Chapter Three

Facility Requirements

To properly plan for the future of Ryan Airfield, it is necessary to translate forecast aviation demand into the specific types and quantities of facilities that can adequately serve projected demand levels. This chapter uses the results of the forecasts prepared in Chapter Two, as well as established planning criteria, to determine the airfield (i.e., runways, taxiways, navigational aids, marking and lighting) and landside (i.e., hangars, general aviation terminal, aircraft parking apron, fueling, automobile parking and access) facility requirements.

The objective of this effort is to identify, in general terms, the adequacy of the existing airport facilities and outline what new facilities may be needed as well as when they 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 cost-effective and efficient means for implementation.

PLANNING HORIZONS

The 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. Thus, in order to develop a master plan that is demand-based rather than time-based, a series of planning horizon milestones have been established that take into consideration the reasonable range of aviation demand projections.

Over time, the actual activity at the airport may be higher or lower than

the annualized forecast portrays. By planning according to activity milestones, the resultant plan can accommodate unexpected shifts or changes in the aviation demand in a timely fashion. The demand-based schedule provides flexibility in development, as the schedule can be slowed or expedited according to actual demand at any given time over the planning period. The resultant plan provides airport officials with a financially responsible and needs-based program. **Table 3A** presents the planning horizon milestones for each activity demand category.

TABLE 3A
Aviation Demand Planning Horizons
Ryan Airfield

	2008	Short Term (± 5 Years)	Intermediate Term (± 10 Years)	Long Term (± 20 Years)
ANNUAL OPERATIONS				
General Aviation				
Itinerant	59,930	61,000	70,500	100,000
Local	104,262	107,000	119,500	150,000
Military	3,760	3,500	3,500	3,500
Total Operations	167,952	171,500	193,500	253,500
Based Aircraft	242	266	296	369

PEAKING CHARACTERISTICS

Airport capacity and facility needs analyses typically relate to the levels of activity during a peak or design period. The periods used in developing the capacity analyses and facility requirements in this study are as follows:

- **Peak Month** - The calendar month when peak volumes of aircraft operations occur.
- **Design Day** - The average day in the peak month. This indicator is easily derived by dividing the peak month operations by the number of days in a month.
- **Busy Day** - The busy day of a typical week in the peak month. This descriptor is used primarily to determine general aviation transient ramp space requirements.
- **Design Hour** - The peak hour within the design day.

It is important to note that only the peak month is an absolute peak within a given year. All other peak periods will be exceeded at various times during the year. However, they do represent reasonable planning standards that can be applied without overbuilding or being too restrictive.

General Aviation Itinerant Operations Peak Periods

General aviation itinerant peak operational characteristics were also included in this analysis. The current peak month for itinerant operations was determined to be at 11 percent of the annual itinerant operations. This ratio was kept constant through the planning period. Busy day operations were calculated at 1.3 times design day operations. This ratio can be expected to decline as activity increases and becomes more balanced throughout the week. Design hour operations were calculated at 16 percent of design day operations in 2008. This percentage can also be expected to decline slightly as activity increases over the long term. **Table 3B** summarizes the peak operations forecast for the airport.

TABLE 3B
Peaking Characteristics
Ryan Airfield

	2008	Short Term (± 5 Years)	Intermediate Term (± 10 Years)	Long Term (± 20 Years)
OPERATIONS				
Total Operations				
Annual	167,952	171,500	193,500	253,500
Peak Month	17,803	18,179	20,511	26,871
Design Day	574	586	662	867
Busy Day	747	751	834	1,075
Design Hour	93	94	103	113
Itinerant General Aviation Operations				
Annual	59,930	61,000	70,500	100,000
Peak Month	6,592	6,710	7,755	11,000
Design Day	213	216	250	355
Busy Day	276	277	315	440
Design Hour	34	32	35	46

AIRFIELD CAPACITY

Airfield capacity is measured in a variety of different ways. The **hourly capacity** measures the maximum number of aircraft operations that can take place in an hour. The **annual service volume (ASV)** is an annual level of service that may be used to define airfield capacity needs. **Aircraft delay** is the total delay incurred by aircraft using the airfield during a given timeframe. FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*, provides a methodology for examining the operational capacity of an airfield for planning purposes. This analysis takes into account specific factors about the airfield. These various factors are depicted in **Exhibit 3A**. The following describes the input factors as they relate to Ryan Airfield:

- **Runway Configuration** – The existing airfield layout consists of two parallel runways (6R-24L and 6L-24R) and a crosswind runway (15-33), which intersects the parallel runways. Each runway end is equipped with taxiway access and Runway 6R is equipped for instrument approaches.

- **Runway Use** – Runway 6R-24L has a length of 5,500 feet and Runway 6L-24R has a length of 4,900 feet. Crosswind Runway 15-33 has a length of 4,000 feet. A preferential runway use system is in place, but it is subject to wind and weather conditions. The preferred uses are east flow (arrivals and departures on Runways 6R & 6L) in the morning hours, and west flow (arrivals and departures on Runways 24L & 24R). The change from Runway 6 to Runway 24 is due to common shifts in wind conditions throughout the day. Crosswind Runway 15-33 is used when crosswind conditions occur.

- **Exit Taxiways** - Based upon mix, taxiways located between 2,000 and 4,000 feet from the landing threshold count in the exit rating for each runway. There are currently two exits available within this range for each runway. Therefore, the exit rating is two for all runways.

- **Weather Conditions** – The airport operates under visual meteorological conditions (VMC) 99 percent of the time. Instrument meteorological conditions (IMC) occur when cloud ceilings are between 500 and 1,000 feet and visibility is between one and three statute miles. This occurs one percent of the time. Poor visibility conditions (PVC) apply for minimums below 500 feet and one mile. PVC is negligible for this analysis.

- **Aircraft Mix** - Descriptions of the classifications and the percentage mix for each planning horizon are presented in **Table 3C**.

- **Percent Arrivals** - Generally follows the typical 50-50 percent split.

- **Touch-and-Go Activity** - Percentages of touch-and-go activity are presented in **Table 3C**.

- **Operational Levels -** Operational planning horizons were outlined in the previous section of this chapter. The peak month averages 10.6 percent of the year. The design hour averages 16.1 percent of the operations in a day.

TABLE 3C
Aircraft Operational Mix – Capacity Analysis
Ryan Airfield

Aircraft Classification	Base Year 2008	Short Term (± 5 Years)	Intermediate Term (± 10 Years)	Long Term (± 20 Years)
Classes A & B	99.0%	98.9%	98.6%	98.0%
Class C	1.0%	1.1%	1.4%	2.0%
Class D	0.0%	0.0%	0.0%	0%
Touch-and-Go's	55.2%	54.9%	54.8%	54.6%

Definitions:
Class A: Small single-engine aircraft with gross weight of 12,500 pounds or less.
Class B: Small twin-engine aircraft with gross weight of 12,500 pounds or less.
Class C: Large aircraft with gross weights over 12,500 pounds up to 300,000 pounds.
Class D: Large aircraft with gross weights over 300,000 pounds.

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Exhibit 3A
AIRFIELD CAPACITY FACTORS

HOURLY RUNWAY CAPACITY

The first step in determining overall airfield capacity involves the computation of the hourly capacity of each runway use configuration. Wind direction; the percentage use of each runway configuration in VFR, IFR, and PVC weather conditions; the amount of touch-and-go training activity; and the number and locations of runway exits become important factors in determining the hourly capacity of each runway configuration.

Considering the existing airfield configuration, the current aircraft mix, percentage of touch-and-go operations, and the exit taxiway ratings of each existing runway, the existing hourly capacity of each potential runway use configuration was computed. The existing maximum hourly capacity during VFR conditions totaled 270, while IFR operations totaled 137 operations per hour.

As indicated on **Table 3C**, the percentage of Class C aircraft can be expected to increase slightly through the long range planning horizon. This contributes to a slight decline in the hourly capacity over the long term planning horizon.

The weighted hourly capacity reflects the average capacity of the airfield taking into account VMC, IMC, and PVC conditions. The current and future weighted hourly capacities are depicted in **Table 3D**. At Ryan Airfield, the current weighted hourly capacity is 209.4 operations. This is expected to decline to 204.6 operations in the long term. This is still above the design hour demand of 192 operations expected in the long term.

TABLE 3D
Aircraft Operational Mix – Capacity Analysis
Ryan Airfield

	Base Year 2008	Short Term (± 5 Years)	Intermediate Term (± 10 Years)	Long Term (± 20 Years)
Operational Demand				
Annual	167,952	171,500	193,500	253,500
Design Hour	93	94	103	113
Capacity				
Annual Service Volume	380,000	381,000	391,000	460,000
Weighted Hourly Capacity	209.4	208.6	207.3	204.6
Percent Capacity	44.2%	45.0%	49.5%	55.1%
Delay				
Per Operation (Min.)	0.30	0.34	0.40	0.45
Total Annual (Hrs.)	800	1,000	1,300	1,900

ANNUAL SERVICE VOLUME

The weighted hourly capacity is utilized to determine the annual service volume in the following equation:

$$ASV = C \times D \times H$$

C = weighted hourly capacity;

D = ratio of annual demand to the average daily demand during the peak month; and

H = ratio of average daily demand to the design hour demand during the peak month.

The ratio of annual demand to average daily demand (D) at Ryan Airfield was determined to remain relatively constant in the future at 292. The ratio of average daily demand to average peak hour demand (H) was determined to currently be 6.20. This ratio will grow to 7.69 over the long term as peaks spread slightly with increased operations.

The current ASV was determined to be 380,000 operations. Slight changes in the weighted hourly capacity and in the daily and hourly demand ratios result in a slight increase in the ASV as activity increases. The ASV for the long term was calculated to be 460,000.

Annual operations for the long term planning horizon are 253,500, which would be 55.1 percent of the airport's ASV. **Table 3D** summarizes and compares the airport's ASV and projected annual operations over the planning horizons.

AIRCRAFT DELAY

As the number of annual aircraft operations approaches the airfield's capacity, increasing amounts of delay to aircraft operations begin to occur. Delays occur to arriving and departing aircraft in all weather conditions. Arriving aircraft delays result in aircraft holding outside the airport traffic area. Departing aircraft delays result in aircraft holding at the runway end until released by air traffic control.

Table 3D summarizes the aircraft delay analysis conducted for Ryan Airfield. The delay per operation represents an average delay per aircraft. It should be noted that delays of five to ten times the average could be experienced by individual aircraft during peak periods. Current total annual aircraft delay is 800 hours. As an airport's operations increase toward the annual service volume, delay increases exponentially. Analysis of delay factors for the long term planning horizon indicates that annual delay could potentially reach 1,900 hours.

CAPACITY ANALYSIS CONCLUSIONS

The current ASV was determined to be 380,000 operations. The current operational level represents 44 percent of the airfield's ASV. In the intermediate horizon, total operations are expected to represent 50 percent of ASV and 55 percent of annual service volume in the long term.

FAA Order 5090.3C, *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. Since the long-range operational forecast does not surpass the annual service volume level, improvements such as additional taxiway exits should provide adequate mitigation of aircraft delays and other congestion issues through the planning period.

CRITICAL AIRCRAFT

The selection of appropriate FAA design standards for the development and location of airport facilities is based primarily upon the characteristics of the aircraft which are currently using or are expected to use the airport. The critical design aircraft is defined as the most demanding category of aircraft, or family of aircraft, which conducts at least 500 itinerant operations per year at the airport. Planning for future aircraft use is of particular importance since design standards are used to plan separation distances between facilities. These future standards must be considered now to ensure that short term development does not preclude the long term potential needs of the airport.

The FAA has established a coding system to relate airport design criteria to the operational and physical characteristics of aircraft expected to use the airport. This airport reference code (ARC) has two components: the first component, depicted by a letter, is the aircraft approach category and relates to aircraft approach speed (operational characteristic); the second component, depicted by a Roman numeral, is the airplane design group and relates to aircraft wingspan (physical characteristic). Generally, aircraft approach speed applies to runways and runway-related facilities, while airplane wingspan primarily relates to separation criteria involving taxiways, taxilanes, and landside facilities.

According to FAA Advisory Circular (AC) 150/5300-13, *Airport Design*, an aircraft's approach category is based upon 1.3 times its stall speed in landing configuration at that aircraft's maximum certificated weight. The five approach categories used in airport planning are as follows:

Category A: Speed less than 91 knots.

Category B: Speed 91 knots or more, but less than 121 knots.

Category C: Speed 121 knots or more, but less than 141 knots.

Category D: Speed 141 knots or more, but less than 166 knots.

Category E: Speed greater than 166 knots.

The airplane design group (ADG) is based upon the aircraft's wingspan. The six ADGs used in airport planning are as follows:

Group I: Up to but not including 49 feet.

Group II: 49 feet up to but not including 79 feet.

Group III: 79 feet up to but not including 118 feet.

Group IV: 118 feet up to but not including 171 feet.

Group V: 171 feet up to but not including 214 feet.

Group VI: 214 feet or greater.

Exhibit 3B summarizes representative aircraft by ARC.

The FAA advises designing airfield facilities to meet the requirements of the airport's most demanding aircraft, or critical aircraft. An aircraft or group of aircraft within a particular Approach Category or ADG must conduct more than 500 operations annually to be considered the critical design aircraft. In order to determine facility requirements, an ARC should first be determined, and then appropriate airport design criteria can be applied. This begins with a review of aircraft currently using the airport and those expected to use the airport through the planning period.

Ryan Airfield is currently used by a variety of general aviation aircraft. General aviation aircraft using the airport include single and multi-engine aircraft less than 12,500 pounds, which fall within Approach Categories A and B and ADG I. Occasionally, aircraft in ADG II use the airport (such as the Beechcraft King Air 300 and the Cessna Citation 560). Turbojet aircraft currently use the airport on an infrequent basis. A review of completed instrument flight plans for calendar years 2004, 2005, 2006, and through November of 2007, reveal that turbojet aircraft averaged less than 31 operations annually during this period.

All based aircraft currently fall within ARC A-I and ARC B-I. Representative based aircraft include single-engine Cessna aircraft, although numerous other aircraft makes and models are based at the airport. McDonald Douglas C-54s are also based at Ryan Airfield however ARDCO, the operator of the C-54, has plans to eliminate its use at Ryan Airfield in the near future.

The aviation demand forecasts projected the mix of aircraft to use the airport to consist of mainly the single-engine and multi-engine piston-powered aircraft which fall within Approach Categories A and B and ADGs I and II. The turboprop aircraft projected to base at the airport in the future would also fall within similar categories. While ten turbojet aircraft are projected to base at the airport by the end of the planning period, business jet aircraft can include a wide range of Approach Categories and ADGs. The newest microjets being developed fall within ARC A-I. The most common business jet in use today, the Cessna Citation, falls within ARC B-II. Some larger business jets fall within ARCs C-I, C-II, D-I, and D-II.

As the community develops towards Ryan Airfield, business jet use of the airport is expected to increase in the future, and it can be anticipated that aircraft in Approach Category C or D will conduct 500 or more annual oper-

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A-I

- Beech Baron 55
- Beech Bonanza
- Cessna 150
- Cessna 172
- Cessna Citation Mustang
- **Eclipse 500**
- Piper Archer
- Piper Seneca

C-I, D-I

- Beech 400
- **Lear** 25, 31, **35**, 45, 55, 60
- Israeli Westwind
- HS 125-400, 700

B-I *less than 12,500 lbs.*

- Beech Baron 58
- Beech King Air 100
- Cessna 402
- **Cessna 421**
- Piper Navajo
- Piper Cheyenne
- Swearingen Metroliner
- Cessna Citation I

C-II, D-II

- Cessna Citation III, VI, VIII, X
- **Gulfstream** II, III, **IV**
- Canadair 600
- ERJ-135, 140, 145
- CRJ-200, 700, 900
- Embraer Regional Jet
- Lockheed JetStar
- Super King Air 350

B-II *less than 12,500 lbs.*

- **Super King Air 200**
- Cessna 441
- DHC Twin Otter

C-III, D-III

- ERJ-170, 190
- Boeing Business Jet
- B 727-200
- **B 737-300 Series**
- MD-80, DC-9
- Fokker 70, 100
- A319, A320
- Gulfstream V
- Global Express

B-I, B-II *over 12,500 lbs.*

- Super King Air 300
- Beech 1900
- Jetstream 31
- Falcon 10, 20, 50
- Falcon 200, 900
- **Citation II**, III, IV, V
- Saab 340
- Embraer 120

C-IV, D-IV

- **B-757**
- B-767
- C-130
- DC-8-70
- DC-10
- MD-11
- L1011

A-III, B-III

- DHC Dash 7
- **DHC Dash 8**
- DC-3
- Convair 580
- Fairchild F-27
- ATR 72
- ATP

D-V

- **B-747** Series
- B-777

Note: Aircraft pictured is identified in bold type.

RYAN AIRFIELD
TUCSON AIRPORT AUTHORITY

Exhibit 3B
AIRPORT REFERENCE CODES

ations at the airport. The previous master plan established the ARC B-III/D-II design standards for the airport to accommodate the C-54, and in anticipation of faster business jet aircraft. With the departure of the C-54 aircraft, the focus for airfield development should be on meeting the needs of business jet aircraft. The current airfield is designed to ARC B-II standards. This Master Plan recognizes the potential for growth in business jet operations during the period of this Master Plan. Therefore, even though the majority of based aircraft are expected to fall within ARC B-II or below in the future, Ryan Airfield should establish and maintain ARC D-II design standards through the planning period.

AIRFIELD REQUIREMENTS

The analyses of the operational capacity and the critical design aircraft are used to determine airfield needs. This includes runway configuration, dimensional standards, and pavement strength, as well as navigational aids and lighting.

RUNWAY CONFIGURATION

Key considerations in the runway configuration of an airport involve the orientation for wind coverage and the operational capacity of the runway system. The airfield capacity analysis indicated that additional airfield capacity will not need to be considered through the long-term planning horizon.

FAA Advisory Circular 150/5300-13, *Airport Design,* recommends that a crosswind runway should be made available when the primary runway orientation provides less than 95 percent wind coverage for any aircraft forecast to use the airport on a regular basis. The 95 percent wind coverage is computed on the basis of the crosswind component not exceeding 10.5 knots (12 mph) for ARC A-I and B-I; 13 knots (15 mph) for ARC A-II and B-II; 16 knots (18 mph) for ARC A-III, B-III, and C-I through D-II; and 20 knots (23 mph) for ARC C-III through D-IV.

Ten years of accumulated wind data were not available for this study; therefore, wind data collected from Tucson International Airport was used to produce a wind rose for Ryan Airfield. The most recent ten years of wind data from Tucson International Airport at the time of this analysis was 1997-2006. This data is graphically depicted on the wind rose in **Exhibit 3C**.

Runway 6-24 provides 94.5 percent coverage for 10.5 knot crosswinds, 97.4 percent coverage for 13 knot crosswinds, 99.4 percent coverage for 16 knot crosswinds, and 99.9 percent coverage for 20 knot crosswinds. Based on this data, the primary and parallel runway system does not meet the 95 percent wind coverage standard for all aircraft using the airport; therefore, the crosswind runway is necessary at Ryan Airfield for small aircraft in approach categories A and B.

The crosswind runway provides 92.1 percent coverage for 10.5 knot crosswinds, 95.7 percent coverage for 13 knot crosswinds, 98.7 percent coverage for 16 knot crosswinds, and 99.8 percent coverage for 20 knot crosswinds. Combined, Runways 6-24 and 15-33 provide 98.5 percent coverage for 10.5 knot crosswinds, 99.6 percent coverage for 13 knot crosswinds, 99.9 percent coverage for 16 knot crosswinds, and 99.9 percent coverage for 20 knot crosswinds. Thus, the existing runway configuration has adequate wind coverage for all sizes and speeds of aircraft.

RUNWAY DIMENSIONAL REQUIREMENTS

Runway dimensional standards include the length and width of the runway, as well as the dimensions associated with runway safety areas and other clearances. These requirements are based upon the design aircraft, or group of aircraft. The runway length must consider the performance characteristics of individual aircraft types, while the other dimensional standards are generally based upon the most critical airport reference code expected to use the runway. Dimensional standards are outlined for the planning period for the primary, parallel, and crosswind runways.

Runway Length

The aircraft performance capability is a key factor in determining the runway length needed for takeoff and landing. The performance capability and, subsequently, the runway length requirement of a given aircraft type can be affected by the elevation of the airport, the air temperature, the gradient of the runway, and the operating weight of the aircraft.

The airport elevation at Ryan Airfield is 2,417 feet above mean sea level (MSL). The mean maximum daily temperature during the hottest month is 99.6 degrees Fahrenheit. The gradient for the primary runway is 0.08 percent.

Table 3E outlines the runway length requirements for various classifications of general aviation aircraft specific to Ryan Airfield. These were derived utilizing the FAA Airport Design Computer Program. This program uses performance figures provided in AC 150/5325-4B, *Runway Length Requirements for Airport Design*. These runway lengths are based upon groupings or "families" of aircraft. As discussed earlier, the runway design required should be based upon the most critical family of aircraft with at least 500 annual operations.

Small aircraft are defined as aircraft weighing 12,500 pounds or less. Small airplanes make up the vast majority of general aviation activity at Ryan Airfield and most other general aviation airports. In particular, piston-powered aircraft make up the majority of the small airplane operations.

According to the table, the present primary runway length of 5,500 feet is adequate to accommodate all small airplanes with 10 or more passenger seats and 75 percent of large airplanes at 60 percent useful load. This includes all small aircraft in the ARC B-II category and some business jet aircraft. Future fleet mix is anticipated

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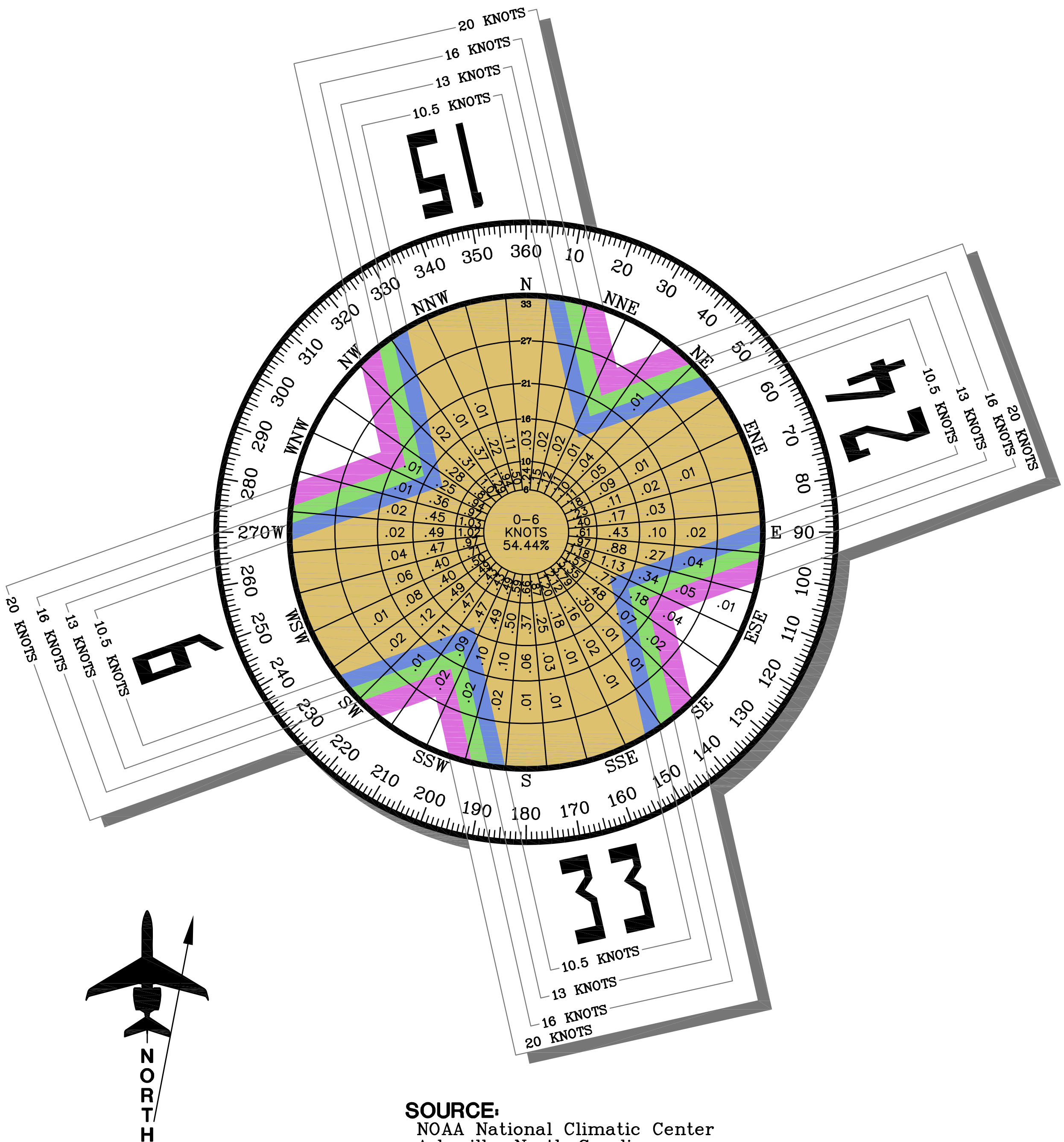
ALL WEATHER WIND COVERAGE

Runways	10.5 Knots	13 Knots	16 Knots	20 Knots
Runway 6–24	*94.47%*	*97.36%*	*99.43%*	*99.88%*
Runway 15–33	*92.10%*	*95.65%*	*98.72%*	*99.75%*
Combined	*98.47%*	*99.58%*	*99.92%*	*99.99%*



Magnetic Variance
10° 51' East (November 2007)
Annual Rate of Change
00° 06' West (November 2007)

SOURCE:
NOAA National Climatic Center
Asheville, North Carolina
Tucson International Airport (TUS)
Tucson, Arizona

OBSERVATIONS:
78,630 All Weather Observations
1997–2006

TUCSON AIRPORT AUTHORITY

Exhibit 3C
WINDROSE

to include more business jet airplanes that fall in the large airplane category. To accommodate a larger portion of the business jet fleet at 60 percent useful load, a runway length of 7,200 feet is needed. Aircraft that would be able to operate at the airfield with this runway length include Gulfstream business jets and Bombardier Challenger series business jets. Longer haul business jet operations to the east coast would require business jets to carry larger fuel loads. A runway length of 8,300 feet is recommended for 75 percent of large airplanes at 90 percent useful load. Based on the demand of the future critical aircraft to be able to conduct operations to any part of the country from Ryan Airfield, the primary runway length should be planned to an ultimate length of 8,300 feet.

TABLE 3E
General Aviation Runway Length Requirements
Ryan Airfield

AIRPORT AND RUNWAY DATA	
Airport elevation	2,417 feet
Mean daily maximum temperature of the hottest month	99.6 F
Maximum difference in runway centerline elevation	5 feet
RUNWAY LENGTHS RECOMMENDED FOR AIRPORT DESIGN	
Small airplanes with less than 10 passenger seats	
75 percent of these small airplanes	3,500 feet
95 percent of these small airplanes	4,300 feet
100 percent of these small airplanes	**4,800 feet**
Small airplanes with 10 or more passenger seats	5,000 feet
Large airplanes of 60,000 pounds or less	
75 percent of these large airplanes at 60 percent useful load	5,500 feet
100 percent of these large airplanes at 60 percent useful load	7,200 feet
75 percent of these large airplanes at 90 percent useful load	**8,300 feet**
100 percent of these large airplanes at 90 percent useful load	10,400 feet

Chapter Two of AC 150/5325-4B, *Runway Length Requirements for Airport Design*, no changes included.

The parallel runway provides the airfield with additional capacity. To do this effectively, the parallel runway should be capable of serving at least 90 percent of the operational fleet mix at the airport. Comparing to **Table 3E**, the present runway length of 4,900 feet can accommodate 100 percent of the small airplane fleet. The critical aircraft anticipated to use the parallel runway through the planning period should remain within the small airplane category. Therefore, the present runway length of 4,900 feet should be maintained through the long-term planning horizon.

The crosswind runway was constructed to meet crosswind demands at the airport. Its present length is 4,000 feet. A runway length of 4,800 feet will meet the needs of 100 percent of small airplanes with less than 10 passenger seats. FAA Advisory Circular 150/5325-4A, *Runway Length Requirements for Airport Design,* suggests that a crosswind runway should have a length of at least 80 percent of the design length. The 4,000-foot runway length meets this rule-of-thumb criterion; however, the long-term plan for the crosswind runway should be to extend it 800 feet to meet the 4,800-foot design standard.

Pavement Strength

An important feature of airfield pavement is the ability to withstand repeated use by aircraft of significant weight. Runways 6R-24L and 6L-24R are both strength-rated at 12,500 pounds single wheel loading (SWL) and 30,000 pounds dual wheel loading (DWL). The crosswind runway is strength rated at 12,500 pounds SWL. Future design aircraft such as the Gulfstream IV, can weigh up to 75,000 pounds on dual wheel gear. Based on anticipated design aircraft the primary runway pavement strength should be planned to 75,000 pounds DWL in the long-term.

The parallel runway should be planned to accommodate at least 90 percent of the airport's operational fleet mix. At 12,500 pounds SWL, the parallel runway pavement strength will be adequate through the planning period. The crosswind runway is needed almost exclusively for small aircraft only. A 12,500-pound design strength should be adequate through the planning period.

Dimensional Design Standards

Runway dimensional design standards define the widths and clearances required to optimize safe operations in the landing and takeoff areas. These dimensional standards vary depending upon the ARC for the runway. **Table 3F** outlines key dimensional standards for the airport reference codes most applicable to Ryan Airfield, both now and in the future.

The primary runway currently meets ARC B-II design requirements. The primary runway should be planned to meet and maintain its critical ARC, which is D-II through the long-range planning horizon. The parallel runway currently meets ARC B-II design requirements, which should be maintained through the planning period. The crosswind runway serves primarily small airplanes, therefore it should maintain ARC B-I small airplanes exclusive design standards through the planning period.

The following considers those areas where standards will need to be met for each runway:

Runway Width – The current width of each runway (75 feet) meets the 75-foot design requirement for ARC B-II. The primary runway will need to be widened to 100 feet to meet D-II design requirements.

Runway Safety Area – The runway safety area (RSA) is defined in FAA Advisory Circular 150/5300-13, *Airport Design*, as a surface surrounding the runway, prepared or suitable for reducing the risk of damage to airplanes in the event of an overshoot, undershoot, or excursion from the runway. The RSA is centered on the runway and extends beyond either end. The FAA requires the RSA to be cleared and graded, drained by grading or storm sewers, capable of accommodating fire and rescue vehicles, and free of obstacles not fixed by navigational purposes.

The RSA standard for Category D-II aircraft is 500 feet wide and extends 1,000 feet beyond each runway end. The existing airport layout should allow these standards to be met without affecting any existing airport facilities. Land beyond the primary runway ends will need to be graded to meet the extended RSA design standards.

The parallel and crosswind runways currently meet ARC B-II design requirements. These RSAs should be maintained through the planning period.

TABLE 3F
Airfield Design Standards
Ryan Airfield

Airport Reference Code	Available Primary Runway (ft.)	Available Parallel & Crosswind (ft.)	B-II (Small Airplane Only) (ft.)	B-II ¾-Mile Visibility (ft.)	D-II ½-Mile Visibility (ft.)
Runway Width	75	75	75	75	100
Runway Safety Area					
Width	300	150	150	150	500
Length Beyond End	300	300	300	300	1,000
Runway Object Free Area					
Width	500	500	500	500	800
Length Beyond End	300	300	300	300	1,000
Runway Centerline to:					
Holding Position	200/150	125	125	200	275
Parallel Taxiway	300	240	240	240	425
Parallel Runway	700	700	700	700	700
Taxiway Width	50	35	35	35	35
Taxiway Centerline to:					
Fixed or Movable Object	93	65.5	65.5	65.5	65.5
Parallel Taxilane	152	105	105	105	105
Taxilane Centerline to:					
Fixed or Movable Object	57.5	57.5	57.5	57.5	57.5
Parallel Taxilane	140	97	97	97	97
Runway Protection Zones - One mile or greater visibility					
Inner Width	500	250	250	500	500
Length	1,000	1,000	1,000	1,000	1,700
Outer Width	700	450	450	700	1,010
Not Lower than ¾-Mile					
Inner Width	N/A	N/A	1,000	1,000	1,000
Length	N/A	N/A	1,700	1,700	1,700
Outer Width	N/A	N/A	1,510	1,510	1,510
Lower than ½-Mile					
Inner Width	N/A	N/A	1,000	1,000	1,000
Length	N/A	N/A	2,500	2,500	2,500
Outer Width	N/A	N/A	1,750	1,750	1,750

Runway Object Free Area – The object free area (OFA) is an area centered on the runway to enhance the safety of aircraft operations by having an area free of objects, except for objects that need to be located in the OFA for air navigation or ground maneuvering purposes. The OFA must provide clearance of all ground-based objects protruding above the runway safety area (RSA) edge elevation, unless the object is fixed by a function serving air or ground navigation.

For ARC B-II, the OFA extends 300 feet beyond the runway end and has a width of 500 feet. OFA design standards for ARC D-II extend 1,000 feet beyond the runway end and 800 feet in width. The primary runway will need to extend this safety area to the full ARC D-II design standards in the future.

The parallel and crosswind runways meet ARC B-II design requirements for the OFA at 500 feet wide and 300 feet beyond the runway end. These design requirements should be maintained through the planning period.

Aircraft Holding Positions – The current hold positions for the primary runway are marked 200 feet from the runway centerline on Taxiway B6 and on Runway 15-33, where it intersects with the end of Runway 6R. This 200-foot separation meets the standard for ARC B-II runways. On all other exit taxiways from the primary runway, the hold positions are marked 150 feet from the runway centerline, which exceeds the standard for ARC B-II small airplanes but does not meet the 200-foot separation standards for aircraft over 12,500 pounds. The separation standard for ARC D-II is 250 feet with an additional foot added for each 100 feet the airport's elevation is above sea level resulting in a separation distance of 275 feet. The holding positions for the parallel and crosswind runways are marked at 125 feet from the runway centerline. This meets small aircraft exclusive design requirements.

Runway Protection Zone – The runway protection zone (RPZ) is an area off the runway end that enhances the protection of people and property on the ground. This is best achieved through airport owner control over the RPZs. Such control includes maintaining RPZ areas clear of incompatible objects and activities.

The RPZ is trapezoidal in shape and is centered on the extended runway centerline. The dimensions of the RPZ are a function of the critical aircraft and the approach visibility minimums associated with the runway. Runway 6R is currently equipped with an instrument landing system (ILS) approach with approach visibility minimums that are not lower than one mile. The existing RPZ on the Runway 6R end currently meets design requirements for this type of instrument approach. The RPZ on the Runway 24L end meets ARC B-II one mile or greater visibility design standards. The RPZs on the parallel runway meet design standards for greater than one mile visibility for an ARC B-II runway. The RPZs on the crosswind runway meet design standards for greater than one mile visibility for an ARC B-II small airplanes only runway.

Table 3F depicts the RPZ requirements for runway ends equipped with low-visibility instrument approach procedures. Based upon the capabilities of any instrument approach procedures developed in the future, the RPZs for each runway end would become larger in the future if instrument approach procedures had visibility minimums less than one mile.

TAXIWAY REQUIREMENTS

Taxiways are constructed primarily to facilitate aircraft movements to and from the runway system. Some taxiways are necessary simply to provide access between the aprons and runways, whereas other taxiways become necessary as activity increases at an airport to provide safe and efficient use of the airfield.

As detailed in Chapter One, each runway is served by a full-length parallel taxiway. **Table 3F** outlines the runway-to-taxiway centerline separation standards for ARCs B-II and D-II. Taxiway B currently meets ARC B-II design standards; however, when ARC D-II design standards are implemented, the taxiway separation standard extends to 425 feet taking the airport elevation into account. Taxiways A, D, and E currently meet ARC B-II separation standards.

Bottlenecks can occur near the takeoff end of a runway when a preceding aircraft is not ready to takeoff and blocks the access taxiway for the aircraft next in line. This can be a common occurrence at airports such as Ryan Airfield where there is a high amount of training activity. Holding bays provide flexibility in ground circulation by permitting departing aircraft to maneuver around an aircraft that is not ready to depart. Holding bays are recommended when runway operations exceed 30 per hour. Holding bays are currently available at each end of the parallel and crosswind runways.

Presently, it is not uncommon for several of the holding bays to become overcrowded which causes heavy two-way traffic congestion between the terminal area and the runway system. To alleviate some of these circulation issues, it is recommended that dual taxiways be included in the short range planning horizon.

Exit taxiways provide a means to enter and exit the runways at various points on the airfield. The type and number of exit taxiways can have a direct impact on the capacity and efficiency of the airport as a whole. The primary runway has a total of five exit taxiways. Exit taxiways are effective when planned at least 800 feet apart. Taxiways B3 and B4 are separated by 600 feet; therefore, the five exit taxiways are essentially equivalent to four. The parallel and crosswind runways both have three exit taxiways. Exit Taxiways D2 and B for Runway 15-33 are separated by 430 feet. Right-angled exits require an aircraft to be nearly stopped before it can safely exit the runway. Angled exits (high-speed exits) allow aircraft to use a higher safe exit speed while exiting the runway. Potential locations for new exit taxiways that may improve capacity or efficiency will be examined in Chapter Four, Alternatives.

Dimensional standards for the taxiways are depicted on **Table 3F**. Taxiway width and clearance standards are based upon the ADG for a particular runway or taxiway. Taxiway B currently exceeds ADG II width standards, and Taxiway A and D currently meets ADG II standards.

NAVIGATIONAL AIDS AND INSTRUMENT APPROACH PROCEDURES

Navigational Aids

Navigational aids are electronic devices that transmit radio frequencies which properly equipped aircraft and pilots translate into point-to-point guidance and position information. The very high frequency omnidirectional range (VOR), Global Positioning System (GPS), non-directional beacon (NDB), and LORAN-C are available for pilots to navigate to and from Ryan Airfield. These systems are sufficient for navigation to and from the airport; therefore, no other navigational aids are needed at the airport.

Instrument Approach Procedures

Instrument approach procedures consist of a series of predetermined maneuvers established by the FAA for navigation during inclement weather conditions. Currently, there are two established instrument approach procedures for Ryan Airfield. Due to 99 percent VFR weather, the demand for instrument approaches is based primarily on training activity. The best minimums to Ryan Airfield are provided by the ILS approach to Runway 6R. This approach provides weather minimums down to 250-foot AGL cloud ceilings and one mile visibility for Approach Categories A to D. To acquire Category I minimums of one-half mile visibility would require the installation of a medium intensity approach lighting system with runway alignment indicator lights (MALSR). This should be a consideration in the long-term planning horizon.

A GPS modernization effort is underway by the FAA and focuses on augmenting the GPS signal to satisfy requirements for accuracy, coverage, availability, and integrity. For civil aviation use, this includes the continued development of the Wide Area Augmentation System (WAAS), which was initially launched in 2003. The WAAS uses a system of reference stations to correct signals from the GPS satellites for improved navigation and approach capabilities. Where the non-WAAS GPS signal provides for enroute navigation and limited instrument approach (lateral navigation) capabilities, WAAS provides for approaches with both course and vertical navigation. This capability was historically only provided by an instrument landing system (ILS), which requires extensive on-airport facilities. The WAAS upgrades are expected to allow the development of approaches to most airports with cloud ceilings as low as 200 feet above the ground and visibilities restricted to one-half mile, after 2015.

Nearly all new instrument approach procedures developed in the United States are being developed with GPS. GPS approaches are currently categorized as to whether they provide only lateral (course) guidance or a combination of lateral and vertical (descent) guidance. An approach procedure with vertical guidance (APV), GPS approach provides both course and descent guidance. A lateral navigation approach (LNAV) only provides course guidance. In the future, as WAAS is upgraded, precision approaches similar in capability to the existing ILS will become available. These approaches are currently categorized as the Global Navigation Satellite System Landing System (GLS). A GLS approach may be able to provide for approaches with one-half-mile visibility and 200-foot cloud ceilings. A GLS would be implemented in lieu of an ILS approach.

Since both course guidance and descent information is desirable for an instrument approach to Ryan Airfield and GPS does not require the installation of costly navigation equipment at the airport, a GLS should be planned to the Runway 24L end. APV approaches may be considered for the parallel and crosswind runways to provide one mile visibility minimums.

AIRFIELD LIGHTING, MARKING, AND SIGNAGE

There are a number of lighting and pavement marking aids serving pilots using Ryan Airfield. These lighting and marking aids assist pilots in locating the airport during night or poor weather conditions, as well as assist in the ground movement of aircraft.

Identification Lighting

The location of an airport at night is universally indicated by a rotating beacon. The rotating beacon at the airport is located on top of the airport traffic control tower (ATCT). The rotating beacon is sufficient and should be maintained through the planning period.

Runway and Taxiway Lighting

The medium intensity runway edge lighting (MIRL) currently available along the primary runway will be adequate for the planning period. The parallel and crosswind runways should each have MIRL systems installed during the planning period. Entrance/exit Taxiways B2, B3, B4, B5, and B6 are equipped with medium intensity taxiway lighting (MITL). In the short term, MITL should be planned for the full-length of all existing taxiways. All future taxiway construction should include the installation of MITL.

Airfield Signs

Airfield signage assists pilots in identifying their location on the airport. Signs located at intersections of taxiways provide crucial information to avoid conflicts between moving aircraft and potential runway incursions. Directional signage also instructs pilots as to the location of taxiways and apron areas. The existing unlit directional signage should be lighted during the planning period.

Visual Approach Lighting

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. Runway 24L is currently equipped with a visual approach slope indicator (VASI-4). This lighting system should be upgraded to a precision approach path indicator (PAPI-4) lighting system to better serve larger aircraft. PAPI-4s should be planned for all other runway ends.

Approach and Runway End Identification Lighting

Runway end identifier lights (REILs) are flashing lights located at each runway end that facilitate identification of the runway end at night and during poor visibility conditions. REILs provide pilots with the ability to identify runway ends and distinguish the runway end lighting from other lighting on the airport and in the approach areas. REILs are installed at the end of Runway 6R. These lighting aids should be maintained through the planning period. REILs should also be planned at the end of Runway 24L, and at both ends of the parallel and crosswind runways.

Distance Remaining Signs

Distance remaining signage should be planned for the primary runway. These lighted signs are placed in 1,000-foot increments along the runway to notify pilots of the length of runway remaining.

Pilot-Controlled Lighting

Ryan Airfield is equipped with pilot-controlled lighting (PCL). PCL allows pilots to control the intensity of the runway lighting using the radio transmitter in the aircraft. PCL also provides for more efficient use of airfield lighting energy. A PCL system turns the airfield lights off or to a lower intensity when not in use. Similar to changing the intensity of the lights, pilots can turn up the lights using the radio transmitter in the aircraft. This system should be maintained through the planning period. Any future taxiway lighting and visual approach lighting should be added to the PCL system.

Pavement Markings

In order to facilitate the safe movement of aircraft about the field, airports use pavement markings, lighting, and signage to direct pilots to their destinations. Runway markings are designed according to the type of instrument approach available on the runway. FAA Advisory Circular 150/5340-1H, *Marking of Paved Areas on Airports*, provides the guidance necessary to design airport markings.

The primary runway currently has precision markings on the Runway 6R end, and basic markings on the Runway 24L end. Precision runway markings identify the runway centerline, threshold, designation, touchdown point, aircraft holding positions, and provide side strips. The basic markings identify the runway centerline, aiming point, and designation. Precision markings should be added to the Runway 24L end when a GLS approach is implemented for that runway. The parallel and crosswind runways are currently marked with basic markings. The parallel and crosswind runways should be planned for non-precision markings to accommodate the planned GPS APV approaches.

Holdlines need to be marked on all taxiways connecting to the runway. The holdlines for the primary runway are currently required to be placed 200 feet from the runway centerline. The parallel and crosswind runways have holdline markings placed 125 feet from the runway centerline which meets small airplane only design standards. These markings assist in reducing runway incursions as aircraft must remain behind the holdline until taking the active runway for departure. As it was discussed previously, the holdlines for the primary runway will need to be relocated to meet ARC D-II separation standards.

Taxiway and apron areas also require marking to assure that aircraft remain on the pavement and clear of any objects located along the taxiway/taxilane. Yellow centerline stripes are currently painted on all taxiway and apron surfaces at the airport to provide assistance to pilots in taxiing along these surfaces at the airport. Besides routine maintenance, these markings will be sufficient through the planning period.

HELIPADS

The airport does not have a designated helipad. Helicopters utilize the same areas as fixed-wing aircraft. Helicopter and fixed-wing aircraft should be segregated to the extent possible. Facility planning should include establishing a designated transient helipad at the airport. Lighting should be provided to allow safe operation to the helipad at night.

WEATHER REPORTING

The airport has a lighted wind cone that provides pilots with information about wind conditions. A segmented circle provides traffic pattern information to pilots. These facilities are sufficient and should be maintained in the future.

The airport is equipped with an AWOS. The AWOS provides automated weather observations 24 hours per day. The system updates weather observations every minute, continuously reporting significant weather changes as they occur. The AWOS reports cloud ceiling, visibility, temperature, dew point, wind direction, wind speed, altimeter setting (barometric pressure), thunderstorm activity, and density altitude (airfield elevation corrected for temperature). The AWOS is sufficient and should be maintained through the planning period.

REMOTE COMMUNICATIONS FACILITIES

Ryan Airfield is currently equipped with a remote transmitter receiver (RTR). An RTR provides pilots with a direct communication link to the Albuquerque Air Route Traffic Control Center. This communication link facilitates the opening and closing of flight plans. This RTR should be maintained through the planning period.

AIRPORT TRAFFIC CONTROL

Ryan Airfield is presently equipped with an ATCT operated on a contract basis. The existing tower is undersized and needs to be expanded in the short horizon to provide adequate office space. Ultimately, a new ATCT will need to be considered to meet the long term needs of the airport. Currently, the ATCT is in operation between the hours of 6:00 a.m. and 8:00 p.m. As activity increases, particularly in late night or evening hours, the operational hours of the ATCT may need to be extended.

LANDSIDE FACILITIES

Landside facilities are those necessary for handling general aviation aircraft and passengers while on the ground. This section is devoted to identifying future landside facility needs during the planning period for the following types of facilities normally associated with general aviation terminal areas:

- Hangars
- Aircraft Parking Apron
- General Aviation Terminal Services
- Support Requirements

HANGARS

The demand for hangar facilities typically depends on the number and type of aircraft expected to be based at the airport. Hangar facilities are generally classified as T-hangars and conventional hangars. Conventional hangars can include individual hangars (executive hangars) or multi-aircraft hangars. These different types of hangars offer varying levels of privacy, security, and protection from the elements.

Demand for hangars varies with the number of aircraft based at the airport. Another important factor is the type of based aircraft. Smaller single-engine aircraft usually prefer T-hangars, while larger, more expensive and sophisticated aircraft will prefer conventional hangars. The weather also plays a role in the demand for hangar facilities. The hot summers that are experienced in the Tucson area create a high demand for enclosed or shaded parking spaces. Rental costs will also be a factor in the choice.

Surveys of Ryan Airfield based aircraft owners indicated that the hangar type most in demand at Ryan Airfield are executive box hangars followed closely by T-hangars. It was also indicated that most based aircraft owners that presently store their aircraft on an uncovered tie-down spot desire T-hangar facilities more than any other aircraft storage type.

Ryan Airfield has two T-hangar storage facilities, providing 30 storage units. T-hangar space available at the airport totals approximately 54,000 square feet for aircraft storage. A planning standard of 1,200 square feet per based aircraft stored in T-hangars was used. Analysis of future T-hangar requirements, as depicted on **Table 3G**, indicates that additional T-hangar positions are needed currently, and will be needed as the number of based aircraft grows.

TABLE 3G
Hangar Storage Requirements
Ryan Airfield

	Available	Current Need	Short Term	Intermediate Term	Long Term
BASED AIRCRAFT					
Piston		236	255	280	341
Turbine		3	7	11	22
Rotor		3	4	5	6
Total		242	266	296	369
AIRCRAFT TO BE HANGARED					
Piston		214	225	257	319
Turbine		3	7	11	22
Rotor		3	4	5	6
Total		220	236	273	347
HANGAR POSITIONS					
T-Hangar	30	36	46	60	78
Shade Hangar[1]	64	50	54	58	71
Executive/Conventional	157	133	136	155	198
Total Hangar Positions	251	220	236	273	347
HANGAR AREA REQUIREMENTS (s.f.)					
T-Hangar	54,000	43,700	55,400	71,800	94,200
Shade Hangar	37,800	29,600	31,800	34,400	41,700
Executive/Conventional	343,030	202,600	211,400	243,300	318,500
Total Hangar Area	434,830	275,900	298,600	349,500	454,400
Maintenance Hangars	44,000	42,350	46,550	51,800	64,575

[1] Nose shade hangars are considered tie-downs and are not included here.

There are currently 157 conventional/executive general aviation hangar positions on the airport, totaling approximately 343,030 square feet. This type of hangar is typically used to store multiple single-engine aircraft or one or more corporate aircraft. Currently, more than 50 percent of based aircraft are stored in conventional or executive hangars. Based on the Ryan Airfield general aviation user surveys, the demand for conventional and executive hangars is already high and will increase as based aircraft grows over the planning period. Conventional/executive hangar space will need to be planned to at least accommodate the turbine aircraft, as well as a large segment of the piston aircraft forecast to base at Ryan Airfield. For conventional/executive hangars, a planning standard of 1,500 square feet for piston and rotary aircraft was used, while 2,500 square feet per turbine aircraft was used.

There is currently no full-service fixed base operator (FBO) on the airport. The based aircraft owners survey indicated the highest priority improvement for the airport is a FBO and aircraft maintenance services. Some FBO-related services are provided through the specialty operators on the airport.

Requirements for maintenance and FBO hangar area were estimated at 175 square feet per based aircraft. **Table 3G** compares the existing hangar space to the future hangar requirements. It is evident from the table that there is a need for additional enclosed hangar storage space throughout the planning period.

AIRCRAFT PARKING APRON

A parking apron should be provided for at least the number of locally based aircraft that are not stored in hangars, as well as be capable of accommodating transient aircraft during the busy day of the peak month. The north apron, south apron, and the flight school apron currently provide approximately 63,400 square yards of total apron. The 6,055 square-yard apron area north of the Vista West hangars, which include 16 tiedown spots and 15 nose shades, are also included in the local ramp positions. There are an additional five aircraft tiedown positions north of the flight school hangar facilities on approximately 1,044 square yards of apron.

The Ryan Airfield based aircraft owner survey indicated that only three percent of based aircraft owners prefer ramp storage over hangar storage. Currently, approximately nine percent of Ryan Airfield aircraft owners utilize tiedowns for aircraft storage. The number of local tiedowns needed through the planning period was determined based on increasing the current level slightly through the short term to take into account based aircraft owners who may decide to pay cheaper storage rates on the ramp as opposed to a hangar, then a gradual decrease through the long term.

TABLE 3H
General Aviation Apron Requirements
Ryan Airfield

	Available	Current Need	Short Term	Intermediate Term	Long Term
Based Aircraft in Tiedowns		22	30	23	22
Busy Day Itinerant Operations		276	277	315	440
Local Ramp Positions	109	22	30	23	22
Transient Ramp Positions	51	48	48	55	77
Total Ramp Positions	160	71	78	78	99
Apron Area (s.y.)	70,499	32,300	35,000	35,850	46,500

FAA Advisory Circular 150/5300-13, *Airport Design*, suggests a methodology by which transient apron requirements can be determined from knowledge of busy-day itinerant operations. At Ryan Airfield, the number of transient spaces required was determined to be approximately 17.5 percent of busy-day itinerant operations. A planning criterion of 360 square yards per local parking space and 500 square yards per transient parking space was used to determine future apron requirements. The number of local and itinerant tiedowns and apron space for the planning period is presented in **Table 3H**.

The available local parking positions are currently more than adequate to meet the local aircraft parking demands at Ryan Airfield. Transient ramp positions will need to be expanded through the planning period to meet forecasted demand.

TERMINAL FACILITIES

Terminal facilities are often the first impression of the community that air travelers or tourists will encounter. Terminal facilities at an airport provide space for passenger waiting, a pilots' lounge and flight planning, concessions, management, storage, and various other needs. At Ryan Airfield, much of this is accommodated in the 2,500 square-foot airport administration building. An additional 800 square feet of public terminal area is also provided by Air Centers West.

The methodology used in estimating terminal facility needs was based upon the number of airport users expected to utilize the terminal facilities during the design hour, as well as FAA guidelines. Space requirements for terminal facilities were based on providing 90 square feet per design hour itinerant passenger. **Table 3J** outlines the space requirements for terminal services at Ryan Airfield through the long term planning horizon.

TABLE 3J
General Aviation Terminal Area Facilities
Ryan Airfield

	Available	Short Term	Intermediate Term	Long Term
General Aviation Terminal Building Area (s.f.)	3,300	5,300	5,700	7,500
Design Hour Itinerant Passengers		58	63	83
Auto Parking Spaces	252	194	212	272

SUPPORT REQUIREMENTS

Various facilities that do not logically fall within classifications of airfield, terminal building, or general aviation facilities have been identified for inclusion in this Master Plan. Facility requirements have been identified for these remaining facilities:

- Automobile Parking
- Airport Access

- On-Airport Access
- Aviation Fuel Storage
- Aircraft Wash Facility
- Airport Maintenance
- Perimeter Fencing
- Security
- Aircraft Rescue and Firefighting

Automobile Parking

Vehicle parking requirements were examined based on an evaluation of the existing airport use, as well as industry standards. Vehicle parking spaces were calculated at 33 percent of based aircraft plus the product of design hour itinerant passengers and the industry standard of 1.8. Automobile parking requirements are summarized in **Table 3J**.

Airport Access

In airport facility planning, both on- and off-airport vehicle access is important. For the convenience of the user (and to provide maximum capacity), access to the airport should include (to the extent practical) connections to the major arterial roadways near the airport.

Access to Ryan Airfield is available from State Route 86 (Ajo Highway) and West Valencia Road. Both are currently two-lane arterial roadways with turn lanes in the vicinity of the airport. Ajo Highway runs along the southern boundary of Ryan Airfield, while West Valencia Road terminates at its intersection with the highway and Airfield Drive, one of two entrances to the airport. This intersection is unsignalized with turn lanes from the highway. The airport's other entrance, Aviator Lane, has an unsignalized intersection with the highway.

The capacity of a roadway is the maximum number of vehicles that can pass over a given section of 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.

As with the airfield, the means of describing the operational efficiency of a given roadway segment is defined in terms of six descriptive service levels. These various levels of service (LOS) range from A to F and are defined as follows:

- **LOS A** – Free flowing traffic with minimal delays.
- **LOS B** - A stable flow of traffic, with occasional delays due to the noticeable presence of others in the traffic stream.
- **LOS C** – Still stable flow, but operations become more significantly affected by the traffic stream. Periodic delays are experienced.
- **LOS D** – Flow becomes more high density, and speed and freedom to maneuver become severely restricted. Regular delays are experienced.
- **LOS E** – Maximum capacity operating conditions. Delays are extended and speeds are reduced to a low, relatively uniform level.
- **LOS F** – Forced flow with excessive delays. A condition where more traffic is approaching a point than can traverse the point.

Level of Service "D" is generally considered as the threshold of acceptable traffic conditions during peak periods in an urban area, and is commonly used by Pima County and the Pima Association of Governments (PAG) in transportation planning.

According to information included in the *Pima County Southwest Infrastructure Plan*, the average daily traffic (ADT) on West Valencia Road near the intersection is currently 5,200. Ajo Highway carries 8,400 ADT northeast of the intersection and 8,600 ADT southwest of the intersection. Both roadways currently operate under LOS D capacity.

Using trip generation estimates from the *Institute of Transportation Engineers (ITE) Trip Generation Model, Version 5*, design day traffic generated by Ryan Airfield can be expected to grow from a current level of 1,600 to 2,500 by the long range planning horizon.

The *2030 Regional Transportation Plan*, adopted by PAG in 2006, includes recommendations for both Ajo Highway and West Valencia Road to be widened to four lanes to accommodate anticipated traffic increases.

The on-airport access roads were joined by an on-airport connector road after the recommendation in the previous master plan. The two lane design of these roads should be adequate to accommodate on-airport traffic in the future.

On-Airport Access

Occasionally, private vehicles use the apron and taxilanes for movement as there is no dedicated interior access road. The segregation of vehicle and aircraft operational areas is supported by FAA guidance established in June 2002. FAA AC 50/5210-20, *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."

Service roads are typically used to segregate vehicles from the aircraft operational areas. The alternatives analysis will examine options for interior access roads to serve hangar facilities as well as a service road extending around the runway and airport perimeter for airport maintenance vehicles.

Aviation Fuel Storage

The TAA has the only fuel storage facilities at Ryan Airfield. These storage facilities combined total 25,000 gallons of 100LL Avgas storage and 5,500 gallons of Jet A fuel storage.

Fuel storage requirements are typically based upon keeping a one-month supply of fuel during an average month; however, more frequent deliveries can reduce the fuel storage capacity requirement. Based on historical fuel sales from Ryan Airfield and similar general aviation airports, an average of two gallons per piston operation was used to project Avgas fuel storage requirements.

Turbine aircraft operations at Ryan Airfield have been comprised primarily of turboprop fixed wing aircraft and turbine-powered helicopters. Business jet operations have been infrequent with less than 200 operations annually.

Surveys of turbine aircraft owners in the Tucson area as well as users of both Ryan Airfield and Tucson International Airport (TIA) indicate that convenience is the primary factor in why most of these aircraft currently use TIA or Marana Regional Airport. As the community continues to develop towards Ryan Airfield, additional activity from jet aircraft can be expected.

Projections of future Jet A fuel storage requirements were based upon average Jet A fuel sales per turbine operation at Ryan Airfield over the past five years. A ratio of 60 gallons per turbine operation was used. Turbine operations were estimated at 300 annual operations per based turbine aircraft. Based upon these ratios, turbine operations will reach 6,600 annually in the long range.

100LL Avgas and Jet A fuel storage requirements are summarized in **Table 3K**. Available fuel storage meets the current demand at Ryan Airfield, however it is projected that this will need to be expanded over the planning horizon.

TABLE 3K
Fuel Storage Requirements
Ryan Airfield

	Available	Current Need	Short Term	Intermediate Term	Long Term
Two-Week Fuel Storage Requirements					
100LL Avgas (gal)	25,000	16,000	16,300	18,300	23,800
Jet A (gal)	5,500	2,400	4,000	6,700	15,300

Aircraft Wash Facility

Ryan Airfield currently has an aircraft wash facility which is located on the north apron. This wash facility provides an area for the collection of aircraft cleaning fluids used during the cleaning process. This facility is sufficient and should be maintained through the planning period.

Airport Maintenance Building

The TAA has a three building dedicated maintenance facility at Ryan Airfield. These facilities provide shelter for maintenance equipment used for general maintenance activities, which assist in the cost-effective and time-efficient maintenance of the airport. This maintenance facility sufficiently meets the maintenance needs of the airport and should be maintained through the planning period.

Perimeter Fencing

Perimeter fencing is used at airports to primarily secure the aircraft operations 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 facility security.
- Provides a cost-effective method of protecting facilities.
- Limits inadvertent access to the aircraft operations area by wildlife.

The airport perimeter is equipped with 8-foot chain-link fencing with three-strand barbed wire on top. Automated gates are located at various locations in the terminal area which are either padlocked or remote security controlled. There are several manual access gates around the perimeter of the airport. The existing perimeter fence is adequate and should be maintained through the planning period.

Security

In cooperation with representatives of the general aviation community, the Transportation Security Administration (TSA) published security guidelines for general aviation airports. These guidelines are contained in the publication entitled, Security Guidelines for General Aviation Airports, published in May 2004. Within this publication, the TSA recognized that general aviation is not a specific threat to national security. However, the TSA does believe that general aviation may be vulnerable to misuse by terrorists as security is enhanced in the commercial portions of aviation and at other transportation links.

To assist in defining which security methods are most appropriate for a general aviation airport, the TSA defined a series of airport characteristics that potentially affect an airport's security posture. These include Airport Location, Based Aircraft, Runways and Operations.

Based upon the results of the security assessment, the TSA recommends 13 security enhancements for Ryan Airfield. These enhancements include Access Controls, Lighting System, Personal ID System, Challenge Procedures, Law Enforcement Support, Security Committee, Transient Pilot Sign-In/Sign-Out Procedures, Signs, Documented Security Procedures, Positive/Passenger/Cargo/Baggage ID, Aircraft Security, Community Watch Program and Contact List.

- **Implemented Security Measures**

Several security measures outlined above have already been implemented at Ryan Airfield. Implementation measures include:

- Access Controls
- Security Signage
- Security Lighting System
- Law Enforcement Support
- Community Watch Program

Access Control measures have been implemented by the construction of an interior perimeter fence for approximately 50% of the airfield. The perimeter fence is a six-foot high chain link fence with a three-stranded barbed wire on top. Gates are electronically controlled with keyed switch and wireless clicker access.

Security signs are located on the interior perimeter fence. The signs provide a deterrent by warning of the airport boundary as well as notification of the consequences for violation.

The Security Lighting System is in place for the apron and hanger areas. Lighting is provided for vehicle access, detection of intruders, deterrent of illegal entrants, and pilot and employee recognition. In addition, personnel in the control tower have a view of the airport and are able to detect unusual activity within the airport. As an additional deterrent for illegal activity, the tower lights in the cab are left on after traffic controllers are off duty. This gives an impression that there are air traffic controllers in the tower and are able to detect any unusual activity.

Law Enforcement Support is provided by the Tucson Airport Authority Police Department. They have implemented proactive crime suppression patrols comprised of uniformed police officers in patrol vehicles, police bicycle and explosion detection canine patrols on a regular schedule or as needed.

A Community Watch Program has been implemented as part of a monthly Ryan Airfield Users Meeting. The Tucson Airport Authority Police Department provides a "Community Policing" presence at Ryan whereby officers attend community functions to be able to interact and be proactive in crime prevention, to offer assistance and guidance to the community as well as in return the Department becomes more informed and better able to prevent problems and to keep the community safe and informed.

- **Recommended Security Measures To Be Implemented**

Several security measures are recommended for implementation at Ryan Airfield. Recommended Implementation of security measures include:

- Access Controls
- Tower Operating Hours
- Documented Security Procedures

Access controls include the completion of the interior perimeter fence to secure the airfield. The existing interior perimeter fence is adequate but the completion of the fence would provide additional security within the airport. In addition extending the airport perimeter road around the airfield would provide access for maintenance vehicles and repair of the interior perimeter fence as well as responding to entrants accessing the airfield from the perimeter.

An additional security measure would be to expand the operating hours of the traffic control operators. This would extend the hours that traffic controller operators are able to detect unusual activity within the airport.

Documenting security procedures would include having a security plan written down encompassing security measure already in place as well as additional measures. A security procedure would include airport and law enforcement contact information, alternatives if available and utilization of a program to increase airport user awareness of security precautions and an airport watch program.

Aircraft Rescue and Firefighting (ARFF)

The requirements for Aircraft Rescue and Firefighting (ARFF) equipment and services at an airport are determined by whether the airport is required to be certificated under 14 CFR Part 139 and the size of the aircraft. Ryan Airfield is presently not required to be certificated under 14 CFR Part 139; therefore, there is no requirement now for ARFF equipment or facilities. However, the Tucson Airport Authority (TAA) has assigned an Index A ARFF vehicle to Ryan Airfield, which is stored in the maintenance facilities on the airport.

SUMMARY

The intent of this chapter has been to outline the facilities required to meet aviation demands projected for Ryan Airfield through the long term planning horizon. A summary of the airfield and general aviation facility requirements are presented on **Exhibits 3D** and **3E**.

Following the facility requirements determination, the next step is to develop a direction for development to best meet these projected needs. The remainder of the Master Plan will be devoted to outlining this direction, its schedule, and its costs.

07MP02-3D-4/13/09

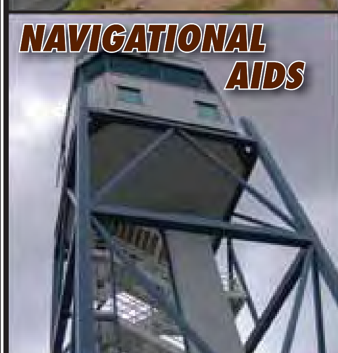
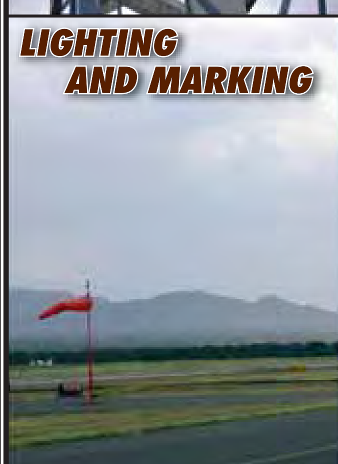
	EXISTING	SHORT TERM NEED	LONG TERM NEED
RUNWAYS 	**Runway 6R-24L** 5,500'x75' 12,500# SWL 30,000# DWL ARC B-II **Runway 6L-24R** 4,900'x75' 12,500# SWL 30,000# DWL ARC B-II **Runway 15-33** 4,000'x75' 12,500# SWL ARC B-I (small airplane exclusive)	**Runway 6R-24L** 5,500'x75' 73,000# DWL ARC B-II **Runway 6L-24R** 4,900'x75' 12,500# SWL 30,000# DWL ARC B-II **Runway 15-33** 4,000'x75 12,500# SWL ARC B-I (small airplane exclusive)	**Runway 6R-24L** 8,300'x100' 75,000# DWL ARC D-II **Runway 6L-24R** 4,900'x75' 12,500# SWL 30,000# DWL ARC B-II **Runway 15-33** 4,800'x75' 12,500# SWL ARC B-I (small airplane exclusive)
TAXIWAYS 	**Runway 6R-24L** 50' Wide Full Length Parallel **Runway 6L-24R** 35' Wide Full Length Parallel **Runway 15-33** 35' Wide Full Length Parallel	**Runway 6R-24L** High Speed Exits Dual-Parallel Taxiway **Runway 6L-24R** 35' Wide Full Length Parallel **Runway 15-33** 35' Wide Full Length Parallel	**Runway 6R-24L** High Speed Exits Dual-Parallel Taxiway **Runway 6L-24R** 35' Wide Full Length Parallel **Runway 15-33** 35' Wide Full Length Parallel
NAVIGATIONAL AIDS 	ATCT, AWOS, NDB, GPS, VOR-DME **Runway 6R-24L** ILS (6R), LOC (6R), GPS (6R) **Runway 6L-24R** None **Runway 15-33** None	ATCT, AWOS, NDB, GPS, VOR-DME **Runway 6R-24L** ILS (6R), LOC (6R), GPS (6R) **Runway 6L-24R** None **Runway 15-33** None	ATCT, AWOS, NDB, GPS, VOR-DME **Runway 6R-24L** ILS (6R), LOC (6R), CAT-1 (6R), GPS-GLS (24L) **Runway 6L-24R** GPS-APV **Runway 15-33** GPS-APV
LIGHTING AND MARKING 	Airport Beacon, Windcones **Runway 6R-24L** MIRL, REIL (6R), VASI-4 (24L) Precision/Basic Marking **Runway 6L-24R** Basic Marking **Runway 15-33** Basic Marking	Airport Beacon, Windcones, MITL **Runway 6R-24L** MIRL, REIL, PAPI-4 (6R) VASI-4 (24L) Precision Markings **Runway 6L-24R** MIRL, REIL, PAPI-4 Non-Precision Marking **Runway 15-33** MIRL, REIL, PAPI-4, Basic Marking	Airport Beacon, Windcones, MITL **Runway 6R-24L** MIRL, REIL, PAPI-4 MALSR (6R, 24L) Precision Markings **Runway 6L-24R** MIRL, REIL, PAPI-4 Non-Precision Marking **Runway 15-33** MIRL, REIL, PAPI-4, Non-Precision Marking

Exhibit 3D
AIRFIELD SUMMARY

07MP02-3E-9/14/09

AIRCRAFT STORAGE HANGAR REQUIREMENTS

	Available	Short Term	Intermediate Term	Long Term
Aircraft to be Hangared	220	236	273	347
T-Hangar Positions	30	46	60	78
Shade Hanger Positions	64	54	58	71
Conventional/Executive Hangar Positions	157	136	155	198
T-Hangar Area (s.f.)	54,000	55,400	71,800	94,200
Shade Hangar (s.f.)	37,800	31,800	34,400	41,700
Conventional Hangar Area (s.f.)	343,030	211,400	243,300	318,500
Total Hangar Area (s.f.)	**434,830**	**298,600**	**349,500**	**454,400**
Maintenance Area (s.f.)	44,000	46,550	51,800	64,675

AIRCRAFT PARKING APRON REQUIREMENTS

	Available	Short Term	Intermediate Term	Long Term
Single, Multi-Engine Transient Aircraft Positions	51	48	55	77
Locally-Based Aircraft Positions	109	30	23	22
Total Positions	160	78	78	99
Total Apron Area (s.y.)	**70,499**	**35,000**	**35,850**	**46,500**

TERMINAL FACILITIES

	Available	Short Term	Intermediate Term	Long Term
General Aviation Terminal Building Area (s.f.)	3,300	5,300	5,700	7,500
Total Airport Automobile Parking Spaces	252	194	212	272

OTHER FACILITIES

	Available	Short Term	Intermediate Term	Long Term
	Maintenance Facility Aircraft Wash Rack	Maintenance Facility Aircraft Wash Rack	Maintenance Facility Aircraft Wash Rack Heliport	Maintenance Facility Aircraft Wash Rack Heliport

FUEL STORAGE REQUIREMENTS

	Available	Short Term	Intermediate Term	Long Term
100LL Augas (gal.)	25,000	16,300	18,300	23,800
Jet A (gal.)	5,500	4,000	6,700	15,300

Exhibit 3E
LANDSIDE FACILITY REQUIREMENTS