CHAPTER V. AIRFIELD FACILITY REQUIREMENTS

The purpose of this paper is to identify the need for future airport developments in the areas of:

- runways and runway improvements;
- taxiways, including additional cross-taxiways connecting the north and south sides of the airport;
- passenger terminal facilities, including gates, and covering both domestic and international needs;
- air cargo;
- general aviation;
- support facilities, including airport and airline administrative and maintenance areas; fuel storage and distribution system; crash, fire and rescue facilities; flight kitchens; FAA facilities;
- and roadway, curbside and parking requirements.

Previous studies have addressed many of these items of airport development. It is the intent of the following chapters to re-evaluate the conclusions of these earlier studies in the light of current conditions and revised expectations.

1. AIRFIELD CAPACITY AND DELAYS

The number of aircraft operations at Sky Harbor is expected to increase from 416,659 operations in 1986 to 567,934 in 2007. This increase will place additional demand on the airfield and will lead to increases in delays to aircraft if no improvements are implemented.

An analysis was conducted of airfield capacity and delay to determine the extent of delays today and in the future with and without the most significant improvement available, namely, a third parallel runway located south of the existing Runway 8R-26L.

The analysis of airfield capacity was conducted in accordance with the procedures identified in the FAA AC 150/5060-5, "Airport Capacity and Delay". The capacity of the existing runway system to meet forecast traffic levels was evaluated and the limitations of the existing runway system were addressed. The need for additional runway capacity also was identified.

A. Demand

Table V.1 shows the forecast demand for 1988 and 2007. Annual demand is expected to increase by nearly 30 percent in this time period, causing peak hour traffic (on the average day of the peak month) to increase from 91 in 1988 to 117 in 2007.

Table V.2 shows the change in aircraft mix that is forecast to occur over the same time period, with the percent of large and heavy aircraft increasing from approximately 64 percent in 1988 to approximately 82 percent in 2007.

B. Capacity

Table V.3 shows the hourly runway capacity for 1988 for the existing airfield with committed taxiway improvements, for 2007 with the existing airfield, and for 2007 with an improved airfield that has three parallel runways. The analyses are shown for different situations, depending on how many departure streams are operating. A "departure stream" is an independent flow of departing large jet-transport aircraft from one runway that is not dependent on sequencing of aircraft from another runway. For the three-runway case, capacities are shown with one and with two simultaneous independent departure streams. The assumption is that in 2007 there will continue to be only one such departure stream to the east. The two-departure stream case represents the capacity of the airport when it is operating to the west. In westerly flow, it is assumed that two departure streams by turbo-jet aircraft may be used simultaneously.

Due to the change in aircraft mix between 1988 and 2007, VFR runway capacity in 2007 is slightly less than VFR capacity in 1988, while IFR runway capacity is slightly more than IFR capacity in 1988.

Table V.4 shows values of Annual Service Volume for the same cases. Annual Service Volume is an approximate indicator of the annual capacity of the airport. Annual service volume in 2007, for the existing airfield, is approximately the same as that experienced today. Adding a runway would increase annual service volume to approximately 685,000 in 2007. This should be regarded only as a general indicator of airfield capacity, but it clearly indicates that the demand post-2000 will exceed the capability of the airport with two runways.

C. Delays and Costs of Delays

Table V.5 shows average delays in minutes for each aircraft operation for the different cases described together with estimated costs of delays (based on $1,120 operating costs per aircraft hour). The average delay is for both landings and departures at all hours of the day for the whole year. Some operations will experience zero delays. Others will experience delays beyond the averages provided.

Table V.1

AIRCRAFT OPERATIONS FORECASTS FOR 1988 AND 2007

Demand	1988	2007
Annual	436,740	567,934
Average-Day, Peak-Month	1,248	1,623
Peak Hour (Average-Day, Peak-Month)	91	117

Note: Traffic on the peak day of the peak month is approximately 10 percent higher than that occurring on an average day during the peak month.

Source: Phoenix Sky Harbor International Airport Master Plan Update, Working Paper "Revised Activity Forecasts," August 1988, HNTB.

Table V.2

AIRCRAFT MIX, 1988 AND 2007

Aircraft Class	Percent of Aircraft in Class 1988	2007
A. Small Single Engine	34.8%	16.2%
B. Small Twin Engine	1.6%	2.0%
C. Large Aircraft	61.9%	76.3%
D. Heavy Aircraft	1.7%	5.5%
TOTAL	100.0%	100.0%

Notes: [a]Above mix is for fixed-wing aircraft, approximately one percent of total mix is helicopter traffic.

[b]Small aircraft have gross takeoff weights of less than 12,500 lbs.

[c]While the system will provide an added mode of travel to and from the airport, itscharacteristics are such that it would not be well-suited for inter-terminal or intra-airport transportation needs. Large aircraft have gross takeoff weights of between 12,500 and 300,000 lbs.

[d]Heavy aircraft have gross takeoff weights in excess of 300,000 lbs.

Source: Phoenix Sky Harbor International Airport Master Plan Update, Working Paper, "Revised Activity Forecasts," August 5, 1988, HNTB.

Table V.3

HOURLY RUNWAY CAPACITY, 1988 AND 2007

Number of Runways	Number of Jet Departure Streams	VFR 1988	VFR 2007	IFR 1988	IFR 2007
2	1	98-103	97-103	47-70	48-72
2	2		99-107		48-72
3	1		118-141		96-119
3	2		121-152		96-132

Notes: [a]The ranges of capacity shown are for the different ratios of arrivals to departures that occur during different hours of the day. The first number is for 60 percent arrivals (an arrival peak hour when 60 percent of total operations are arrivals and 40 percent are departures). The second number is for 40 percent arrivals and 60 percent departures (a departure peak).

[b]Only one jet departure stream is assumed to occur to the east (for noise abatement purposes), while two jet departure streams are assumed to occur to the west.

[c]For operations in both directions, two propeller-driven aircraft departure streams are assumed to occur.

Source: Hockaday Associates Ltd., 1988.

Table V.4

ANNUAL SERVICE VOLUME, 1988 AND 2007

Annual Service Volume	Number of Jet Departure Streams	1988	2007
2 Runways	1 to East, 2 to West	475,000	475,000
2 Runways	2 to East, 2 to West		490,000
3 Runways	1 to East, 2 to West		685,000

Note: [a]Annual Service Volume is a general indicator of annual airfield capacity.

Source: Hockaday Associates, Ltd., 1988.

Table V.5

AIRCRAFT DELAYS AND DELAY COSTS

Number of Runways	Number of Jet Departure Streams	Year	Average[a] Delays	Annual Delay Cost
2 Runways	1 to East 2 to West	1988	1.5 mins.	$12.2M/yr.
2 Runways	1 to East 2 to West	2007	7.3 mins.	$77.4M/yr.
2 Runways	2 to East 2 to West	2007	4.6 mins.	$48.8M/yr.
3 Runways	1 to East 2 to West	2007	1.3 mins.	$ 13.9M/yr.

Note: [a]Calculated according to FAA AC 150/5060-5, "Airport Capacity and Delay". During the study, a parallel study by an FAA Capacity Task Force separately calculated that delays would be very similar to those described above.

Source: Hockaday Associates, Ltd., 1988.

Table V.6

TOTAL ANNUAL COSTS OF AIRCRAFT AND PASSENGER DELAYS

		Aircraft Delay Costs	Passenger Delay Costs	Total Delay Costs
2 Runways	1988	$12.2M	$9.8M	$22.0M
2 Runways	2007	$77.4M	$122.5M	$199.9M
3 Runways	2007	$13.9M	$21.8M	$35.7M

Source: HNTB and Hockaday Associates, Ltd., 1988.

Average delays to aircraft would increase from approximately 1.5 minutes per aircraft today to approximately 7.3 minutes per aircraft in 2007 if additional runway capacity is not added. Corresponding aircraft operating costs due to delays would increase from approximately $12 million per year today to approximately $77 million per year in 2007.

Adding a third parallel runway would reduce the 2007 delays to approximately 1.3 minutes per aircraft operation and lower delay costs to approximately $14 million per year, producing a savings of $63 million per year in operating costs.

This average delay is well within normal limits and is less than the delays currently experienced at most of the nation's major airports. This indicates that the third runway will provide the capacity needed to accommodate traffic well beyond the Year 2007.

The airlines operating costs are only a part of the total costs attributable to delays. The passengers' time lost has a value that routinely recognized in the cost and benefit analyses of capacity enhancement projects such as the third runway. Because the principal advantage of air travel is high speed, the value of time to air travelers is important. The value of time according to FAA guidelines[1] is $25.00 per hour. The annual costs of delays to the traveler are identified in Table V.6 as follows:

1988 costs (with existing airfield).....	$ 9.8 million
2007 costs (with two runways).....	$122.5 million
2007 costs (with three runways).....	$ 21.8 million

These costs are in 1988 dollars.

The annual reduction in the delay costs to passengers with the third runway will be in excess of $100 million annually in the year 2007. The total annual savings to both passengers and airlines will be in excess of $160 million.

D. The Need for a Third Runway

Demand and capacity at the airport are relatively in balance with each other today. Aircraft delays and the delay costs are relatively low compared with other major airports nationally. The increase in aircraft operations forecasted for 2007 will cause significant additional delays and increase aircraft operating costs and passenger travel time costs, unless a third runway is constructed. The annual savings in operating costs and travel time costs exceed the capital costs of constructing the runway. The addition of a third runway would

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[1] Economic Values for Evaluation of Federal Aviation Administration Investment and Regulatory Programs, FAA-APO, 84-3.

keep 2007 delay levels and costs similar to those experienced today. Permitting a second departure stream to the east would reduce delays somewhat, but this is not a reasonable substitute for construction of a third parallel runway.

The optimium timing of the proposed third runway is determined by a comparison of the annualized costs of the new runway on the one hand, and the annual savings in aircraft operating costs on the other hand. Order of magnitude annualized costs of the proposed runway is likely to be in the range of $6 million and $10 million. By 1995 the annual delay costs will be of the order of $35 million annually. These aircraft delay costs would be reduced by approximately $27 million per year with the proposed runway in place. Construction of the proposed runway in the early 1990's is clearly justified, though it is recognized that it may be the 1995 timeframe before the facility could be in place, given the associated actions which must occur.

In the event that a third runway is not constructed, the airlines and travelers would sustain the delays described above, or the region would lose a significant amount of its air service.

The need for a third parallel runway has been a long-term item in airport development plans and first appeared on the airport layout plan (ALP) in the mid-1970s. It is shown on the current ALP and was approved by City Council in 1983. This documentation of the need for the additional runway capacity confirms the conclusions of the earlier studies.

2. OTHER AIRFIELD AND RUNWAY REQUIREMENTS

Future airfield requirements are identified according to the guidelines spelled out in FAA AC 150/5300-12, "Airport Design Standards - Transport Airports." The controlling aircraft design group used (from the Advisory Circular) is Group IV, which includes all aircraft with wingspans up to 171 feet (DC-10/L-1011 and smaller). Provisions for Group V (B-747) aircraft operations for certain areas of the airport will be maintained throughout plan development.

A. Runway Configuration

Capacity. As documented above, the existing airfield will not adequately meet the demand in the year 2007. Therefore, a third parallel runway with associated taxiway improvements will be proposed.

Wind Coverage. FAA standards require that airports served by large aircraft provide a 95 percent wind coverage with a maximum crosswind component of 13 knots (15-mph) and 10.5 knots(12-mph) for light aircraft. Should the runway system be unable to meet these requirements, the FAA standards recommend additional crosswind runway capability.

Table V.7 shows the existing runway configuration wind coverage under all-weather conditions. The coverage in all-weather conditions is 99.1 percent for large aircraft (13 knots maximum crosswind component) and 98.3 percent for light aircraft (10.5 knots maximum crosswind component). The coverage is adequate for both large and small aircraft. The All-Weather Wind Rose for PHX is shown in Figure V-1.

B. Runway Length Requirements

The purpose of this analysis is to determine the required length for the recommended third runway and/or extensions of existing runways. The analysis examines the percentage of the existing and forecasted air carrier fleet using Sky Harbor that could be accommodated on alternative runway lengths. A range of runway lengths 7,000 feet to 12,500 feet is examined. The runway requirements have been calculated in accordance with the FAA AC 150/5325-4 and individual aircraft planning manuals. The calculations utilize an average high temperature of 106.3° F (July) and the airport's elevation of 1,132 feet above mean sea level.

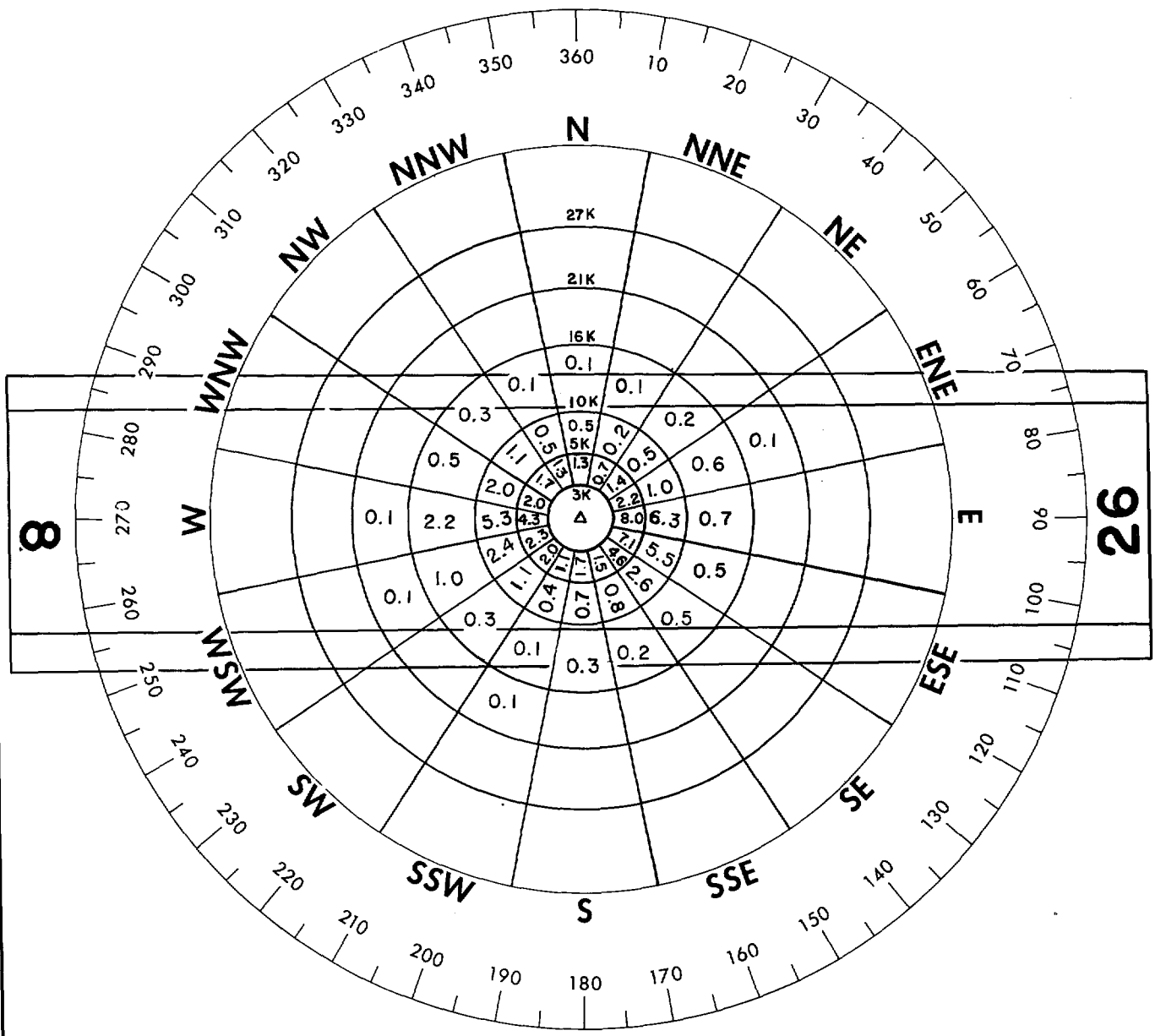
The extensive tables generated in this analysis are presented in Appendix A, Runway Length Requirements Analysis.

The aircraft departures that can be accommodated by a runway of a given length are affected by three factors:

- Runway requirements of the individual aircraft,
- Payload (passengers, cargo, fuel) carried, and
- Mix of aircraft using the runway.

For a given aircraft, the length of runway required depends on the takeoff weight of the aircraft (passengers plus cargo) with the amount of fuel, which in turn determines the stage length of the aircraft. Table A-1 presents runway requirements for different aircraft types, assuming 100 percent passenger load and 50 percent cargo load. The 100 percent passenger/50 percent cargo load represents the maximum length takeoff likely under current operating conditions and will be referred to as a "full load."

Table A-2 in Appendix A shows aircraft runway requirements assuming a 70 percent passenger load and a 30 percent cargo load. The 70 percent passenger/30 percent cargo load represents an average takeoff load under current operating conditions and will be referred to as an "average load." The lighter load reduces the runway length requirement for a given stage length. The tables show the runway length requirements for non-stop flights up to 2,250 miles. All current destinations within North America are located less than 2,250 miles from Phoenix.



Total Coverage : 98.3% (12 MPH)
99.1% (15 MPH)

Source: 1965 - 1974 Observations

△ Calms=17.3%

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT MASTER PLAN UPDATE

All Weather Wind Rose

Figure V-I

Table V.7

RUNWAY WIND COVERAGE

Runway Configuration	All-Weather Coverage[a] 15-mph	12-mph
Runway 8 (Calm 17.3% incl.)	64.7%	64.3%
Runway 26 (Calm 17.3% incl.)	51.7%	51.3%
Total Runway 8-26	**99.1%**	**98.3%**

Note: [a]IFR conditions occur less than one percent annually at PHX; therefore, data to prepare a separate IFR wind rose is not available.

Source: Phoenix Sky Harbor International Airport Climatological Summary and HNTB analysis.

Generally, newer aircraft such as the Boeing 737-300, 757 and 767 series require less runway than the older jet aircraft. Runway requirements for landings are normally less than for takeoff and, therefore, do not constitute a constraining factor for this analysis.

The critical aircraft is the 727-200 (JT8D-15), which with full loads requires 12,900 feet of runway for takeoff to current destinations.

Table A-3 in Appendix A shows which of the existing aircraft can be accommodated on runways of various length at current stage length. Assuming a full load factor, all aircraft can be accommodated with a 12,100-foot runway (except the one daily 727-200 departure to New York). Runway 8L-26R, an 11,000-foot runway, could accommodate 96 percent of the current departures at full load, including 79 percent of the 727-200s Runway 8R-26L, a 10,300-foot runway, accommodates 95 percent of all departures with 79 percent of the 727-200 departures. These calculations are all made for the average daily high temperature for July, the hottest month of the year.

With an average load factor, a greater percentage of departures can be accommodated. Table A-4 in Appendix A shows that a 9,500-foot runway would accommodate all departures. The two existing runways are able to accommodate all departures with an average load.

There are currently international flights to Mexico (scheduled), Canada, the Bahamas, and other foreign destinations (non-scheduled). Most of these international markets are not appreciably longer than the current or forecasted domestic markets. However, the introduction of non-stop international service to markets significantly longer than those forecasted would alter the runway requirement. Tables A-5 and A-6 show the runway length requirements for long-range aircraft types used on long non-stop routes, including the 767-200ER, the 747-400, DC-10-30, and the 747-200B. Runway length requirements were developed for 2,000, 3,000, 4,000, 5,000, and 6,000 mile stage lengths and for maximum takeoff and landing weights. With a full load, only the 747-400 and the 767-200ER could serve international flights to Europe on existing runways with required runway lengths of around 9,000 feet. The 747-200 and DC-10-30 would require runway lengths in excess of 13,700 feet at the "hottest month" temperatures used in this analysis.

The preceding runway length analysis indicates that a runway length of 12,900 feet is needed to serve the needs of the B-727-200 at full loads with 12,400 feet needed for typical loads to the east coast. The airport has a runway gradient factor of 0.23 percent, which requires an additional 300 feet to be added to the runway length. Therefore, a length of 13,200 feet is needed if a significant number of B-727-200 long-haul flights are to be accommodated. Given existing constraints off the ends of both runways (roadways and Salt River off of 8R-26L; roadways and Pueblo Grande Municipal Monument off 8L-26R) and the need to extend only one runway for the few aircraft that need additional runway length, it is recommended that only extension of Runway 8L-26R be considered. A 1,000-foot extension to the west is recommended for inclusion on the ALP to

provide an ultimate length of 12,000 feet. Given the few current long-haul operations by the B-727-200, the extension should be delayed until such time that there is a clearly identified demand for the 12,000-foot length. It is anticipated that future runway length requirements will be reduced as more new generation aircraft, which require shorter lengths, are introduced into the mix.

For new international service, new generation aircraft such as the B-767-200ER and B-747-400 could serve destinations in Europe with existing runway lengths. The latter aircraft also could serve markets in the Orient.

For the third parallel runway, a length of 9,500 feet would be desirable if it is to be used for westerly departures and easterly arrivals. This length would meet the needs of 90 percent of the existing air carrier departures during the hot summer months and would meet the specific needs of the MD-80 and DC-9-30 with full loads.

It is recognized that a length of 9,500 feet may not be achievable at reasonable cost, given the alignment of the Salt River to the south. If procedures could be established so that the new runway can be used much like "outside" parallel runways at Atlanta, Dallas-Ft. Worth, and Los Angeles, then a runway length of approximately 7,800 feet would be adequate. One procedure which could permit this type of use would be for Runway 26L landings to "side-step" to the new runway after passing noise-sensitive areas east of the airport. A 7,800-foot length would meet the landing requirements of all aircraft on a wet runway. This would obviate the need for expensive construction beyond the 7,800-foot length. The optimum length for the runway is discussed further in plan development in Chapter IX of the report.

C. Runway Widths

Both runways are 150 feet wide. This dimension meets the existing and future needs of all Airplane Design Group IV and Group Aircraft. The new runway also should be 150-feet wide.

D. Runway Clearances

Runway clearances addressed in this section include Building Restriction Lines (BRL), FAR Part 77 surfaces, aircraft parking limit lines, and runway safety areas. These criteria provides clearances from potential hazards for routine operations by aircraft operating on the Airport's runways.

BRLs establish proper clearances between buildings or other fixed objects and runway centerlines. FAA criteria for Group IV aircraft require that BRLs be established 750 feet from all runway centerlines. Part 77 criteria have been applied to identify any violations of this criterion.

There are numerous buildings (obstruction lighted), several general aviation hangars, and a blast fence south of Runway 8L in the "Airport Industrial Development" area, that violate the BRL to Runway 8L-26R. However, none of these

violations appear to affect operations (through reduced operating minima) on the runway. FAA airspace reviews for future instrumentation on the runway should confirm this fact.

Aircraft parking limit lines define the closest distance that the highest point on an aircraft parked at a terminal can be to a runway, according to FAR Part 77 criteria. There are numerous violations of these criteria:

- Some of the parked general aviation aircraft on the north and south sides of Runway 8L-26R.

- Aircraft parked at Gates 10, 11, and 12 of the south concourse of Terminal 3, when these are longer than DC-9-50 aircraft (134 feet).

Runway safety area standards should be applied to all runways. However, for runways constructed prior to adoption of the standards, the regulations permit application of the maximum feasible length of runway safety area without reducing the existing or planned length of the runway.

The current roadway system limits the size of the safety areas for Runway 8L-26R. Runway 8L has a 500-foot x 900-foot safety area. With the relocation of 24th Street a full-length safety area can be established. Runway 26R, bound by 40th Street, includes a 500-foot x 750-foot safety area. This street is scheduled for removal in 1991 at which time a standard safety area may be established. On the east end of Runway 8R-26L, a full-size safety area has been established. The west end of the runway currently has a 500-foot x 900-foot safety area and, with the relocation of 24th Street, a full-size safety area may be established.

3. TAXIWAY REQUIREMENTS

Potential improvements have been considered to improve operational flows between existing runways and functional areas of the airport and to provide adequate clearances between aircraft on taxiways and structures or parked aircraft.

A. Current Taxiway Improvements

There are several taxiway improvement projects currently under design or under construction which will improve the efficiency of ground movements on the airport. These improvements include:

- a second crossover taxiway (W) on the east end of the airfield,
- extension of dual, parallel Taxiway BB to the east end of Runway 8L-26R,
- partial dual, parallel Taxiway CC on the east end of Runway 8R-26L,
- extension of Taxiway D to the east end of Runway 8R-26L,
- widening and filet improvements to exit Taxiways C-4, C-5, and C-7,
- an additional angled exit taxiway for Runway 26L landings, between Taxiways C-3 and C-4,

- an additional angled exit taxiway for Runway 8R landings to the south between Taxiways D-3 and D-4, and
- an extension of partial dual, parallel Taxilane CC to the west end of Runway 8R-26L.

These taxiway improvements are considered "givens" for this analysis; additional improvements have been investigated to augment them.

B. Additional Taxiway Improvements

Areas where additional taxiway improvements are required include:

- the need for additional crossover taxiways to efficiently transition aircraft between the north and south sides of the airport;

- holding aprons at all runway ends (bypass taxiways do not provide good utility at PHX);

- improvements to "light aircraft only" exit taxiways on Runway 8L-26R to permit use by large aircraft;

- the need for dual, parallel taxiways serving Runway 26R that do not interfere with the America West facility; and

- the need to relocate certain runway and taxiway lights to accommodate new aircraft types.

Based on FAA ATC comments and a review of individual components of the taxiway system, potential improvements were identified.

C. Additional Crossover Taxiways

Presently, the only existing crossover taxiway, Taxiway X, is located east of Terminal 3. A second crossover taxiway, (Taxiway W), is under construction on the east end of the airfield. Ground traffic flows analyzed for easterly and westerly operations identified inefficiencies in taxiing routes. With existing traffic levels, aircraft generally takeoff and land on the side of the airport nearest their gate. However, as traffic levels increase, ATC will switch to a runway use system whereby all aircraft originating from or destined for specific cities will use specific runways. This reduces the crossing of aircraft in the air but significantly increase crossings on the ground between the north and south sides of the airport.

This change in runway use will require increased capability in north-south taxiing between the two sides of the airport. For operations on Runways 8L and 8R, aircraft originating from the general aviation area in the northwest corner of the airport and leading for Runway 8R must taxiway all the way east to Taxiway X, wait for aircraft using the taxiway from south to north, then taxi across and back taxi to Runway 8R. Aircraft originating from Terminal 2 and bound for

Runway 8L must make the same inefficient movement. During periods of operations on Runways 26L and 26R, landing aircraft on either runway bound for the opposite side of the airport must back taxi to cross over Taxiway X after landing, cross over, and then taxi west again to Terminals 2 and 3. While crossover Taxiway W will improve some of the major inefficient flows on the airport, particularly after the completion of Terminal 4, it will not improve any of the key deficiencies in the taxiway system noted in this paragraph.

D. Exit Taxiway Improvements

A review of existing and programmed exit taxiways identifies locations where improvements could be made to improve runway exit capability, to reduce runway occupancy times. On Runway 8R-26L, there is one location where an improvement would be beneficial. The addition of an angled exit to the south for general aviation aircraft for landings on Runway 26L would reduce runway occupancy times for these aircraft, increasing the capacity of the runway for other landings. After the incorporation of the recommended runway concept in the next phase of the study, additional analysis will be undertaken to optimize the future runway/taxiway system on the south side of the airport.

For Runway 8L-26R, five potential improvements have been identified. Taxiway B-6 is a right-angled turnoff in the optimal location for an angled turnoff for Runway 8L landings (5,500-6,500 feet from landing threshold). Modification of this taxiway to provide an angled capability for these landings is recommended as shown in Figure V-1. In addition, Taxiways B-4 and B-8 are angled turnoffs for light aircraft only. Improvements to these taxiways are recommended to permit them to serve as right-angled turnoffs for reverse direction landings that have rolled past the last of the angled turnoffs (B-5 and B-7) available to them in the optimum range. Finally, the FAA ATC has suggested that two additional exits for general aviation aircraft on the north side of the runway, one each for 8L and 26R landings between Taxiways A-4 and A-5, would reduce runway occupancy times. These improvements are depicted in Figure V-1 also. These additional exit taxiway improvements are consistent with the on-going FAA Capacity Task Force Study.

E. Parallel Taxiways

Runway 8L-26R currently is served by parallel taxiways both on the north (Taxiway A) and south side (Taxiway B) of the runway. Both of these taxiways are spaced 400 feet from the runway, centerline to centerline. On the south side, a dual, parallel taxiway (BB) is available from a point near the Executive Terminal east to the end of the runway. This taxiway is 300 feet from Taxiway B, which permits simultaneous use of both taxiways by aircraft as large as the B-747-400. However, a B-747-400 using Taxiway BB in the vicinity of Terminal 3 would limit use of the gates at the end of the concourse to aircraft shorter than 190 feet (all aircraft except the B-747 series). When a B-747 is parked at one of these end gates, a passing B-747 would be required to use Taxiway B, a minor problem given the relatively few number of forecasted operations by aircraft of this size.

Extension of Taxiway BB would involve extensive disruption of the Executive Terminal and FBO facilities in the area. The two-way capability becomes important only where taxiing aircraft bound for the end of Runway 8L must pass aircraft that have landed on 8L, exited the runway and are taxiing towards the terminal or FBO buildings. This capability already exists. In the event that Runway 8L-26R is extended to the east, the dual taxiway capability east of Taxiway B-3 will still adequately meet needs. For this reason, the extension is not considered necessary for ground traffic flows. A holding apron capable of accommodating three 757-size aircraft will be recommended for the Runway 8L end (see next page).

On the south side of the airport, Runway 8R-26L is also served by full-length parallel taxiways on both sides -- Taxiway C, 400 feet to the north, and Taxiway D, 400 feet to the south. However, because of the limited distance between Taxiway C and Terminals 2 and 3, there is not adequate room on the north side of the runway for dual, parallel taxiways for either Group IV or Group V aircraft. Currently, dual parallels are provided for Group III aircraft (B-727-200 and smaller) between Taxiway C-3 and C-6. This capability will be required by ATC so that ground traffic flows can be handled effectively.

F. Holding Apron Improvements

Holding aprons are available at runway ends 8R and 26L. Additional aprons are under design or construction at the ends of Runways 26R, 8L, and 26L. The holding apron concept is preferable to a bypass taxiway in that any one of three or four aircraft at the head of the departure queue (depending on the size of the apron) can be cleared for takeoff without the need to move other aircraft.

It is recommended that holding aprons continue to be provided for all runways. The provision of a holding apron for three 727-200 size aircraft for Runway 8L will require the loss of use (or removal) of four to eight T-hangars, each consisting of four bays.

G. Taxiways For Proposed New Runway

The taxiway system for the new runway should include parallel taxiways both north and south of the runway. Taxiway D will serve as the north parallel taxiway, with a new parallel taxiway 400 feet to the south serving the south. At the west end of the runway, the alignment of the south taxiway will be modified as needed to accommodate proper siting of a future glide slope antenna.

The exit taxiway system for the new runway will be detailed on the Airport Layout Plan.

4. RUNWAY STRENGTHS

The current (1987) rated strengths of the airport's two runways will meet the future needs of aircraft expected to be in use at the airport throughout the

study period. Continuing maintenance, including complete overlays when necessary, will be required to maintain these runway strengths.

5. NAVIGATIONAL AND LANDING AIDS

A. Landing Aids

Current landing aids consist of REILs[1] and VASIs[2] on all runways and a Category I ILS[3] on Runway 8R. To provide fully adequate IFR capability, additional runway ends at both the east and west ends of the airport should be provided with precision instrumentation such as ILS or MLS[4] systems. The potential for installation of these systems at the east end is limited by the Salt River Channel to Runway 26L. This location also will require approvals from the state DOT to place lighting standards between the new highways proposed for that area. At the west end of the airport, the additional instrumentation could be located on 8L. The existing system on 8R could remain on that runway end or could be relocated to the end of the proposed new runway.

B. Navigational Aids

The FAA currently is selecting a site on the airport for a TVOR[5], an instrument which will provide a reference point to the center of the Phoenix TCA[6]. Alternative locations include a site to the east of the airport, the roof of Terminal 3, and a location in the southwest quadrant of the airfield. Of these locations, the last two provide the best reference to the center of the TCA. Provided that a southwest location can be identified which does not interfere with the proposed third runway and its associated taxiways, this would be a satisfactory site for the facility.

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[1] Runway End Identifier Lights.

[2] Visual Approach Slope Indicator.

[3] Instrument Landing System.

[4] Microwave Landing System.

[5] Terminal VOR.

[6] Terminal Control Area.