Chapter Three: Capacity Analysis

In this chapter the capacity of the Yakima Air Terminal is examined. From this analysis, the capacity of the airport's facilities to serve forecast levels of demand can be determined. By analyzing the relationship between demand and capacity, deficiencies in the system can be identified and steps toward alleviating them can be studied. Three major components of the airport were examined:

- Airfield
- Terminal Area
- General Aviation Area

The analytical techniques, input data, and results of these examinations are detailed throughout this section.

3.1 Airfield Capacity

The capacity of the airfield is a measure of the theoretical maximum number of aircraft operations that can be accommodated on the airfield, or its components, over a specified period of time. A variety of techniques have been developed for determining this airfield capacity. Currently, the most widely accepted technique is described in FAA Advisory Circular 150/5060-5. The analyses employed herein are based upon this publication and its associated computer modeling techniques.

Utilizing the methodology presented in the FAA document produces statements of airfield capacity in these major terms:

- Hourly Capacity of Runways: The number of aircraft operations that can take place on the runway system in one hour; and
- Annual Service Volume (ASV): A reasonable estimate of the airport's annual capacity. The ASV accounts for differences in runway use, aircraft mix, weather conditions, and other limiting factors that can occur over a year's time.

Following the determination of the airfield capacity, computational techniques are available by which the total annual delay to both arriving and departing aircraft can be estimated.

3.1.1 Runway Capacity

The capacity of a runway system is determined by several factors. Among these are meteorology, runway use patterns, aircraft mix, percent of operations that are arrivals, percent of operations that are touch-and-goes, the spacing of exit taxiways, and runway length.

Each of these elements, and its impact on the runway capacity of Yakima Air Terminal, are discussed in the following paragraphs.

Meteorology

Weather conditions at an airport affect runway utilization due variations in wind direction and velocity, together with changes in visibility. The prevailing wind and visibility conditions serve to determine the directions in which takeoffs and landings may be conducted, and the frequency of use for each available operating configuration. Since various airport operational configurations have different capacities, it is necessary to identify each potential configuration, calculate its capacity, and determine the percentage of the time it is likely to be in use.

The terms visual meteorological conditions (VMC) and instrument meteorological conditions (IMC) are used as measures of ceiling and visibility. VMC conditions occur when the ceiling is at least 1,000 feet and visibility is three miles or greater. During these conditions pilots can elect to fly under visual flight rules (VFR) on a see-and-be-seen basis and visual approaches can be conducted independently on parallel runways that are at least 700 feet apart. IMC conditions occur when the ceiling is less than 1,000 feet or visibility drops below three miles. In IMC weather, pilots must fly under instrument flight rules (IFR) and the air traffic control (ATC) system assumes sole responsibility for the safe separation between aircraft. Parallel runways separated by less than 2,500 feet are seen as a single runway with operations on one completely dependent on operations on the other.

The method of analyzing meteorological conditions related to ceiling, visibility, and runway orientation involves the use of wind roses. Wind data for all weather, VMC, and IMC conditions are represented on the wind roses in terms of the percentage of time winds of different velocities blow from various directions. Data for conducting weather and wind analysis for the Yakima Air Terminal were obtained from the National Oceanic and Atmospheric Administration's (NOAA), National Climatic Center (NCC) in Asheville, North Carolina. The FAA's Airport Design for Microcomputers Version 4.2D was used to perform the analysis.

Exhibit 3-1 tabulates the weather categories and wind coverage for individual and combinations of runways.

EXHIBIT 3-1
WIND COVERAGE OF EXISTING RUNWAYS

Weather Category	Max. Cross. Component	Occurrence	Runway Coverage						
			9	27	9-27 Combined	4	22	4-22 Combined	Total
All Weather	10.5 knots	100%	0.2%	94.2%[1]	94.4%	0.5%	3.8%	4.4%	98.1%
	13.0 knots		1.1%	96.2%[1]	97.3%	0.3%	0.6%	0.9%	99.05%
VMC	10.5 knots	93%	0.5%	93.6%[2]	94.1%	0.5%	3.8%	4.3%	99.05%
	13 knots		1.1%	95.9%[2]	97.0%	1.2	0.2%	1.4%	99.24%
IMC	10.5 knots	5.72%	0.0%	0.0%	0.0%	0.0%	99.7%	99.7%	99.95%
	13 knots		0.0%	99.7%[3]	99.7%	0.1%	0.0%	0.1%	99.9%

[1] Runway end wind coverage includes 0-3 mph "calms" that occur 87.8 percent of the time.
[2] Runway end wind coverage includes 0-3 mph "calms" that occur 86.9 percent of the time.
[3] Runway end wind coverage includes 0-3 mph "calms" that occur 99.6 percent of the time.

The following observations were made from the analyses of wind data:

- Visual meteorological conditions (VMC) occur 93.0 percent of the year;
- Instrument Meteorological Conditions (IMC) occur 5.7 percent of the year;
- The combined coverage of the existing runways is 98.4 percent in VMC and 99.7 percent in IMC using a 10.5 knot crosswind component; and

The combined coverage of the existing runways is 98.3 percent in a VMC environment and 99.8 percent in IMC using a 13 knot crosswind component.

Terminal Area Navigational Aids

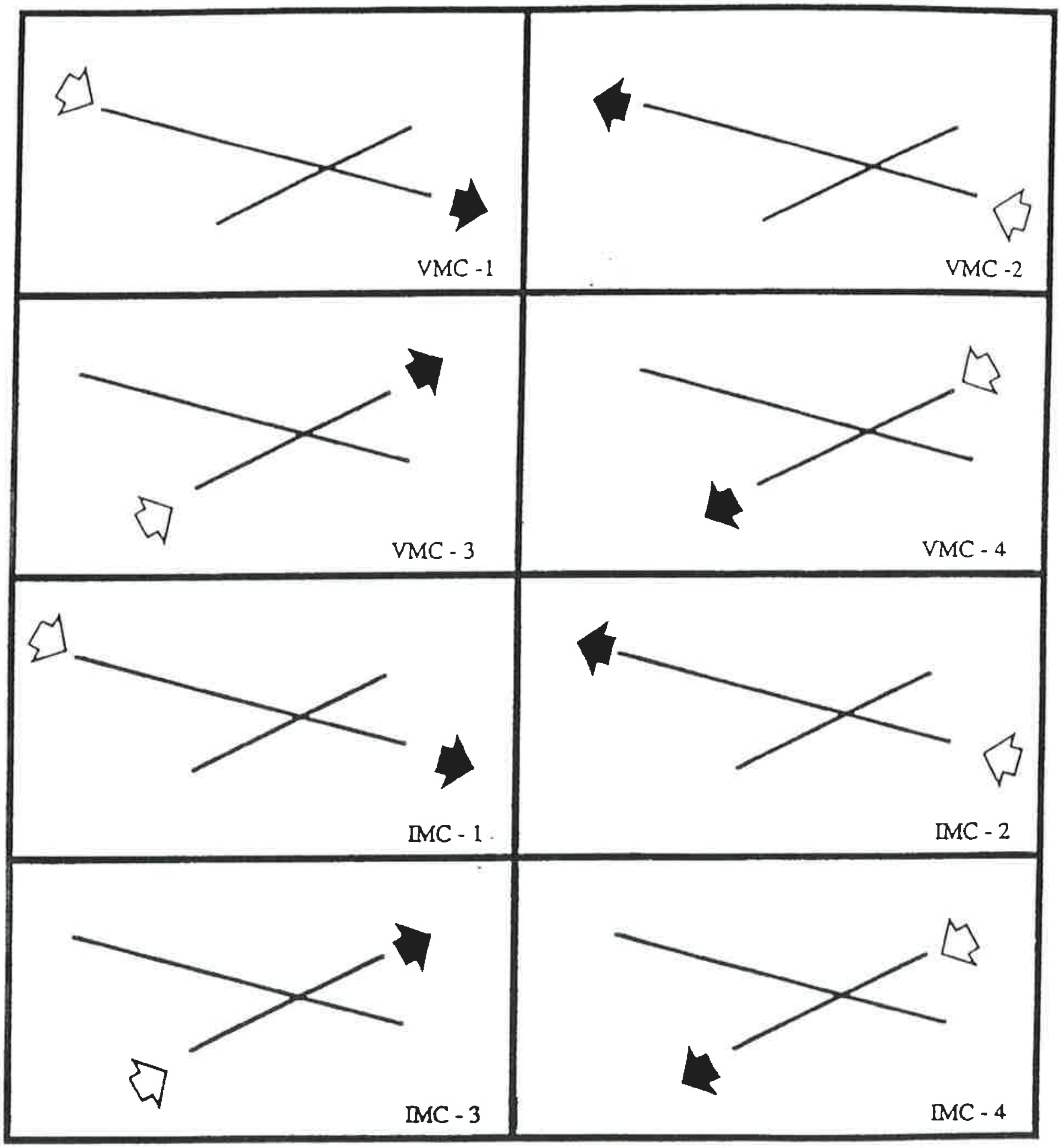
The availability, types, and location of navigational aids on and in the vicinity of an airport affect the capacity of the facility in both visual and meteorological weather conditions. For instance, multiple instrument runways increase the number of operational configurations available during IMC conditions and, therefore permit greater flexibility in selecting capacity efficient configurations under a variety of weather conditions.

The navigational aids available at Yakima were described in Chapter 1. The runway ends available for IMC operation were defined in terms of the published approaches associated with these facilities. The IMC operating configurations were then selected on the basis of this information, with precision instrument approaches available to Runway 27, while nonprecision approaches are available to all other runway ends.

Runway Usage

Runway use is expressed in terms of the number, location, and orientation of active runways. It involves the directions and kinds of aircraft operations using each runway. During periods of high wind, operations are conducted on the runway providing the highest wind coverage. Therefore, the operational configurations for the capacity analysis shown in Exhibit 3-2 are determined by wind conditions.

EXHIBIT 3-2
RUNWAY CONFIGURATIONS



Operational Fleet Mix

The mix of the aircraft fleet using, or expected to use, the Yakima Air Terminal is another important factor in determining the capacity of the airfield. A homogeneous fleet would result in higher airfield capacity due to evenly spaced approaching and departing aircraft. As the mix between large and small aircraft increases, the need for broader spacing to avoid wake vortices occurs.

The analysis of airfield capacity requires that total annual operations be presented according to aircraft classification categories. Forecasts of annual operations were developed for each planning period and presented in Chapter 2. Further, the aircraft fleet mixes were also determined.

The next step required that the forecast of operations data be translated into a classification system compatible with the airfield capacity methodology. The capacity and delay model used for the Yakima Air Terminal defines the aircraft fleet mix in terms of four classes, as presented in Exhibit 3-3. Using the fleet mix forecasts from Chapter 2 together with the data from this exhibit, the annual operations forecast by aircraft classification were prepared and are shown in Exhibit 3-4 and 3-5.

EXHIBIT 3-3
OPERATIONAL FLEET MIX CLASSIFICATION SYSTEM

Category A: Small single-engine, gross weight 12,500 pounds or less.

Examples:	Cessna 172/182	Cessna 150
	Beech Bonanza	Piper Cherokee/Warrior

Category B: Small twin-engine, gross weight 12,500 pounds or less.

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

Category C: Medium multi-engine, gross weight 12,500 to 300,000 pounds.

Examples:

General:	Beech King Air 200	Fairchild FH-227
	DeHavilland DH-7	Gulfstream III
	Lear 35/55	
	Embraer Bandeirante	
Stage II:	Boeing 727-100 and 200	
(2-3 engine)	Boeing 737-100 and 200	
	McDonnell Douglas DC-9, DC-9-30, DC-9-50	
	Fairchild F-28	
Stage III:	Boeing 737-300, 737-400, 737-500,757	
(2-3 engine)	McDonnell Douglas MD80	
	Airbus Industrie A320	
Stage III:	British Aircraft BAe 146	
(4 engine)		

Category D: Large aircraft, gross weight more than 300,000 pounds.

Examples:

Stage II:	McDonnell Douglas DC-8 (Hushkit)
4 engine narrow-body	Boeing 707 (Hushkit)
3-4 engine wide-body	Boeing 747-100, 747-200
Stage III:	
2 engine wide-body	Boeing 767
3-4 engine wide-body	Lockheed L-1011
	Boeing 747-200, 747-300, 747-400
	McDonnell Douglas DC-10-40, DC-10-10, DC-10-30
4 engine narrow-body	McDonnell Douglas DC-8-70

EXHIBIT 3-4
OPERATIONAL FLEET MIX - VMC CONDITIONS

Aircraft Classification	2002	2008	2013	2022
A	73%	57%	53%	48%
B	17%	14%	15%	17%
C	8.5%	28%	30%	34%
D	1.6%	1.2%	1.3%	1.2%
Total	100%	100%	100%	100%

Under IMC conditions this fleet mix will be slightly different due to the limitations of the aircraft operating. Smaller aircraft and discretionary flyers are not generally equipped to, or choose not to, operate under these conditions. Therefore the percentage of C and D aircraft will be higher. Exhibit 3-5 presents the IMC fleet mix.

EXHIBIT 3-5
OPERATIONAL FLEET MIX - IMC CONDITIONS

Aircraft Classification	2002	2008	2013	2022
A	0%	0%	0%	0%
B	46%	20%	20%	20%
C	45%	77%	77%	77%
D	9%	3%	3%	3%
Total	100%	100%	100%	100%

Percent Arrivals

The percentage of all aircraft operations that are arrivals has an influence on the capacity of runway configurations. For example, a runway used exclusively for departures will have a different capacity than one used solely for arrivals, and either case will exceed the capacity of a runway used for both arrivals and departures. At Yakima Air Terminal, all runways are used for arriving and departing aircraft. It is assumed that arrivals and departures each constitute 50 percent of total annual and peak period operations.

Touch-and-Go Operations

A touch-and-go operation refers to an aircraft landing and then making an immediate takeoff without coming to a full stop. These operations are normally associated with training and are important contributors to airport operational activity. Because of their continuous motion, touch-and-go operations do not occupy a runway for very long, and therefore a high percentage of touch-and-go activity yields a relatively high airfield capacity. Touch-and-go activity was determined to be approximately 40 percent of total operations.

Exit Taxiways

An important physical characteristic considered in the airside capacity analysis is the number and type of taxiways available to exit the runway. The location of exit taxiways affects the occupancy time of the runway. The longer a plane remains on the runway, the lower the capacity of that runway. Likewise, the type of exit also affects capacity. For instance, high-speed turnoffs allow arriving aircraft to depart the active runway more quickly, thereby making the runway available sooner for the next arrival or departure. The existing facilities map in Chapter 1 identified the location of the exit taxiways on the airport. These will be used in the capacity calculations.

3.1.2 Analysis of Capacity and Delay

The results of the capacity and delay analysis provide estimates of hourly airfield capacity and aircraft delay. Hourly airfield capacity is defined as the maximum number of aircraft operations that can take place on the airfield in one hour.

Delay to aircraft is defined as the difference between the actual time it takes an aircraft to operate on the airfield and the normal time it would take the aircraft to operate without interference from any other aircraft using the airspace or airfield. Therefore, the delay refers to the time spent waiting to land or take off caused by other aircraft.

Hourly Capacity of the Runway System

Hourly runway capacities were calculated under VMC and IMC conditions for the years 2002, 2008, 2013, and 2022. Exhibit 3-6 shows the results of the hourly capacity analysis for the airport.

EXHIBIT 3-6
HOURLY DEMAND/CAPACITY SUMMARY

Year	VMC Demand	VMC Capacity	IMC Demand	IMC Capacity
2002	31	98	9	59
2008	45	77	8	57
2013	48	77	9	57
2022	52	77	9	57

As demonstrated in the exhibit, hourly capacity is not exceeded during the planning period.

Annual Service Volume

The hourly capacity figures cited in the previous section are representative of the number of operations that can occur during a specific time period. It is unreasonable to assume that this peak saturation level could be maintained over a long period of time without a breakdown in the system. To account for this fact, another measure of capacity called the Annual Service Volume (ASV) is used. The ASV is not a measure of saturation but rather of service. This measurement uses the following criteria in its calculation.

- As annual demand approaches the ASV, delay to aircraft starts to increase rapidly
- When annual demand equals ASV, a reasonable level of service exists for much of the year
- When annual demand is 20 percent higher than annual service volume, the airport will experience severe congestion.

Annual service volume is used as a planning guide to determine the need for new facilities. It is also useful as a measure of the level of annual demand that can be expected to occur at an airport with marginal capacity available.

Annual service volume is a function of the weighted hourly capacity of the airfield and its peaking characteristics. The calculation of ASV combines the hourly capacity of each operational configuration and the percentage of time that each configuration is in use with the ratio of design day operations to peak month operations and design hour operations to design day operations. If the airport has very low peak period demands, as expressed by peak month, design day, and design hour operations, it will have a higher ASV. If the airport experiences periods of great demand followed by periods of low demand, its ASV will be much lower. ASV is an important indicator of an airport's ability to meet the demands placed on its airfield because ASV combines the physical capacity of the airfield, as measured by its weighted hourly capacity, with the characteristics of the users of the airport, as measured by design hour operations. Exhibit 3-7 presents the Yakima Air Terminal's ASV as compared to its annual demand.

EXHIBIT 3-7
ANNUAL SERVICE VOLUME AND ANNUAL DEMAND

Descriptor	2002	2008	2013	2022
Annual Service Volume	230,000	200,000	200,000	200,000
Forecast Demand	43,737	64,637	67,972	73,839
Capacity Surplus (Deficit)	186,263	135,363	132,028	126,161

As evidenced in Exhibits 3-6 and 3-7, the Yakima Air Terminal has sufficient runway capacity to meet the demand for service as measured by the hourly capacity and annual service volume.

3.2 Terminal Area Capacity

Components of the terminal area complex include the terminal building, automobile access and parking lots, terminal curb frontage, and terminal support facilities.

3.2.1 Terminal Building

Information regarding the passenger terminal capacity can be found in the following document: *Terminal Area Plan - Yakima Air Terminal,* August 1988, prepared by Knipper Dunn Franklund AIA Architects in association with Edward Just Associates.

3.2.2 Terminal Apron

According to the 2001 Pavement Condition Index Survey, the passenger terminal apron is approximately 11,770 square yards in size with a PCI rating of 67. It has the following load bearing capacities:

- 75,000 pounds - Single Gear;
- 95,000 pounds - Dual Gear; and
- 160,000 pounds - Dual tandem.

3.2.3 Access System

The capacity of the access system was calculated for the following system components:

- Airport access roadways;
- Terminal automobile parking; and
- Terminal curb frontage.

Access Roadways

The capacity of the airport access roadway system is defined as the systems capability to accommodate a stream of moving vehicles. The flow capacity of a facility is affected by a number of factors, including:

- Roadway Conditions: the geometric characteristics of the street;
- Traffic Conditions: the characteristics of traffic using the facility; and
- Control Conditions: the types of control devices and regulations of the facility.

Since the objective of any transportation facility is to accommodate demand at an acceptable level of service, the first step in determining capacity must be to select the level of service desired. In keeping with current highway capacity definitions, service level C was selected for this analysis.

Service level C describes a zone of relatively stable traffic flow, but at a volume and density level where most drivers are becoming restricted in their freedom to vary speed, change lanes, or pass. Exhibit 3-8 tabulates the urban roadway volumes to be expected at level of service C.

EXHIBIT 3-8
DESIGN SERVICE VOLUME OF ROADWAYS AT LEVEL OF SERVICE C

Roadway Type and Operating Conditions	Service Volume Per Lane
Suburban highway with moderate interference from cross traffic and roadsides.	720 vehicles per hour
Suburban highway with considerable interference from cross traffic an roadsides.	560 vehicles per hour
Arterial street.	480 vehicles per hour

Using the volumes shown in Exhibit 3-8 as a point of departure, the service volumes in Exhibit 3-9 below were estimated for the access roads to the Yakima Air Terminal.

EXHIBIT 3-9
AIRPORT ACCESS ROADWAY SERVICE VOLUMES

Roadway	Number of Lanes	Service Volume Per Lane
Lower Ahtannum Road	4	480 vehicles per hour
South 16th Ave.	4	400 vehicles per hour
South 40th Ave.	4	400 vehicles per hour
West Washington Ave.	4	480 vehicles per hour
Terminal Access Road	2	300 vehicles per hour

Terminal Area Parking

Terminal area automobile parking spaces can be classified as public, rental car, and employee. Current capacity is presented in Exhibit 3-10.

EXHIBIT 3-10
PUBLIC PARKING

Descriptor	Number of Spaces
Standard Parking	221
Disabled Parking	6
Disabled Van – Accessible	1
Total	228

EXHIBIT 3-11
RENTAL CAR PARKING

Descriptor	Number of Spaces
Standard Parking	52
Overflow Parking	19
Total	71

EXHIBIT 3-12
EMPLOYEE PARKING/OTHER

Descriptor	Number of Spaces
Standard Parking	50
Disabled Parking	2
Fire Department Parking	4
Police Parking	2
Lind Accounting Parking	12
Lind Accounting Disabled	1
Air Freight	22
Overflow and Itinerant Pilot Parking	33
Total	126

Terminal Building Curb Frontage

The terminal building at the Yakima Air Terminal provides 396 feet of curb frontage.

3.3 General Aviation Facility Capacity

Determining the capacity of the general aviation facilities at Yakima Air Terminal is a relatively straightforward process. Using the inventory data from Chapter 1 of this report and on-site inspection, and FBO and based aircraft owner survey forms, the available facilities were analyzed. Actual building or apron usage was not considered in this analysis, but rather generic categories were specified, with capacity expressed in terms of area measurements. Detailed determination of required new facilities will be provided in the following chapter on facility requirements.

Chapter 4: Airport Facility Requirements

This chapter identifies the airfield, terminal area, air cargo, general aviation, and access system improvements that are necessary to accommodate the forecast levels of demand at Yakima Air Terminal. In general, these requirements were determined by comparing forecast demand levels to the existing capacity of the facilities as specified. Problem areas were noted, and the facilities necessary to correct these deficiencies were identified.

Facility requirements are presented here in two distinct forms. The summary exhibits generally present requirements in an incremental-phased manner. The basic assumption here is that existing facilities will continue to be used throughout the planning period and that all of the requirements shown for Phase I will be completed prior to Phase II. Should any existing facility require replacement, relocation, or major rehabilitation, this need would be in addition to the requirements noted in these incremental tables.

For example, if the need for conventional hangars is 24,000 square feet (sf) and there now exists a 10,000 sf hangar, then a new 14,000 sf hangar should be constructed. Therefore, the facility requirements noted here would be 14,000 sf. If, however, the existing hangar deteriorates beyond economical repair, or is recommended for relocation, there may be a need for 24,000 sf of hangar construction. At this point the individual total requirement exhibits must be consulted to determine the total requirement for the individual planning.

Secondly, the requirements are developed assuming that no developmental constraints exist. If the requirements show that 90 acres of land will be needed to provide the facilities, then this amount of land is assumed to be available. If, in fact, only 50 acres are available, and no land acquisition is possible, then the requirements set forth herein must be revised. This does not mean that the facilities are no longer required, only that it is not possible to provide them. If this proves to be the case, the alternatives analysis, presented in the following chapter, will examine the implications of this situation.

A general summary of the required facilities, by planning phase, for Yakima Air Terminal is presented in Exhibit 4-1.

4.1 AIRFIELD REQUIREMENTS

The previous chapter described the major factors impacting the operation of the airport at Yakima Air Terminal. Airfield facility requirements, in response to the relationship between the demands placed on the airfield and it's capability to meet that demand, are presented in this section.

Before proceeding with the determination of facility requirements, it is appropriate to examine and define the role of the airport and determine the classification of the facility. As has been established in preceding chapters, the Yakima Air Terminal is the primary commercial service airport serving the passenger needs of Yakima County and beyond. It has also been determined that the airport is ultimately expected to play an essential role in the economic development of the area as a transshipment hub for high value, time-sensitive agricultural produce destined for national and international markets. Consequently, the airport should be classified as a long haul (over 1,500 miles) transport facility for planning purposes.

EXHIBIT 4-1
FACILITY REQUIREMENTS SUMMARY

Item	Phase I 2003-2007	Phase II 2008-2012	Phase III 2013-2023
Airfield			
Runways	Obstruction removal; RW 9-27 Safety Improvements; Valley Mall Boulevard Improvements; Relocate West Washington to South 48th Corridor	Shift and Extend RW 4-22 585 ft.; Acquire Property for Approach Protection	Environmental Study for RW 9-27 Extension; Extend RW 9-27 and Parallel TWs A & D; Acquire Property for Approach Protection
Taxiways	Construct airfield access roads; Acquire Property for Approach Protection	Construct Parallel TW D	—
Instrumentation	—	Install RW 9 PAPI	—
Terminal Area			
Terminal Building	—	Construct Fuel Farm; Expand Terminal Bldg. to the East for Baggage; Expand Terminal Bldg. to the West for Ticketing	—
Terminal Apron	—	Relocate Fire Station; Construct De-icing Facility	—
Access & Parking	—	Relocate/Expand Auto Parking; Relocate/Expand Rental Car Parking	—
Terminal Support	ARFF Vehicle Index B	—	ARFF Vehicle Index C
Air Cargo			
Cargo Building	—	—	Construct South Side Air Cargo Complex
Cargo Apron	—	—	Construct South Side Cargo Apron

General Aviation			
Hangars	Construct T-hangars (Private); Acquire Property for Development; Construct South GA Access Road & Utilities; Construct South GA TWs; Construct South GA Storage Hangars	Acquire GA Development Land; Construct Armory Apron (Private)	Construct South GA Commercial Facilities (Private)

Designing the various functional elements of the airfield, however, requires the use of the FAA's Airport Reference Code (ARC). As explained in Chapter 1, the ARC is a coding system developed by the FAA to relate airport design criteria to the operational and physical characteristics of the airplanes intended to operate at an airport. The ARC has two components related to the airport design aircraft. The first component, depicted by a letter, is the aircraft approach category and relates to aircraft approach speed. The approach categories 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; and
- Category E: Speed 166 knots or more.

The second component, depicted by a Roman numeral, is the airplane design group and relates to airplane wingspan. This grouping links an airport's dimensional standards to aircraft wingspans. The design categories are as follows:

- Design Group I: Wingspan up to but not including 49 feet;
- Design Group II: Wingspan 49 feet up to but not including 79 feet;
- Design Group III: Wingspan 79 feet up to but not including 118 feet;
- Design Group IV: Wingspan 118 feet up to but not including 171 feet;
- Design Group V: Wingspan 171 feet up to but not including 197 feet; and
- Design Group VI: Wingspan 197 feet up to but not including 262 feet.

Generally, aircraft approach speed applies to runways and runway related facilities. Airplane wingspan primarily relates to separation criteria involving taxiways and taxilanes.

Airports expected to accommodate single-engine airplanes normally fall into Airport Reference Code B-I. Airports serving larger general aviation and commuter-type planes are usually Airport Reference Code B-II or C-II. Small to medium-sized airports serving air carriers are usually Airport Reference Code C-III, while larger air carrier airports are usually Airport Reference Code D-VI.

Chapter 2 presented the details on the types of aircraft currently using the airport and expected to do so in the future. As described, aircraft ranging from small single-engine piston aircraft to large cargo jets are included in this fleet. It was therefore determined that the critical design aircraft should be the Boeing 757-200PF and the appropriate FAA Airport Reference Code for the Yakima Air Terminal should be C-IV. This group includes aircraft with approach speeds of 121 knots or more but less than 141 knots and wingspans of 118 feet up to but not including 171 feet. The ARC for Runway 4-22 should be B-III.

In order to prevent over-design of facilities designated solely to general aviation, or under-design of individual critical items such as cargo apron taxilanes, specific aircraft characteristics will be applied in some instances.

4.1.1 Runways

The requirements for runways and taxiways may be described in a number of terms. In this study, the following descriptors are used:

- Runway Orientation;
- Runway Capacity;
- Runway Length;
- Geometric Design Standards;
- Pavement Strength; and
- Taxiway Configuration.

Each of these requirement categories are discussed below.

Runway Orientation

The orientation of runways for takeoff and landing operations is primarily a function of wind velocity and direction, together with the ability of aircraft to operate under adverse conditions. As a rule, the primary runway at an airport is oriented as closely as possible in the direction of the prevailing winds. The most desirable runway configuration will provide the largest wind coverage for a given maximum crosswind component. The crosswind component is the vector of wind velocity and direction that acts at a right angle to the runway. Further, runway coverage is that percentage of time in which operations can safely occur because of acceptable crosswind components. The desirable wind coverage criterion for a runway system has been set by the FAA at 95 percent.

As a part of the master plan process, a detailed analysis of the wind and weather data was prepared for the airport. The existing layout of the airfield at Yakima Air Terminal provides for a runway configuration that provides 98.1% coverage at 10.5 knots and 99.1% coverage at 13.5 knots during all weather conditions. Based on this, no new runways are required to increase wind coverage.

Runway Capacity

The preceding chapter examined the capacity of the airfield at Yakima, compared it with the forecast demand, and determined that sufficient capacity exists to accommodate future activity levels. This indicates that no improvements will be required to increase airfield capacity.

Runway Length

An analysis of the active and future fleet mix composition as well as the non-stop markets to be served from Yakima Air Terminal results in a required runway length of 10,160 feet. This calculation is based upon two aircraft: the Boeing 727-100C, representing the near term fleet mix, and the Boeing 757-200PF, representing the future fleet mix. The following data was used in the analysis:

Design Aircraft:	Boeing 727-100C	Boeing 757-200PF
Engines:	3 JT8D-7	PW2037
Takeoff Weight (Maximum):	160,000 lbs. (Dual)	250,000 lbs. (Dual Tandem)
Temperature:	87 degrees F.	87 degrees F.
Airport Elevation:	1,095 ft. mean sea level	1,095 ft. mean sea level
Elev. Difference in R/W Ends:	59 ft.	66 ft.
Runway Length Requirement:	8,990 ft.	10,160

The primary runway at Yakima Air Terminal is 7,603 feet long. To accommodate the fleet mix expected to utilize the airport, Runway 9-27 will need to be extended 1,387 feet for the near term fleet mix, with an additional 1,170 feet for the future fleet mix.

The crosswind Runway 4-22 is 3,835 feet. To accommodate small airplanes with 10 or more passenger seats under conditions when Runway 9-27 is experiencing crosswinds greater than 10.5 knots, Runway 4-22 should be extended 585 feet to a total length of 4,420 feet.

Runway Dimensional Standards

The runways at Yakima Air Terminal have various dimensional criteria that are based upon the relevant aircraft design groups as discussed earlier in this chapter. All existing and proposed runways and taxiways must be constructed in accordance with FAA geometric design standards for both design and facility separation. These standards are included in the FAA's Airport Design (for microcomputers) Version 4.2D. A printout as to how they apply to the Yakima Air Terminal is produced below in Exhibit 4-2. These standards have been developed to assure that facilities can be operated in a safe and efficient manner and represent a minimum standard to be achieved.

All runway improvements at the airport must incorporate these criteria in their design to the degree possible. In some instances, deficiencies exist and facility improvements are best designed to coordinate with the existing condition. This is only true, however, when the criteria being violated can be waived by the FAA after a determination that no negative impact will result from such a waiver.

EXHIBIT 4-2:
AIRPORT DESIGN AIRPLANE AND AIRPORT DATA

PRIMARY RUNWAY 09-27

Aircraft Approach Category C		
Airplane Design Group IV		
Airplane wingspan		170.99 feet
Primary runway end approach visibility minimums are not lower than CAT I		
Other runway end approach visibility minimums are not lower that ¾ mile		
Airplane undercarriage width (1.15 x main gear track)		24.00 feet
Airport elevation		1095 feet
Airplane tail height		45.00 feet

RUNWAY AND TAXIWAY WIDTH AND CLEARANCE STANDARD DIMENSIONS

Runway centerline to parallel runway centerline simultaneous operations when wake turbulence is not treated as a factor:		
VFR operations with no intervening taxiway		700 feet
VFR operations with one intervening taxiway		800 feet
VFR operations with two intervening taxiways		1015 feet
IFR approach and departure with approach to near threshold 100 feet for each 500 feet of threshold stagger to a minimum of 1000 feet.		2500 feet less
Runway centerline to parallel runway centerline simultaneous operations when wake turbulence is treated as a factor:		
VFR operations		2500 feet
IFR departures		2500 feet
IFR approach and departure with approach to near threshold		2500 feet
IFR approach and departure with approach to far threshold 100 feet for each 500 feet of threshold stagger		2500 feet plus
IFR approaches		3400 feet
Runway centerline to parallel taxiway/taxilane centerline	335.5	400 feet
Runway centerline to edge of aircraft parking	400.0	500 feet
Runway width		150 feet
Runway shoulder width		25 feet
Runway blast pad width		200 feet
Runway blast pad length		200 feet
Runway safety area width		200 feet
Runway safety area width		500 feet
Runway safety area length beyond each runway end or stopway end, whichever is greater		1000 feet
Runway object free area width		800 feet
Runway object free area length beyond each runway end or stopway end, whichever is greater		1000 feet
Clearway width		500 feet
Stopway width		150 feet

Obstacle free zone (OFZ):

Runway OFZ width		400 feet
Runway OFZ length beyond each runway end		200 feet
Inner-approach OFZ width		400 feet
Inner-approach OFZ length beyond approach light system		200 feet
Inner-approach OFZ slope from 200 feet beyond threshold		50:1
Inner-transitional OFZ height H	41.6	41.6 feet
Inner-transitional OFZ slope		6.1

Runway protection zone at the primary runway end:

Width 200 feet from runway end		1000 feet
Width 2700 feet from runway end		1750 feet
Length		2500 feet

Runway protection zone at other runway end:

Width 200 feet from runway end		1000 feet
Width 1900 feet from runway end		1510 feet
Length		1700 feet

Departure runway protection zone:

Width 200 feet from the far end of TORA		500 feet
Width 1900 feet from the far end of TORA		1010 feet
Length		1700 feet

Threshold surface at primary runway end:

Distance out from threshold to start of surface		200 feet
Width of surface at start of trapezoidal section		1000 feet
Width of surface at end of trapezoidal sections		4000 feet
Length of trapezoidal section		10000 feet
Length of rectangular section		0 feet
Slope of surface		20:1

Taxiway centerline to parallel taxiway/taxilane centerline	215.2	215 feet
Taxiway centerline to fixed or movable object	129.7	129.5 feet
Taxilane centerline to parallel taxilane centerline	198.1	198 feet
Taxilane centerline to fixed or movable object	112.6	112.5 feet
Taxiway width	54.0	75 feet
Taxiway shoulder width		25 feet
Taxiway safety area width	171.0	171 feet
Taxiway object free area width	259.4	259 feet
Taxilane object free area width	225.2	225 feet
Taxiway edge safety margin		15 feet
Taxiway wingtip clearance	44.2	44 feet
Taxilane wingtip clearance	27.1	27 feet

REFERENCE: AIRPORT DESIGN VERSION 4.2D

RUNWAY 04-22

Aircraft Approach Category B		
Airplane Design Group III		
Airplane wingspan		117.99 feet
Primary runway end approach visibility minimums are visual exclusively		
Other runway end approach visibility minimums are visually exclusively		
Airplane wheelbase is less than 60 feet		
Airport undercarriage width (1.15 x main gear track)		14.75 feet
Airport elevation		1090 feet

RUNWAY AND TAXIWAY WIDTH AND CLEARANCE STANDARD DIMENSIONS

Runway centerline to parallel runway centerline simultaneous operations when wake turbulence is not treated as a factor:		
VFR operations with no intervening taxiway		700 feet
VFR operations with one intervening taxiway		700 feet
VFR operations with two intervening taxiways		752 feet
IFR approach and departure with approach to near threshold 100 feet for each 500 feet of threshold stagger to a minimum of 1000 feet.		2500 feet less
Runway centerline to parallel runway centerline simultaneous operations when wake turbulence is treated as a factor:		
VFR operations		2500 feet
IFR departures		2500 feet
IFR approach and departure with approach to near threshold		2500 feet
IFR approach and departure with approach to far threshold 100 feet for each 500 feet of threshold stagger		2500 feet plus
IFR approaches		3400 feet
Runway centerline to parallel taxiway/taxilane centerline	259.0	300 feet
Runway centerline to edge of aircraft parking	400.0	400 feet
Runway width		100 feet
Runway shoulder width		20 feet
Runway blast pad width		140 feet
Runway blast pad length		200 feet
Runway safety area width		300 feet
Runway safety area length beyond each runway end or stopway end, whichever is greater		600 feet
Runway object free area width		800 feet
Runway object free area length beyond each runway end or stopway end, whichever is greater		600 feet
Clearway width		500 feet
Stopway width		100 feet

Obstacle free zone (OFZ):

Runway OFZ width	400 feet
Runway OFZ length beyond each runway end	200 feet
Inner-approach OFZ width	400 feet
Inner-approach OFZ length beyond approach light system	200 feet
Inner-approach OFZ slope from 200 feet beyond threshold	50:1
Inner-transitional OFZ slope	0:1

Runway protection zone at the primary runway end:

Width 200 feet from runway end	500 feet
Width 1200 feet from runway end	700 feet
Length	1000 feet

Runway protection zone at other runway end:

Width 200 feet from runway end	500 feet
Width 1200 feet from runway end	700 feet
Length	1000 feet

Departure runway protection zone:

Width 200 feet from the far end of TORA	500 feet
Width 1200 feet from the far end of TORA	700 feet
Length	1000 feet

Threshold surface at primary runway end:

Distance out from threshold to start of surface	0 feet
Width of surface at start of trapezoidal section	400 feet
Width of surface at end of trapezoidal sections	1000 feet
Length of trapezoidal section	1500 feet
Length of rectangular section	8500 feet
Slope of surface	20:1

Taxiway centerline to parallel taxiway/taxilane centerline	151.6	152 feet
Taxiway centerline to fixed or movable object	92.6	93 feet
Taxilane centerline to parallel taxilane centerline	139.8	140 feet
Taxilane centerline to fixed or movable object	80.8	81 feet
Taxiway width	34.8	50 feet
Taxiway shoulder width		20 feet
Taxiway safety area width	118.0	118 feet
Taxiway object free area width	185.2	186 feet
Taxilane object free area width	161.6	162 feet
Taxiway edge safety margin		10 feet
Taxiway wingtip clearance	33.6	34 feet
Taxilane wingtip clearance	21.8	22 feet

REFERENCE: AIRPORT DESIGN VERSION 4.2D

Presently, most facilities meet or exceed these standards with the following exceptions:

South 16th Avenue is situated just east of the threshold of Runway 27. The runway is located in such a manner that the safety area for Runway 27 is restricted to 750 feet, rather than the current standard of 1,000 feet. Also, a portion of the roadway is in violation of FAR Part 77 height restrictions, requiring that the height of vehicles traversing the roadway must be limited to 13 feet, 6 inches in overall height.

To mitigate these conditions it is recommended that the right of way of South 16th Avenue that passes under the approach path be abandoned and the roadway be filled and leveled.

Runway Pavement Strength

Runway 9-27 pavement strength is rated for 160,000 pounds dual wheel (DWG) and 220,000 pounds dual tandem gear (DTG). The maximum design taxi weight for a Boeing 727-100C is 160,000 DWG and 250,000 DTG for a Boeing 757. To accommodate the ultimate 757 aircraft the pavement strength of 9-27 should be evaluated to determine if an upgrade is necessary. Runway 4-22 is rated at 80,000 pounds DWG, which is adequate for the B-III aircraft expected to utilize this runway.

4.1.2 Taxiway Requirements

The existing taxiway layout on the north side of the airport is sufficient to accommodate the demand levels forecast in an efficient manner. The existing parallel taxiway should be extended in conjunction with the recommended runway extension.

Water and sewer has been installed on the south side of the airport, making additional acreage available for development. This infrastructure allows for aviation-related development on the south side, which includes general aviation development, along with the air cargo facilities identified in the 1996 Master Plan Update. To safely facilitate this aviation growth on the south side, a south parallel taxiway is recommended for Runway 9-27.

Any new taxiway development should meet or exceed FAA design and separation standards outlined in Exhibit 4-2.

4.1.3 Instrumentation, Visual Navaids, and Lighting

The existing instrumentation and lighting equipment at Yakima Air Terminal have been described in Chapter 1: Inventory.

Instrumentation

The current electronic navigational system is sufficient to provide for a precision instrument approach to Runway 27, and circling nonprecision instrument approaches to all runways. It is recommended that a Global Positioning System (GPS) precision approach be developed for Runway 9. To lower airport approach minimums, it is also recommended that all existing electronic navigation approaches be supplemented by GPS approaches.

An Airport Surveillance Radar (ASR-9) is sited at the airport. The ASR-9 is used to identify and control traffic generally within 60 nautical miles of the airport. The ASR-9 facility is sited midway along the South Airport Access Road. Clearance requirements call for a 1,500 foot restrictive zone in which all buildings may not extend into the radar beam and no radio or television broadcasting facilities may be constructed.

Lighting

Taxiway edge lighting is presently limited to air carrier taxiways. Lighting should be installed on all taxiways to facilitate aircraft maneuvering.

4.1.4 Runway Protection Zones and Approach Slopes

Approach slope and runway protection zone standards are set by FAA recommendations. For runways accommodating precision instrument approaches, the ratio is 50:1. For runways providing nonprecision instrument approaches, it is 34:1, and 20:1 for visual runways.

Runway 27 currently has an approach slope of 50:1. The Runway 9 approach slope should be planned for a precision instrument approach. This will increase the current approach slope from 34:1 to 50:1. Runway 04 and 22 have 20:1 approach slopes.

The Runway Protection Zone is a trapezoidal area representing the ground level at the innermost portion of the runway approach. The exact dimensions of this zone are defined by the type of aircraft and operations to be conducted on the runway. The RPZ begins 200 feet beyond the runway threshold at the end of the area usable for takeoff and landings, and is centered along the extended runway centerline. The RPZ function is to enhance the protection of people and property on the ground.

Where practical, the airport should own the property under the runway approach and departure areas to at least the limits of the RPZ. It is desirable to clear the entire RPZ of all above ground objects. Where this is impractical, airport owners, as a minimum, shall maintain the RPZ clear of all facilities supporting incompatible activities. Incompatible activities include, but are not limited to, those which lead to an assembly of people.

The RPZ for Runway 9 should be expanded to accommodate a precision instrument approach. This will require increasing the zone length from 1,700 feet to 2,500 feet, and the outer zone width from 1,510 feet to 1,750 feet. The inner width will remain at 1,000 feet.

4.2 TERMINAL AREA REQUIREMENTS

Terminal building and parking facility requirements were taken from the *Terminal Area Plan - Yakima Air Terminal,* August 1988, prepared by Knipper Dunn Franklund AIA Architects in association with Edward Just Associates. Facility requirements recommended in the report were based upon a 1987 forecast of 160 peak hour passengers. New forecasts presented in Chapter 2, based upon more recent data, indicate the airport will experience only 70 peak hour passengers by year 2022. To account for the slower growth rate in passenger levels, the time frame for implementing terminal area facility requirements have been adjusted.

4.2.1 Terminal Building

Terminal building area requirements in gross square feet are presented in Exhibit 4-3. The *Terminal Area Plan* referenced above indicated the building was structurally in good condition. However, the building was operationally in poor condition, its interior organization causes several functional and operational problems for ticketing, enplaning and deplaning passenger flows, baggage claim, and customer queuing; and was deficient on compliance for local building codes and the Americans with Disabilities Act (ADA) requirements, and should be replaced.

Based on examination of a variety of factors, the 1996 Master Plan Update recommended that the terminal remain at its present location for the time being. Therefore, in the late 1990's, the airport implemented a three-phase project to improve the existing terminal building deficiencies, meet current code requirements, and provide expanded concourse area. Along with additional terminal area improvements recommended as part of the 2003 ALP Update, the existing terminal area facilities are expected to meet the projected demand through the current 20 year planning horizon.

4.2.2 Terminal Apron

Considering the forecast of peak hour passengers and fleet mix, no additional terminal apron will be required during the planning period.

4.2.3 Terminal Parking

Parking requirements are listed in Exhibit 4-4.

EXHIBIT 4-3:
TERMINAL BUILDING REQUIREMENTS

Facility	Existing (sf)*	Year 2007 Requirements**(sf)	Ultimate Buildout**
Airline ATO/Operations	5,120	5,600	6,800
Public Space	5,360	14,330	20,900
Passenger Holdroom	7,460	3,600	5,200
Baggage Claim Area	960	7,200	7,900
Concessions	8,850	11,820	13,200
Utilities	1,890	2,750	3,480
Offices	1,090	1,200	1,500
Total Area (sf)	30,730	46,,500	59,000
Ticket Counters (LF)	50	96	144
Baggage Claim Device (LF)	32	85	105
Curb Canopy (sf)	4,900	10,200	11,200

* Source: *Yakima Air Terminal – McAllister Field, Airport Security Plan, March 2001*
** Source: *Terminal Area Plan - Yakima Air Terminal,* August 1988.

EXHIBIT 4-4:
TERMINAL PARKING REQUIREMENTS

	Year 2007 Requirements		Ultimate
Auto Parking:			
Public Parking Spaces	158		220
Rental Car Parking	108		165
Employee	92		122
Total	355		507
Enplaning Curb:			
Auto Parking	6		9
Taxi/Limo	1		2
Bus	(1)		(1)
Total	7		11
Deplaning Curb:			
Auto	7		10
Taxi/Limo	1		2
Bus	1		(1)
Total	9		12
Enplaning Curb Length	180	feet	270
Deplaning Curb Length	200	feet	295
Total Curb Length	380	feet	565

Source: *Terminal Area Plan - Yakima Air Terminal*, August 1988.

4.2.4 Airport Access Road

The terminal roadway system includes the roadway serving the terminal building and associated parking areas, and the service roads that provide access to the terminal support facilities, to the airfield , and to other nonpublic areas. Provision for adequate vehicle access, efficient circulation, and parking is essential to the success of a passenger terminal.

The terminal access road should be sufficiently long to permit smooth channeling of traffic into appropriate lanes for safe access to terminal curbs, parking lots, and other parking facilities. Traffic circulation in front of the terminal building should be one-way and counter-clockwise for convenience of right-side loading and unloading of vehicles. Recirculation of vehicles to the passenger terminal should be permitted by providing road sections to link the ingress and egress lanes of the access road.

The access road should be planned to accommodate 900 to 1,000 vehicles per lane per hour. A minimum of two 12 foot lanes should be provided. The terminal frontage road should have at least two lanes adjacent to the curb. The inside lane, sized at eight feet, provides terminal curbfrontage and the 12 foot outside lane serves through traffic and maneuvering to the terminal curbfrontage. The planned capacity of the outside lane should be 300 vehicles per hour, the inside lane is considered to have no throughput capacity.

The terminal access road configuration is anticipated to be adequate throughout the 20-year planning horizon.

4.2.5 Terminal Support Facilities

Terminal support facilities are those that support the commercial operations side of airport activity.

Aircraft Rescue and Fire Fighting (ARFF)

ARFF facilities were described in Chapter 1: Inventory. Regulations and guidelines that control ARFF facilities include the following:

FAA Advisory Circular 150/5210-10, and
Federal Aviation Regulations (FAR) Part 139.

These documents establish a level of service index based upon the type, size, and frequency of aircraft serving the airport in scheduled air service. Using these criteria, the Yakima Air Terminal currently requires an Index A level of equipment and facilities. Current equipment meets these standards. To accommodate the influx of longer turboprop and regional jet aircraft into the system, the airport should upgrade equipment to Index B in the near term. The airport should upgrade equipment to Index C to accommodate the cargo aircraft identified in the latter portion of the planning period.

Federal Inspection Services (FIS) Facilities

FIS is provided by the U.S. Customs Service, Department of the Treasury. They control the entrance and clearance of aircraft arriving in and departing from the United States and inspect the crew, passengers, baggage, stores, and cargo carried thereon. As there are currently no scheduled international passenger flights into or out of Yakima, customs primarily provides inspection service for general aviation and cargo operations.

FIS facilities are currently located at the hangar east of the terminal building. There is room for parking three piston engine aircraft on the ramp in front of the customs office. An increase in international activity will most likely require relocation to an area that will accommodate larger aircraft. To accommodate large aircraft charter operations from Mexico or Canada, a temporary structure could be sited on the terminal apron parallel to the rental car parking lot and adjacent to the terminal baggage claim area.

Foreign Trade Zone

The Yakima Air Terminal was designated as a Foreign Trade Zone (FTZ) in the mid 1990's. A FTZ is a site within the United States, at or near a U.S. Customs Port of Entry, where foreign and domestic merchandise is generally considered to be in international commerce. Foreign or domestic merchandise may enter this enclave without a formal Customs entry or the payment of Customs duties or government excise taxes.

While the airport continues to support the Foreign Trade Zone and User Fee Customs Port of Entry to promote air freight and community development, the FTZ was temporarily deactivated due to the financial burden of maintaining Customs. When sufficient industry is located in the Yakima area to support the costs of the FTZ and Customs, it will be reactivated.

The entire airport was declared a FTZ, however, according to *Part 400-General Regulations Governing Foreign Trade Zones in the United States, With Rules of Procedure*; the FTZ must be "...an isolated, enclosed, and policed area, operated as a public utility, in or adjacent to a port of entry, furnished with facilities for loading, unloading, handling, storing, manipulating, and exhibiting goods, and for reshipping them by land, water, or air." To summarize Section 400.402, warehouses in the FTZ must be constructed to meet the special requirements of the Treasury Department to safeguard the revenue, and all zones must be segregated from the land area of adjacent customs territory by a fence of at least ten feet in height.

It is recommended that the FTZ be operated as an "Open Zone". The open zone concept is one that allows an airport tenant to choose whether to take advantage of the benefits of zone operation. Under the open zone concept, a company can activate zone status in all, or part, of its property. As world conditions alter supplies and markets, each company can evaluate the advantages of zone use and add or subtract active zone space to meet the needs of its particular operation for a specific period.

4.3 CARGO AREA REQUIREMENTS

The three essential components that are basic to cargo operations include the cargo building for the transfer of cargo from landside to airside, the loading and unloading lots for landside delivery and pick-up, and the aircraft apron/hardstand for the airside handling of cargo. The cargo building, in addition to acting as a simple transfer point for cargo passing to and from airside to landside handlers, may also be used for warehousing and storage, container makeup and breakdown, and package sorting operations.

Current small package cargo operations are being handled in a congested area east of the terminal building. Landside parking and access along West Washington Avenue is very constrained, and not suitable for large trucks. The approximately 60,000 square feet of ramp in front of the Federal Express building is limited to small aircraft due to runway design criteria and pavement strength.

Cargo facility requirements were determined by comparing the operational capacity of existing facilities to total cargo demand projected for the future.

4.3.1 Building/Warehouse Facilities

Building/warehouse utilization rates are expressed as square feet per annual ton of cargo. According to a study completed for the FAA (*Air Cargo in the 1980's and Beyond*, July 1984) about one square foot of cargo building is required to process one annual ton of cargo, with a factor of two either way, as indicated by data on actual facilities. Sea-Tac operates with a utilization rate of 2.47 square feet per annual ton. Since the major trend is toward greater use of mechanization and automation to improve the productivity of cargo buildings, a national average of 1.7 square foot per annual ton of cargo will be assumed to be adequate for sizing facilities at Yakima.

Cargo building requirements for Yakima Air Terminal for the planning period are shown in Exhibit 4-5.

EXHIBIT 4-5:
CARGO BUILDING REQUIREMENTS

Year	Annual Tons of Freight	Warehouse (sf)
1997	14,562	24,755
2002	16,792	28,546
2012	21,384	36,354

Cargo buildings should be a maximum of 150 feet wide with a clearspan design. Length of buildings will vary depending on layouts. Chill facilities should be provided on a case by case basis. A minimum of a 200 foot landside corridor should be provided between building faces. This will provide adequate room for access, circulation, and parking.

4.3.2 Landside Access and Parking

Access to and from the airport cargo complex and circulatory roads within it should be direct and unimpeded. Parking areas required include those designed to serve truckers, customers, and employees. The planning criteria used for cargo facility layouts are listed below.

- Terminal truck apron: minimum overall depth of 100 feet.
- Truck docks: 0.3 spaces/1000 sf of warehouse.
- Truck docks: 75% of length of building.
- Auto parking: 1 space/1,000 s.f
- Customer parking: 25% of building length.
- Traffic generation: 0.8/1,000 sf

All cargo activities should logically be located in the same general area, with reasonable access to the passenger terminal and primary Runway 9-27.

4.3.3 Cargo Apron

Paved apron/hardstand requirements for aircraft parking and loading positions adjoining air carrier cargo facilities are dependent upon the type and size of the aircraft used, airline schedules, and the type of handling system used. The critical aircraft used for facility planning is the Boeing 757-200PF (Airport Reference Code C-IV).

It is assumed that only large and heavy aircraft (jets and large turboprops) will require individual hardstand positions, and they will all be in common usage. Smaller turboprops will be interspersed among the larger aircraft.

An area capable of accommodating two heavy aircraft will be sufficient over the planning period. The criteria listed below should be used in developing the ramp area.

- B-757 tail clearance requires: 500 feet from centerline of runway.
- Taxilane clearance for
- Design Group IV: 112.5 feet from centerline.
- Cargo marshalling area
- building to nose of aircraft: 125 feet maximum, 55 feet minimum.
- Cargo road: 40 feet.
- Aircraft to cargo road: 25 feet.
- B-757 length: 154.08 feet.
- Aircraft parking positions: 200 feet in length and 160 feet in width.

Total area set aside for cargo apron area will vary with detailed facility layouts. For general planning purposes, a total of 9,100 square yards will be used as a guideline.

4.4 GENERAL AVIATION FACILITIES

General aviation encompasses the majority of activity at Yakima Air Terminal at the present time, and forecasts show that this can be expected to continue. Therefore, it is important to determine what facilities will be required to accommodate this component of users.

Existing general aviation facilities are positioned in four areas around the airport: to the west of the terminal building, both on and off airport property; to the east of the Central building; at the east end of the airport between Runways 22 and 27; and the southeast corner of the airport, at the end of the north-south taxiway. Available facilities include fixed base operator (FBO) facilities, privately owned hangars, aircraft parking aprons, and fuel storage/distribution.

Facility projections were prepared for the following facility categories:

- Hangars and Hangar Apron;
- Local Parking Apron;
- Itinerant Parking Apron;
- FBO/Maintenance Areas;
- Ground Access and Vehicle Parking;
- Fuel Storage;
- Aircraft Parking Apron; and
- Auto Parking.

The requirements for each of these areas are shown in Exhibit 4-6, and the methods used in determining them are detailed in the following paragraphs.

EXHIBIT 4-6:
GENERAL AVIATION DEMAND

Facility	2002	2008	2013	2022
			Planning Year Requirements	
Hangars:				
Number of Aircraft to be Hangared	116*	120	126	147
Conventional Hangar Spaces	21	18	21	36
Conventional Hangar Area	76,100 sf	30,700 sf	37,200 sf	46,500 sf
T-Hangars	80	102	105	111
T-Hangar Area	84,700 sf	142,800 sf	147,000 sf	155,400 sf
FBO/Maint.	91,500 sf	17,400 sf	18,400 sf	20,200 sf
Total Area	252,300 sf	190,900 sf	202,600 sf	222,100 sf
Apron:				
Hangar	22,600 *	27,200 sy	28,600 sy	31,100 sy
FBO	1,800 *	1,900 sy	2,000 sy	2,200 sy
Local Aircraft Parking	15,600*	16,200 sy	16,500 sy	17,400 sy
Itinerant Aircraft Parking	6,000 *	8,400 sy	8,800 sy	9,600 sy
Total	23,400 *	26,500 sy	27,300 sy	29,200 sy
Auto Parking:				
Spaces	210 **	115	120	131

* *Calculated Current Requirement*
** *Per 1996 Airport Master Plan Update*

4.4.1 Hangars and Hangar Apron

Hangar demands imposed by general aviation aircraft are a function of the number of based aircraft, the type of aircraft accommodated, owner preferences, and area climate. Hangar apron demand is based upon the amount of hangar space provided. Hangar apron demand, when combined with hangar space requirements, provides a planning guideline for the amount of total area needed for hangar separation distances and associated pavement such as hangar taxiways and taxilanes.

Hangars

Generally, more sophisticated aircraft types, such as turbine or multi-engine aircraft, tend to have higher demands for hangar facilities than do single-engine aircraft. Due to the major capital investment more expensive aircraft represent, hangar storage rates increase with the size and costs of stored aircraft.

Prefabricated, conventional hangars, and T-hangar units are available from a variety of manufacturers throughout the nation. Storage space for based aircraft was determined by using guidelines suggested in manufacturer's literature. Typical aircraft sizes were also reviewed in light of the evolution of business aircraft sizes. Conventional hangar space was based upon a standard of 1,200 square feet for single-engine aircraft, 1,400 square feet for multi-engine pistons, 1,800 square feet for turbo-props, and 3,500 square feet for turbojet/fans. A standard of 1,400 square feet per piston aircraft was used in calculating T-hangar space requirements.

Exhibit 4-7 sets forth the requirements for hangar space at Yakima Air Terminal through the planning period as well as the assumptions used in calculating the various hangar types.

Hangar Apron

Hangar apron demands were established using an aviation industry planning guideline which indicates a need to develop conventional hangar apron equal to hangar area and T-hangar apron equal to 1-1/2 times hangar area. Exhibit 4-8 details these requirements.

4.4.2 Local Aircraft Parking Apron

Local apron area is planned to ensure adequate tie down space for those based aircraft that are not anticipated to desire hangar storage. FAA Advisory Circular 150/5300-13 indicates that 300 square yards is an adequate area for each piston aircraft tie down on local apron. Applying these standards to the number of based aircraft expected to require space on the local apron results in the areas set forth in Exhibit 4-9.

EXHIBIT 4-7:
HANGAR AREA DEMAND

Planning Year & Aircraft Type	Total Aircraft by Type	Conventional Hangar		T-Hangars	
		No.	Area	No.	Area
2008					
Single-Engine[1]	124	6	7,200 sf	93	130,200 sf
Multi-Engine[2]	20	7	9,800 sf	9	12,600 sf
Turbojet/Fan[3]	3	3	10,500 sf	-	-
Rotocraft	2	2	3,200 sf	-	-
Total	149	18	30,700 sf	102	142,800 sf
2013					
Single-Engine[1]	126	6	7,200 sf	95	133,000 sf
Multi-Engine[2]	23	8	11,200 sf	10	14,000 sf
Turbojet/Fan[3]	4	4	14,000 sf	-	-
Rotocraft	3	3	4,800 sf	-	-
Total	156	21	37,200 sf	105	147,000 sf
2022					
Single-Engine[1]	132	7	8,400 sf	99	138,600 sf
Multi-Engine[2]	27	9	12,600 sf	12	16,800 sf
Turbojet/Fan[3]	5	5	17,500 sf	-	-
Rotocraft	5	5	8,000 sf	-	-
Total	169	36	46,500 sf	111	155,400 sf

1 20 percent stored on local apron, 75 percent in T-hangars, 5 percent in conventional hangars.
2 Twenty percent stored on local apron, 45 percent in T-hangars, 35 percent in conventional hangars.
3 One hundred percent in conventional hangars.

EXHIBIT 4-8:
HANGAR APRON

Year	Conventional Hangars	T-Hangars	Total
2008	3,400 sy	23,800 sy	27,200 sy
2013	4,100 sy	24,500 sy	28,600 sy
2022	5,200 sy	25,900 sy	31,100 sy

EXHIBIT 4-9:
LOCAL AIRCRAFT PARKING APRON

Year	Number of Aircraft			Total Area Required
	Single-Engine[1]	Multi-Engine[2]	Total	
2008	50	4	54	16,200 sy
2013	50	5	55	16,500 sy
2022	53	5	58	17,400 sy

1 Forty percent of total.
2 Twenty percent of total

4.4.3 Itinerant Aircraft Parking Apron

Areas designated for parking transient aircraft are termed itinerant aprons. The amount of such apron required was estimated using an approach suggested by the FAA. Notable steps in the methodology employed are as follows:

- Use the general aviation itinerant design day operations as the basis for estimating itinerant apron demands;

- Estimate that 12.5 percent of the design day itinerant aircraft will require apron parking space at any one time. This estimate is derived from one-half design day operations, to account for aircraft, with the assumptions that 50 percent will be based aircraft and only 50 percent of the remaining will be on the ground at any one time; and

- Estimate itinerant ramp demands on the basis of 360 square yards per piston aircraft and 800 square yards per turbine aircraft in accordance with FAA guidelines.

Applying this approach to the general aviation itinerant operations forecast developed in Chapter 2 yields the demand for itinerant apron areas as shown in the following exhibit.

EXHIBIT 4-10:
ITINERANT PARKING APRON DEMAND

Year	Design Day Itinerant Operations	Number of Aircraft Needing Parking	Required Itinerant Apron
2008	169	21	8,400 sy
2013	177	22	8,800 sy
2022	192	24	9,600 sy

4.4.4 Fixed Base Operator/Maintenance Area

Fixed base operator (FBO) maintenance area demands differ according to the level and type of services provided. Therefore, no fixed guidelines are available. A frequently used estimate is to compute FBO maintenance area at ten percent of the total aircraft hangar area. Using this approach produces the planning year maintenance hangar demands shown in Exhibit 4-11. The demand for maintenance apron area is equal in size to building area.

EXHIBIT 4-11:
FBO/MAINTENANCE AREA DEMAND

		Required FBO/Maintenance Area	
Year	Total Hangar	Hangar	Apron
2008	173,500 sf	17,400 sf	1,900 sy
2013	184,200 sf	18,400 sf	2,000 sy
2022	201,900 sf	20,200 sf	2,200 sy

4.4.5 Auto Parking

Vehicle parking demand in the hangar area is dependent on the level of local and itinerant operations that occur. The methodology used in this analysis follows the steps outlined in the following information.

- Determine design day, general aviation itinerant pilots, and passenger levels based on an aircraft occupancy level of 2.8 persons per operation.
- Assume an average occupancy rate of 1.5 person per vehicle.
- Multiply the number of vehicle spaces required by the planning standard of 22.2 square yards per parking space to determine the total parking area requirements for itinerant operations.
- Add one parking space for every two based aircraft.

Exhibit 4-12 shows the result of this analysis.

EXHIBIT 4-12:
GA AREA VEHICLE PARKING DEMAND

Descriptor	2008	2013	2022
Itinerant Pilots & Passengers	60 people	63 people	69 people
Itinerant Parking Requirement	40 spaces	42 spaces	46 spaces
Based Parking Requirement	75 spaces	78 spaces	85 spaces
Total			
Spaces	115 spaces	120 spaces	131 spaces
Area	2,600 sy	2,700 sy	2,900 sy

Because general aviation activity is scattered around the airport, actual auto parking requirements will vary according to individual facility needs.

4.4.6 Fuel Storage

Fuel capacity is adequate throughout the planning period. Presently, there are three (3) facilities at the airport supplying aviation fuels. These facilities are outlined in Chapter 1 Inventory.

4.4.7 Landside Facility Requirements

The preceding sections calculated total general aviation landside area demand. To determine phased facility requirements, existing capacity is compared with these demands to produce required new facilities by phase. Exhibit 4-13 shows this relationship.

EXHIBIT 4-13:
LANDSIDE AVIATION FACILITY REQUIREMENTS

Facility Type/Descriptor	Existing	Requirements by Phase		
		2003-2007	2008-2012	2013-2022
Hangars:				
Conventional Hangar Units	21	0	0	15
T-Hangars	80	22	0	9
T-Hangar Area	84,700 sf	58,100 sf	0 sf	12,600 sf
FBO/Maint. Area	91,500 sf	0	0	0
Total Area	252,300 sf	58,100 sf	0	28,400 sf
Aprons:				
Hangar	22,600 *sy	4,600 sy	0	3,900 sy
FBO/Maint.	1,800 * sy	100 sy	100 sy	100 sy
Local Parking	15,600 * sy	600 sy	300 sy	900 sy
Itinerant Parking	6,000 * sy	2,400 sy	400 sy	800 sy
Total Apron	23,400 * sy	3,100 sy	800 sy	1,800 sy
Auto Parking:				
Spaces	210 **	0	0	0

** Calculated Current Requirements*

*** Per 1996 Airport Master Plan Update*