D FACILITY REQUIREMENTS

INTRODUCTION. This chapter presents the analysis of requirements for airside and landside facilities necessary to meet aviation demand at Will Rogers World Airport. For those components determined to be deficient, the type and size of facility required to meet future demand are identified. Airside facilities examined include the runways, taxiways, runway protection zones, and navigational aids. Landside facilities include such facilities as the passenger terminal building, hangars, aircraft apron areas, and airport support facilities.

This analysis uses the growth scenario presented in the *Forecasts of Aviation Activity* chapter for establishing future development needs at the Airport. This is not intended to dismiss the possibility that, due to the unique circumstances in the region, either accelerated growth or consistently higher or lower levels of activity may occur. Aviation activity levels should be monitored for consistency with the forecasts. In the event of changes, the schedule of development should be adjusted to correspond to the demand for facilities rather than set to pre-determined dates of development; hence, over-building or under-building can be avoided.

Airside Facilities

Dimensional Standards

The types of aircraft that currently use Will Rogers World Airport and those aircraft that are projected to use the Airport in the future will affect the planning and design of airport facilities. Knowledge of the aircraft using the Airport is translated to dimensional standards concerning minimum clearances and design criteria for runways, taxiways, safety areas, object free areas, aprons, and other physical airport features. It also provides input into determining adequate runway length and pavement strength. Dimensional standards are predicated on the Airport Reference Code (ARC) and availability and type of approach instrumentation. As determined in the preceding chapter, an ARC classification of D-V has been used historically for Runways 17R/35L, 17L/35R, and 13/31. Runway 18/36 has historically been defined as an ARC C-IV facility. Thus, each individual runway system, along with the associated taxiway and apron system, should be designed accordingly. The following tables and narrative provide existing dimensions and corresponding design criteria applicable to each runway at the Airport.

Table D1 **RUNWAY 17R/35L DIMENSIONAL STANDARDS, IN FEET**

Item	Existing Dimension [1]	ARC D-V w/< ¾ mile vis. min.
Runway:		
Width	150	150
Safety Area Width	500	500
Safety Area Length (beyond runway end)		
Runway 17R	1,000	1,000
Runway 35L	1,000	1,000
Object Free Area Width	800	800
Object Free Area Length (beyond runway end)		
Runway 17R	1,000	1,000
Runway 35L	**700**	1,000
Precision Obstacle Free Zone Width	800	800
Precision Obstacle Free Zone Length (beyond runway end)	200	200
Obstacle Free Zone Width	400	400
Obstacle Free Zone Length (beyond runway end)		
Runway 17R	2,450	2,450
Runway 35L	2,450	2,450
Taxiway:		
Width	75+	75
Runway Centerline to:		
Parallel Runway Centerline (Simultaneous VFR Operations)	5,000	700
Parallel Runway Centerline (Simultaneous IFR Operations)	5,000	4,300
Holdline	293	293
Parallel Taxiway Centerline	500-700	400
Aircraft Parking Area	600+	500

Source: FAA Advisory Circular 150/5300-13, *Airport Design*, and actual airport conditions as determined by BARNARD DUNKELBERG & COMPANY using aerial photography.

Runway 17R/35L. As identified in the preceding table, the only dimensional standard associated with Runway 17R/35L not met or exceeded is the Runway Object Free (ROFA) length beyond the Runway 35L end. While the perimeter road loops far enough to the south to remain clear of the Runway Safety Area (RSA)(1000 feet in length and 500 feet in width), the wider ROFA (1,000 feet in length and 800 feet in width) clips the perimeter road at approximately 700 feet south of the Runway 35L threshold. An ROFA is an area on the ground, centered on the runway, to enhance the safety of aircraft operations by having the area free of objects, except for objects required for air navigation or aircraft ground maneuvering purposes.

Within the ROFA, taxiing and holding aircraft are permitted, but parked aircraft are not. Since this perimeter road remains clear of the RSA, it is of a lesser concern. Added to this is the fact that this perimeter road is a controlled access road; the non-standard ROFA is not considered as significant as it might otherwise be.

Table D2 **RUNWAY 17L/35R DIMENSIONAL STANDARDS, IN FEET**

Item	**Existing Dimension** [1]	**ARC D-V w/< ½ mile vis. min.**
Runway:		
Width	150	150
Safety Area Width	500	500
Safety Area Length (beyond runway end)		
Runway 17L	1,000	1,000
Runway 35R	1,000	1,000
Object Free Area Width	800	800
Object Free Area Length (beyond runway end)		
Runway 17L	1,000	1,000
Runway 35R	1,000	1,000
Precision Obstacle Free Zone Width	800	800
Precision Obstacle Free Zone Length (beyond runway end)	200	200
Obstacle Free Zone Width	400	400
Obstacle Free Zone Length (beyond runway end)		
Runway 17L	2,450	2,450
Runway 35R	2,450	2,450
Taxiway:		
Width	75+	75
Runway Centerline to:		
Parallel Runway Centerline (Simultaneous VFR Operations)	5,000	700
Parallel Runway Centerline (Simultaneous IFR Operations)	5,000	4,300
Holdline	293	293
Parallel Taxiway Centerline	**450**, 500	500
Aircraft Parking Area	900+	500

Source: FAA Advisory Circular 150/5300-13, *Airport Design*, and actual airport conditions as determined by BARNARD DUNKELBERG & COMPANY using aerial photography.

Runway 17L/35R. As noted in the preceding table, the only dimensional standard not met or exceeded by this runway is the separation of Taxiway H, which, basically between Taxiways H-1 and H-2, is located 450 feet to the east (runway centerline to taxiway centerline).

The separation standard for parallel taxiways serving ARC D-V runways with approaches having visibility minimums lower than ½-mile is 500 feet. Alternatives to resolve this non-standard condition will be examined in the next chapter.

Table D3 **RUNWAY 13/31 DIMENSIONAL STANDARDS, IN FEET**

Item	**Existing Dimension [1]**	**ARC D-V w/not-lower-than ¾ mile vis. min.**
Runway:		
Width	150	150
Safety Area Width	500	500
Safety Area Length (beyond runway end)		
Runway 13	**850**	1,000
Runway 31	1,000	1,000
Object Free Area Width	800	800
Object Free Area Length (beyond runway end)		
Runway 13	**700**	1,000
Runway 31	1,000	1,000
Obstacle Free Zone Width	400	400
Obstacle Free Zone Length (beyond runway end)		
Runway 13	200	200
Runway 31	200	200
Taxiway:		
Width	75	75
Runway Centerline to:		
Holdline	250	250
Parallel Taxiway Centerline	400	400
Aircraft Parking Area	500	500

Source: FAA Advisory Circular 150/5300-13, *Airport Design*, and actual airport conditions as determined by BARNARD DUNKELBERG & COMPANY using aerial photography.

Runway 13/31. As the preceding table indicates, Runway 13/31 deficient dimensional standards include the Runway Safety Area (RSA) and ROFA length beyond the Runway 13 end. An RSA is a defined surface surrounding a runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway. Until recently, along the west side, MacArthur Boulevard converged with the RSA and ROFA such that the lengths were limited to approximately 850 feet and 700 feet, respectively. However, with the recent relocation of MacArthur Boulevard, the RSA and ROFA length deficiencies listed here are being corrected.

It should be noted that the northeast corner of the Mike Monroney Aeronautical Center apron is located as close as 270 feet southwest of the Runway 13/31 centerline. Should aircraft be allowed to park between this location and 500 feet from the runway centerline, deficiencies would be created to the ROFA width and the aircraft parking area standard.

Table D4 **RUNWAY 18/36 DIMENSIONAL STANDARDS, IN FEET**

Item	Existing Dimension[1]	ARC C-IV w/not-lower-than ¾ mile vis. min.
Runway:		
Width	**75**	150
Safety Area Width	500	500
Safety Area Length (beyond runway end)		
Runway 18	1,000	1,000
Runway 36		1,000
Object Free Area Width	800	800
Object Free Area Length (beyond runway end)		
Runway 18	1,000	1,000
Runway 36	1,000	1,000
Obstacle Free Zone Width	400	400
Obstacle Free Zone Length (beyond runway end)		
Runway 18	200	200
Runway 36	200	200
Taxiway:		
Width	N.A.	75
Runway Centerline to:		
Holdline	**200**	250
Parallel Taxiway Centerline	N.A.	400
Aircraft Parking Area	1,600+	500

Source: FAA Advisory Circular 150/5300-13, *Airport Design*, and actual airport conditions as determined by BARNARD DUNKELBERG & COMPANY using aerial photography.

Runway 18/36. As can be seen in the preceding table, Runway 18/36 deficient dimensional standards include the runway width and the separation distance of the holdlines from the runway centerline. The continued operation of Runway 18/36, which was used for assault strip training by the Air National Guard C-130 crews, is in question and its closure will be considered in the next chapter.

Conclusion. With complex facilities such as Will Rogers World Airport, and, in consideration of FAA standards which have evolved over many years, dimensional standards are often not fully obtained. One of the important goals for a Master Plan Update is to understand any dimensional standard deficiencies and program potential remedies.

Runway Pavement Strength

The runway pavement associated with Runways 17L/35R, 17R/35L, and 13/31 at Will Rogers World Airport can support the regular use of aircraft with gross weights of 50,000 pounds single wheel, 200,000 pounds dual wheel, and 400,000 pounds dual tandem wheel main landing gear configuration. Runway 18/36 can support the regular use of aircraft with gross weights of 50,000 pounds single wheel, 150,000 pounds dual wheel, and 240,000 pounds dual tandem wheel main landing gear configuration. The runway pavement strengths seem adequate for the duration of the planning period. However, sections of taxiway pavements serving Runway 17L/35R are not adequate for all air carrier aircraft serving the Airport and are in need of strengthening. This is especially true of Taxiway H on the east side of Runway 17L/35R.

Conclusion. The runway pavement strengths are adequate to accommodate the existing and forecast aircraft fleet; although, routine pavement maintenance and rehabilitation will continue to be required during the course of the planning period. Those pavement strengths of the taxiways east of Runway 17L/35R are not adequate for air carrier aircraft and will require strengthening as the east side of the Airport develops.

Airfield Capacity

The evaluation of airfield capacity presented earlier indicates that the Airport will not exceed the capacity of the existing airfield system before the end of the planning period. The Airport's Annual Service Volume (ASV) at the end of the planning period was determined to be approximately 290,580 operations. FAA planning standards indicate that when 60% of the ASV is reached (in this case some 174,348 operations), the Airport should start the planning process for facilities that will increase capacity. Additionally, when 80% of the ASV is reached (i.e., about 232,464 operations), construction of those facilities should be initiated.

During 2006, aircraft operations at the Airport totaled approximately 108,318, which is short of the 60% ASV level. Forecasts indicate that approximately 132,688 aircraft operations will occur at the Airport by the year 2026. It should be noted that taxiway improvements will increase the Airport's capacity and enhance its ability to accommodate increased aircraft operational activity.

Even before an airfield reaches capacity, it begins to experience certain amounts of delay in aircraft operations. As an airport's operations increase toward capacity, delay increases exponentially. Therefore, it is important to monitor the number of aircraft operations regularly and identify factors that may be acting as capacity constraints. This will enable the Airport to react to unexpected trends before the lack of operational capacity might become a critical issue.

Conclusion. As presented earlier, the forecast operations are not expected to exceed the capacity of the airfield system, and do not indicate the need for a new runway. However, past planning documents for the Airport have indicated the development of a future parallel runway, new Runway 17R/35L. To reserve room for its potential construction (particularly in consideration of airspace and off-airport land use planning decisions), it is anticipated that the new runway will continue to be shown on planning documents and will be considered a post-planning period improvement project.

Because of increased landside development demand and other factors, appropriate taxiway improvements should be programmed to allow the airfield system to operate at maximum efficiency and to serve future aviation use development areas.

Runway Length

The determination of runway length requirements for an airport is based on several factors. These include airport elevation, normal mean maximum daily temperature of the hottest month, maximum difference in the runway elevation at the centerline, critical aircraft type expected to use the airport, and stage length of the longest non-stop destination. The calculations for runway length requirements at Will Rogers World Airport are based on an airport elevation of 1,295.2 feet AMSL, 94° F NMT (normal mean maximum temperature), and a maximum difference in the runway centerline elevation of 18.4 feet.

Generally, runway length requirements for design purposes at commercial service airports are premised upon the specific requirements of the most demanding aircraft that regularly, or will regularly, use the Airport. This information is then supplemented with the information related to the percentage of the large (business jet) general aviation aircraft fleet to be accommodated at the Airport.

As can be seen in the following table, entitled *GENERALIZED RUNWAY LENGTH REQUIREMENTS*, there are seven different lengths listed for the large aircraft type runways. The first four rows in the table pertain to those general aviation aircraft, generally turbojet-powered, of 60,000 pounds or less maximum certificated takeoff weight. The next three rows pertain to general runway length requirements of the air carrier aircraft fleet.

The runway lengths were derived from the computer based FAA Airport Design Software supplied Advisory Circular 150/5300-13, *Airport Design*.

Each of the lengths specified in the table below provides a runway sufficient to satisfy the operational requirements of a certain percentage of the large general aviation aircraft fleet at a certain percentage of the useful load (i.e., 75% of the fleet at 60% useful load). Useful load is defined as the difference between the maximum allowable structural gross takeoff weight and the operating weight empty. In other words, it is the load that can be carried by the aircraft composed of passengers, fuel, and cargo. The aircraft that comprise 75% of the general aviation aircraft fleet between 12,500 and 60,000 pounds include such airplanes as Learjets, Citations, Falcons, and Hawkers.

Table D5 **GENERALIZED RUNWAY LENGTH REQUIREMENTS**

	Length (Feet)	
Aircraft Category	**Dry**	**Wet**
Large Aircraft less than 60,000 pounds		
75% of fleet at 60% useful load	5,120	5,500
75% of fleet at 90% useful load	7,270	7,270
100% of fleet at 60% useful load	6,230	6,230
100% of fleet at 90% useful load	9,420	9,420
Large Aircraft greater than 60,000 pounds		
500 mile stage length	5,470	5,470
1,000 mile stage length	6,490	6,490
1,500 mile stage length	7,430	7,430

Source: FAA Advisory Circular 150/5300-13, *Airport Design*.

Note: Lengths based on 1295.2' AMSL, 94° F NMT and a maximum difference in runway centerline elevation of18.4 feet.

It must be remembered that the runway lengths provided in the above table are generalized, and the actual runway length necessary for a particular aircraft is a function of elevation, temperature, and aircraft stage length. As temperatures change, runway length requirements change accordingly (i.e., the cooler the temperature the shorter the required runway length). Therefore, if a runway is designed to accommodate a certain aircraft under all conditions, it can also accommodate a larger aircraft, or one requiring a longer runway, when temperatures are cooler or when a shorter stage length is required. However, the amount of time such operations can occur in a safe manner is limited.

Table D6, entitled *COMMERCIAL SERVICE AIRCRAFT RUNWAY LENGTH REQUIREMENTS*, provides the operational requirements for several of the existing commercial service and air cargo aircraft regularly operating at the Airport. Primarily, different runway lengths are provided for each aircraft based on three stage lengths: 500 Nautical Mile (NM), 1,000 NM, and 1,500 NM. The stage lengths provide a range of travel distances to major U.S. markets from Oklahoma City. For example: Dallas, Houston, Denver, Kansas City, Memphis, St. Louis, and New Orleans are within 500 NMs; Las Vegas, San Diego, Phoenix, Chicago, and Atlanta are within 1,000 NMs; and Los Angeles, San Francisco, Seattle, New York, and Miami are within 1,500 NMs. The markets with the longest stage lengths that are currently served with non-stop service include Baltimore, Maryland (1,025 NMs); Los Angeles, California (1,030 NMs); Sacramento, California (1,165 NMs); and Newark, New Jersey (1,165 NMs). However, nearly 60% of the existing non-stop departures serve markets within 500 NMs.

Table D6 **COMMERCIAL SERVICE AIRCRAFT RUNWAY LENGTH REQUIREMENTS**

Aircraft/Stage Lengths	Length (Feet)
B-737-300 (500/1,000/1,500 NM Stage Lengths)	4,800/5,400/6,000
B-737-500 (500/1,000/1,500 NM Stage Lengths)	4,800/5,300/6,100
B-737-700 (500/1,000/1,500 NM Stage Lengths)	5,000/5,900/6,500
B-737-800 (500/1,000/1,500 NM Stage Lengths)	6,000/6,700/7,700
B-737-900 (500/1,000/1,500 NM Stage Lengths)	6,200/6,750/7,400
MD-81 (500/1,000/1,500 NM Stage Lengths)	5,800/6,600/7,900
MD-83 (500/1,000/1,500 NM Stage Lengths)	5,300/5,900/6,650
MD-87 (500/1,000/1,500 NM Stage Lengths)	4,600/5,100/5,700
B-757-200PF (500/1,000/1,500 NM Stage Lengths)	5,450/5,950/6,200[1]
DC-9-30 (500/1,000/1,500 NM Stage Lengths)	7,400/10,600/---[2]
DC-9-40 (500/1,000/1,500 NM Stage Lengths)	7,800/---/---[3]
A 310-200 (1,815 NM Maximum Payload Range)	6,100
CRJ 200 (500/1,000/1,500 NM Stage Lengths)	5,100/5,600/6,300
CRJ 700 (1,732 NM Maximum Payload Range)	6,600
ERJ 145 (500/1,000/1,500 NM Stage Lengths)	5,250/7,050/7,700

Source: Manufacturer specific *Airplane Characteristics for Airport Planning* documents. Runway lengths based on airport elevation of 1,295.2 feet, standard day conditions, plus 15° Celsius (27° Fahrenheit), unless otherwise noted.

Notes: [1] Runway lengths based on standard day conditions, plus 14° Celsius (25° Fahrenheit). [2] Maximum payload weight exceeded. A weight penalty of approximately 7,000 pounds required for takeoff on 10,600-foot runway length and 1,500 NM stage length. [3] Maximum payload weight exceeded. Weight penalties of approximately 2,700 pounds and 10,200 pounds required for takeoff on 7,800-foot runway length and 1,000 NM and 1,500 NM stage lengths.

The information presented in the previous table is based on maximum payload capabilities (i.e., full passenger or cargo loads) for the respective stage lengths. It is intended to represent "worst case" scenarios required for completely full aircraft. It is understood that this condition is not encountered by the airlines on a regular basis. However, this is balanced by the fact that the calculations use a temperature of approximately 86° Fahrenheit (30° Celsius), which is routinely exceeded in Oklahoma City especially during the hot summer months.

Past planning documents for Will Rogers World Airport have indicated extensions to Runways 17R/35L and 17L/35R that provide approximately 12,000 feet of runway length. Additionally, past documents included an extension of approximately 2,200 feet to the crosswind runway, Runway 13/31, for an ultimate runway length of 10,000 feet.

Conclusion. As it is at most airports, the determination of appropriate runway lengths for Will Rogers World Airport is a complex consideration. With the analysis presented here, it appears that the existing lengths of the primary parallel runways of approximately 9,800 feet are adequate to accommodate the existing and forecast aircraft fleet. However, with respect to post-planning period considerations and off-airport land use decisions, the runway extensions should remain on future documents and plans. Additionally, the retention of the crosswind runway extension to an ultimate length of 10,000 feet is recommended.

Taxiways

Taxiways provide defined movement paths for aircraft between the runway system and the various functional areas on the airport. Some taxiways are necessary simply to provide access between aircraft parking aprons and runways; whereas, other taxiways become necessary to provide more efficient and safer use of the airfield. In general, the taxiway system at the Airport meets most of the dimensional standards as related to the aircraft fleet being served. However, as identified previously, the separation distance between the Runway 17L/35R centerline and the Taxiway H centerline does not meet standards for ARC D-V runways with instrument approaches having visibility minimums less than ½-mile. Additionally, improvements to the exit taxiway system will minimize occupancy times for landing aircraft, thus improving the efficiency and increasing capacity of the airfield system.

Conclusion. Generally, the layout of the taxiway system at Will Rogers World Airport is well configured to accommodate existing and forecast activity efficiently and safely. Improvements to the taxiway system and the correction of the deficient dimensional standards will be evaluated in the next chapter of the document.

Line-of-Sight

According to runway line-of-sight standards applicable to Will Rogers World Airport, any two points located five feet above the runway centerline must be mutually visible for a distance of one-half the runway length. Runways 17R/35L, 13/31, and 18/36 currently meet this standard. However, Runway 17L/35R does not appear to comply with the standard, primarily because the high point of the runway is over 12 feet above, and within 3,600 feet of, the Runway 35R end elevation.

Additionally, intersecting runway line-of-sight standards indicate that an unobstructed line-of-sight must be established from any point five feet above the runway centerline to any other point five feet above the intersecting runway centerline within the visibility zone. The visibility zone at Will Rogers World Airport is established by four points located equidistant from the intersection point of Runways 17R/35L and 13/31 and the four runway ends. The intersecting runway line-of-sight standard within this visibility zone is currently met.

Conclusion. Since the Runway 17L/35R does not comply with the line-of-sight standards, actions should be evaluated that rectify this situation. Any proposed runway improvements or extensions will include further examination of this standard to ensure the compliance with line-of-sight criteria.

Instrumentation and Lighting

Existing electronic landing aids, including instrument approach capabilities and associated equipment, airport lighting, and weather/airspace services, were detailed in the *Inventory of Existing Conditions* chapter of this document. The Airport is currently equipped for CAT I and II ILS precision instrument approaches, GPS, and VOR non-precision instrument approaches.

The existing precision approach procedures available for Runways 17R/35L and 17L/35R provide excellent instrument approach capabilities under a variety of wind conditions and operational circumstances and should be maintained. Additionally, the non-precision capabilities available to both ends of Runway 13/31 should be maintained for the near-term. Long-term, instrument approach procedures with lower visibility minimums should be evaluated and programmed.

Conclusion. Maintain the existing low-minimum precision instrument approach capabilities on the parallel runways. For Runway 13/31, maintain the non-precision instrument approach capabilities, while planning and protecting for the lower visibility minimum approach procedures to both runway ends. The continuing evolution of satellite-based GPS technologies increases the ability to implement the low visibility minimum approach procedures with relatively little on-ground investment. However, if the instrument approach procedures include vertical guidance, then approach lighting systems will be required.

Runway Protection Zones (RPZs)

The function of the RPZ is to enhance the protection of people and property on the ground beyond the runway ends, which is achieved through airport control of the RPZ areas. The RPZ is trapezoidal in shape and centered about the extended runway centerline. It begins 200 feet beyond the end of the area usable for takeoff or landing. The RPZ dimensions are functions of the type of aircraft operating at the Airport and the approach visibility minimums associated with each runway end.

In consideration of the existing instrument approach minimums and the type of aircraft each runway is designed to accommodate, the following table, entitled *RUNWAY PROTECTION ZONE DIMENSIONS*, lists existing RPZ dimensional requirements, along with the requirements for improved approach capabilities.

Conclusion. Maintain the existing RPZ criteria and properly plan for future RPZs in consideration of the proposed runway extension projects.

Table D7 **RUNWAY PROTECTION ZONE DIMENSIONS**

Item	Width at Runway End (feet)	Length (feet)	Width at Outer End (feet)
Existing RPZ Dimensional Requirements:			
Runway 17R	1,000	2,500	1,750
Runway 35L	1,000	2,500	1,750
Runway 17L	1,000	2,500	1,750
Runway 35R	1,000	2,500	1,750
Runway 13	500	1,700	1,010
Runway 31	500	1,700	1,010
Runway 18	500	1,700	1,010
Runway 36	500	1,700	1,010
Required RPZ Dimensions for Various Visibility Minimums:			
Visual and not lower than one mile, Small Aircraft Only	250	1,000	450
Visual and not lower than one mile, Approach Categories A & B	500	1,000	700
Visual and not lower than one mile, Approach Categories C & D	500	1,700	1,010
Not lower than ¾ mile, All Aircraft	1,000	1,700	1,510
Lower than ¾ mile, All Aircraft	1,000	2,500	1,750

Source: FAA Advisory Circular 150/5300-13, *Airport Design*.

Landside Facilities

Landside facilities are those facilities that are supported by the airside facilities, but are not actually part of the aircraft operating surfaces. These consist of such facilities as passenger terminal facilities, aprons, access roads, hangars, and support facilities. Following an analysis of these existing facilities, current deficiencies can be noted in terms of accommodating both existing and future needs.

Passenger Terminal Facilities

Components of the passenger terminal complex include the terminal building, gate/parking positions, apron area, ground access, and auto parking. The recently completed remodel of the terminal building, including construction of the west concourse, provided adequate space for airlines, baggage check, baggage claim, departure lounges, rental car counters, circulation, concessions, and public spaces. The remodel specifically addressed deficiencies associated with departure lounges and terminal curb frontage.

The *Will Rogers World Airport Gate Utilization Study* has identified a deficiency in the number and use of gates. This study recommends the common use of gates to create opportunities for additional flights. However, even with the common use of gates, the flight schedule cannot expand beyond what is forecast during the busy morning hours. Therefore, the planning for the east concourse expansion of the terminal building is recommended in the near future. The *Gate Utilization Study* further recommended improvements that expedite passenger flow through and near security checkpoints, and reduce congestion near airline ticket counters and gates.

Ground Access and Parking Requirements

The ground access system consists of three components: local access roadways (Terminal Drive and Meridian Avenue), terminal area vehicular parking, and terminal building curb frontage. Based on the projected growth and subsequent increase in passenger landside traffic at the Airport throughout the planning horizon, some improvements to the Airport ground access and parking system may be required.

As stated previously, the recently completed remodel of the terminal building addressed a specific need associated with terminal curb frontage. Currently, there is an adequate amount of curb frontage with no constraints anticipated in the foreseeable future. Terminal Drive was also enlarged and improved to accommodate increased passenger generated traffic.

A new five-story parking garage is currently under construction just north of the existing parking garage. When completed, this facility will provide an additional 1,800 parking spaces, bringing the total public parking spaces to over 7,500. When the new parking garage and renovation of the existing two-story garage are complete, rental companies will be allocated a total of approximately 500 ready car spaces. The *Will Rogers World Airport Public Parking and Rental Car Operations Study* will determine the need for additional public parking and the potential for a consolidated rental car facility on airport property.

General Aviation Aircraft Storage

General aviation aircraft that are based at Will Rogers World Airport are stored in the general aviation facilities located east of Runway 17R/35L and northwest of the terminal area. Over the course of the 20-year planning period, the number of based aircraft at the Airport is forecast to increase moderately. The trend of increasing general aviation aircraft size also plays a role in defining future development needs.

Perhaps the most important influence contributing to the need for a comprehensive analysis of the future development needs for general aviation is the configuration of the existing facilities in consideration of space currently available for development. There is a limited amount of area remaining within the general aviation development area that can be easily developed for general aviation needs. Following are several issues that will be considered in the development of a plan for the configuration of future general aviation facilities at the Airport.

Tiedown Storage Requirements/Based Aircraft. Aircraft tiedowns are provided for those aircraft owners that do not require, or do not desire to pay the cost for, hangar storage. Because of the great value of even small, unsophisticated general aviation aircraft, most aircraft owners prefer some type of indoor storage. There will continue to be some demand for based aircraft tiedown areas; however, it is anticipated that the Airport has enough area on existing aprons to accommodate future demand.

Tiedown Storage Requirements/Itinerant Aircraft. In addition to the needs of the based aircraft tiedown areas addressed in the preceding section, transient aircraft also require apron parking areas at the Airport. This storage is provided in the form of transient aircraft tiedown space. As the plan for future general aviation development is formulated, adequate space will be provided for transient aircraft parking areas, especially in those areas that cater to transient aircraft needs [i.e., fixed base operator (FBO) services].

Hangars. The development plan for future general aviation hangars will focus on identifying potential parcels, in consideration of the ability to provide roadway and taxiway access.

Air Cargo

Air cargo at Will Rogers World Airport is transported in the belly compartments of passenger airline aircraft and on dedicated air cargo aircraft. As presented earlier, the quantity of air cargo passing through the Airport is anticipated to increase during the forecast period, but is not expected to exceed the previous peak volume (approximately 53,000 metric tonnes in 1999) until the year 2023. Typically, comparable throughput requires comparable facilities capacity and such a projection would suggest no new air cargo facilities would be required for at least ten years. However, due to extenuating circumstances, such accommodations may be required and will be addressed in the following sections.

Air Cargo Building Requirements. Currently, there are three buildings on the Airport associated with air cargo, which include: the air cargo building, the cargo annex building, and the Aeroterm building. The air cargo building hosts ground-handling tenant Evergreen and four passenger airlines belly cargo operations, but also has considerable space falling into three categories: 1) Vacant; 2) Occupied by non-cargo tenants, such as airport contractors; and, 3) Seemingly excess space leased, but not necessarily needed by passenger airlines for belly cargo. Half of the cargo annex building is used by the Airport's Operations staff, the other half by a speculative air cargo venture.

Based on the east concourse expansion of the terminal building and respective apron requirements, the air cargo and cargo annex buildings are planned for elimination. While the Airport may need to replace its own space, it is not thought that replacement of the cargo annex building is necessary for the purposes of air cargo capacity. It is thought that replacement of the air cargo building need not be assumed as a 1:1 square foot proposition based on the amount of vacant or excess space. Therefore, the priority replacement space would be for Evergreen and UPS, with secondary consideration for space occupied by the passenger airlines belly cargo operations when the air cargo building is demolished.

The Aeroterm building is currently 100% occupied. However, one existing tenant is BAX Global, which operates no aircraft at the Airport and therefore has no compelling need to reside on airport property. Therefore, it may be justifiable to allow former air cargo building tenants that actually require airfield access (such as UPS, passenger airline belly carriers, or ground-handler Evergreen) to replace BAX Global in this space. Alternatively, Aeroterm is required (under its agreement with the Airport) to build an additional 25,000 square feet of warehouse space. However, it is worth noting that the impetus for this requirement originally was the belief that the air cargo building needs would require complete replacement on an equal basis, rather than perhaps some modified (reduced) level. With the needs of the displaced tenants of the air cargo building principally in mind, Aeroterm could expand its facility to the south (i.e., in the direction of the passenger terminal).

In determining future air cargo building requirements, a number of complicating factors discourage the evolution of a single, accurate metric, especially those with multiple, and often dissimilar, tenants. While many computations are based on expected throughput (tonnage), the variable of dwell-time is often inadequately considered. It is not enough to know how much, but also how quickly, air cargo moves through a facility because spatial consumption depends upon how long cargo remains on-site.

The International Air Transport Association (IATA) has developed the *Airport Development Reference Manual*, which provides guidelines for planning of air cargo terminal facilities based on an automation factor and the volume of air cargo. Using a less productive "average" automation factor (integrated carriers such as DHL, FedEx, and UPS are considered highly automated), the guidelines indicate that the Aeroterm building's 50,992 square feet should be enough to accommodate 47,300 metric tonnes of air cargo, a volume that is not forecasted to occur at the Airport until the year 2019. The long-term forecast of 57,617 metric tonnes by the year 2026 can be accommodated by a total of approximately 63,000 square feet of air cargo terminal space, again by using the average automation factor. Such a requirement equates to a net gain of about 12,000 square feet of additional air cargo terminal building space to what Aeroterm already provides.

Air Cargo Apron Requirements. Existing air cargo apron space includes 170,955 square feet located east of the air cargo and cargo annex buildings (i.e., air cargo apron), and the apron east of the Aeroterm building (Aeroterm apron), consisting of 270,200 square feet. The entire air cargo apron space is likely to be needed for the east concourse expansion of the terminal building and its apron requirements. Currently, the Aeroterm apron has 47,600 square feet not leased and 47,600 square feet of common use space available. According to Aeroterm (which manages both apron areas), these positions would be adequate to accommodate the operations (once daily with a second on Saturday) that UPS currently performs on the air cargo apron, as well as occasional charters.

The Air Transport Association's *Facility Planning Guidelines for Air Cargo Facilities (2001)* provides guidelines for a range of apron space (exclusive of taxiways) based on warehouse space. Using the "Express Spoke" designation for Will Rogers World Airport and the existing Aeroterm building space of 50,922 square feet, the Aeroterm apron space of 270,200 square feet is more than adequate both for the current warehouse (indicating between 89,000 and 127,000 square feet of apron) and even the augmented warehouse space (approximately 63,000 square feet) projected by 2026, which would project to between 110,000 and 157,250 square feet of apron.

One of the trickiest aspects of air cargo planning is reconciling the need to accommodate peak period requirements - for both cargo terminal and ramp demand - with the desire to limit investments in facilities only used a portion of the year. For the immediate future, it would seem that Will Rogers World Airport even has a modest surplus of space to accommodate peak volumes, although, this should be gauged and possibly re-evaluated as the elimination of the air cargo building approaches.

Conclusion. It appears that even with the relocation of the tenants displaced by the loss of the air cargo building, adequate air cargo building and apron space is available at the Aeroterm facilities to accommodate future demand, provided that additional building space is provided in the future. In consideration of the potential unforeseen or extraordinary growth in air cargo activity (e.g., demand for a regional sorting facility or some other significant influence), an area air cargo development will be identified as a component of the recommendations in the Master Plan Update. This area will likely be on the east side of the Airport and is the most logical location for such larger scale activity.

Support Facilities Requirements

In addition to the facilities described above, there are several airport support facilities that have quantifiable requirements and that are vital to the efficient and safe operation of the Airport.

Airport Traffic Control Tower (ATCT). In its present location (west of the passenger terminal complex), the ATCT meets all requirements to enable it to properly function with the existing runway configuration. As the runway and taxiway system evolves in the future with potential runway extensions and taxiway additions to service new/reconfigured landside development areas, ATCT line-of-sight and viewing angle concerns will be important feasibility determinants.

Aircraft Rescue and Fire Fighting (ARFF) Facility. The ARFF facility serving Will Rogers World Airport is located west of the passenger terminal building and northeast of the intersection of Runways 13/31 and 17R/35L. According to Code of Federal Regulations (CFR) Part 139.317, ARFF equipment and staff requirements are based upon the length of the largest air carrier aircraft that serves the Airport with an average of five or more daily departures. The following table presents the ARFF Index, length criteria, and representative air carrier aircraft.

Table D8 **REPRESENTATIVE AIR CARRIER AIRCRAFT LENGTHS AND ARFF INDEX**

ARFF Index	Length Criteria	Representative Aircraft
A	< 90 Feet	ATR-72, CRJ-200
B	90 Feet < 126 Feet	B-737, A-320, ERJ-145, Avro RJ-85
C	126 Feet < 159 Feet	B-727, B-757, MD-80
D	159 Feet < 200 Feet	B-767, DC-10
E	> 200 Feet	B-747, MD-11

Source: CFR Part 139.317.

The Airport currently maintains an ARFF Index C classification, which adequately serves the existing and projected runway system and airline operational schedule.

Fuel Storage Facility. The fuel storage facility is located east of the approach end of Runway 17R, west of Meridian Avenue, just south of Amelia Earhart Drive. The site is provided with excellent access for delivery trucks from Meridian Avenue, and has adequate access for aircraft fueling trucks to the airfield via the on-airport service road system. The size of the existing site provides the capacity to accommodate expansion needs that can be reasonably anticipated during the next 20 years.

Maintenance Facility. The existing airport maintenance facility, located in the southern portion of the Airport north of S.W. 104th Street, is adequately sized for existing and future needs. If additional facilities are required, then ample space is available for the expansion of the facility.

Potential Demand – Post Planning Period Considerations & Unpredictable Circumstances

The ultimate purpose of planning for long-term airport improvements (i.e., the preparation of an Airport Master Plan) is to reserve room for potentially needed airport facilities through a comprehensive analysis of all airport development issues without overly restricting other development potentials. It is recognized that it will be increasingly difficult to plan for new aviation facilities in the future as developable area on the Airport, and in the vicinity of the Airport, is utilized. Therefore, as this area is subjected to greater utilization, potential areas to develop new aviation facilities naturally become more limited. As such, the development program that is recommended in this Master Plan Update should likely define development envelopes that will be available for new aviation facilities for much longer than the 20-year planning horizon dictated by FAA guidance.

With those concerns in mind, two planning dynamics should receive additional consideration. The first is post-planning period forecasts of aviation demand and the second is the unpredictable circumstances that might impact the need for airport facility improvements.

Post Planning Demand

Projecting aviation demands even out to 20 years, as is done in this Master Plan Update, is not something that can be accomplished with a great degree of certainty. Forecasting beyond 20 years is even more difficult and results in even more subjective results. However, if the goal is to test for area reservation for potentially needed facilities, with the idea of making certain no decisions are made today that could ultimately affect the efficient and safe operation of the Airport, perhaps this exercise is worth the effort.

The two critical components that can be analyzed in light of such potential demand are: order of magnitude estimates for terminal area development and the capacity of the airfield based upon long-term forecasting assumptions. As such, the following table, entitled *POST PLANNING PERIOD FORECASTS, 2026-2046*, presents data relative to potential future demand at Will Rogers World Airport. The forecasting summary presents a straight line projection of possible passenger and operations growth, based upon annual growth assumptions presented in Chapter B, *Forecasts of Aviation Activity.* Annual growth is relatively modest, but still may exceed actual conditions in the out-years. The importance of these forecast numbers is that they represent possible and reasonable planning-level expectations for space reservation needs and potential capacity needs. Whether actual future activity meets these projected demand levels isn't as important as attempting to grasp space reservation needs and smartly assess long-term development envelopes that preserve areas capable of meeting a robust future, should it come to pass. As such, the post planning period forecast summary is an effort to quantify what this long-term future might look like.

Table D9 **POST PLANNING PERIOD FORECASTS, 2026-2046**

Year	Passengers	Commercial Service Operations	Air Cargo Operations	Military Operations	General Aviation Operations	Total Operations
2026	2,688,600	73,250	5,958	15,800	37,680	132,688
2027	2,742,400	74,200	6,090	15,800	38,360	134,450
2031	2,968,400	78,080	6,640	15,800	41,200	141,720
2036	3,277,400	83,230	7,410	15,800	45,040	151,480
2041	3,618,500	88,720	8,260	15,800	49,250	162,030
2046	3,995,100	94,580	9,210	15,800	53,840	173,430

Unpredictable Circumstances

There are also several unpredictable factors that might positively or negatively impact the quantity of activity and/or need for additional facilities at the Airport to a significant degree.

Air Cargo. Although air cargo activity at the Airport is forecast for only slow growth over the next few years, the potential for greater growth should not be discounted completely. This potential drives two aspects of the long-term planning program: runway length and air cargo facility development area.

Runway Length. The parallel runways at the Airport are currently 9,800 feet each in length. As documented earlier in the chapter, this length is projected to meet the needs of the most critical aircraft forecast to use the Airport in future years. However, current runway lengths at other airports within the region that accommodate national and international commercial aviation activity include four (4) 13,400-foot runways at Dallas-Fort Worth International Airport, one (1) 12,001-foot runway at George Bush Intercontinental/Houston Airport, and one (1) 12,248-foot runway at Austin-Bergstrom International Airport. As such, it is the goal of the Airport to preserve enough land to the south of the runways to allow for possible extensions of 2,200 feet (increasing their total runway lengths to 12,000 feet) in the eventuality that this would be required due to operational considerations. Note that this would also extend to the preservation of airspace appropriate for 12,000-foot runways.

Air Cargo Facilities Development Area. It is likely that the air cargo facilities development area to the east and north of the passenger terminal is large enough to accommodate needed new facilities for the foreseeable future; however, if there was demand for a new facility of significant size, the east side of the Airport is the obvious choice for its location.

Mike Monroney Aeronautical Center. The Mike Monroney Aeronautical Center (MMAC) is a critical component of the Airport's makeup. With over 5,500 employees and an operational budget of over $1 billion annually and a continually growing mission, it is important for the Airport's airfield infrastructure to have the growth potential to support the progressive development of the MMAC within the FAA and DOT. This would indicate that post-planning period considerations related to the new parallel runway and the extended main runway should be retained on planning documents developed as part of the Master Plan Update.

Other Unpredictable Factors. The future role of general aviation, aircraft maintenance/manufacturing facilities, and the military at Will Rogers World Airport is also fairly unpredictable. The two known considerations are that both of these airport uses will continue to be important and significant, and their respective roles are subject to change and will evolve over the planning period and beyond. Moreover, it is of critical importance to protect for airfield infrastructure that can support growth from any given aviation sector, should it occur in the post planning period environment.

Summary

The information provided in this chapter provides the basis for understanding what facility improvements at the Airport might help in the effort to accommodate future demands efficiently and safely. Following are the major improvement considerations that have been identified in this chapter:

- Continue to plan and protect for extensions to Runways 17R/35L, 17L/35R, and 13/31. Additionally, continue to plan and protect for a future third parallel runway, new Runway 17R/35L.
- Maintain and correct the FAA safety and object clearing standards for the areas immediately surrounding the runway system. The requirements have evolved significantly over the last several years, becoming more stringent. Additional improvements will be implemented in the future as standards continue to evolve and as areas for upgrades are identified.
- Evaluate improvements to the taxiway system layout that correct the dimensional standard deficiencies, increase the safety and efficiency of the airfield system, improve aircraft movement patterns, and provide access to future development areas.
- Maintain the low visibility minimum precision ILS instrument approach capabilities on the parallel runways. Implement instrument approach procedures providing vertical guidance to the crosswind runway (Runway 13/31).
- Evaluate the most efficient and economic way to remove the line-of-sight deficiency associated with Runway 17L/35R.
- Increase deficient taxiway pavement strengths, especially in the pavements to the east of Runway 17L/35R.
- The general aviation development area will be maintained and expanded through efficient use of existing available property.
- Incorporate recommendations from the *Gate Utilization Study*, the *Public Parking and Rental Car Operations Study*, and the *Strategic Development Plan* as they become available.

It is important to note that the recommendations in this Master Plan Update are provided to understand what facilities improvements might be needed at the Airport, and where those facilities might be best placed. In other words, the Master Plan Update provides recommendations on how various parcels of the Airport might be best developed, in consideration of potential demand and community/environmental influences. One of the basic assumptions for a master plan (for a complex facility like an airport) is that if a future improvement is identified on the recommended development plan, it will only be built if there is actual demand, if the project is financially feasible, and if environment impacts are insignificant.

In summary, the facility needs information provided in this chapter will be used to develop alternatives for the configuration of future airport facilities.