of Runway 9-27.

Alternative 2

Similar to the first alternative, this alternative option would extend the southernmost portion of Taxiway B to the threshold of Runway 33. In addition, the plan would create a "tea cup" configuration allowing for the taxiway to shift out to achieve a runway to taxiway centerline separation of 300 feet. Ultimately, the increased runway to taxiway centerline separation would allow all aircraft to perform a complete 90-degree turn and hold completely perpendicular to the runway when utilizing the Taxiway B entrance taxiway serving Runway 33. It should be noted that this alternative option also does not address the angled runway crossing through the high energy area of Runway 9-27; however, Alternatives 1 and 2 could possibly be paired with other alternatives in order to address these issues.

Alternative 3

This alternative depicts rerouting a portion of Taxiway B north of Runway 9-27 so that it can cross the runway at 90 degrees, then reconnect back into the existing Taxiway B to the south, ensuring that the 200-foot runway to hold position requirement has been met; however, Taxiway B would still cross through the Runway 9-27 high energy area. While this option would meet the spirit of FAA's new geometry rules, it would not likely be required as the guidance does allow for non-perpendicular taxiway crossings through runways if the taxiway crossing is a parallel taxiway associated with the crosswind runway orientation. This alternative is being shown to illustrate the complication of rerouting the taxiway to be cross at 90 degrees with the primary runway.

Alternative 4

Alternative 4 assumes the re-use and/or reconditioning of the closed parallel runway pavement to become a full length parallel taxiway serving Runway 9-27. In this scenario, the portion of Taxiway B crossing Runway 9-27 is realigned at a 90-degree angle to the runway, as depicted on **Exhibit 4E**. The proposed revision to Taxiway B could extend south from the converted full length parallel taxiway (closed runway), cross Runway 9-27 at 90 degrees, and continue south until intersecting with the existing Taxiway B. It should be noted that this particular scenario still has Taxiway D crossing through the high energy area of Runway 9-27 and does not address the angled entrance taxiway and holding position for Runway 33.

Alternative 5

Utilizing the same concept described in Alternative Four, the closed parallel runway could be converted into a parallel taxiway serving Runway 9-27. As proposed on **Exhibit 4E**, this alternative proposes the re-routing of Taxiway B from the closed runway south through Runway 9-27 just east of the high energy area, approximately 230 feet south of the runway, and then angled back to existing Taxiway B. Similar to Alternative 4, this option also leaves the angled connecting taxiway and holding position serving Runway 33 unaddressed.

Alternative 6

Alternative 6 also assumes that the closed runway is utilized as a full-length parallel taxiway serving Runway 9-27. This alternative is aimed at improving all non-standard conditions associated with Taxiway B. As depicted, the taxiway would extend north-south from the closed runway, through Runway 9-27 east of the high energy area, and then back to be perpendicular to the Runway 33 threshold. If implemented this alternative would no longer route Taxiway B through Runway 9-27 at an acute angle or through the high energy area and would allow for a standard holding position for aircraft departing Runway 33.

TAXIWAY B NON-STANDARD HOLDING APRON

The current position and overall layout/design of the hold apron at the northern end of Taxiway B no longer meets FAA standards according to AC 150/5300-13A, Change 1, *Airport Design*. Essentially, this hold apron configuration is considered to be non-standard in its general design as it extends beyond the Runway 15 threshold and creates a potential obstruction to the TSS by aircraft utilizing the hold apron. **Exhibit 4F** presents possible alternatives to mitigate the holding apron for Runway 15.

Exhibit 4E
TAXIWAY B ALTERNATIVES

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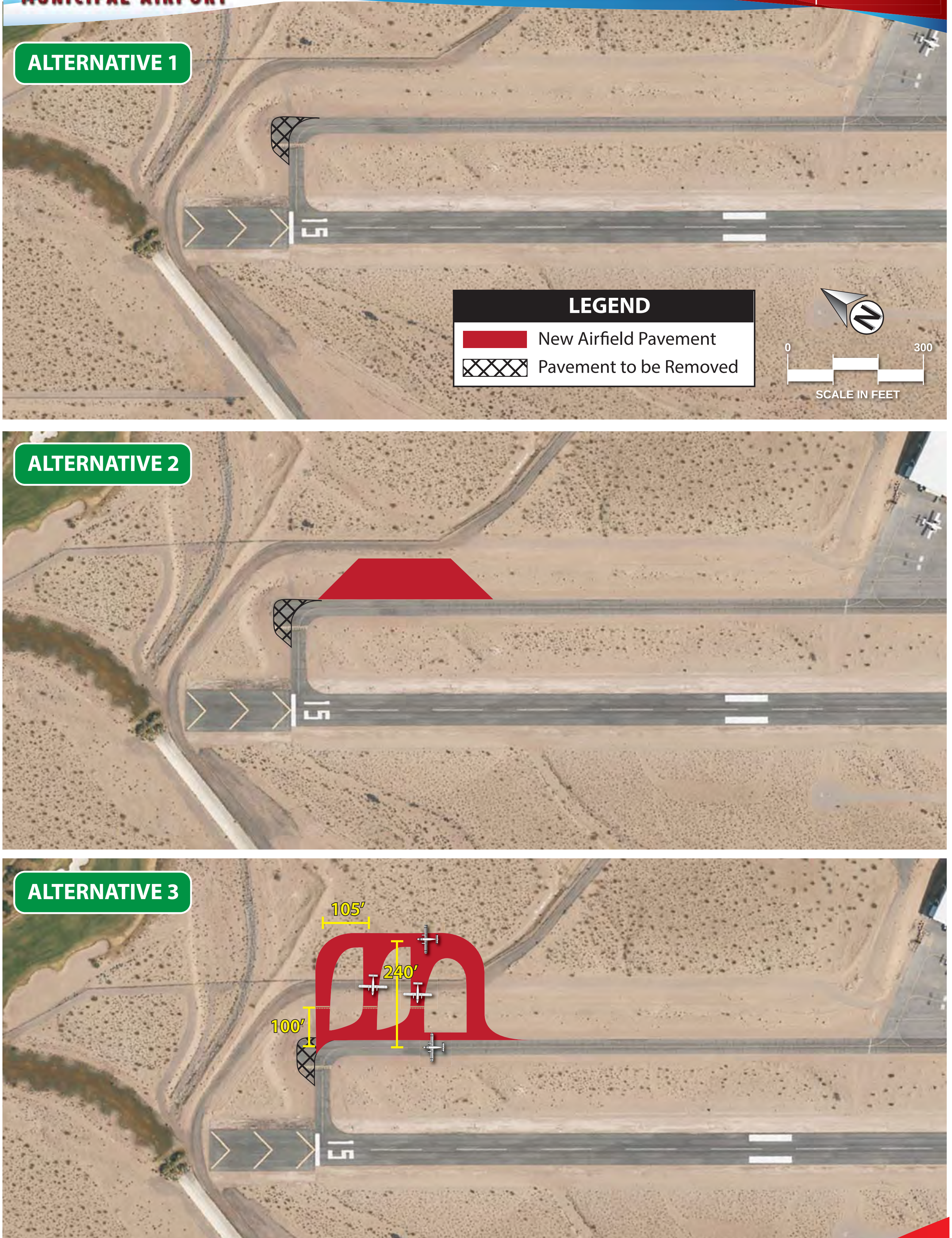

Exhibit 4F
TAXIWAY B NON-STANDARD HOLDING APRON

Alternative 1

Alternative one proposes that the hold apron be removed altogether. This is a cost-effective and viable option to mitigate the hold apron deficiency as Runway 15 is minimally used, per discussions with airport management and airport operators.

Alternative 2

The second alternative on **Exhibit 4F** depicts the removal and relocation of the current hold apron. Under this mitigation strategy, the hold apron that exists prior to the runway threshold could be removed and a larger, trapezoidal shaped apron could be placed on the eastern side of the full length parallel taxiway serving Runway 15-33, essentially removing the potential for aircraft to cause TSS obstructions. As previously noted, however, the trapezoidal shape historically utilized as proper design is no longer considered such and would need FAA approval to implement.

Alternative 3

A third and final Runway 33 hold apron alternative includes the implementation of the FAA's newly accepted design standard hold apron along the eastern side of Taxiway B. As proposed, the holding design utilizes directional cues via taxilanes for pilots versus a large expanse of pavement hold apron historically accepted. This option would allow multiple (up to 4) aircraft to utilize the hold apron at the same time, while maintaining adequate separation.

TAXIWAY D RECONFIGURATION ALTERNATIVES

The existing configuration of Taxiway D contains several areas that no longer meet FAA taxiway/airfield geometry design standards. First, Taxiway D offers direct access from the apron area to Runway 15-33 without requiring aircraft to turn prior to entering the runway environment. As previously noted, direct access linkage increases the likelihood of a runway incursion event. In addition, Taxiway D crosses Runway 15-33 within the high energy area at an angle other than 90 degrees and contains a non-standard holding position and apron serving Runway 9. Five alternative configuration options for Taxiway D are presented on **Exhibit 4G** and discussed below.

Alternative 1

The minimalist alternative is to simply reconfigure the portion of Taxiway D that crosses Runway 15-33 to cross at 90 degrees, or perpendicular to the runway and implement a No Taxi Island which would

Exhibit 4G
TAXIWAY D ALTERNATIVES

Exhibit 4G
TAXIWAY D ALTERNATIVES

require aircraft to make a turn before entering the runway environment. Although this option is likely the most cost-effective and addresses both direct access and the angled runway crossing, two significant deficiencies remain: crossing through the high energy area of Runway 15-33, and the non-standard hold apron/holding position serving Runway 9. Neither are addressed in this alternative option.

Alternative 2

The second Taxiway D reconfiguration alternative explores the option of relocating the portion of Taxiway D extending from the aircraft apron area, crossing Runway 15-33 in order to mitigate the direct runway access and angled runway crossing taxiway issues. As shown, the portion of Taxiway D extending from the aircraft apron area then crossing through Runway 15-33 could be relocated immediately to the south so that the runway crossing occurs at 90 degrees and the connection to the ramp does not offer direct access. Similar to Alternative 1, this option does not correct the high energy runway crossing or the hold apron/holding position serving for Runway 9.

Alternative 3

The approach with the third alternative is to re-route Taxiway D to cross Runway 15-33 north of the high energy area and at a 90-degree angle. This requires closing the existing portion of Taxiway D linking the apron and Runway 15-33. Once the re-routed taxiway crosses through the runway, the alternative then presents two options. Option 1 presents extending Taxiway D approximately 600 feet west of Runway 15-33. Taxiway D could then proceed to the south to connect with the existing Taxiway D, while maintaining a 600-foot runway to taxiway centerline separation in order to clear the existing AWOS, segmented circle, and lighted wind indicator.

Option 2 essentially has the same intention as Option 1; however, instead of maintaining a 600-foot runway to taxiway centerline separation, Option 2 proposes a 300-foot separation. Maintaining a 300-foot runway to taxiway centerline separation proposed in Option 2 would also correct all of the taxiway deficiencies associated with Taxiway D; however, Option 2 would require relocation of the AWOS, segmented circle, and lighted wind indicator. It should be noted that both options associated with Alternative 3 correct the major taxiway deficiencies identified for Taxiway D, with the exception of the hold apron/holding position serving Runway 9.

Alternative 4

This alternative proposes a similar relocation of Taxiway D on the eastern side of Runway 15-33, as discussed in both options of Alternative 3. This portion of Taxiway D could be relocated approximately 950 feet to the north, and then extend to the west, crossing Runway 15-33 at 90 degrees while remaining clear of the high energy area associated with the runway. Taxiway D could then be extended 350 feet west of the Runway 15-33 centerline to allow for a 200-foot separation between the holding position marking and the Runway 15-33 centerline. The taxiway could then proceed in an angular fashion to the southwest, eventually connecting into the existing Taxiway D as it joins the existing holding apron serving Runway 9. Similar to Alternative 3, this alternative addresses all of the identified deficiencies associated with Taxiway D except the hold apron/holding position for Runway 9.

Alternative 5

Alternative 5 proposes that existing Taxiway D be replaced by converting the closed runway pavement and extending it to be a full-length parallel taxiway serving Runway 9-27. The current separation distance of the converted taxiway and Runway 9-27 would be maintained at approximately 500 feet and would extend to the threshold of Runway 9. A standard holding apron design could replace the current holding apron serving Runway 9, as shown on **Exhibit 4G**. In addition, the holding position marking could be placed 200 feet from the runway centerline at 90 degrees perpendicular to Runway 9.

The overall purpose of this alternative (and the two alternatives to follow) would be to replace the functional nature of existing Taxiway D with the new alignment. As such, the existing Taxiway D can be "repurposed" as an edge of apron taxilane which could also aid in improving movements by air tour operators. Although this alternative would address the direct access and non-standard hold position associated with the current configuration of Taxiway D, the other taxiway deficiencies identified, including the angled and high energy runway crossing of Runway 15-33, would not be addressed.

Alternative 6

Comparable to alternative five, this alternative proposes the conversion of the closed runway to be part of a full-length parallel taxiway serving Runway 9-27; however, instead of maintaining the 500-foot centerline separation between Runway 9-27 and the converted parallel taxiway throughout, this alternative suggests shifting the pavement to the southwest beginning at the western edge of the converted parallel taxiway in order to generate a runway crossing at 90 degrees to Runway 15-33. After crossing through Runway 15-33, the proposed taxiway could continue west, maintaining a runway to taxiway centerline separation of 300 feet until connecting with the existing Taxiway D pavement as shown on **Exhibit 4G**. This alternative also includes repositioning the holding apron serving Runway 9 in the traditional fashion, which would need to be approved by FAA. The result of the repositioning would allow for aircraft to fully hold perpendicular to the runway at the holding position marking.

Though this alternative mitigates the direct access, angular runway crossing, and non-standard hold position marking serving Runway 9, the proposed taxiway still crosses Runway 15-33 within the high energy area of the runway.

Alternative 7

Alternative 7 presents the option of constructing a completely new full-length parallel taxiway serving the northern side of Runway 9-27. The proposed taxiway would be designated to replace Taxiway D and would be located at a distance of 300 feet from the runway (centerline to centerline). This alternative would mitigate the direct access issue on existing Taxiway D and could improve the non-standard holding position serving Runway 9 as well; however, the addition of a traditional full-length parallel taxiway serving the northern side of Runway 9-27 would still contain an angled runway crossing as well as a crossing through the high energy area of Runway 15-33, and would need specific approval from the FAA.

Alternative 8

Finally, Alternative 8 proposes the construction of a full-length parallel taxiway serving the southern side of Runway 9-27. As such, the taxiway would maintain a 300-foot runway to taxiway centerline separation and would serve to replace the functional purpose of the existing Taxiway D. This particular taxiway configuration would eliminate direct access from the apron area and allow for standard hold positions to be placed at 90 degrees to respective Runways 9 and 27 while sustaining the 200-foot runway centerline to hold position requirement. In addition, holding aprons could be implemented to serve both Runways 9 and 27, but these aprons would need to be approved as they are no longer standard. The implementation of a full-length parallel taxiway serving the southern side of Runway 9-27 would ultimately eliminate the crossing through the high energy area of Runway 15-33.

Given that this alternative mitigates taxiway deficiencies such as direct access, a runway crossing through a high energy area, and a non-standard holding position marking, this alternative is the only option which can meet all FAA geometry standards. Moreover, the use of a traditional full-length parallel taxiway configuration could provide enhanced taxiway efficiency when compared to other alternatives presented. In addition, a parallel taxiway serving the southern side of Runway 9-27 could also provide increased access to potential general aviation development areas (to be discussed); however, its location on the south side of Runway 9-27 is a significant drawback as it would require a runway crossing movement each time an aircraft needs to transition from Runway 9 to the terminal services area.

RUNWAY EXTENSION ANALYSIS

Analysis in the previous chapter recommended that the Master Plan consider a potential runway extension on Runway 9-27 to at least 5,800 feet. Being the primary runway at the airport, Runway 9-27 accommodates the air tour commercial service aircraft and the general aviation business jets that occasionally utilize the facility. The business jet aircraft are often weight-restricted when combining operational factors such as high temperatures and density altitudes experienced at the airport during the summer months. Furthermore, the forecast analysis anticipates the potential increase of business jet operations at the airport in the future.

As previously discussed, the prior Airport Layout Plan and Narrative Update analyzed runway extension alternatives for Runway 9-27 that provided an overall length of 5,800 feet. This determination was mainly driven by the potential need to accommodate large aircraft between 12,500 and 60,000 pounds.

The alternatives to follow analyze two separate runway extension options: those for Runway 9-27 and those for Runway 15-33. For Runway 9-27, the alternatives consider a 997-foot extension in order to provide an overall length of 5,800 feet of runway pavement. Within this alternative are options that propose an extension to each end of the runway simultaneously, and options to extend only the west or east end of the runway. The alternatives for Runway 15-33 consider an ultimate length of 5,800 feet of pavement as well. As such, the alternative options for Runway 15-33 factor a 1,948-foot extension should justification be warranted. Runway 15-33 extension alternatives include an option for extending the runway simultaneously in both directions as well as options for only extending the runway to the northwest or the southeast.

The prior Airport Layout Plan and Narrative Update analyzed runway extension alternatives for Runway 9-27 that provided an overall length of 5,800 feet.

These alternatives also identify the impacts an extension would have on existing features located beyond the ends of the runway. Associated changes to airfield geometry and efficiency must also be considered to include the relocation of the runway's high energy area and the need to extend the taxiways serving each runway end.

RUNWAY 9-27 EXTENSION ALTERNATIVES

Exhibit 4H considers three overall options to extend Runway 9-27 to an overall physical pavement length of 5,800 feet. Each of the three alternatives are described below.

Alternative 1

Alternative 1 presents a 997-foot easterly extension of Runway 9-27 which would ultimately shift the runway beyond the airport property line by approximately 430 feet. As such, all safety areas (RSA, ROFA, ROFZ, and RPZ) associated with the runway would also extend beyond the airport property line as much as an estimated 1,650 feet. In total, the extension of Runway 9-27 to the east would require the acquisition of an estimated 18.96 acres of property, much of which is currently a part of the adjacent cemetery. The resultant Runway 27 RPZ shift would need to be approved by FAA Headquarters APP-400 as the cemetery and associated roadways serving the facility are not explicitly approved for uses in the RPZ. FAA approval for the RPZ atop a cemetery is possible but not likely if another option meets standard approved uses in the RPZ.

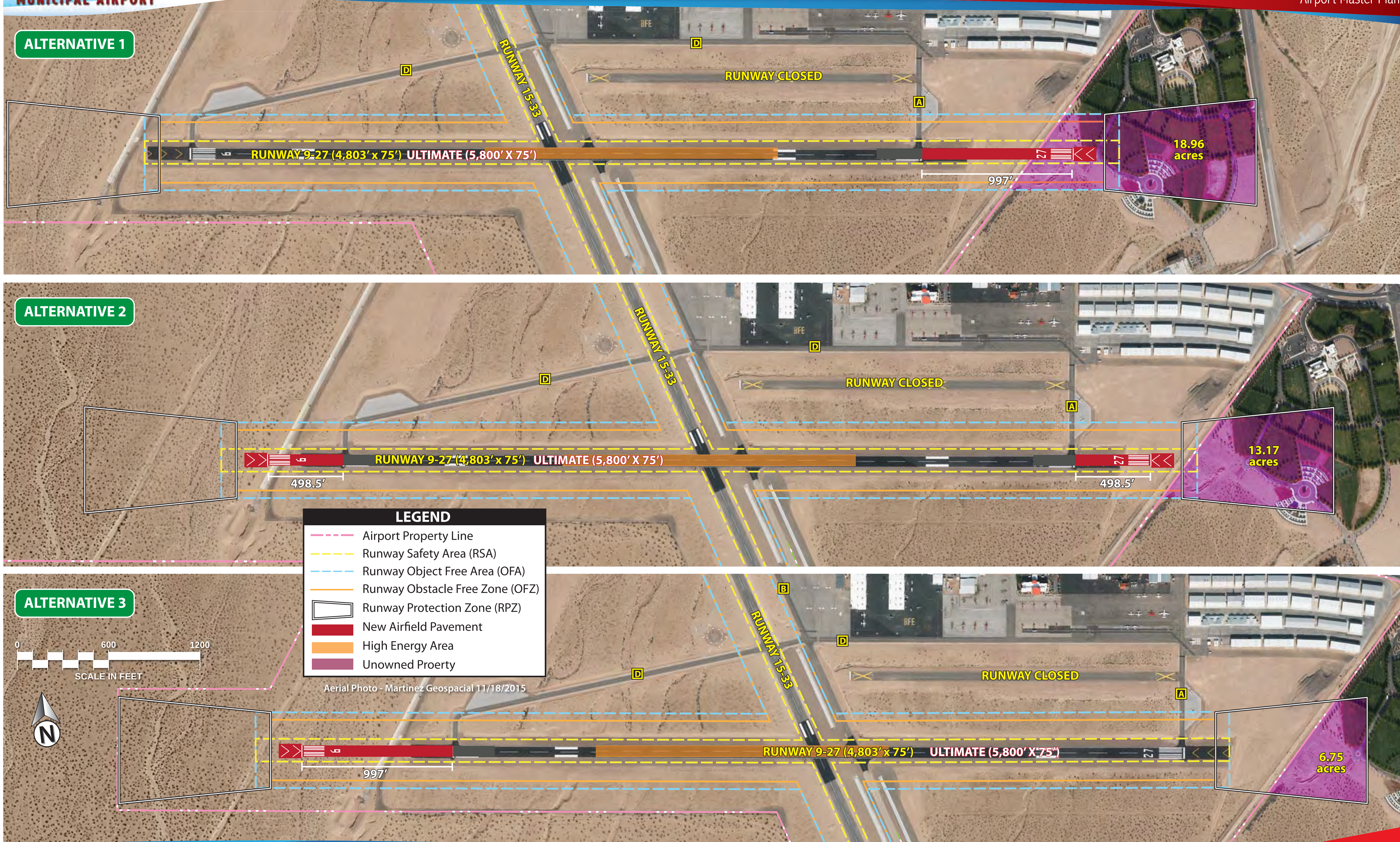

Exhibit 4H
RUNWAY 9-27 EXTENSION ALTERNATIVES

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Alternative 2

This alternative evenly distributes the proposed 997-foot extension between the east and west ends of the runway. Under this particular scenario, the runway extension on the west end of Runway 9-27 and all associated safety areas including the RPZ for Runway 9 would remain on existing airport property; however, the extended runway, RSA, ROFA, and ROFZ would all cross an airport drainage ditch and would need to adhere to appropriate standards. As such, the drainage ditch and perimeter road would need to be routed under the runway and safety areas or rerouted to the west.

On the east end of the extended Runway 9-27, the physical runway pavement would remain on airport property; however, the RSA, ROFA, ROFZ, and RPZ would all extend off of existing airport property. The safety areas associated with the proposed 498-foot extension would require the acquisition of approximately 13.17 acres of property. Nearly half of the needed land is currently in the adjacent cemetery, resulting in issues similar to those detailed in Alternative 1 for the Runway 9-27 extension.

Alternative 3

Alternative 3 proposes the entire 997-foot extension to the west, which would also extend the RSA, ROFA, ROFZ and RPZ farther west as depicted on **Exhibit 4H**. All safety areas would remain on existing airport property, but proper clearing and grading associated with the runway extension and relocating the drainage and perimeter road would be needed.

RUNWAY 15-33 EXTENSION ALTERNATIVES

As shown on **Exhibit 4J**, three extension alternatives are presented to provide an overall length of 5,800 feet for Runway 15-33.

Alternative 1

The first alternative extension for Runway 15-33 proposes a 1,948-foot extension entirely to the southeast. This particular scenario would shift the runway and associated safety areas beyond existing airport property by approximately 2,010 feet. Under this alternative, the total acreage of unowned airport property required for acquisition would be 22.46 acres. In addition, the runway would extend into the water treatment plant located south and east of the current Runway 33 threshold, requiring the relocation of this utility facility.

Alternative 2

Alternative 2 includes the entirety of the proposed 1,948-foot extension on the northwest end of Runway 15-33. Under this alternative, the RSA, ROFA, and ROFZ would remain on existing airport property;

however, they would extend atop a portion of the existing golf course north of the runway. Currently, two partial golf holes are located on existing airport property. This option would also generate a need to acquire a total of 13.26 acres of property north in the existing golf course to secure the RPZ. It is very likely that the FAA would not support the continuance of the golf course within the proposed RPZ.

Alternative 3

The third and final Runway 15-33 extension option applies an equal 974-foot addition to each end of Runway 15-33. Under this alternative, all runway pavement, RSAs, OFAs, OFZs, and the Runway 15 RPZ would remain on existing airport property; however, all associated safety areas for Runway 33 would extend beyond the airport property line, encompassing a total of 13.46 acres. In addition, the RPZ would encompass a water treatment plant, a potential bird attractant which may not be approved by the FAA

RUNWAY LENGTH ANALYSIS SUMMARY

The previous runway extension alternatives considered methods which attempt to provide additional runway length, while also attempting to meet FAA airport safety design criteria. Any capital expenditures required to meet the needs of aircraft utilizing BVU will require specific justification. The FAA typically stipulates that if a runway extension is planned, documentation of 500 annual itinerant operations of the design aircraft will be required.

The FAA has indicated that any changes to the runway environment must also conform to an RPZ free of incompatible uses, including residences, commercial/industrial facilities, and roadways.

There are several methods to track aircraft activity. The FAA has made available a comprehensive database called the Traffic Flow Management System Count (TFMSC). There are also several user subscription services, such as *Airport IQ* and *Flight Aware*, which offer similar services. The airport's fixed base operators (FBOs) can also track individual activity by business jets. Finally, letters from air tour commercial service and business operators addressing their runway needs can provide documentation for justification of FAA support.

As previously discussed, the FAA has indicated that any changes to the runway environment must also conform to an RPZ free of incompatible uses, including residences, commercial/industrial facilities, and roadways. In the event that a runway extension is planned, the airport should pursue the fee simple acquisition of unowned airport property in order to meet the highest level of safety. At the very minimum, avigation easements, or airspace (and some other tangible rights such as noise, etc.) easements, should be pursued for any property which cannot be acquired in fee simple processes.

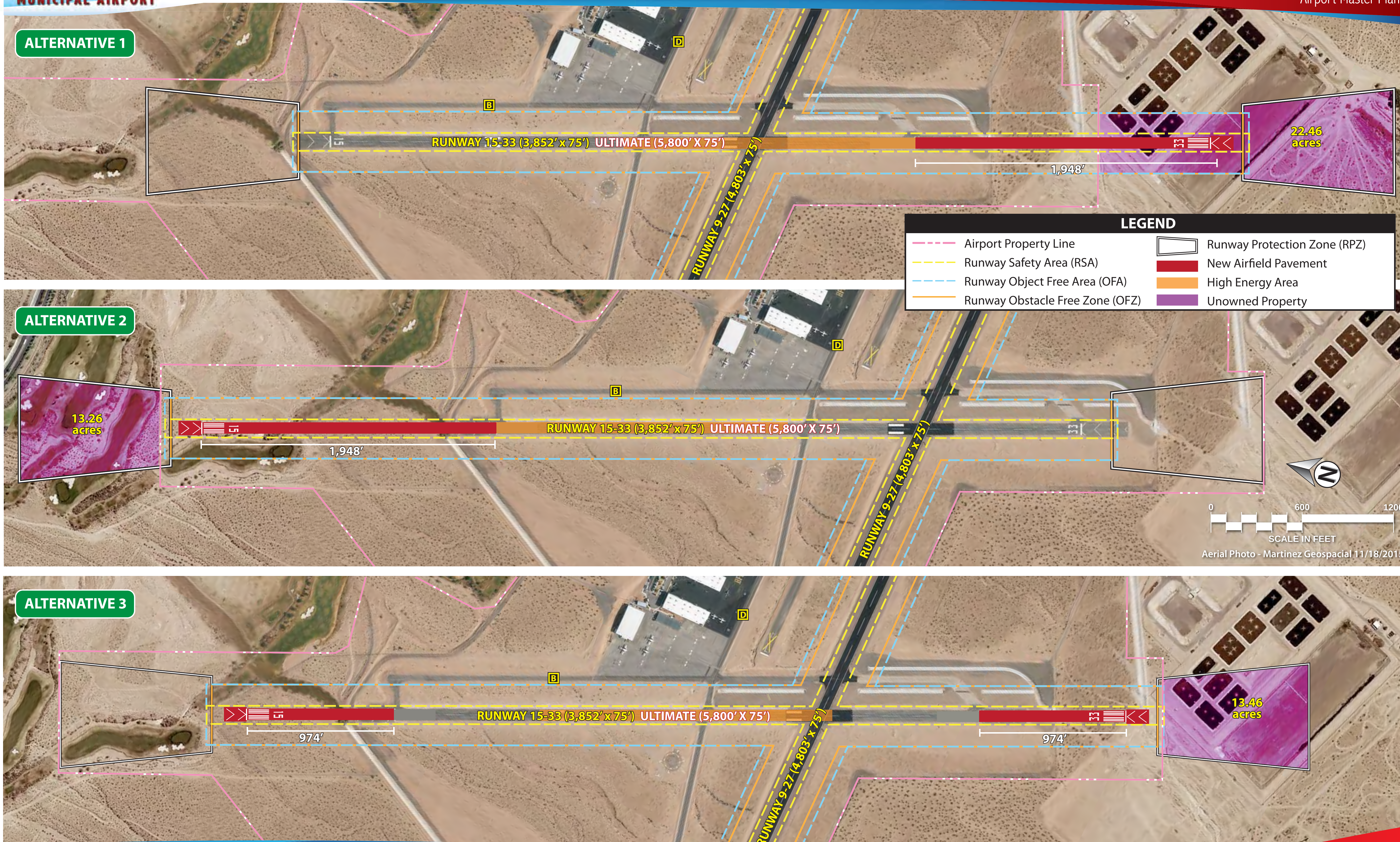

Exhibit 4J
RUNWAY 15-33 EXTENSION ALTERNATIVES

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Based on the analysis presented above, an extension to Runway 15-33 is not considered feasible, practicable, and/or prudent. The golf course to the north and water treatment facility to the south are significant constraints which would likely present challenges, both physical and financial, which would prevent a north or south runway extension from being implemented.

FINAL APPROACH AND TAKEOFF (FATO) AREA LOCATION

Commercial air tour passenger operations are a significant portion of daily airport activity at BVU. The majority of tour service providers conduct their operations via helicopters. The final approach and takeoff (FATO) areas are centrally located on the aircraft parking apron immediately north of Taxiway D. The majority of typical helicopter arrival and departure operations must cross Taxiway D as well as primary Runway 9-27 as the operations depart to and arrive from the south. This exercise becomes problematic due to the operational volume occurring at the airport paired with the amount of coordination needed in order to safely operate fixed-wing and rotorcraft simultaneously on Taxiway D.

Taxiway D is a highly traveled taxiway serving fixed-wing, rotorcraft, and ground based vehicles such as fuel trucks. This mix of traffic causes increased congestion and potentially increases the chances of an accident, especially since the airport is not served by airport traffic control tower (ATCT). The alternatives presented below could be implemented with or without proposed changes to Taxiway D as presented earlier in this chapter; however, the most ideal situation would be for Taxiway D to be replaced so that air tour operations could be conducted without interruption from other airport traffic transitioning through the central portion of the main apron. Taxiway D Alternatives 5 through 8 would be the best options to help improve the helicopter FATO issues.

Given the existing safety and capacity concerns associated with the current location of the FATOs, multiple alternatives, as shown on **Exhibit 4K**, were developed in order to increase operational safety and capacity.

ALTERNATIVE 1

The first FATO alternative option is to extend the aircraft apron south by approximately 125 feet, thus increasing the apron area available by an estimated 31,900 square yards. Subsequently, three elevated helipad structures directly connected to Taxiway D could be placed upon the closed runway. This option would ultimately shift helicopter takeoff and landings from taking place on the aircraft apron area to instead take place on designated helipads. Although helicopters would still need to cross Taxiway D to conduct operations, crossing of the taxiway would take place during hover taxi as opposed to takeoff or landing. Due to existing gradient limitations, helipads located on the closed runway would need to be elevated and served by an elevated pier-style connecting taxiway. This would need to be done in an effort to meet the required taxiway gradient of two percent.

ALTERNATIVE 2

Alternative 2 examines the implementation of a 125-foot southerly apron extension, as previously mentioned, and relocation of the FATOs to the southern edge of the proposed apron area. Ultimately, this would shift the helicopter takeoff and landings to be south of existing Taxiway D. Much like the previous scenario, helicopters would still be required to cross Taxiway D in order to conduct an operation unless Taxiway D is replaced as proposed earlier; however, the taxiway crossing would take place as hover taxi versus a critical phase of flight such as takeoff or landing.

ALTERNATIVE 3

The third FATO alternative explores the possibility of extending the apron area and constructing what is essentially an elongated helipad on the closed runway. The helipad would be elevated to meet gradient requirements for hover taxi operations on the pier taxiways linking the ramp and the FATO pavement. This option would help to maximize the use of the extended apron, much like the first alternative option, as well as potentially increase operational safety by providing added safety margins for helicopter operators. In addition, this option would also ensure that helicopter crossings of Taxiway D take place in the form of a hover taxi which would be more desirable until and/or unless Taxiway D is replaced as noted above.

ALTERNATIVE 4

Finally, the option of relocating the air tour facilities and helicopter operations area is examined. It should be stated quite clearly that the three FATO alternatives presented above will still require helicopter activity to depart to and arrive from the south, which means most helicopter traffic must cross the active Runway 9-27. The most ideal option would be to relocate the operators to the southeast quadrant of the airport as identified on **Exhibit 4K**. The primary benefit of this option would be that the helicopters could depart and arrive without crossing an active runway.

The costs associated with relocating the operations to the south side would be prohibitive for the City of Boulder City alone to undertake. The FAA would likely only provide minimal funding for apron spaces whereas all terminal services, building spaces, utilities, roadways, etc. would be the financial responsibility of the City and/or private operators unless the facility was developed by the City and not the operator. If the City developed a terminal building in a traditional commercial service scenario, the terminal building and some of the utility, roadway, and auto parking would be eligible for federal funding assistance. Such an alternative could be considered a long term option; however, the alternatives presented below are designed to offer more immediate solutions to the FATO issues. Although this option would prove very costly, relocation of the air tour facilities and helicopter operations could alleviate the current apron area congestion and present an opportunity for future fixed wing activity growth.

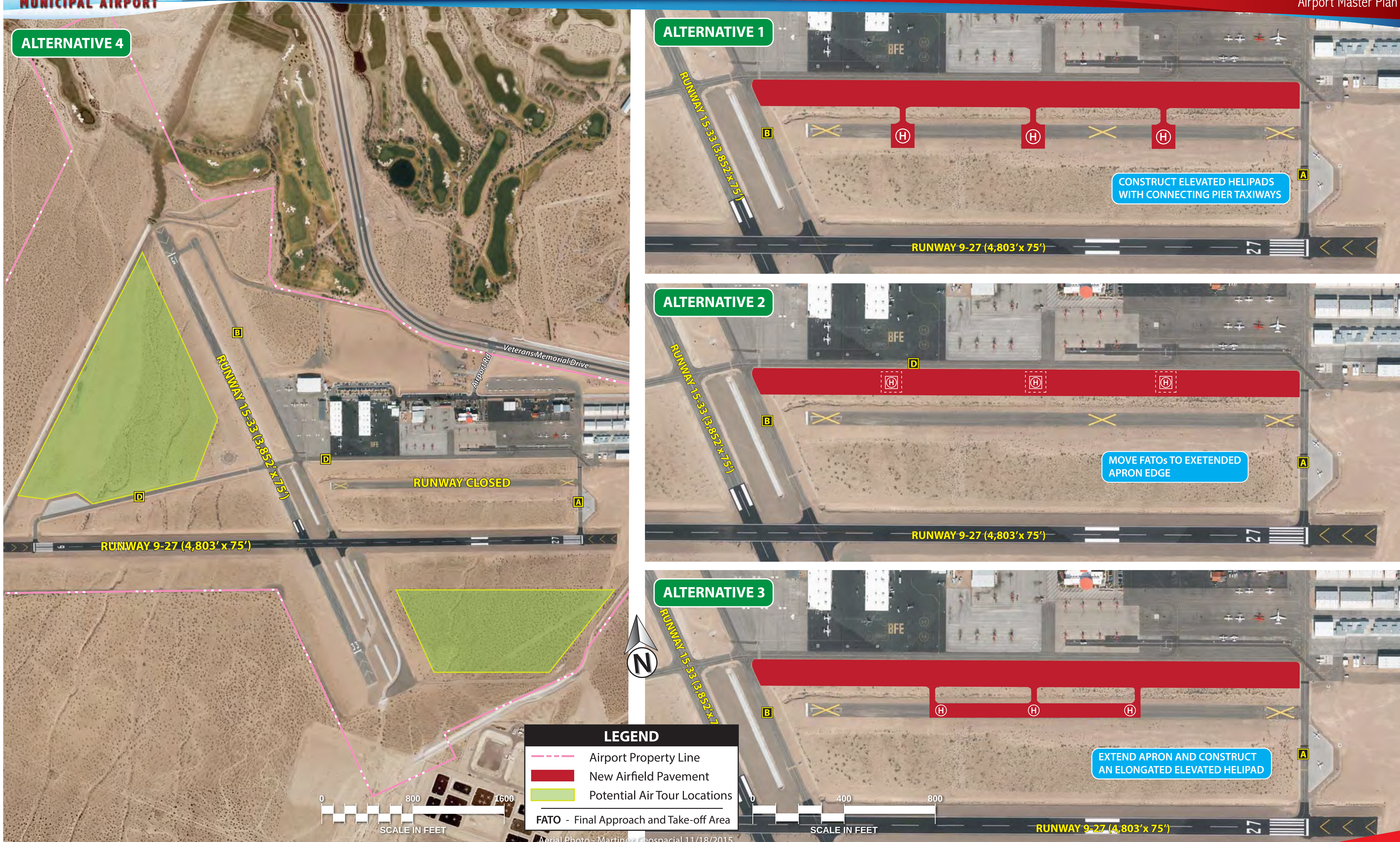

Exhibit 4K
AIR TOUR FACILITY DEVELOPMENT

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AIRSIDE ALTERNATIVE SUMMARY

The airside development considerations have focused on several elements that include mitigating safety area deficiencies, improving existing and future airfield geometry issues, realigning and reconfiguring taxiways, enhancing instrument approach capabilities to the runway system, relocating or reconfiguring the FATOs primarily used by air tour operators, and analyzing potential runway extension options. These alternatives will be considered by the PAC, airport management, City of Boulder City, and the general public. Following discussion and review with these entities, a preferred recommended airside development concept will be drafted and presented in the next chapter.

In addition, cost estimates for each airside alternative, summarized in **Table 4C**, were prepared by Kimley-Horn and Associates. It should be emphasized that these cost estimates were rendered at planning level detail for comparative purposes only and may or may not be utilized to justify any one alternative discussed.

TABLE 4C
Alternative Cost Summaries
Boulder City Municipal Airport

Alternative Project	Description	Amount
Taxiway A	Alternative 1	$1,392,072.00
	Alternative 2	$1,072,632.00
	Alternative 3	$1,070,322.00
Taxiway B	Alternative 1	$562,848.00
	Alternative 2	$1,263,570.00
	Alternative 3	$928,620.00
	Alternative 4	$1,924,758.00
	Alternative 5	$2,651,668.00
	Alternative 6	$2,970,924.00
Taxiway B Non-Standard Holding Apron	Alternative 1	$115,816.80
	Alternative 2	$427,864.80
	Alternative 3	$814,756.80
Taxiway D	Alternative 1	$767,910.00
	Alternative 2	$1,083,918.00
	Alternative 3, Option 1	$1,250,172.00
	Alternative 3, Option 2	$1,130,316.00
	Alternative 4	$1,397,352.00
	Alternative 5	$3,476,167.20
	Alternative 6	$3,398,802.00
	Alternative 7	$3,191,654.40
	Alternative 8	$4,049,370.60
Runway 15-33 Extension	Alternative 1	$9,109,135.20
	Alternative 2	$3,025,855.80
	Alternative 3	$3,159,482.70
Runway 9-27 Extension	Alternative 1	$7,012,500.00
	Alternative 2	$3,821,136.00
	Alternative 3	$2,637,756.00
FATO Area Relocation	Alternative 1	$3,369,458.40
	Alternative 2	$3,000,518.40
	Alternative 3	$3,614,978.40
	Alternative 4	NA

FATO: Final Approach and Takeoff
NA: Not Applicable
Source: Kimley-Horn and Associates

ANALYSIS OF LANDSIDE DEVELOPMENT CONSIDERATIONS

Generally, landside issues are related to those facilities necessary, or desired, for the safe and efficient parking and storage of aircraft, movement of pilots and passengers to and from aircraft, airport support facilities, and overall revenue support functions. Landside planning considerations, summarized previously on **Exhibit 4B**, will focus on strategies following a philosophy of separating activity levels. To maximize airport efficiency, it is important to locate facilities together that are intended to serve similar functions. The best approach to landside facility planning is to consider the development to be like that of a community where land use planning is the guide. For airports, the land use guide in the terminal area should generally be dictated by aviation activity levels.

The best approach to landside facility planning is to consider the development to be like that of a community where land use planning is the guide.

AVIATION LAND USE PLANNING

Land use planning is a very common practice for communities across the country. The primary purpose of land use planning is to adequately plan for future needs in an organized, efficient, and beneficial manner. Airport planning also commonly considers land use planning concepts to ensure that development is orderly, efficient, safe, and maximizes available land inventories.

A land use plan has been prepared for future development at BVU. Obviously, this is a simple plan based on separation of activity levels and historic development. It should be taken in the intent it was developed, as simply a guide for the airport sponsor to consider. It is fully understood that the airport sponsor may modify the plan if necessary to satisfy its intended goals and needs. The land use plan depicted on **Exhibit 4L** includes five broad development categories:

- Airfield Operations
- Aviation Related – Air Tour Commercial Service and General Aviation
- Aviation Support
- Aviation Reserve
- Mixed Use Reserve – Aviation and Non-Aviation

The **Airfield Operations** land use category is designated to delineate areas not available for landside development. The airside operations area has been established based on existing airfield conditions and includes safety areas associated with each runway, as well as the clearances needed for taxiways. This area should remain clear of objects except for those fixed by navigational function. If changes are made in line with airside alternatives previously discussed, the airfield operations area would change, thereby altering landside use options as well.

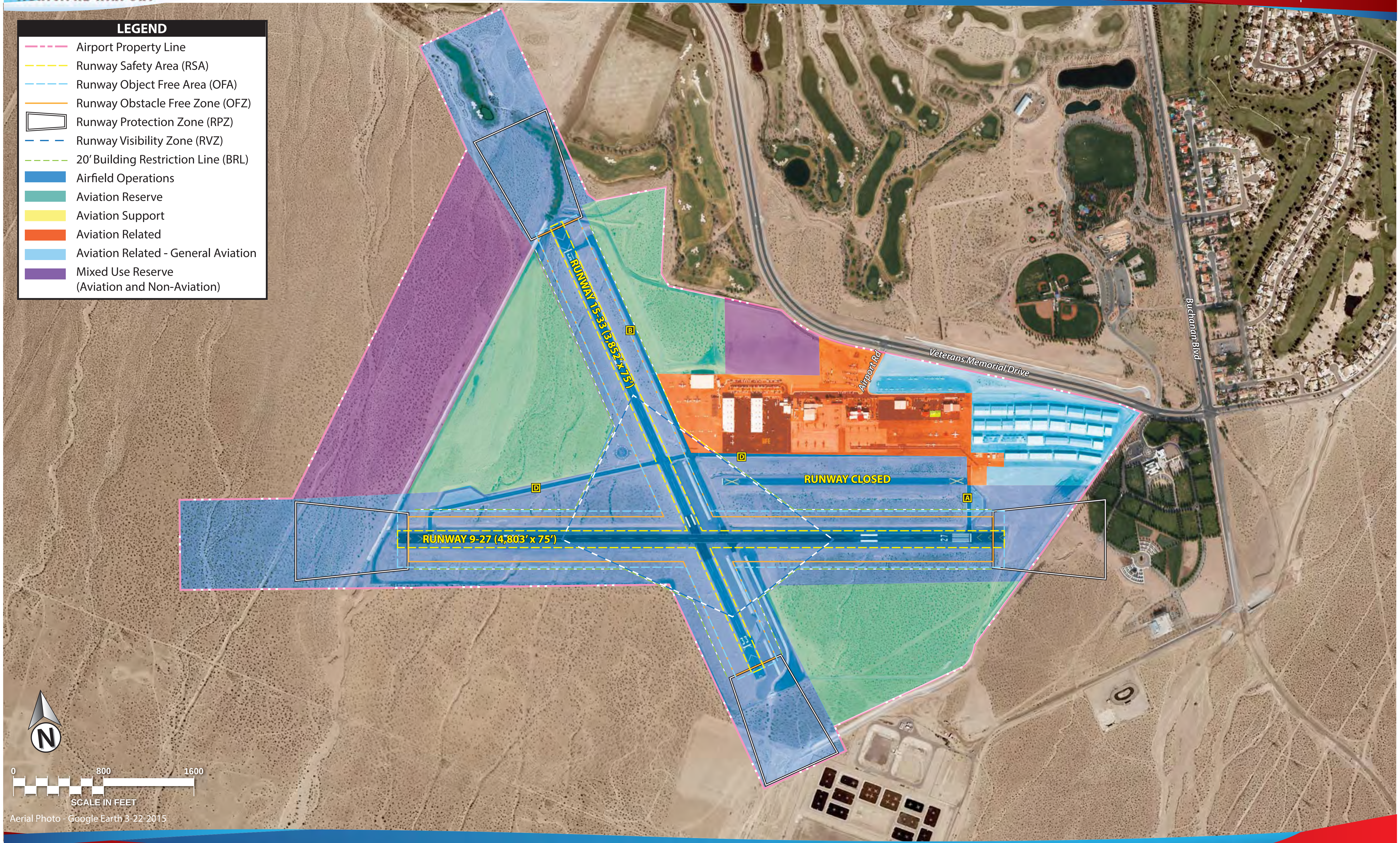

Exhibit 4L
FUTURE AIRPORT LAND USE

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Aviation Related – Air Tour Commercial Service and General Aviation consists of a mix of aviation related facilities. Air tour commercial service amenities include facilities necessary to accommodate the transition of air tour passengers and their belongings between air and ground. At BVU, this includes the commercial terminal building and parking apron, as well as areas to accommodate vehicle parking demand associated with the air tour commercial operations.

General aviation facilities represent the full array of general aviation activities and includes users that provide aviation services or house aircraft. A good example of this type of use is an FBO. These uses will generate a moderate activity level on both the airside and landside, including based aircraft and itinerant aircraft traffic. Facilities typical of commercial uses range from T-hangars to larger conventional hangars. These uses, however, are more commonly those that only have one primary hangar facility and are best suited for flight line access. This use is also characteristic of facilities which simply house based aircraft. The most common use is for T-hangars or linear box hangars. Daily activity for these areas is relatively low as the aircraft owners will commonly operate only sporadically throughout the week, or less often.

For the sake of this planning study, the area delineated as aviation related for air tour commercial service and general aviation has been combined unless otherwise noted. This designation was made as many air tour commercial service and general aviation related areas already coexist on the airfield and share potential development areas. In doing so, designated future aviation development areas can either cater toward air tour commercial service or general aviation, ultimately adding flexibility to future airport land use. In addition, these areas will be the focus of future development options as they are the areas capable of serving the needs of future aviation facilities.

Aviation Support includes those facilities and functions used to support the overall maintenance, safety, and security on the airfield. This includes the potential aircraft rescue and firefighting (ARFF) facility and dedicated airport maintenance facilities that house operations and maintenance personnel and equipment.

Aviation Reserve includes those areas on airport property that are currently undeveloped and should be dedicated for potential aviation related development in the future given their location to the runway and taxiway system.

Mixed Use Reserve – Aviation and Non-Aviation considers airport property that could accommodate a mix of aviation and/or the possibility of non-aviation activity in the future. Non-aviation related land uses are allowed on airports for areas not required for aviation purposes. In some cases, airport land inventories allow for non-aviation uses as long as the areas are not accessible to the airfield. This use could support commercial, industrial, or business park development and would provide the airport with an opportunity to improve revenue streams on land that would otherwise remain vacant. Areas on the north and northwest sides of the airport are designated for this use. Significant utility infrastructure roadway access enhancements would need to be provided in these areas to allow for future development.

REVENUE SUPPORT LAND USES

The amount of land on airport property could potentially exceed the space needed for the forecast aviation demand. Consideration is given for BVU to utilize portions of its property for non-aviation purposes that include commercial, industrial, or manufacturing development. It should be noted that the airport does not have the approval to use undeveloped property for non-aviation purposes at this time. Specific approval from the FAA will be required to utilize undeveloped property for non-aviation uses. This planning document does not gain approval from the FAA for airport land being developed for non-aviation uses, even if these uses are ultimately shown in the Master Plan and on the ALP. A separate land use release request to the FAA justifying the use of airport property for non-aviation uses will be required; however, this study can be a source for developing proper justification.

An environmental determination will also be required. While FAA Order 1050.1F, *Environmental Impacts: Policies and Procedures*, states that a release of an airport sponsor from federal obligations is normally categorically excluded and would not normally require an Environmental Assessment (EA), the issuance of a categorical exclusion is not automatic, and the FAA must determine that no extraordinary circumstances exist at the airport. Extraordinary circumstances would include a significant environmental impact to any of the environmental resources governed by federal law. An EA may be required if there are extraordinary circumstances. The generalized land use alternatives to follow outline areas on the airport which could be planned and ultimately developed for non-aviation related uses.

On-Airport Land Use Obligations

The airport has accepted grants for capital improvements from the FAA. As such, the City of Boulder City (airport sponsor) has agreed to certain grant assurances. Grant assurances related to land use assure that airport property will be reserved for aeronautical purposes. If the airport sponsor wishes to sell (release) airport land or lease airport land for a non-aeronautical purpose (land use change), they must petition the FAA for approval. The ALP and the Airport Property Map must then be updated to reflect the sale or land use change of the identified property.

Release of Airport Property

A release of airport property would entail the sale of land that is not needed for aeronautical purposes currently or into the future. The following documentation is required to be submitted to the FAA for consideration of a land release:

1. What is requested.
2. What agreement(s) with the United States are involved.
3. Why the release, modification, reformation, or amendment is requested.
4. What facts and circumstances justify the request.

5. What requirements of state or local law or ordinance should be provided for in the language of an FAA-issued document if the request is consented to or granted.
6. What property or facilities are involved.
7. How the property was acquired or obtained by the airport owner.
8. What is the present condition and what present use is made of any property or facilities involved.
9. What use or disposition will be made of the property or facilities.
10. What is the appraised fair market value of the property or facilities. Appraisals or other evidence required to establish fair market value.
11. What proceeds are expected from the use or disposition of the property and what will be done with any net revenues derived.
12. A comparison of the relative advantage or benefit to the airport from sale or other disposition as opposed to retention for rental income.

Each request should have a scaled drawing attached showing all airport property and facilities which are currently obligated for airport purposes by agreements with the United States. Other exhibits supporting or justifying the request, such as maps, photographs, plans, and appraisal reports should be attached as appropriate. There are no areas of airport property currently planned for release from obligation and/or sale.

Land Use Change

A land use change permits land to be leased for non-aeronautical purposes; it does not authorize the sale of airport land. Leasing airport land to produce revenue from non-aeronautical uses allows the land to earn revenue for the airport, as well as serve the interests of civil aviation by making the airport as self-sustaining as possible. Airport sponsors may petition for a land use change for the following purposes:

- So that land not needed for aeronautical purposes can be leased to earn revenue from non-aviation uses. This is land that is clearly surplus to the airport’s aviation needs.

- So that land which cannot be used for aeronautical purposes can be leased to earn revenue from non-aviation uses. This is land that cannot be used by aircraft or where there are barriers or topography that prevents an aviation use.

- So that land not presently needed for aeronautical purposes can be rented on a temporary basis to earn revenue from non-aviation uses.

A land use change shall not be approved by the FAA if the land has a present or future airport or aviation purpose, meaning the land has a clear aeronautical use. If land is needed for aeronautical purposes, a land use change is not justified. Ordinarily, land on or in proximity to the flight line and airport operations area is needed for aeronautical purposes and should not be used or planned for non-aviation purposes.

The proceeds derived from the land use change must be used exclusively for the benefit of the airport and may not be used for a non-airport purpose. The proceeds cannot be diverted to the airport sponsor's general fund or for general economic development unrelated to the airport.

Generally, a land use change of airport property will be reviewed on a case-by-case basis at the time that the change is necessary. However, the airport land use drawing, which is included as part of the ALP set, shows those areas likely eligible to be released from obligation.

AVIATION ACTIVITY LEVELS

The aviation development areas should be divided into high, medium, and low activity levels at the airport. The high activity area should be planned and developed to provide aviation services on the airport. An example of high activity areas is the airport air tour terminal building and adjoining aircraft parking apron, which provides tiedown locations and circulation primarily for air tour aircraft. In addition, large conventional hangars used for air tour operations, FBOs, corporate aviation departments, or storing a large number of aircraft would be considered a high activity use area. The best location for high activity areas is along the flight line near midfield, for ease of access to all areas on the airfield. All major utility infrastructure would need to be provided to these areas.

The medium activity use category defines the next level of airport use and primarily includes smaller corporate aircraft that may desire their own executive hangar storage on the airport. The best location for medium activity use is off the immediate flight line, but still readily accessible to aircraft including business jets. Due to an airport's layout and other existing conditions, if this area is to be located along the flight line, it is best to keep it out of the midfield area of the airport, so as to not cause congestion with transient or air tour aircraft utilizing the airport. Parking and utilities, such as water and sewer, should also be provided in this area.

Consideration to aesthetics should be given high priority in all public areas, as the airport can serve as the first impression a visitor may have of the community.

The low activity use category defines the area for storage of smaller single and multi-engine aircraft. Low activity users are personal or small business aircraft owners who prefer individual space in linear box hangars or T-hangars. Low activity areas should be located in less conspicuous areas. This use category will require electricity, but generally does not require water or sewer utilities

In addition to the functional compatibility of the aviation development areas, the proposed development concept should provide a first-class appearance for BVU. As previously mentioned, the airport serves as a very important link to the entire region, whether it is for business or pleasure. Consideration to aesthetics should be given high priority in all public areas, as the airport can serve as the first impression a visitor may have of the community.

BVU is located on approximately 530 acres. In order to allow for maximum development of the airport while keeping with mandated safety design standards, it is very important to devise a plan that allows for the orderly development of airport facilities. Typically, airports will reserve property adjacent to the runway system for aviation related activity exclusively. This will allow for the location of taxiways, aprons, and hangars.

HANGAR DEVELOPMENT

Analysis in Chapter Three indicated that the airport should plan for the construction of additional aircraft hangars over the next 20 years. Hangar development takes on a variety of sizes corresponding with several different intended uses.

Commercial general aviation activities are essential to providing the necessary services on an airport. This includes privately owned businesses involved with, but not limited to, aircraft rental and flight training, aircraft charters, aircraft maintenance, line service, and aircraft fueling. These types of operations are commonly referred to as FBOs or specialized aviation service operators (SASOs). The facilities associated with businesses such as these include large conventional type hangars that hold several aircraft. High levels of activity often characterize these operations, with a need for apron space for the storage and circulation of aircraft. These facilities are best placed along ample apron frontage with good visibility from the runway system for transient aircraft. Utility services are needed for these types of facilities, as well as vehicle parking areas.

The airport should plan for the construction of additional aircraft hangars over the next 20 years.

Aircraft hangars used for the storage of smaller aircraft primarily involve T-hangars or linear box hangars. Since storage hangars often have lower levels of activity, these types of facilities can be located away from the primary apron areas in more remote locations of the airport. Limited utility services are needed for these areas.

Other types of hangar development can include executive hangars for accommodating either one larger aircraft or multiple smaller aircraft. Typically, these types of hangars are used by corporations with company-owned aircraft or by an individual or group of individuals with multiple aircraft. These hangar areas typically require all utilities and segregated roadway access.

Table 4D summarizes the aircraft hangar types and corresponding size and aviation uses that are typically associated with each facility. Currently, there is approximately 378,250 square feet of hangar space (including maintenance area) provided on the airport, made up of a combination of the hangar types previously discussed.

TABLE 4D
Aircraft Hangar Types
Boulder City Municipal Airport

Hangar Type	Typical Size	Aviation Uses
Conventional	Clear span hangars greater than 10,000 square feet	FBOs, SASOs, and other commercial aviation activities resulting in high activity uses
Executive	Clear span hangars less than 10,000 square feet	SASOs, corporate flight departments, and private aircraft storage resulting in medium-to-high activity uses
T-Hangar/Linear Box	Individual storage spaces offering 1,200 - 1,500 square feet	Private aircraft storage resulting in low activity uses

FBO – Fixed Base Operator
SASO – Specialized Aviation Service Operator

Exhibit 4M presents four potential aviation related development areas. For the most part, each development area presented could be used primarily for general aviation or air tour commercial service purposes. The exception to this is the East Aviation Development Area, which is recommended to be used for general aviation development purposes only. Below, a brief description of each development area and its attributes is provided.

East Aviation Development Area

Given the proximity of the eastern development area to the current general aviation hangars, it is recommended that any development taking place in this area be oriented exclusively toward general aviation. In addition, the proposed area could provide convenient access to Taxiway A as well as the fueling island and apron area. At the time of this writing (July 2016), the airport has plans of adding a wash rack on the northeastern corner of the proposed development area. Hangar layout options specific to the East Aviation Development Area are presented in **Exhibit 4N**.

East Aviation Development Area Alternative 1

This alternative proposes a hangar build-out option, suggesting five linear box hangars, each capable of accommodating six aircraft. This would produce a total of 30 new hangar spaces and a total of 52,500 square feet of new hangar space; however, the individual hangar spaces offered under this option would most likely cater toward single engine piston aircraft given the square footage allotment of 1,750 square feet per hangar space.

This alternative would also generate some additional aircraft apron area on the southern edge of the proposed development area, which could be utilized for additional aircraft tiedown spaces if demand warrants.

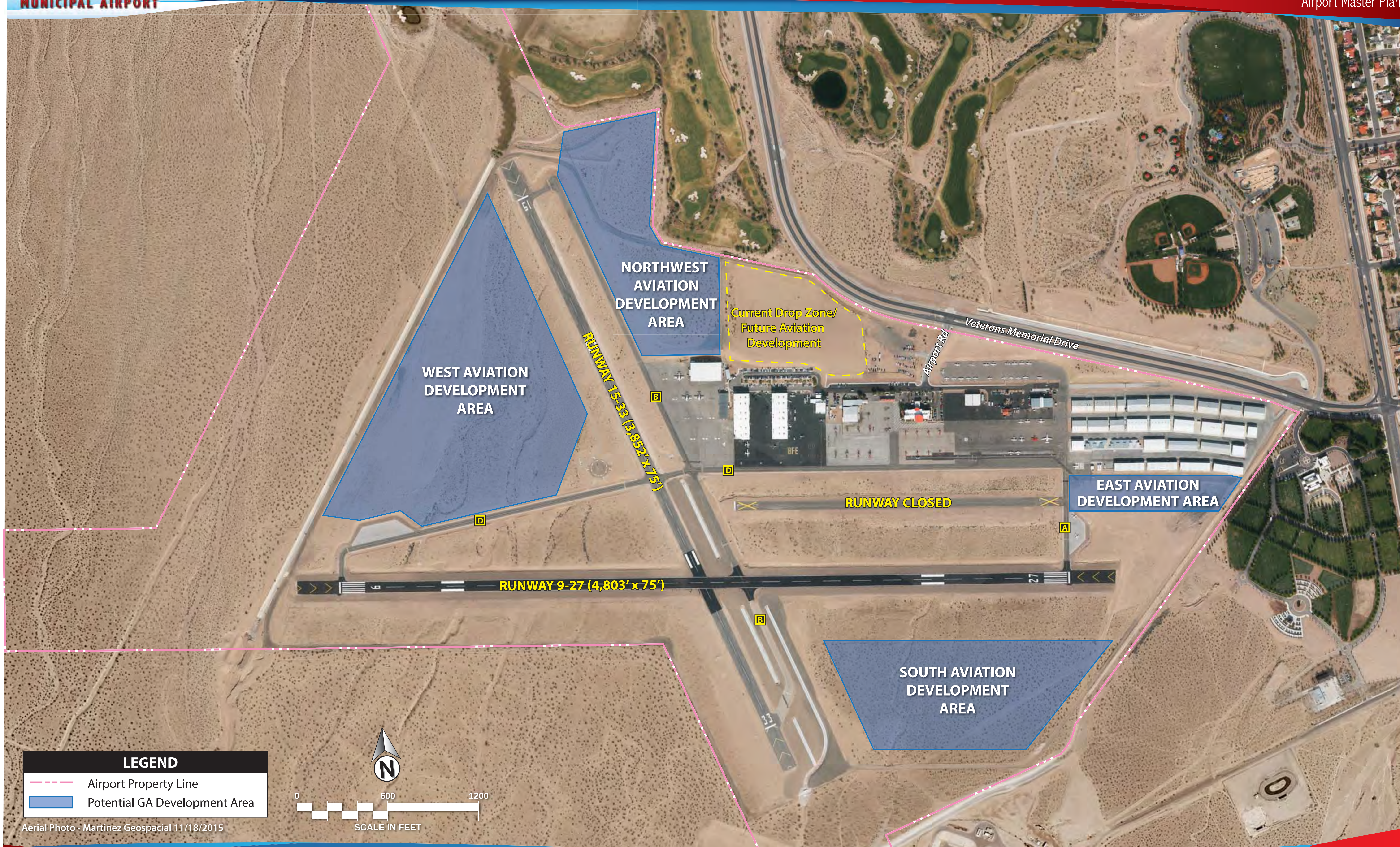

Exhibit 4M
AVIATION DEVELOPMENT AREAS

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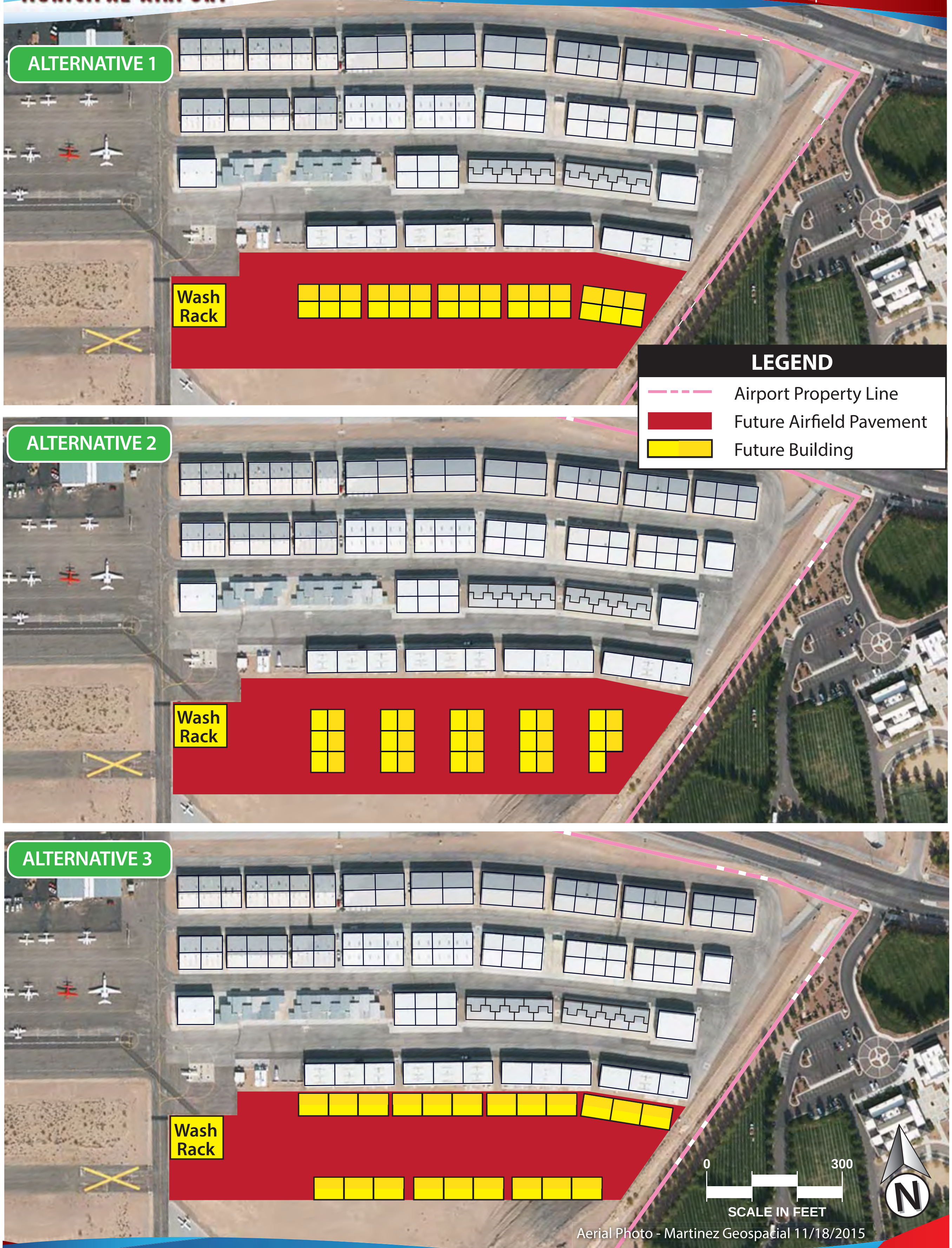

Exhibit 4N
EAST DEVELOPMENT
AREA HANGAR BUILD-OUT

East Aviation Development Area Alternative 2

The second east aviation development area alternative examines the addition of four 10,500 square foot linear box hangars, which could accommodate a total of six aircraft, and one 8,750 square foot hangar capable of housing five aircraft. This alternative would provide a total of 50,750 square feet of new hangar space. Given the positioning of the easternmost hangar, only five hangar spaces are allotted in order to provide adequate space between the hangar and eastern edge of the development area. The linear box hangars would provide 1,750 square feet of hangar space per hangar.

East Aviation Development Area Alternative 3

Alternative 3 explores the option of implementing seven linear box hangars offering 21 individual storage units along the northern and southern edges of the eastern development area. In total, these hangars will create 70,000 square feet of additional hangar space. Given that the square footage of each hangar space provided in this alternative is relatively large, this particular option may cater toward owners of larger aircraft. Thus, the larger aircraft apron and movement area centrally located between the hangars could be an added benefit, allowing more room for aircraft movement.

South Aviation Development Area

This potential for development in the south aviation area was discussed earlier as an option for future air tour helicopter operations. While the area could support both commercial air tour operations and general aviation fixed wing operations, its use would best fit air tour operations in the future. Development in this area could be advantageous as it would alleviate congestion that occurs on the primary aircraft apron north of Taxiway D. In addition, this site would provide convenient access to Runways 27 and 33. However, this particular site does not have any surrounding facilities. In turn, any future development in this area will require substantial investment as there are currently no existing service roads or utilities serving the area.

West Aviation Development Area

The West Aviation Development Area is located on the northern side of Runway 9-27 and west of Runway 15-33. This potential development area is quite sizable and would be capable of accommodating a large expanse of pavement that could be designated as additional apron area as well as provide space for aircraft hangars, air tour commercial service facilities, support facilities, and airport maintenance facilities. Nevertheless, this particular development site would require significant investments to include the extension of all utilities and access roads.

Northwest Aviation Development Area

The Northwest Aviation Development Area is positioned on the eastern side of Runway 15 and north of the Grand Canyon Airlines ramp area. This development area would provide easy airside access to the existing flight line, while landside access could be attained via an extension of the existing Airport Road. Moreover, an additional access road could be extended from Veterans Memorial Drive if demand warrants. Utilities could be extended from existing airport development. **Exhibit 4P** depicts three alternative hangar layout development options.

Northwest Aviation Development Area Alternative 1

This alternative examines a hangar build-out option that includes eight external hangar structures, totaling 216,000 square feet of hangar space. The hangars located in the southern portion of the aviation development area offer 24,000 square feet of hangar space, while hangars located in the northern portion total 30,000 square feet. This option will maximize hangar space and provide some additional apron area. The alternative also provides the option to divide each hangar structure internally. Ultimately, the southern portion of the aviation development area could offer a total of eight separate hangars, while the northern portion could offer 12.

In addition, an access road could be added along the eastern and northeastern edge of the aviation development area, providing access to vehicle parking located centrally between the southern and northern hangars respectively.

Northwest Aviation Development Area Alternative 2

Alternative 2 explores a hangar build-out option that provides 201,000 square feet of hangar space, which is slightly less than the previous alternative. This alternative provides a total of seven external hangar structures, two offering 30,000 square feet per hangar structure, and four providing 24,000 square feet per hangar structure. One 45,000 square-foot structure is located in the central portion of the development area, two 30,000 square-foot structures are located in the southern portion, while four 24,000 square-foot structures are located in the northern portion. The hangar layout examined in this alternative is designed to provide a moderate amount of apron area while maximizing the amount of hangar space available. Furthermore, this alternative also presents an option to divide hangars internally in an effort to provide added flexibility.

Alternative 2 also proposes the addition of an access road along the eastern side of the aviation development area, which could provide access to hangars and vehicle parking in the southern, central, and northern portions of the development area.

Northwest Aviation Development Area Alternative 3

Alternative 3 presents a total of five hangar structures generating 132,000 square feet of hangar space. Structures are positioned along the eastern side of the development area in an effort to maximize apron area provided near the flight line. Two 30,000 square-foot structures are proposed along the southeastern portion of the development area, while three 24,000 square-foot structures are located along the northeastern portion. Similar to Alternatives 1 and 2, this alternative proposes an access road along the eastern side of the development area. Vehicle parking areas could be located on the eastern side of the structures proposed in the southeastern area, while vehicle parking areas serving the northeastern structures could be located on the northern side of each building. Access to each vehicle parking area could be provided by the proposed access road along the eastern side of the development area.

Hangar structures presented in Alternative 3 also depict the option for internal sub-division of each building. Ultimately, this will allow the airport to customize their hangar layout to better serve the needs of tenants.

APRON EXTENSION

The facility requirements analysis discussed in the previous chapter examined the need for additional apron space. This analysis identified a need for approximately 12,000 square yards of additional commercial apron area and 10,200 square yards of general aviation apron area, suggesting a total of 22,200 square yards of additional apron area throughout the long term planning horizon.

Exhibit 4Q presents a proposed apron extension along the southern edge of the current aircraft apron and on the south side of the existing Taxiway D. The proposed apron extension would increase the apron square yardage by approximately 32,000 square yards. Paired with previously discussed alternatives to relocate Taxiway D, the usage of this apron extension could be maximized. Furthermore, the apron extension option is compatible with other alternatives that involve the usage and repurposing of the closed parallel runway. It should also be noted that sizable apron gains would also be achieved via development in the east aviation and northwest aviation areas presented above.

INTERIOR VEHICLE ACCESS

A planning consideration for any airport is the segregation of vehicles and aircraft operational areas. This is both a safety and security consideration for an airport. Aircraft safety is reduced and the potential for accidents increase when vehicles and aircraft share the same pavement surfaces. Vehicles contribute to the accumulation of debris on aircraft operational surfaces, which increases the potential for foreign object debris (FOD) damage, especially for turbine-powered aircraft. The potential for runway incursions

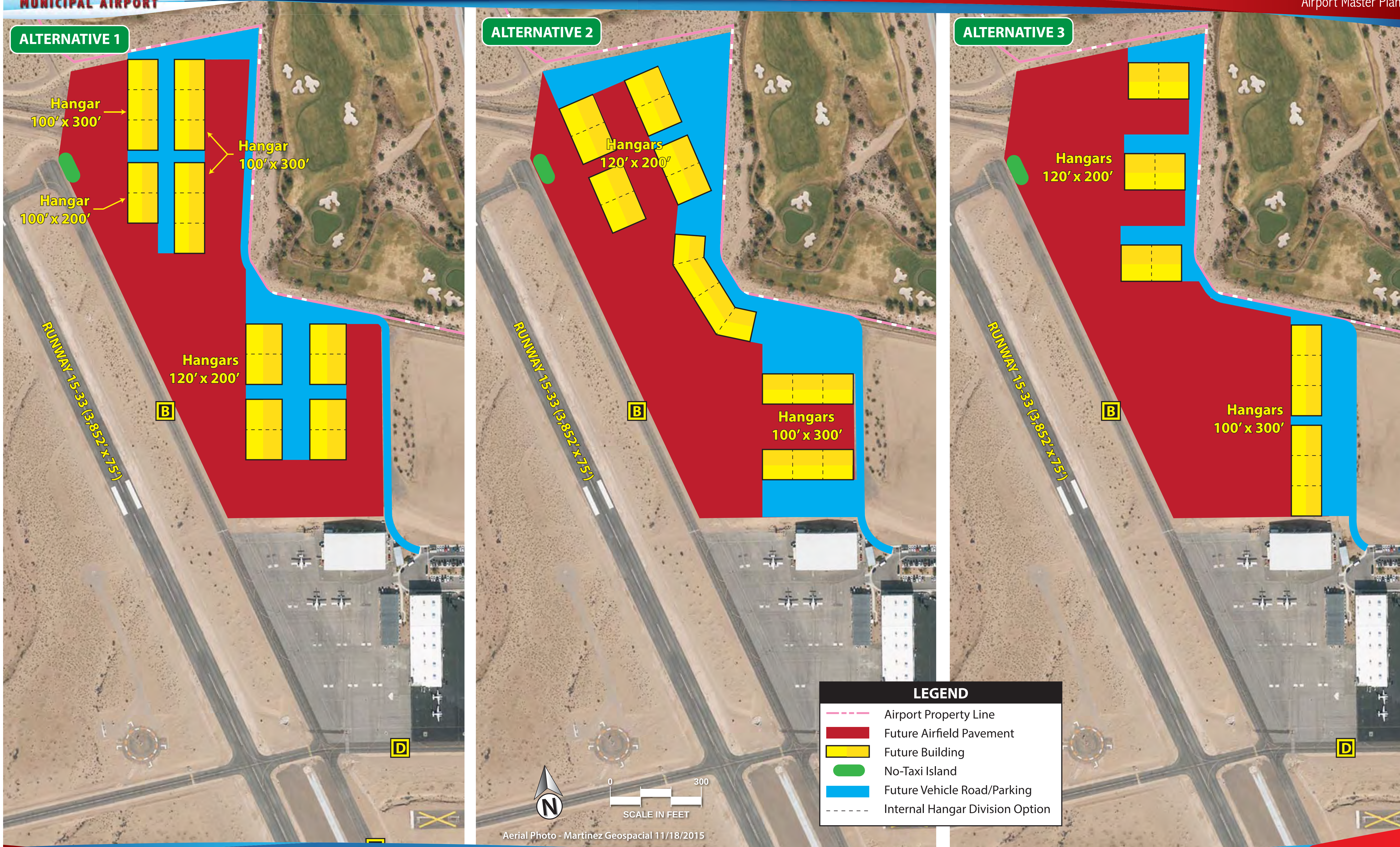

Exhibit 4P
NORTHWEST DEVELOPMENT AREA HANGAR BUILD-OUT

Exhibit 4Q
APRON EXTENSION

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is increased, as vehicles may inadvertently access active runway or taxiway areas if they become disoriented once on the airport operational area (AOA). Airfield security may be compromised as there is loss of control over the vehicles as they enter the AOA. The greatest concern is for public vehicles, such as delivery vehicles and visitors, which may not fully understand the operational characteristics of aircraft and the markings in place to control vehicle access. The best solution is to provide dedicated vehicle access roads to each landside facility that is separated from the aircraft operational areas with security fencing.

The segregation of vehicle and aircraft operational areas is supported by FAA guidance established in June 2002 and amended in March 2008. FAA AC 150/5210-20, *Ground Vehicle Operations on Airports*, states, "The control of vehicular activity on the airside of an airport is of the highest importance." The AC further states, "An airport operator should limit vehicle operations on the movement areas of the airport to only those vehicles necessary to support the operational activity of the airport."

Aircraft safety is reduced and the potential for accidents increase when vehicles and aircraft share the same pavement surfaces.

The present landside facility layout of the Airport requires vehicle traffic to operate on active taxilanes and aircraft parking aprons on occasion in order to access to certain hangars and other aviation operators. This is acceptable for activity associated with small private aircraft storage. In locations where larger hangars that serve commercial general aviation activities exist, it is preferred to segregate aircraft and vehicle operations, while also maximizing the use of potential landside development.

BUILDING RESTRICTION LINE AND RUNWAY VISIBILITY ZONE

The building restriction line (BRL) identifies suitable building area locations on the airport. The BRL encompasses the RPZs, the ROFA, navigational aid critical areas, areas required for terminal instrument procedures, and other areas necessary for meeting airport line-of-sight criteria.

Two primary factors contribute to the determination of the BRL: type of runway (utility or other-than-utility) and the capability of the instrument approaches. Runways 9-27 and 15-33 are considered "other-than-utility" runways.

The BRL is the product of Title 14 CFR Part 77 transitional surface clearance requirements. These requirements stipulate that no object be located in the primary surface, defined as being no closer than 250 feet from a non-precision instrument runway centerline (visibility minimums not lower than ¾-mile) and not closer than 500 feet to a runway served by a precision instrument approach (visibility minimums lower than ¾-mile). From the primary surface, the transitional surface extends outward at a slope of one vertical foot to every seven horizontal feet. The BRL at BVU is set at a point where the transitional

Two primary factors contribute to the determination of the BRL: type of runway (utility or other-than-utility) and the capability of the instrument approaches.

surface is 20 feet above runway elevation. Due to the amount of space between the runway system (Runways 9-27 and 15-33) and existing landside facilities on the east side of the airport, the BRL must be taken into consideration for future landside development within this area.

Airfield development should also be planned so it does not penetrate the runway visibility zone (RVZ). It is recommended that a clear RVZ be maintained where two runways intersect. The RVZ outlines the area needed to be clear of obstructions so that aircraft on both runways can see other aircraft before it is too late to avert an accident. The distance between the runway's intersection and each runway end determines the location of each runway's visibility point.

The RVZ based upon the existing airfield configuration at BVU is depicted on previously presented **Exhibit 4L**. Currently, there are no landside facilities affecting the RVZ at BVU. However, if an obstruction were to penetrate the RVZ, the FAA can allow a Modification to Standard if an acceptable level of safety is maintained and the aircraft activity is controlled by an airport traffic control tower (ATCT). The landside alternatives analysis should consider the location of the existing and proposed RVZ in correlation to future development. It should be noted that any proposed runway extension could shift the RVZ. Future planning will address any RVZ obstructions depending upon runway development.

The RVZ outlines the area needed to be clear of obstructions so that aircraft on all three runways can see other aircraft before it is too late to avert an accident.

AIRPORT TRAFFIC CONTROL TOWER

As mentioned in the previous chapter, BVU currently does not have an operational ATCT; however, a 2011 Benefit/Cost (B/C) analysis study (an analysis used by the FAA to justify federal contract ATCTs) was completed by Quadrex Aviation—Airport Development Services. The study was conducted in accordance with FAA Report APO 90-7, "Establishment and Discontinuance Criteria for Air Traffic Control Towers," which is the guiding document that outlines procedures for conducting the B/C analysis. This particular study produced favorable results and concluded that BVU could potentially participate in the federal contract tower (FTC) program.

Given the results of the B/C analysis, Quadrex Aviation also conducted a Preliminary Site Selection for the ATCT in June of 2015. The study evaluated four potential areas, depicted in **Exhibit 4R**, that could be suitable for ATCT development. Each area identified was evaluated for the following criteria:

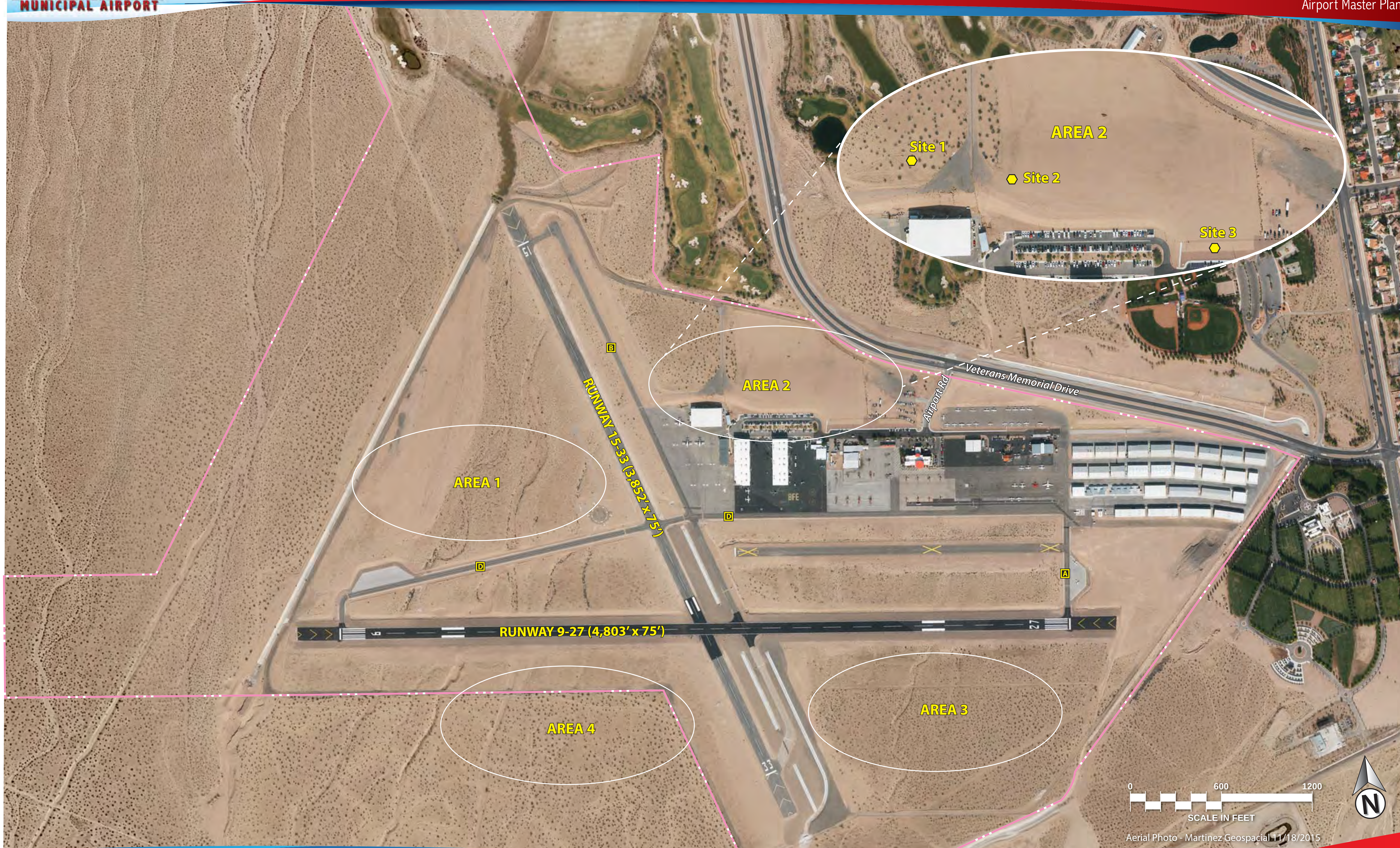

Exhibit 4R
ATCT SITING AREAS

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- Impacts to instrument approach procedures (TERPS)
- Impacts to communications, navigation, and surveillance equipment
- Visibility performance
- Operational requirements
- Economic considerations
- Safety Risk Management / Comparative Safety Assessment (CSA)

Furthermore, several other siting factors were examined in addition to the FAA tower siting criteria established within FAA Order 6480.4B, *Airport Traffic Control Tower Siting Criteria*. Basic criteria for considering the viability of the areas included available access, available utilities, terrain characteristics, and ATCT orientation.

As a result of these analyses, the four general areas evaluated were narrowed to a single area. Area Two, presented on **Exhibit 4R**, was then further broken down into three potential tower sites. In identifying and evaluating the potential sides in Area Two, several assumptions were made in order to consider the effect of meeting FAA line of sight (LOS) as well as other criteria. These assumptions included:

- The closed Runway 9R-27L is reused as a parallel taxiway.
- Taxiway D is downgraded to an apron-edge taxilane and will not be part of the airfield operations area (AOA).
- No new development will be allowed to encroach into the proposed ATCT LOS limits.
- Runway 9-27 will eventually be extended 1,000 feet to the west.

Site One is located in a vacant area just north of the Grand Canyon hangar along the far western section of the terminal area. The terrain is a flat site with an elevation of 2,179 feet (MSL), which is 25 feet lower than the Airport Reference Point (ARP = 2,004 feet).

Site Two is approximately 350 feet east of Site 1 and just on the edge of the parachute landing area. The terrain appears to have been semi-prepared and sits at an elevation of 2,175 feet, which places it at 29 feet below the ARP.

Site Three is located near the center of the terminal area north of the Papillon Helicopters hangar area. The site has been graded and is also at an elevation of 2,175 feet.

Based upon the preliminary analysis, the study found Site Two to be the best alternative for ATCT development. The site has a relatively central location which lends itself to lower development costs when taking into consideration roadway access and the cost of utilities. Site Two was also found to provide the best perspective view for the ability to see over the hangars when compared to the other sites.

AIR TOUR TERMINAL FACILITIES

The previous chapter analyzed current and future air tour terminal space requirements based upon both current and forecast passenger enplanement counts. It should be noted that operations of the air tour service providers can differ significantly from the traditional air carriers and the recommendations provided are for advisory purposed only. In addition, the air tour service providers currently operating at BVU conduct their operations primarily out of separate facilities. Thus, the analysis provided in the previous chapter indicated terminal space requirements for a single facility based upon FAA guidance, which is geared toward more traditional air carrier terminal space requirements. This analysis indicated a need of approximately 5,350 square feet of additional space through the long-term planning horizon; however, each air tour operator will determine their space allotments as based on the individualized business model and on an as-needed basis. As noted earlier, long term consideration should be given to shifting the air tour helicopter operators to the southeast aviation development area as a means to improve overall airfield operational safety. It is very likely that this solution would require substantial investment support via federal and/or private funding sources to be implemented. As such, planning will also continue to support short and intermediate term air tour helicopter operations in existing locations.

GENERAL AVIATION TERMINAL FACILITY

The Facility Requirements Chapter examined the future need for general aviation terminal facilities. At the time of this writing (July 2016), the GA terminal facilities provided at BVU are in two different locations and are provided by FBOs. The previous chapter identified an existing 5,250 square feet of GA terminal space and recognized a potential need of 7,250 square feet of terminal space throughout the long-term planning horizon; however, the Boulder City Aviation Services FBO, in association with Grand Canyon Airlines, has recently opened as well. The Boulder City Aviation Services FBO is housed within the Airport Administration building and provides an estimated 1,400 square feet of space. Thus, the recently opened FBO increases the approximate amount of GA terminal space to 6,400 square feet, which reduces the estimated additional terminal space requirement to 6,100 square feet through the long-term planning horizon. In the future, it is recommended that additional GA terminal facility space be provided on an as-needed basis. A suitable option for additional terminal space could be located within the Northwest Aviation Development Area previously presented in **Exhibits 4M** and **4P**.

AIRPORT PARKING

Analysis in the previous chapter indicated a need for increased airport parking. Given the current and forecast activity associated with air tour commercial service as well as general aviation, the airport could benefit from designating new parking areas. The parking areas should be paved per City of Boulder City requirements with proceeds from the pavement provided by users of the pavement surfaces. **Exhibit 4S** presents two proposed parking areas that could be easily accessed from Airport Road.

Exhibit 4S
PROPOSED PARKING AREAS

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Parking area one is located immediately north of the air tour terminal facility and would accommodate an estimated 320 parking spaces. This proposed parking area is already in use; however, it is not officially designated as a parking area and is currently unimproved. Consideration could be given to paving the area and officially dedicating it to vehicle parking. The parking area would be easily accessible from Airport Road and is located at a reasonable walking distance from the air tour terminal and general aviation facilities.

Parking area two, located on the eastern side of the north-south portion of Airport Road, is another potential site to locate additional airport parking. This parking area could have the capacity to provide up to 450 vehicle parking spaces. This location would require significant earthwork prior to its conversion into a parking area as the gradient between the GA facilities and Veterans Memorial Drive is very steep. Furthermore, the airport could consider the implementation of an additional pedestrian walkway from the eastern portion of the parking area to the western portion, connecting with the walkway provided on Airport Road. Ultimately, this would allow the airport to maintain and install additional security fencing around the general aviation facilities, segregating them from the proposed vehicle parking area.

ANALYSIS OF AIRPORT SUPPORT FACILITY CONSIDERATIONS

Airport support facilities are supplemental to the landside facilities previously discussed. These facilities typically include amenities such as the airport fuel farm, airport maintenance facilities, and aircraft rescue and firefighting facilities.

AIRPORT FUEL FARM

There is currently one fuel farm located on airport property dedicated for the storage of aviation fuel for air tour providers and re-sale. The fuel farm is located on the east side of Taxiway A, near the general aviation aircraft hangars. The existing fuel farm consists of two above ground storage tanks dedicated to Jet A and two below ground storage tanks dedicated to 100LL. Combined, the fuel farm has a storage capacity of approximately 64,000 gallons. Of the 64,000 gallons, 40,000 are designated for Jet A, while 24,000 are designated for 100LL. It should be noted that certain air tour providers are permitted direct access to the fuel farm. Fuel is automatically ordered by a component that monitors the fuel level. Future consideration is given to expanding the current fuel farm in order better meet the two-week fuel storage reserve used for planning considerations.

AIRPORT MAINTENANCE FACILITIES

Currently, there is not a designated airport maintenance facility located on the airport. At this time, the airport stores equipment adjacent to the east and west sides of the Airport Administration building that houses the Boulder City Aviation Services FBO. This area provides for the outside storage of airport equipment. Consideration should be given to constructing an airport maintenance facility for the storage of additional equipment currently kept outside. The landside alternatives to follow will depict a proposed location for a maintenance facility on the airport. It should be noted that if justification for an ARFF facility exists (to be discussed), the ARFF building could also house an airport maintenance facility.

AIRCRAFT RESCUE AND FIREFIGHTING FACILITY

Due to the level of operations occurring at BVU, there is a great amount of tenant and airport interest in locating an ARFF facility on the airport. The FAA does not require that BVU be certificated under 14CFR Part 139 and, as such, an ARFF facility is not required. While not required, an ARFF facility is highly desired by airport users. As a result, several options for locating an ARFF facility have been considered, as presented on **Exhibit 4T**.

As previously mentioned, BVU is currently not certificated under 14 CFR Part 139 Certification of Airports, and thus ARFF services are not a requirement for the airport, nor is federal funding available for ARFF equipment and facilities. In order to become eligible for federal ARFF funding, the airport could explore the possibility of pursuing a Part 139 airport certification. Other options for ARFF funding include privately operating the ARFF facility through airport user fees, establishing a joint-use facility for BVU and the City of Boulder City, or a combination of the two.

14 CFR Part 139 Certification of Airports

The 14 CFR Part 139 certification requirements applicable to Boulder City Municipal Airport will relate to the type of aircraft serving the airport. In helping to define the airport's class, it is important to understand the distinction between the definition of large and small air carrier aircraft.

- A large air carrier aircraft is designed for 31 passenger seats or more.
- A small air carrier aircraft is designed for 10 to 30 passenger seats.

It should be noted that 14 CFR Part 139 does not apply to airports served by scheduled air carrier aircraft with nine seats or less and/or unscheduled air carrier aircraft with 30 seats or less.

14 CFR Part 139 defines four airport classifications as follows:

- **Class I** - an airport certificated to serve scheduled operations of large air carrier aircraft that also can serve unscheduled passenger operations of large air carrier aircraft and/or scheduled operations of small air carrier aircraft. A Class I airport may serve any class of air carrier operations.

Exhibit 4T
POTENTIAL ARFF LOCATIONS

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- **Class II** - an airport certificated to serve scheduled operations of small air carrier aircraft and the unscheduled passenger operations of large air carrier aircraft. A Class II airport cannot serve scheduled large air carrier aircraft.
- **Class III** - an airport certificated to serve scheduled operations of small air carrier aircraft. A Class III airport cannot serve scheduled or unscheduled large air carrier aircraft (this would be the most likely classification for Boulder City Municipal Airport).
- **Class IV** - an airport certificated to serve unscheduled passenger operations of large air carrier aircraft. A Class IV airport cannot serve scheduled large or small air carrier aircraft.

Airports that meet the requirements for Part 139 certification are issued an Airport Operating Certificate (AOC). AOCs serve to ensure safety in air transportation. To obtain a certificate, an airport must agree to operational and safety standards and provide for certain safety services and facilities. These requirements vary depending on the size of the airport and the type of flights available. The regulation, however, does allow FAA to issue certain exemptions to airports that serve few passengers yearly and for which some requirements might create a financial hardship.

According to 14 CFR Part 139, the following steps would need to be taken in order for BVU to receive an AOC:

1. Prepare and submit a Class III Airport Certification Manual (ACM) to the FAA.
2. Prepare ground vehicle operating rules and regulations.
3. Prepare a ground vehicle training program.
4. Prepare a training program for airport personnel involved with Part 139 implementation.
5. Ensure that FBOs comply with the fuel training requirements.
6. Develop a record-keeping system for the following:
    a. Personnel training (24 months)
    b. Emergency personnel training (24 months)
    c. Airport tenant fueling inspection (12 months)
    d. Airport tenant fueling agent training (12 months)
    e. Self-inspection (6 months)
    f. Movement areas and safety areas training (24 months)
    g. Accident and incident (12 months)
    h. Airport Condition (6 months)
7. Prepare and submit an Airport Emergency Plan to the FAA.
8. Acquire an ARFF vehicle and comply with ARFF training and operational requirements.

Private Funding

Due to the volume of operations currently and forecast to take place at BVU, airport tenants and frequent users may be willing to help provide funds for ARFF equipment, facilities, and staffing needs. However, this option would likely be very costly and could even deter some airport users from operating at the airport if expensive airport user fees are implemented in order to provide adequate ARFF funding. Further evaluation of this option is recommended if it is desirable to the airport and its users.

Joint-Use Facility

Another option is to provide an ARFF/firefighting facility located on the airport that is designated for both airport and municipal emergencies. Establishing a joint-use facility could help to alleviate costs associated with building a facility, purchasing equipment, staffing, and fulfilling the training requirements mandated for ARFF services. It should be noted that location of the facility will be critical under this option as a timely response to both airport and municipal emergencies is imperative.

LANDSIDE ALTERNATIVE SUMMARY

On the landside, several alternatives were presented to consider additional hangar and apron development, GA and air tour terminal area expansion, vehicle parking area expansion, the addition of an ATCT, airport maintenance and ARFF facility, and potential for revenue support. Considerations are given to development within the existing landside area and expanding beyond to other undeveloped areas of the Airport. All landside alternatives for hangar and apron development exceed the forecast 20-year need.

AIRPORT ALTERNATIVE SUMMARY

Planning future development of both the airside and landside is important because individual actions taken in one area can impact the potential for other options in the future. Therefore, it is important to examine alternative development options in order to maximize a precious resource, which is land on an airport.

Several development alternatives related to both the airside and landside have been presented. The process utilized in assessing these alternatives involved a detailed analysis of short and long term requirements as well as future growth potential. After review and input from the PAC, airport management, City of Boulder City, and interested local citizens, a recommended development concept for Boulder City Municipal Airport to include a detailed capital improvement program and environmental overview will be presented in the next phase of this study.