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AIRPORT MASTER PLAN & DEVELOPMENT PROGRAM

PHX

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ARIZONA

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December 27, 1972

Col. John C. Lowry, Chief Engineer
and General Manager
Maricopa County Flood Control District
3325 West Durango Street
Phoenix, Arizona 85009

Dear Col. Lowry:

Salt River Low-Flow Channel
Relocation at Sky Harbor.

We are sending you a copy of a report by Quinton-Budlong on the expansion of Sky Harbor and a drawing of the master plan.

The plan contemplates a third runway south of the existing south runway. This can be accomplished after the Salt River is controlled by the construction of Orme Dam. When the dam is built, the river flows can be contained in a low-flow channel. The location of the channel is shown on a plate after page 72. In addition, we are enclosing a larger scale drawing of the proposed channel location from 48th Street to the Maricopa Freeway. Planning for the Airport and channel location must be done now. We therefore solicit your review and approval of this channel location.

Very truly yours,

J. E. Attebery, P.E.
City Engineer

JEA:fhs

Attachments

JAN 5 '73
RECEIVED
FLOOD CONTROL
DISTRICT

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

FINAL PLAN REPORT

Quinton-Budlong
812 W. 8th Street
Los Angeles, California 90017

February 1972

JAN 3 '72
RECEIVED
FLOOD CONTROL
DISTRICT

QUINTON-BUDLONG QB PLANNING • ENGINEERING • ARCHITECTURE

812 West Eighth Street, Los Angeles, California 90017 • (Area Code 213) 624-7651

February 28, 1972 Q-B 118201

Honorable John Driggs
Mayor of City of Phoenix and
Members of the City Council
Phoenix, Arizona 85007

Honorable Council Members:

Quinton-Budlong takes pleasure in presenting to you this final plan report for the Master Plan Study of Sky Harbor International Airport. This report represents the final summary of all the action taken to develop the master plan and growth for the airport over the next 30 to 40 years.

This report addresses itself to the ultimate and phased development of the airport. We have included within this report a discussion of all the items and facilities which will be included in the master plan.

One additional report remains to be prepared for the City and this will include specific details related to the first phase of development. This report is based upon all of the historical data and forecast developed by other consultants to the City of Phoenix earlier this year.

Very truly yours,

Robert P. Cralle
Director of Airport Planning

LOS ANGELES SEATTLE SAIGON

CABLE ADDRESS: QUINTONAE Los Angeles Saigon

* * CITY OF PHOENIX, ARIZONA * *

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ACKNOWLEDGEMENTS

Quinton-Budlong would like to take this opportunity to thank those staff members who have contributed to this study. Without the dedicated efforts of City of Phoenix staffs, this study would not have come to pass. Our special thanks go to Mr. John B. Wentz, City Manager; Mr. Edward M. Hall, Deputy City Manager; Mr. William J. Ralston, Airports Director; Mr. James E. Attebery, City Engineer; Mr. Howard Clark, Deputy Airports Director; Mr. Art Grochowski, Airports Development Engineer; and Mr. Jim Barnett, Civil Engineer. For the consulting team, the tireless efforts of Mr. Paul Johansen, Mr. John Yoders and Mr. Scott Danielson of the John Carl Warnecke and Associates firm; together with Mr. Martin Bouman and Mr. Jim Federhart of the Alan M. Voorhees and Associates firm are sincerely appreciated. For Quinton-Budlong, we would like to express gratitude to Mr. Paul Hayward, Chief Airport Engineer; and Mr. Tom Sexsmith, Chief Airports Planner.

FOREWARD

Aviation has always played a dominant role in Phoenix' past. From the early pioneers to the present jet travelers, air travel has been an important element in the day-to-day business of the community. Sky Harbor has grown to meet those travel needs, and the master plan presented here will insure that the citizens of Phoenix will always have a beautiful and efficient airport.

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I

CHAPTER I

RECAPITULATION

Meeting the Challenges

Phoenix has been involved in aviation since the early pioneer days when transcontinental flights took two full days to fly from coast to coast. The challenges to aviation in those days were not on the ground, but in the air. As long as there was an open field with a smooth surface, aircraft could be accommodated on any type of airfield. The aircraft presented a number of challenges to the designers in order to make them more reliable, more efficient, and more durable.

Today, however, aircraft design has reached a plateau of sophistication whereby aircraft of almost any size and speed can be manufactured with great accuracy and precision. On the ground, the challenge is becoming much greater. The small, open field will no longer suffice to handle today's aircraft. In this modern age, runway lengths of over two miles are needed to provide a safe operating surface for the sophisticated aircraft in the airline fleets. The volume of people and cargo moving in inter-city travel is of such a magnitude that the facilities needed to handle these travelers presents an ever increasing challenge to the designer.

Phoenix has participated in this growth of aviation to a large extent. From the earliest days, the citizens of this area have used aviation to a great advantage. One of the best measures of aviation usage is the number of passengers carried on the airline aircraft.

TABLE I

AIRLINE PASSENGER TRAFFIC

	Airline Passengers		
Year	Enplaned	Deplaned	Total
1957	270,950	264,076	535,026
1958	317,436	311,472	628,908
1959	361,180	356,895	718,075
1960	423,693	418,532	842,225
1961	433,267	430,450	863,717
1962	525,806	510,498	1,036,304
1963	583,955	568,713	1,152,668
1964	682,352	659,291	1,341,643
1965	745,636	725,938	1,471,574
1966	893,899	894,709	1,788,608
1967	1,041,452	1,032,191	2,073,643
1968	1,207,135	1,204,114	2,411,249
1969	1,363,226	1,328,629	2,691,855
1970	1,441,296	1,428,546	2,869,842
1971	1,507,503	1,498,370	3,005,873

Source: City of Phoenix, Official Revenue Bond Statement, January 1971

MASTER PLAN STUDY

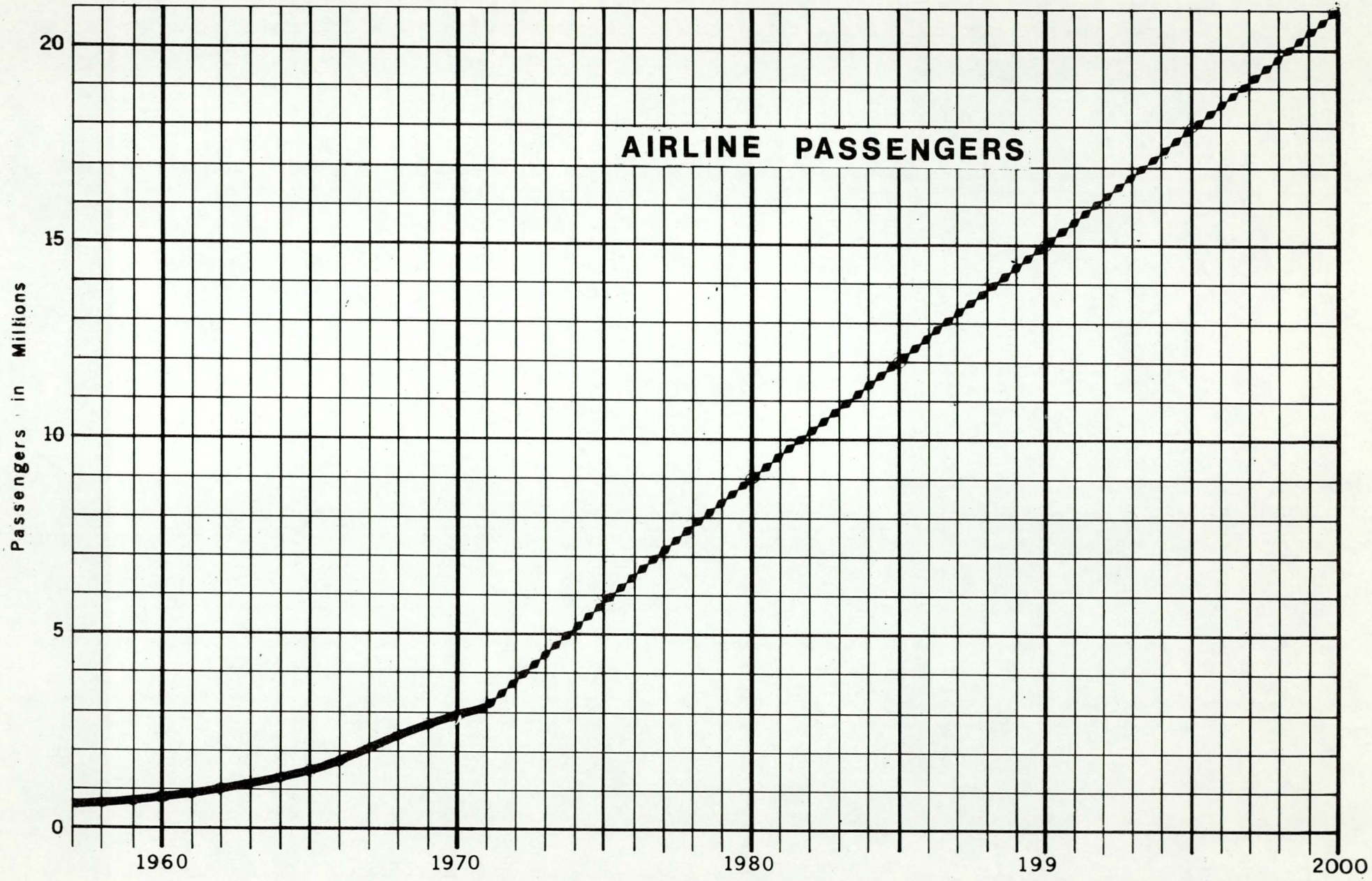
LOCATION MAP

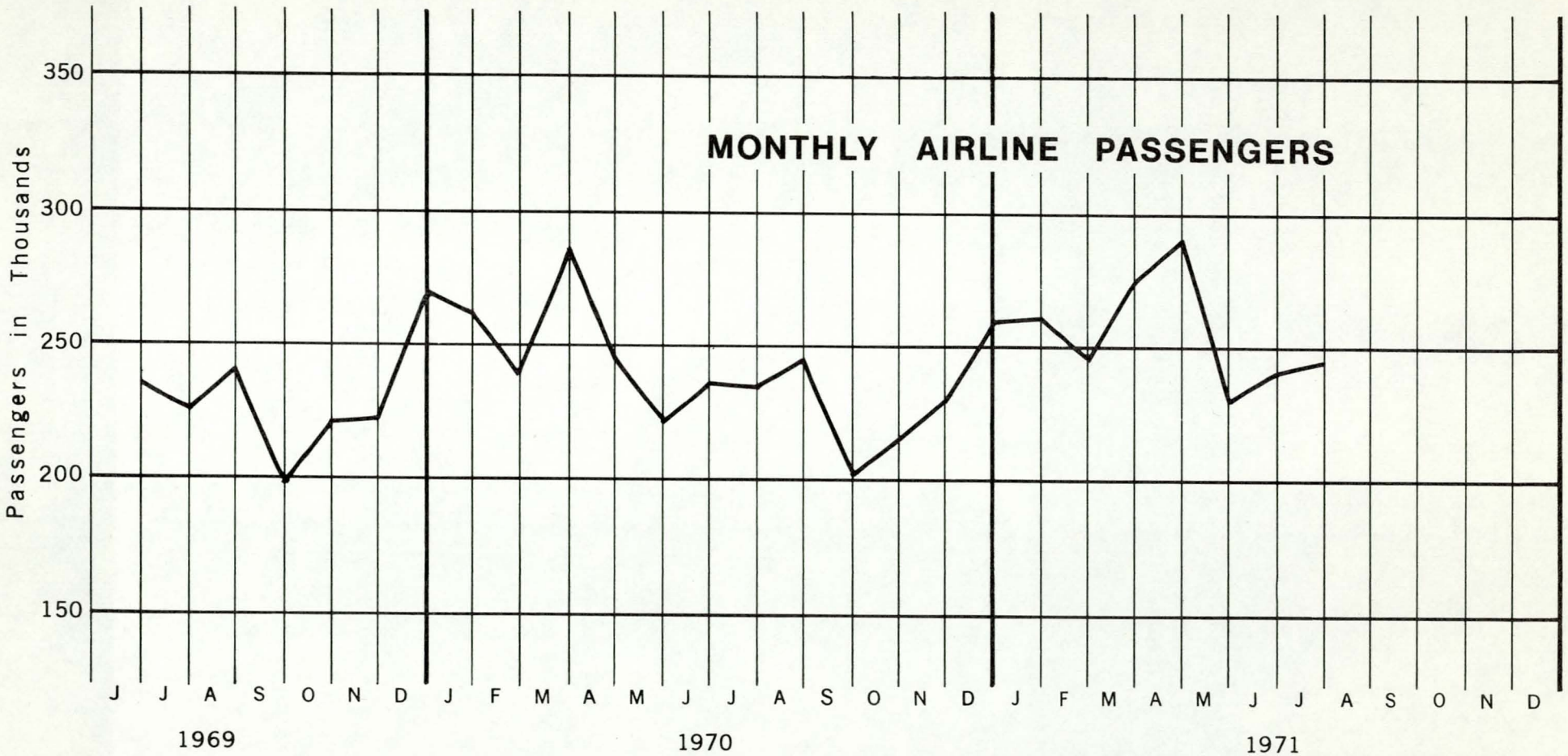
QUINTON-BUDLONG

ALAN M. VOORHEES AND ASSOCIATES, INC.

JOHN CARL WARNECKE & ASSOCIATES

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT


AIRLINE PASSENGERS
Passengers in Millions
20
15
10
5
0
1960
1970
1980
199
2000


MONTHLY AIRLINE PASSENGERS
Passengers in Thousands
350
300
250
200
150
J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1969
1970
1971

Between 1928, when Sky Harbor was first used as an airfield, and the late 1940's there was little demand placed upon the ground facilities at the field. Beginning in that late decade, air travel became the fastest and most efficient way to move people around the country. As the popularity of this method of travel began to increase, the need for additional terminal and apron space began to climb sharply. In the late 1940's around 150 passengers per day were boarding aircraft. This number began to climb sharply and by 1950 it increased to around 235 passengers per day. In 1955 over 600 passengers per day were enplaning at Sky Harbor; by 1960 almost 1200 passengers per day were enplaning; in 1965 and 1970 the numbers had increased to 2000 and 4000 respectively.

The design of airport terminal buildings to accommodate this phenomenal rate of growth is no easy task. As Phoenix discovered, the 50,000 sq. ft. terminal building built in the early 1950's was quickly outgrown. It was decided that the next terminal building to be built for Phoenix should be able to grow in increments to accommodate future passenger travel. The first of these buildings contained over 135,000 sq. ft. and three additional increments were considered to be adequate to meet the forecasted growth.

By the late 1960's it became apparent that Phoenix, being one of the nation's leading air traffic cities, would need to have a terminal design capable of handling substantial growths of passenger traffic in the future. Forecasts of passenger travel indicated that the 4000 passengers per day boarding in 1970 would increase to almost 40,000 passengers per day by the year 2015.

TABLE 2

FORECAST OF AIRLINE PASSENGERS

	Airline Passengers		
Year	Annual Total	Peak Hour	Enpl. Pax/Departure
1975	6,000,000	2,000	43
1980	9,000,000	2,800	50
1985	12,000,000	3,500	55
1990	15,000,000	4,100	60
1995	18,000,000	4,800	66
2000	21,000,000	5,500	72
Saturation	28,000,000	7,100	83

Source: Report No. 1, General Plan for Ultimate Land Development, City of Phoenix, December 1970

Several factors influence the forecasts of activity. One such factor is the identification of the cities which exchange the greatest number of passengers with Phoenix. Correlations can be run to identify those that will have the greatest growth rates, and those that will, in turn, tend to have a significant number of non-stop flights to serve them. The top twenty cities exchanging passengers with Phoenix are given in Table 3 below, and the top ten cities outside the conterminous United States are also given in Table 4.

TABLE 3

TOP TWENTY ORIGIN - DESTINATION CITIES, 1967

City	O & D Passengers	Ranking
Los Angeles	313,890	1
San Francisco	117,690	2
Chicago	97,190	3
New York City	72,070	4
San Diego	64,940	5
Denver	60,950	6
Las Vegas	60,540	7
Tucson	53,280	8
Salt Lake City	39,780	9
Santa Ana	34,630	10
Albuquerque	34,590	11
Dallas	28,990	12
Minneapolis	28,720	13
Seattle	24,710	14
El Paso	24,220	15
Kansas City	22,750	16
Washington, D. C.	20,670	17
Yuma	20,450	18
St. Louis	20,370	19
Detroit	19,390	20

Average distance traveled by Phoenix passengers: 847 miles
Average distance traveled by United States passengers: 740 miles

Phoenix ranking in United States totals: 24th

Source: Domestic Origin-Destination Survey of Airline Passenger Traffic, 1967

TABLE 4

TOP TEN INTERNATIONAL ORIGIN - DESTINATION CITIES *

City	O & D Passengers
Honolulu, Hawaii	6,528
Toronto, Canada	3,000
Vancouver, Canada	1,814
Calgary, Canada	1,764
Montreal, Canada	1,550
Winnepeg, Canada	956
Lihue, Hawaii	954
London, England	768
Anchorage, Alaska	756
Mexico City, Mexico	756

* In 1967 Alaska and Hawaii were reported as "International"

Sources: International Origin-Destination Survey of Passenger Journeys via U. S. Domestic/Foreign Flag Airlines 1967

International Origin-Destination Survey of U. S. Flag Airline Passenger Traffic 1967

These two tables indicate that many of the distant cities play a significant role in passenger generation trends. This trend toward flying to more distant cities is shown in the following table. This table indicates that the average trip length is increasing and is averaging about 15% to 16% over the United States averages.

TABLE 5

AVERAGE PASSENGER TRIP LENGTH

	Trip Length in Statute Miles	
Year	Phoenix Average	United States Average
1960	808	682
1961	808	687
1962	804	689
1963	797	686
1964	796	694
1965	826	710
1966	840	728
1967	847	740

Source: Domestic Origin-Destination Survey of Airline Passenger Traffic, Civil Aeronautics Board

In working on the terminal problem, one other element that needs to be understood is the magnitude of transfer passengers at Sky Harbor. These are the passengers that deplane at Phoenix and then enplane again usually without leaving the terminal. They may enplane on aircraft operated by the same airline (on-line connecting passengers) or on aircraft operated by another airline (interline connecting passengers). These two classes of passengers make up around 16% of the total passenger traffic. Forecasts indicate that transfer passengers will continue to account for 15% to 20% of the total passenger traffic.

For the convenience of the transfer passengers, it is desirable to locate airline gate positions and companies with the greatest incidence of interline connecting passengers close to each other. For those passengers making on-line connections, there is no problem since an airline normally has all of its gate positions in the same general area. For those passengers transferring between airlines, the problem can be lessened by having airline gate areas located as close as possible to the gate areas of the connecting airline. The table given below shows the percentage of transfers between various carriers. From these statistics, it can be seen that American Airlines and Airwest should be located close together since they have around 18% of the transfer passengers. The details of actual terminal design should take these correlations into account.

The data presented in Table 6 is based upon statistics at Phoenix before Delta Airlines began service. An analysis of the market penetration by Delta indicates that this carrier will probably reduce the number of passengers transferring between American and Airwest by 1% or more. Since Delta provides the greatest competition with American, it will probably penetrate the transfer market now existing between American and Frontier, Trans World, and Western. The penetration into the passenger traffic is estimated at less than 0.1% of the transfer passengers between those carriers. The conclusion, therefore, is that Delta will not be a dominant carrier from the standpoint of providing or carrying transfer passengers when compared to the other carrier combinations.

TABLE 6

INTERLINE TRANSFER PASSENGERS

Carriers *	Percentage Interline Passengers 1964	1966	1968
AA - RW	19.4	18.0	17.8
AA - CO	2.8	3.3	3.7
AA - FL	7.9	7.2	6.2
AA - TW	4.9	5.5	8.8
AA - WA	9.4	6.9	9.7
RW - CO	7.5	6.0	7.0
RW - FL	7.6	9.8	5.3
RW - TW	5.4	8.9	9.7
RW - WA	4.5	3.4	5.3
CO - FL	1.1	1.8	1.2
CO - TW	1.5	2.4	2.6
CO - WA	5.6	2.3	3.6
FL - TW	2.9	6.2	2.8
FL - WA	14.8	13.9	8.7
TW - WA	4.7	5.2	7.6
	100.0	100.0	100.0

* AA = American Airlines
RW = Airwest (formerly Bonanza)
CO = Continental Airlines
FL = Frontier Airlines
TW = Trans World Airlines
WA = Western Airlines

Source: Letter Report. Landrum and Brown, May 12, 1970

TABLE 7

TOTAL CONNECTING PASSENGERS

Year	Total Passengers Enplaned/Deplaned	On-Line Connecting Passengers		Interline Connecting Passengers		Total Connecting Passengers	
		Number	Percent	Number	Percent	Number	Percent
1964	1,408,610	35,628	2.5	190,460	13.5	225,746	16.0
1966	1,906,948	26,180	1.4	303,640	15.9	329,820	17.3
1968	2,569,914	85,500	3.3	306,280	11.9	391,780	15.2
Forecast:					12 to 16%		15 to 20%

Source: Letter Report, Landrum and Brown, May 12, 1970

TABLE 8

PEAK HOUR CONNECTING PASSENGERS

Year	Total Passengers Enplaned/Deplaned	Peak Hour Passengers	Peak Hour On-Line Connections		Peak Hour Interline Connections	
			Low	High	Low	High
1980	9,000,000	2,800	85	110	335	450
Saturation	28,000,000	7,100	210	285	850	1,135

Source: Letter Report, Landrum and Brown, May 12, 1970

Forecasts:

Most of the forecasts of activity on the airport were prepared by consultants other than Quinton-Budlong. These consultants have indicated that their forecasts are based upon detailed analysis through the year 1985 and then are projected beyond that year. Recognizing that airport planners have, for years, underestimated the levels of activity that would develop, the consultants have adopted an optimistic forecast which is felt to be a sound basis for planning. They offer this comment: "It is much better to prepare long-range planning on an optimistic rather than a pessimistic basis. The detailed staging and financing can then be developed in increments at a later date. Such increments can address each case at an exact point in time. Optimistic or high potential penetration planning will give a framework to construct within, whereas a lesser level may prove inadequate in the future. Airport planning in general has, in the past, been too shortsighted and less optimistic than desirable." This master plan report is working within the framework of these forecasts.

The New Terminal Concept

A study was inaugurated to review the general concepts that were feasible for the Phoenix Sky Harbor International Airport in order to determine which terminal configuration would best meet the forecast travel demands. After reviewing a number of designs, two similar configurations evolved. These were later modified and the third, or combination, design was also considered. These designs were felt to have some limitations when applied to the particular problems that Phoenix had. It was at this point that a more comprehensive review of terminal configurations and techniques of handling large volumes of passengers was felt to be necessary.

Future Activity

In beginning the analysis of the new terminal design three major inputs were required. The first of these involved the forecast of future activity that the airport would need to accommodate. As discussed in a previous section, passenger travel was expected to increase from 4000 enplanements per day to almost 40,000 enplanements per day by the year 2015. Other analysis indicated that the air carrier flights to carry these passengers had been increasing from around 73 per day in 1960 to 114 flights per day in 1970. The forecast indicated that these would increase to almost 400 flights per day by the year 2015. Los Angeles is the major city which exchanges passengers with Phoenix, there being some 1000 passengers per day traveling both ways at the present time. San Francisco, Chicago and New York are next in rank order.

Military activity however has shown a generally declining usage of the airport. In 1960 there were approximately 60 military operations per day. This declined to 34 operations per day by 1965 and further declined to 22 operations per day by 1970. A continued level of activity of approximately 22 operations per day is projected into the near-term future. It is recognized that at some point the entire Arizona Air National Guard facility may be relocated away from Phoenix Sky Harbor Airport.

General Aviation has shown two distinct trends. The long term trend indicates that there is a gradual increase in itinerant* flights at the airport. These have increased from approximately 371 operations in 1960 to 523 operations in 1970. On the other hand, the long term trend also indicates that there is a gradual decrease in local** flights, going from 228 per day to 172 per day in 1970. The forecasts indicate that a continued moderate increase in itinerant flights can be expected and that the decrease in local flights should continue to be encouraged. Some restrictions on general aviation local flights may be required in the future. These restrictions will probably take the form of limitations on touch-and-go flying during certain prescribed hours. It is not anticipated that severe restrictions will be necessary. Such severe restrictions as are currently imposed on certain airports in the northeast part of the United States will not be necessary at Phoenix Sky Harbor.

Air cargo has shown dramatic increases, going from approximately 2200 lbs. per day in 1950 to 8500 lbs. per day by 1960 to over 60,000 lbs. per day in 1970. Forecasts show that air cargo will increase to nearly 745,000 lbs. per day by the year 2015. A significant amount of cargo will be carried in passenger aircraft as "belly cargo". The rest will need to be accommodated through the cargo center on all-cargo flights. Up to six aircraft positions will be needed in the air cargo center.

Another major element which needed to be evaluated was the runway length required to accommodate larger aircraft. Calculations based on critical aircraft indicate that a runway length of 11,500 feet will be sufficient to carry a full payload in Boeing 747 type aircraft from Phoenix eastbound non-stop to New York City. Two 11,500 foot runways have been programmed for this type of equipment. The third parallel runway, which will be used to provide the airport with dual simultaneous IFR capability will need to be built only to a length of 9200 feet, since this runway will be used primarily for landing aircraft under these conditions.

* Itinerant flights are those whose origin or destination is away from the the local area.

** Local flights are within sight of the control tower or known to be going or coming from a nearby practice area.

TABLE 9

RUNWAY LENGTH REQUIREMENTS

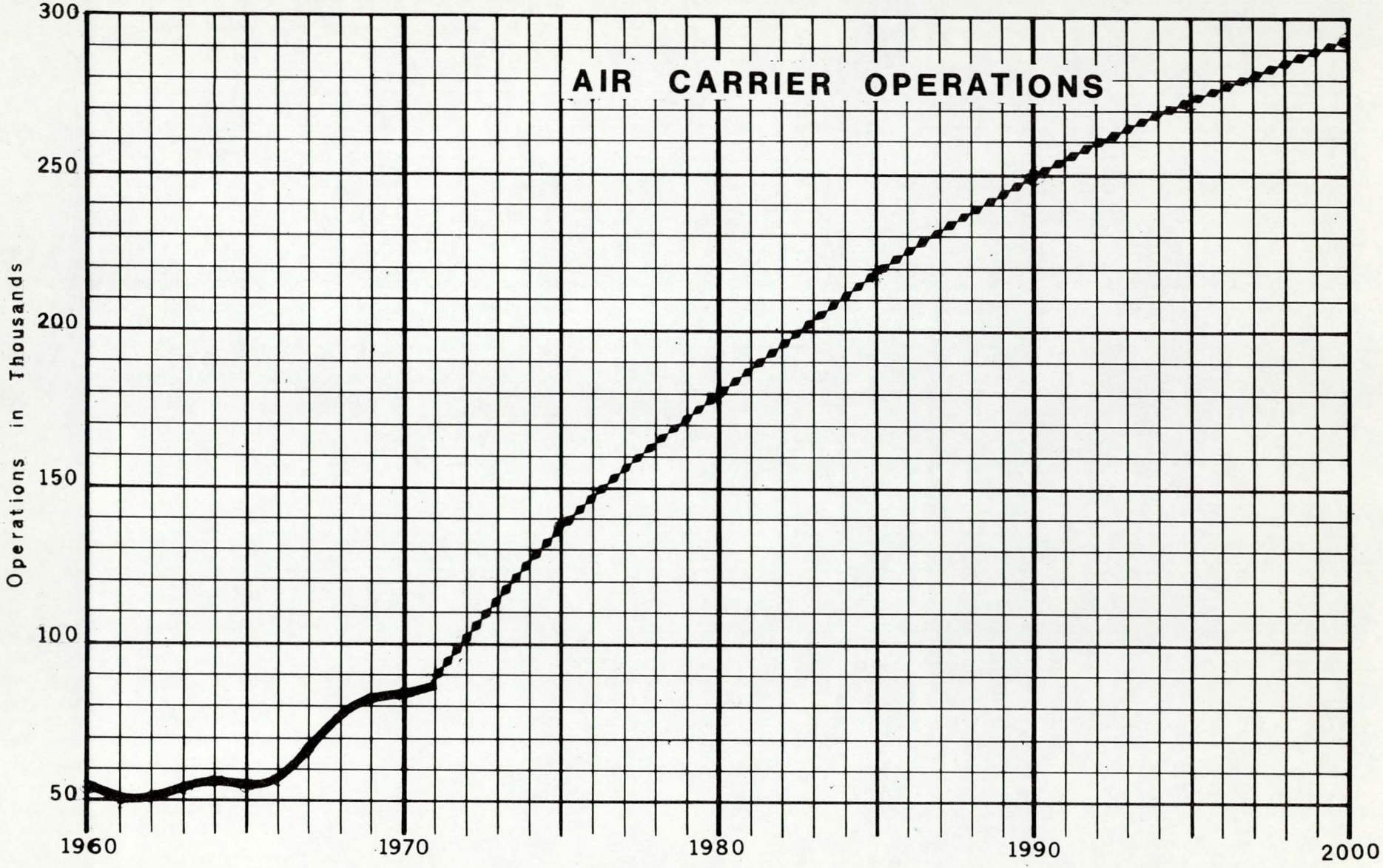
Aircraft Type	Take-Off Weight	Take-Off Rwy Length	Landing Weight	Landing Dry Runway	Landing Wet Runway
B-707-100	238,000	10,650'	191,000	6,700'	7,700'
-200 *	248,000	10,500'	185,000	6,850'	7,880'
-300	279,000	11,400'	198,000	7,550'	8,680'
-400	280,000	10,700'	207,000	7,950'	9,140'
DC-8 - 10	265,000	11,000'	193,000	7,400'	8,510'
- 20	264,000	9,500'	193,000	7,100'	8,170'
- 30	278,000	10,400'	207,500	7,550'	8,680'
- 40	271,000	9,500'	207,000	7,550'	8,680'
B-747	665,000	11,500'	565,000	7,100'	8,170'
L-1011	425,000	10,500'	355,000	6,200'	7,130'
DC-8 - 61	320,000	11,300'	240,000	6,500'	7,480'
- 62	340,000	11,500'	240,000	6,300'	7,250'
- 63	340,000	11,500'	258,000	6,700'	7,710'
DC-10- 10	420,000	10,200'	363,300	5,800'	6,670'
- 20	510,000	11,000'	403,000	6,300'	7,250'
- 30	530,000	11,500'	403,000	6,200'	7,130'

* Range limited to 2000 miles

Design Conditions:

1) Elevation: 1128' MSL
2) Range: 2141 statute miles (New York City)
3) Temperature: 106° (Std. day + 15° + 25°)
4) Maximum weight as applicable.
5) Effective gradient: 0.23%

Source: Appropriate Flight Manuals


AIR CARRIER OPERATIONS
Operations in Thousands
300
250
200
150
100
50
1960
1970
1980
1990
2000

Constraints

The second major input to this study was to list all the major constraints on design. Three constraints on growth were identified. First of these is the Salt River, located on the south and east parts of the airport. This river has infrequent flow, but is subject to flooding during heavy storm run-offs in the watershed area. Several times in the past 30 years the river has flooded and encroached upon the airfield. The Corps of Engineers has proposed to create a low flow channel which would contain the normal water release from the dams upstream. It is estimated that the construction of this low flow channel will be completed by 1985. No development of the south runway complex can take place until the channel has been relocated since future extensions of the south runways will need to encroach on the existing river channel.

The second constraint identified as limiting the ability of the airport to grow is the road and highway network surrounding the airport. These roads limit the length and orientation of the runways. When analyzed from the standpoint of runway alignment, the east-west direction is the only feasible direction in which runway lengths of 11,500 feet can be satisfactorily accommodated. An alignment in any other direction will conflict with the roads and highways, as well as adversely affecting the residential land uses north and south of the field. Sky Harbor is fortunate in that the wind patterns for the area distinctly favor operations in an east or west direction. During the late evening and early morning hours winds favor take offs and landings to the east. During the afternoon hours winds favor take offs and landings to the west. Since the east-west runways provide 99% wind coverage there is no need for a crosswind runway at Sky Harbor.

The constraints caused by the highway network and the river channel created the third constraint on the terminal evaluation study. This was the amount of space that was available between the parallel runways to accommodate a terminal facility. Between the existing east-west runways there is approximately 1600 feet available between the obstacle clearance lines. The master plan for the airport provides for the relocation of the existing south runway some 600 feet farther south. This will allow the existing south runway to be converted into a taxiway and will open up the terminal area by some 300 feet to 1900 feet between the obstacle clearance lines.

Design Criteria

The third major input to the study was to establish the criteria which would govern the concept to be adopted. In addition to the normal safety requirements outlined in Federal Aviation Administration Advisory Circulars, seven additional criteria were added to the study. These have been discussed in detail in other reports. Briefly, these seven are as follows:

1. The design must be modular. Since the anticipated growth demands on the terminal complex will not take place all at one time, the adopted scheme must be able to grow in small increments as the demand develops. In addition, modular units have the advantage of allowing the designers to take advantage of the latest advances in technology and construction techniques as each of the modules is scheduled for construction.

2. The design must be flexible. The interior configuration of a modular terminal must be flexible enough to be responsive to the individual air carrier needs. In addition to this particular flexibility, the airport should have the option to build either concourses or rotundas as future technology may allow, or airline desires may prefer. The design must also be flexible enough that any single module can be built at any time, thus allowing the terminal complex to be responsive to the existing land leases on the airport. Furthermore, the design must be flexible enough that it will accommodate any type or size of aircraft that can be foreseen in the airline inventory.

3. Design must be able to phase in with the existing East Wing terminal building. Since this existing structure is functional and efficient, there is no requirement to remove it from service in the immediate future. Therefore any terminal design which is adopted should be able to work well with the existing East Wing.

4. There must be access to the airport from east and west. Vehicular studies of passenger ground origin and destination indicate that a significant portion of the citizens living to the east and northeast will find it easier to travel to the airport by way of the Hohokam Freeway. From the downtown area and for the citizens living on the west side of town, the Squaw Peak Freeway will be the easiest route. These freeways provide excellent access routes to the airport.

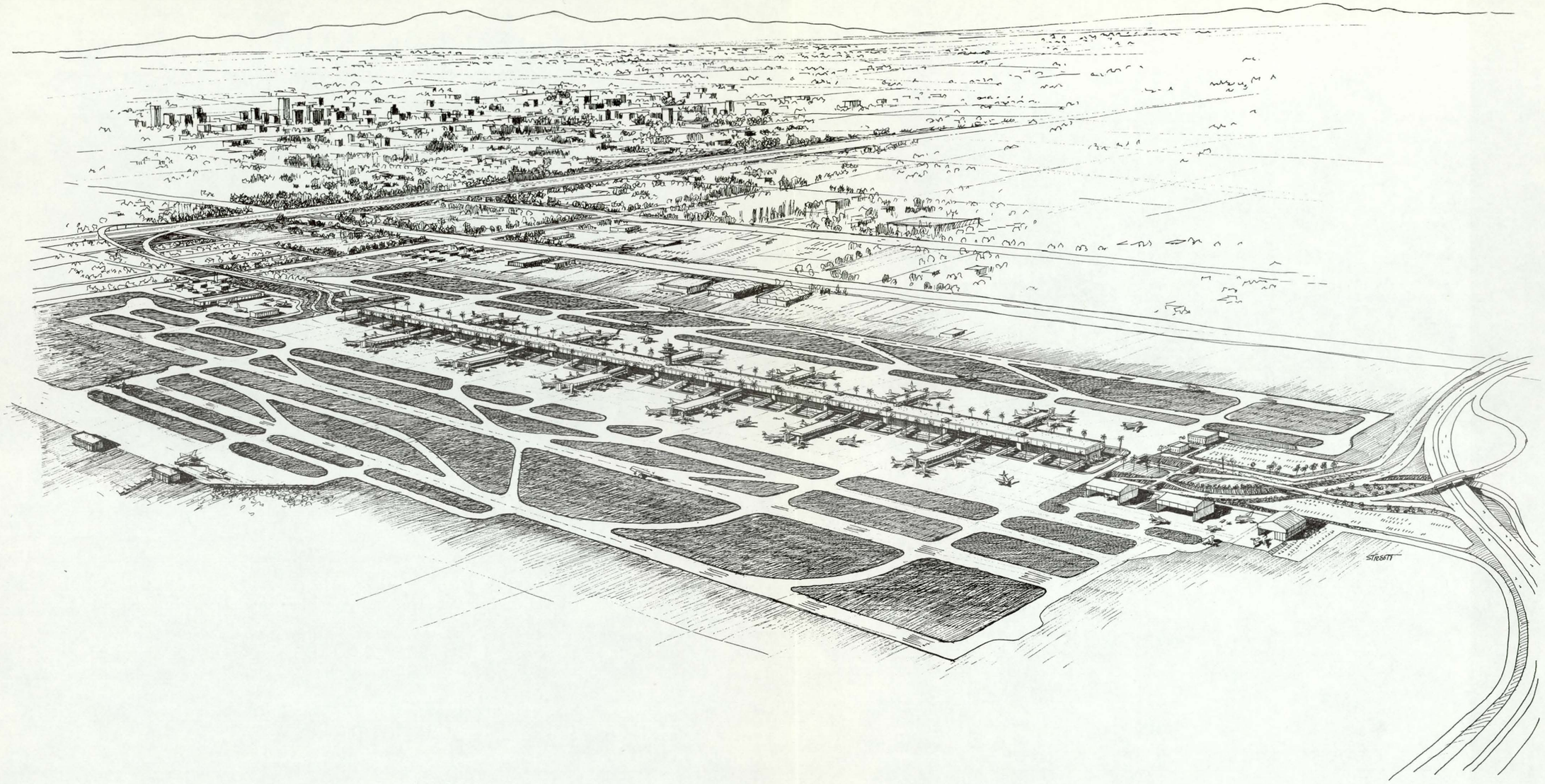
5. The design must not force the building of a new runway. It is recognized that the relocation of the existing south runway is desirable at some point in the future. However, the terminal design to be adopted by the airport must not be such that it would force the immediate relocation of this runway.

6. The design must not obsolete new construction. Several new projects are underway at the airport and the new terminal complex must be designed in such a manner that it will not force the early removal of the new International Building, the terminal concourse expansion, or the new executive aircraft terminal.

7. The design must be compatible with future transportation networks. Phoenix may, some time in the future, require a rapid transit network within the metropolitan area. An airport is a logical terminus for a great many of the travelers on such a network. The terminal design, therefore, must be able to accommodate such a rapid transit system regardless of the type which may be adopted in the future.

Recommended Plan

On the following page is a drawing which shows the terminal concept selected as the best plan to meet the needs of Phoenix Sky Harbor International Airport. This plan incorporates all of the features which have been discussed above and will be discussed at a greater depth in the following sections of this report.



PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

MASTER PLAN STUDY

QUINTON-BUDLONG

AERIAL VIEW

ALAN M. VOORHEES AND ASSOCIATES, INC.

JOHN CARL WARNECKE & ASSOCIATES

II

CHAPTER II

RECOMMENDED MASTER PLAN PROGRAM

The recommended plan which will be discussed in this chapter is based upon the ultimate configuration of the entire terminal complex. All of the factors which will have a bearing on the ultimate configuration of the airport will be discussed, emphasizing the results which will be achieved when the program has run its full course. The staged construction of the airport, together with a sequence of events to reach the ultimate development are discussed in Chapter 3.

AIRSIDE FACILITIES

Runways

Sky Harbor presently has two east-west runways. These are Runway 8L/26R (north runway) which is 150 feet wide by 8,750 feet long. Runway 8R/26L (south runway) is 150 feet wide by 10,300 feet long. Both of these runways can accommodate 747 type aircraft. These runways are currently rated at 100,000 lbs. gross weight strength for a single wheel gear aircraft, 200,000 lbs. for dual wheel gear aircraft and 350,000 lbs. for dual tandem wheel gear aircraft. Runway 8L/26R has an effective gradient of 0.23%, its west threshold elevation being 1108 feet MSL and its east threshold elevation being 1128 feet MSL. Runway 8R/26L has an effective gradient of 0.15%. Its west threshold elevation is 1107 feet MSL and its east threshold elevation is 1116 feet MSL. Both runways are equipped with type L 802 medium intensity lights.

Studies of future runway demands for the airport have been conducted by other consultants and the conclusions are that three parallel east-west runways will be needed to provide operational flexibility for the airport. The existing runway 8L/26R is to be lengthened to 11,500 feet and widened to 200 feet to accommodate wide bodied air carrier aircraft. The existing Runway 8R/26L is to be converted in the future and remarked as a 100 foot wide parallel taxiway. A new runway, located 600 feet south of the present runway 8R/26L will be built to a length of 11,500 feet. It will have a width of 200 feet to accommodate wide bodied aircraft and will be designated Runway 8C/26C. A far south runway will be constructed 1800 feet south of the existing Runway 8R/26L. This far south runway will be 9200 feet long by 200 feet wide and will be known as the new Runway 8R/26L. The distance between the outer runways is over 5000 feet in order to give the airport the capability for dual simultaneous IFR approaches. All runways are to be constructed to strengths capable of handling the largest aircraft anticipated in service.

The runway length calculations have been cross checked against current data and found to be accurate. Computations given in Table 9 indicate that a stage length of 2150 miles from Phoenix to New York is reasonable for planning purposes. Accommodating full pay load, sufficient fuel reserves for "holding" and flight fuel to alternate airports indicates that aircraft departing Phoenix will need to have runway lengths in the order of 11,500 feet to safely fly this stage length. The length of 9200 feet for the new Runway 8R/26L is based upon landing aircraft requirements for air carrier aircraft. This far south runway will receive little usage as a take-off runway for air carrier aircraft because of its proximity to the longer Runway 8C/26C, but will be used extensively by several aviation aircraft.

It can be seen, therefore, that the runway lengths developed in the original "General Land Use Plan" adopted by the City early in 1971 are adequate for the aircraft that will be operating from Sky Harbor.

Capacity

In calculating the capacity of any runway system, there are a number of factors which must be taken into consideration. Among these are (1) the mix of aircraft that will be using the facility; (2) the length of the runway and the location and angle of the exit taxiways from that runway; (3) the configuration of the runway network as a whole; (4) the airspace around the airport; (5) the weather; and (6) total number of flight operations. Most of these items are fairly stable inputs to the calculation process. For example, the runway layout is subject to minor variations, and the airspace utilization is infrequently altered. It might be well, therefore, to briefly discuss some of these items so that a fuller understanding of the meaning of "capacity" can be gained.

Mix of aircraft is the most volatile of the items to be studied. The types of aircraft using the airport vary from day to day, and there is no such thing as a standard mix of aircraft types. But over a longer period of time, usually one year, a pattern of aircraft usage can be developed and identified. The types of aircraft in service with the air carriers is subject to slow change as newer models are introduced, and older models are phased out. The trend is definitely toward the wide body aircraft since these planes are more efficient and profitable for the air carriers to operate. On the other hand, the smaller aircraft, such as the DC-9 or 737 are also necessary for the shorter range flights and service to cities that generate lower load factors.

The other side of this coin is the general aviation fleet. These are the smaller types of aircraft, usually owned by individuals or corporations. Ranging from the small single seat, single engine airplanes to the sophisticated corporate jets seating up to 20; this fleet usage of the airport varies from day to day. It is possible, however, to detect trends in this fleet mix. In the following table, the current and forecasted fleet mixes are given.

TABLE 10

FORECAST OF AIRCRAFT MIX

Year	Aircraft Mix Class of Aircraft (%) * AA + A	B	C	D	E	Class of Aircraft
1975	10+37	29	24			Air Carrier
			4	17	79	General Aviation
1980	14+15	38	33			Air Carrier
			5	20	75	General Aviation
1985	18+11	39	32			Air Carrier
			7	25	68	General Aviation
1990	21+ 8	42	29			Air Carrier
			10	28	62	General Aviation
2000	25+ 5	45	25			Air Carrier
			15	35	50	General Aviation

Source: Landrum and Brown, letter report

A review of these numbers reveals that the subtle shift in the percentage of larger air carrier aircraft is partially counter-balanced by the steady level of Class C aircraft. The growth of the Class AA aircraft is parallel to a decrease in the Class A aircraft, representing the phasing out of the 707 and DC-8 type aircraft from the fleets.

The general aviation fleet also shows increases in the larger Class C aircraft (such as the corporate jets) and a decline in the smallest class, Class E, single engine aircraft. These trends, it must be noted, reflect the aircraft mix at Sky Harbor, and may not necessarily be representative of the Phoenix area as a whole.

* Aircraft Classes

- AA Jet aircraft over 300,000 lbs. gross weight
- A 4-engine jet aircraft under 300,000 lbs.
- B 2 and 3-engine jet, 4-engine piston and turbo-prop aircraft
- C Executive jet and transport type twin-engine piston aircraft
- D, E Light twin-engine piston and single-engine piston aircraft

Another item involved in capacity calculations is the length of the runway and the location and angle of the exit taxiways. The length of the runway determines the types of aircraft that can safely operate on it, and the location of the exit taxiways influences the amount of time that a landing aircraft occupies the pavement surface. Time is the key element in this equation. By locating the exit taxiways in the best possible position, lower runway occupancy times can be achieved. These lower times result in more aircraft being able to use the runway during any given period of time, hence a higher capacity of the runway system.

A third element is the configuration of the runway layouts as a whole. Parallel runways give the best utilization of space, since they allow simultaneous operations. Intersecting runways, naturally, would slow operations since aircraft would have to wait until an arriving aircraft or departing aircraft had cleared the intersection. Open V runways provide good utilization of space provided the operations are away from the point of the V. Operations toward the point have the same restrictions as intersecting runways. Phoenix is in the enviable situation of having parallel runways, hence the most efficient configuration for airport capacity.

A fourth element is the airspace around the airport. For the most part, the airspace in the vicinity of Sky Harbor is "uncluttered". However, the proximity of two military air bases tends to complicate the surrounding airspace. In the future, the addition of a third parallel runway will result in a more complex airspace utilization. Therefore, the calculation of the capacity for the runway system has been based on "normal" conditions until such time as the third parallel runway is operational, and "highly restricted" after that time.

The fifth element is the weather. This is more of a factor in coastal cities than in Phoenix. Since 99% of the weather is VFR (Visual Flight Rules, or good flying weather) there is little or no penalty due to weather in the capacity calculations.

The last significant item is the total number of aircraft operations. Obviously, a low level of activity will not impose any burdens on the runway system, whereas a high level may tax the ability of the system to safely and efficiently accept and dispatch aircraft. It is this last item - the total number of aircraft operations - that needs further study.

Having identified the major elements of the capacity program, the one additional element that needs to be developed is the actual number of aircraft that would be using each of the parallel runways, and then determining the air carrier and general aviation mix of the fleet that will use each runway. The following table gives the estimated air carrier usage of the runways.

TABLE 11

ESTIMATED AIR CARRIER RUNWAY UTILIZATION

Year	Total Operations	Runway Usage 8L/26R	8C/26C	8R/26L
1975	140,000	37,800	102,200 *	-0-
1980	180,000	61,200	118,800 *	-0-
1985	218,000	85,000	119,700	13,300
1990	250,000	97,500	137,200	15,300
1995	274,000	139,700	120,900	13,400
2000	294,000	135,200	142,900	15,900

* Existing 8R/26L

General aviation demand, however, is not equated to any scheduled pattern. Two trends have been identified in analyzing the statistics. "Local" flying, which is usually associated with proficiency flying, had a fairly stable trend except in 1967 when it increased somewhat. After this, the trend has been downward as pilots are encouraged to practice proficiency flying at some of the outlying fields rather than at Sky Harbor. "Itinerant" flying generally represents those pilots travelling between cities, or those leaving the local area. This trend has been generally increasing over the years, with some leveling in the past few years.

A special computer run was made of all aircraft registered in Arizona, and statistical tables were made to identify the activity levels of these aircraft. It is not possible to identify which aircraft are flying "local" and which are "itinerant" since each aircraft will log hours in both categories. In order to establish a forecasting base, the number of aircraft based at Sky Harbor has been used as a springboard against which activity levels have been measured. The mix of general aviation aircraft in the Phoenix area has been established and is given in the following table:

TABLE 12

MIX OF GENERAL AVIATION AIRCRAFT IN PHOENIX AREA

Type Aircraft	Type of Owner Indiv.	P'ship	Corp	Co-owner	Government
Single Engine 4+ Seats	360	23	202	70	14
Single Engine 1-3 Seats	390	32	203	145	7
Multi-Engine	48	11	152	17	3
Rotorcraft	18	-	52	1	2
Other	17	1	14	2	-

Total = 1784

Of these 1784 aircraft, some 600 are based at Sky Harbor. Aircraft owners are requested to submit certain data to the Federal Aviation Administration annually. Among these data is the number of hours flown in the previous year. The following table gives the average number of hours flown for the various categories of aircraft.

TABLE 13

GENERAL AVIATION AIRCRAFT UTILIZATION

Type Aircraft	Indiv	P'ship	Corp	Co-owner	Government
Single Engine 4+ Seats	150	63	487	150	450
Single Engine 1-3 Seats	150	137	284	195	376
Multi-Engine	243	153	257	75	400
Rotorcraft	*	-	423	-	-
Other	17	-	-	-	-

Average = 229 hours

* Sample too small to be meaningful.

As Sky Harbor becomes more fully developed, the types of aircraft based at the field will change. At the present time, approximately 35% of the aircraft are smaller single engine aircraft. The trend is expected to shift toward the bigger multi-engine aircraft and away from the single engine types. Exactly how much of a shift will occur in the nature of this mixture cannot be predicted at this time, but estimates can be made of the levels of activity that can be expected if certain mixes are achieved. Three mixes of aircraft have been developed which reflect this shift toward the multi-engine aircraft. These are:

	Single Eng. +4	Single Eng. 1-3	Multi Engine	Rotor-craft	Other
Mix #1 (existing)	35%	47%	14%	3%	1%
Mix #2	25	40	29	5	1
Mix #3	10	20	64	5	1

Based upon computer runs of the raw data, it has been estimated that the average aircraft in Mix #1, without any restrictions on proficiency flying, will average 573 operations per aircraft per year. With some restrictions on this proficiency flying, the average will drop to 403 operations per aircraft. For Mix #2, with no restrictions, the average is 523 operations; and with restrictions, 378 operations. For Mix #3, with no restrictions, the average is 400 operations, and with restrictions, 300 operations.

As a matter of fact, two restrictions already exist at Sky Harbor. First is the general agreement that proficiency flying will be conducted away from Sky Harbor for most aircraft. The second is a requirement that all aircraft operating at Sky Harbor have a radio transmitter/receiver. In Arizona, about 47% of the aircraft may not be able to meet the radio transmitter/receiver requirement, hence could be restricted from operations at this field.

Having identified the character and activity levels of the general aviation fleet in the Phoenix area, the remaining element in determining the general aviation contribution to the activity at Sky Harbor is to determine the number of based aircraft that will be using each of the runways.

All of the general aviation activity presently uses Runway 8L/26R. With approximately 620 aircraft based in the northwest corner of the airport, the activity level that can be expected is around 250,000 annual operations with the Mix #1 and restrictions on proficiency flying. The actual level of operations in 1970 was 253,650 operations, which correlates well with the calculations. The following table gives the location and number of aircraft parking positions that have been planned for the airport.

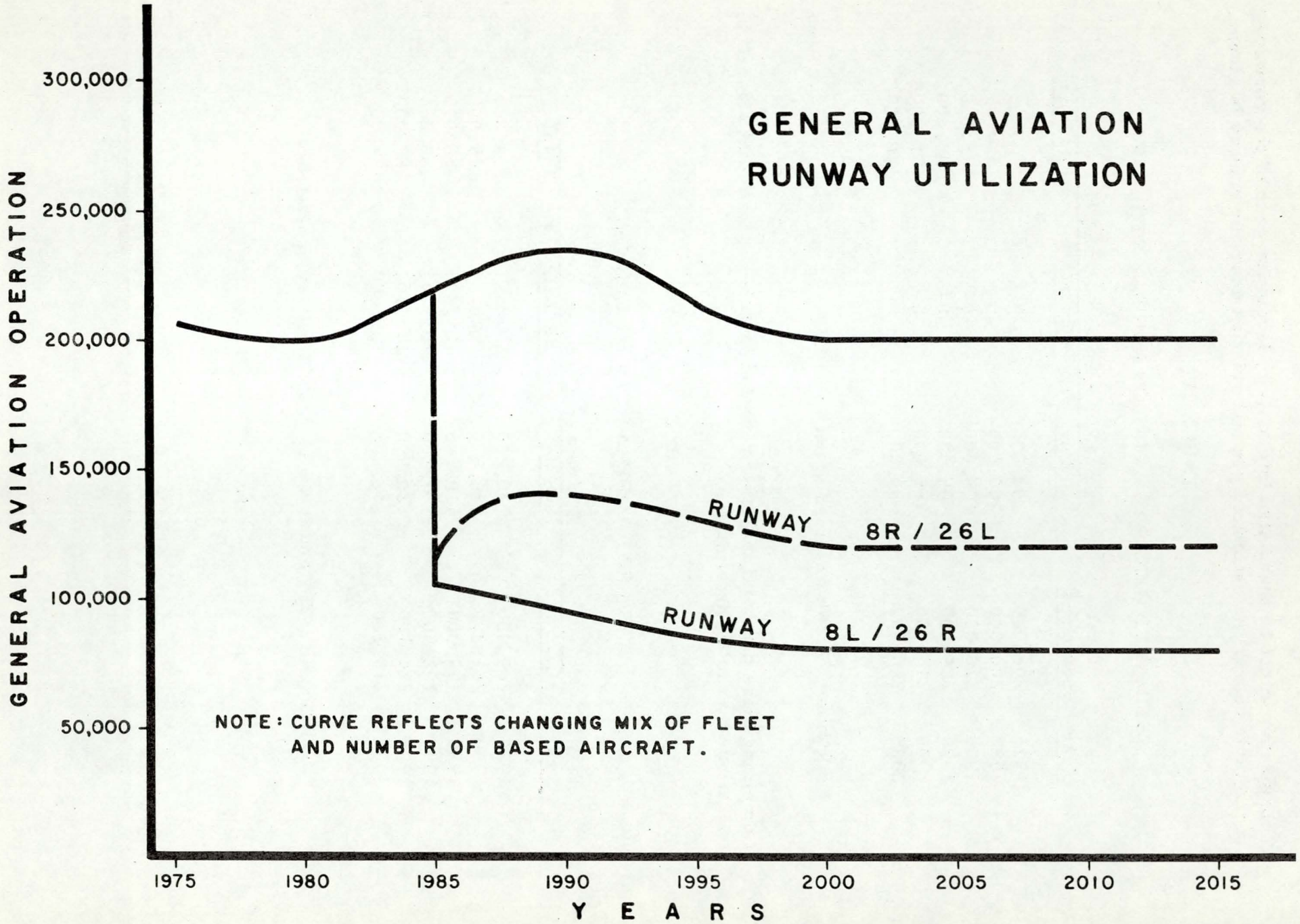
TABLE 14

LOCATION OF BASED AIRCRAFT

Year/Phase	Location	Based Aircraft
1975 Ia	Adjacent to 8L/26R	512
1980 Ib	Adjacent to 8L/26R	512
1985 II	Adjacent to 8L/26R	262
	Adjacent to 8R/26L	400
1990 II	Adjacent to 8L/26R	262
	Adjacent to 8R/26L	400
2000 IV	Adjacent to 8L/26R	262
	Adjacent to 8R/26L	400

In forecasting the general aviation fleet, it has been estimated that the mix will generally approximate Mix #1 through 1980. During the 1980's, the mix will approximate Mix #2, and beyond the year 1990 will approximate Mix #3.

Taking this data, and smoothing out the irregularities in statistical analysis, results in the following graph.


GENERAL AVIATION
RUNWAY UTILIZATION
GENERAL AVIATION OPERATION
300,000
250,000
200,000
150,000
100,000
50,000
RUNWAY 8R / 26L
RUNWAY 8L / 26 R
NOTE: CURVE REFLECTS CHANGING MIX OF FLEET
AND NUMBER OF BASED AIRCRAFT.
1975
1980
1985
1990
1995
2000
2005
2010
2015
YEARS

These data can not be translated into activity levels for each of the runways. In the table below, the estimated general aviation usage by runway is given.

TABLE 15

ESTIMATED GENERAL AVIATION RUNWAY UTILIZATION

Year	Total Operations	Runway Usage 8L/26R	8C/26C	8R/26L
1975	206,000	206,000	-0-	-0-
1980	200,000	200,000	-0-	-0-
1985 *	220,000	105,000	-0-	115,000
1990	235,000	95,000	-0-	140,000
1995	215,000	85,000	-0-	130,000
2000	200,000	80,000	-0-	120,000

* Runway 8R/26L assumed to open in 1985.

Combining these data with the data presented in Table II, the total aircraft operations by runway is as follows:

TABLE 16

AIRCRAFT OPERATIONS BY RUNWAY

Year	Aircraft Operations 8L/26R	8C/26C	8R/26L	Total
1975	243,800	120,200 *	-0-	364,000
1980	261,200	126,800 *	-0-	388,000
1985	190,000	119,700	128,300	438,000
1990	192,500	137,200	155,300	485,000
1995	224,700	120,900	143,400	489,000
2000	215,200	142,900	135,900	494,000

* Existing 8R/26L, and includes 8,000 military operations.

Utilizing these base data, the capacity of each of the runways can now be calculated.

TABLE 17

RUNWAY CAPACITIES

	Runway Peak Hour Capacity					
	8L/26R		8C/26C		8R/26L	
Year	PHOCAP	*Demand	PHOCAP	Demand	PHOCAP	Demand
1975	80	67	48**	30**	-	-
1980	72	73	50**	32**	-	-
1985	56	57	44	30	82	43
1990	52	52	44	34	84	46
1995	55	59	46	30	84	43
2000	55	56	44	37	83	40

** Existing Runway 8R/26L

This analysis is based upon the peak hour demands that are expected to be placed on each of the runways. It can be seen that in the 1980 to 1985 time period, the demand virtually equals the capacity on Runway 8L/26R. This is the main reason for limiting the number of based aircraft in the northwest corner of the field to 512 initially, and 262 later. However, these numbers are based upon mathematical calculations and may not fully reflect the existing situation. When analyzed on an annual basis, the north runway is now substantially "exceeding" its annual capacity. Note also that the capacity of the north runway in 1995 is somewhat less than the demand during the peak hours. The numbers are close, but they do indicate that some delays will occur during peak hour activity in the mid-nineties. Demand exceeds capacity by only 4 operations per hour and peak hour activity is predicted somewhat on a continuation of today's operational methods. It is possible that the actual method of scheduling air carrier aircraft, and the actual number of general aviation aircraft based in this corner of the airport will vary from the forecast data enough to eliminate this excess. On the other hand, it could be greater, in which case, a review of the number of general aviation aircraft based in this part of the airport must be carefully evaluated to bring their activity into balance with the capacity of the system.

* PHOCAP is Practical Hourly Capacity

One other fact needs to be brought out here. The mathematical calculations of annual capacity are not felt to be truly indicative of the capacity of the system. For example, the calculations for the north runway indicated that this runway is now handling more operations than its capacity. The formulae are not fully responsive to the total range of situations that can exist at an airport. We feel that the peak hour capacities, given in Table 17 above, are more indicative of the true situation than are the practical annual capacities (PANCAP) of the runways. The PANCAPs should not, therefore, be taken as a limiting factor in analyzing the runway system.

The table below gives the PANCAP figures for each of the runways, and it is included in this report for information only.

TABLE 18

RUNWAY PANCAP CALCULATIONS

	Runway Annual Capacity					
	8L/26R		8C/26C		8R/26R	
Year	PANCAP*	Demand	PANCAP	Demand	PANCAP	Demand
1975	216,000	243,800	248,000*	120,200*	-	-
1980	229,000	261,200	253,000*	126,800*	-	-
1985	207,000	190,000	223,200	119,700	183,500	128,300
1990	211,000	192,500	222,000	137,200	188,000	155,300
1995	223,000	224,700	236,000	120,900	188,000	143,400
2000	216,000	215,200	228,000	142,900	194,000	135,900

* Existing Runway 8R/26L

The mathematical calculations thus show a demand level in excess of the available "capacity" on an annual basis for the north runway in 1975 and 1980, with a close situation existing throughout the remainder of the time. We feel, that this may be somewhat pessimistic, especially since the demands generated by general aviation tend to be spread over a wider time period than do those of the air carrier activity. Hence general aviation can be more flexible and responsibe to the pressures and permit more operations to be handled on the runway system on an annual basis than the calculations would indicate. Note, too, that on an annual basis, the demand virtually equals the PANCAP for 1995, whereas the peak hour capacity calculations indicate that some over-demand may exist, hence some delays can be expected. Allowing for some margin of error in the mathematical

* PANCAP is Practical Annual Capacity

model, it can be generally said that the design of the airport has kept the capacity of the runways in balance with the demand - recognizing that curtailment of general aviation activity on the north runway will be necessary in order to maintain this balance. The master plan has been arranged in such a manner that the removal of general aviation facilities takes place at the times that demand builds up to the point where the capacity is strained, thus relieving the pressure. The only true way to insure that unnecessary delays do not build up on this runway is to monitor the activity on this runway over the years, and keep the general aviation fleet in balance with the capacity of the field. Note, too, that the overall capacity of the entire runway system is less than the demands generated by the military, the air carriers, and the general aviation fleet. Treating the capacity of the airport as a whole is deceptive, since it would indicate that the based aircraft could be increased substantially. Whereas, an analysis on a runway-by-runway basis indicates that some close situations do exist, and the number of based aircraft must be kept in balance with the air carrier activity and the ability of the system to handle all the aircraft movements.

Weather Analysis

Table 19, which follows, highlights the fact that the Phoenix weather is predominantly visual flying ("VFR"). An average of 22.7 hours per year is in cloudy weather conditions ("IFR") and these 22.7 hours are reasonably distributed over the ceiling and visibility categories. What this means in terms of runway design is that the need for sophisticated landing equipment is minimal. The installation of Instrument Landing System (ILS) equipment on the airport itself is not justified from strictly a weather standpoint, but may be justified from a traffic control standpoint. Because of this safety reason, the master plan makes provision for the installation of ILS equipment on Runway 26R and on Runway 8C or 8R.

TABLE 19

WEATHER ANALYSIS

Weather * Condition	Total Hrs. Per Year	Average Annual Hours: Rwy 8	Rwy 26	Calms	Total Coverage
All Wx	8,761.80	4,545.6	3041.7	1098.8	8686.1
VFR	8,739.10	4,539.2	3033.9	1094.1	8667.2
CIR	7.00	2.1	2.9	1.2	6.2
VOR	6.3	1.4	2.9	1.3	5.6
ILS	3.5	1.2	0.7	0.4	2.3
TWO	2.3	0.8	0.5	0.5	1.8
CLO	3.6	0.9	0.8	1.3	3.0

* Weather conditions shown here relate to the various ceiling and visibility minimal which are applicable to Sky Harbor. See the Appendix for more detailed explanation of symbols.

An analysis of the wind patterns indicates that the runway alignment 8/26 provides adequate wind coverage for aircraft operations 99.2% of the time. This is based upon a maximum cross-wind component of 13 knots. If the maximum cross-wind component is reduced to 10 knots the runway alignment 8/26 still provides more than 95% wind coverage. Unlike many coastal communities, the occurrence of instrument weather does not follow any definable pattern and tends to occur during all months of the year to some degree. Over 62% of the IFR weather occurs with wind speeds less than 10 knots.

Since VFR weather is such a dominant factor in the Phoenix area, a special analysis of this weather condition was run on an hour by hour basis. A distinct pattern was identified which showed that the majority of the winds occur in an east or a west direction. From late evening through the night and morning hours the winds favor Runway 8 (west to east operations). During the afternoon hours and early evening hours the winds tend to favor Runway 26 (east to west operations). In calculating the amount of time that the runways could be used on an operational program, it was found that if Runway 8 is the "calm wind runway" it can be used 64.4% of the time. If, however, Runway 26 is designated as the "calm wind runway" it would be used only 47.2% of the time. (The designation of a runway as a "calm wind runway" simply means that the usage of that runway is established by policy rather than wind velocity and normally applies at any time the winds are less than 4 knots. However, for the purposes of this study, calm winds are considered to be zero winds.)

Wind speeds in the Phoenix area exceed 20 knots on an average of 28.9 hours per year. Of these 28.9 hours, some 64% occur in the 20 to 22 knot range. The remaining time drops sharply as the wind velocity increases. High winds, when analyzed on a time of day basis, occur at every hour of the day, but tend to occur more frequently in the late afternoon and early evening hours. Analyzed on a month-to-month basis, high winds tend to favor the summer months with July being the most predominant with an average of 4.7 hours of high winds out of the total 28.9 recorded over a specific 10-year span.

Details of all this weather analysis are given in the appendix of this report.

The conclusions which can be drawn from the weather analysis support the fact that the Runway 8/26 alignment is the best possible one for the Phoenix Sky Harbor Airport. Analysis also indicates that there is no need for a cross-wind runway to be built at this airport for any type of aircraft activity. The results

of this study also illustrate that there is little justification to install sophisticated instrument equipment to handle aircraft during bad weather conditions since frequency of these low visibility and low ceiling weather conditions is minimal. It has been determined that winds tend to favor Runway 8 for 52.3% of the time, Runway 26 for 35% of the time and that for 12.6% of the time either runway can be used.

Taxiways

Careful studies have been made of the ground taxiing requirements for aircraft and a taxiway network has been planned for the smooth flow of aircraft to and from the various runways. There is a requirement for dual parallel taxiways adjacent to Runway 8L/26R and Runway 8C/26C. One of these dual parallels can be an apron edge taxiway. A single parallel taxiway will be required for aircraft operating on Runway 8R/26L.

Exit taxiways fall into two general categories. Angled taxiways have been provided at a number of points along the runways to allow for expedited clearance of aircraft from the active runway. These angled exit taxiways are not of the high speed design since it has been found that the need for fast exiting under close runway time tolerances is not necessary and subjects aircraft to a high speed turn that is not deemed desirable.

The other type of exit taxiway which has been provided is the standard 90 degree taxiway. All taxiways have been placed at strategic points to allow aircraft to move across the airport in a logical manner and with a minimum amount of interference with other taxiing aircraft. All taxiways to be used by air carrier will eventually be 100 feet wide and built to the wide bodied jet standards. All taxiways to be used by general aviation aircraft on the north side of the airport and on the far south side of the airport can be as wide as 75 feet.

Several holding aprons have been provided near the runway ends for those piston engine aircraft which need to complete their engine warm-up. These aprons are of a size and location to permit an aircraft to taxi past without obstruction and to minimize effects from prop wash or jet blast.

Obstructions

The obstruction plan for the airport has been drawn to the new criteria outlined in Part 77 of the Federal Aviation Regulations. This new criteria represents the latest thinking in safe operating "surfaces" on and around a major airport. It will be noted on the plan that instrument approach zones have been provided for each runway. This permits continuance of instrument landings on Runway 8R/26L and furnishes the opportunity to instrument other runways in the future. As such time as the existing Runway 8R/26L is converted into a taxiway and the new Runway 8C/26C

and 8R/26L are constructed, the obstruction plan can be modified by deleting from it the approach zones applicable to the present 8R/26L. The other major change in the new criteria from Part 77 is the controlling dimensions for the horizontal surface around the airport. The old criteria required a circular horizontal surface based on the airport reference point. The new criteria is based upon a fixed distance from the runway thresholds.

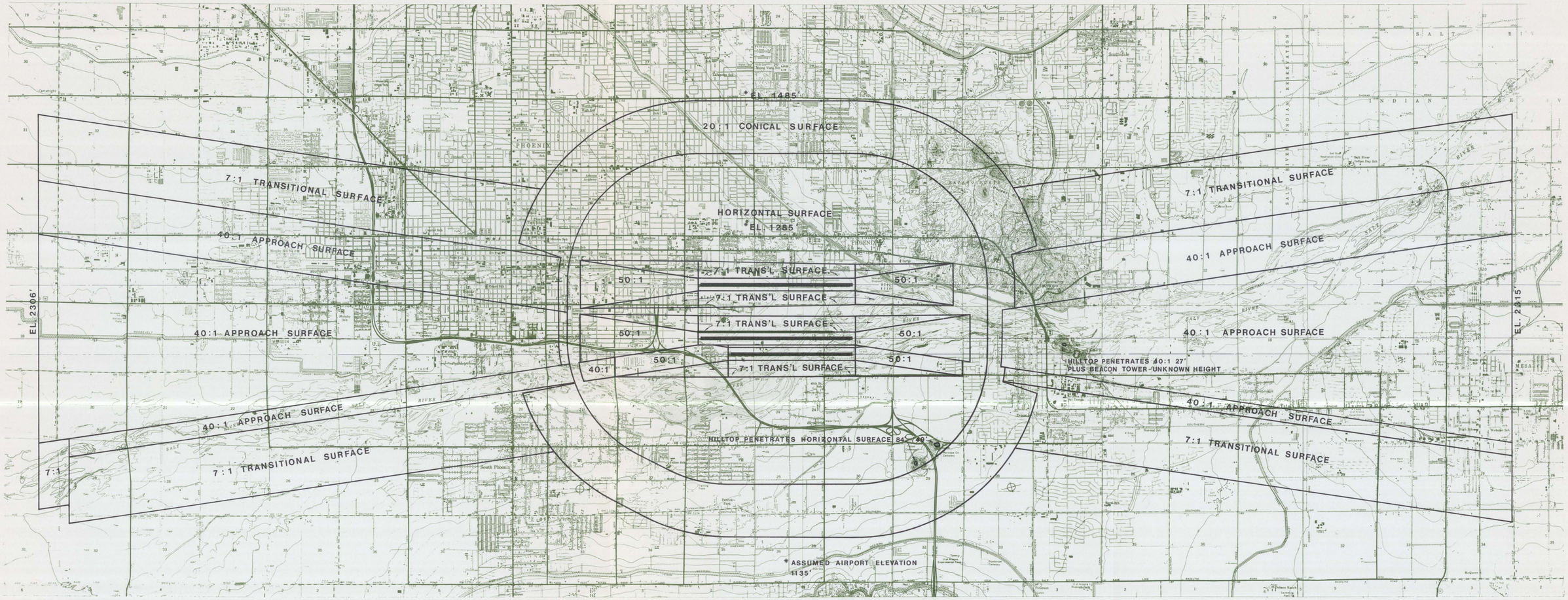
Clear zones and approach zones to the airport have been shown on the revised airport layout plan which will be submitted to the Federal Aviation Administration. The approach zone for each runway is programmed to be 50:1 for the inner 10,000 feet for each runway on the airport. Maintaining this level of protection will not only ensure the safe operation of air carrier aircraft, but will also provide the required clearances for the ILS equipment when it is installed on any of the runways.

Land Acquisition

Land acquisition for the airport has been established in the areas between the Squaw Peak Freeway and the Hohokam Freeway and as far south as the Maricopa Freeway and the Salt River low flow channel. No additional land purchases north of Airlane are anticipated. The acquisition of land has been timed in such a manner that additional parcels will be added to the airport as construction is scheduled. There is no requirement to buy all of the additional land in the immediate future. The land which will be incorporated into the airport boundaries will be purchased over the next 20 years.

Controlling Dimensions

In designing the airside of the terminal complex, a number of factors were taken into consideration. The controlling dimensions from the existing and proposed runways were used as a limiting factor in determining the amount of space that is available for terminal construction. In order to have the smooth flow of traffic to all runway thresholds it is necessary to provide for two-way aircraft movement parallel to each of the major runways. This may be accomplished by providing a parallel taxiway located 600 feet from the runway centerline. Rather than provide a second parallel taxiway 400 feet from the main parallel taxiway, it was decided to conserve space and allow aircraft to taxi along the apron edge. This is double utilization of the apron space which permits aircraft to maneuver around the concourses as well as pass enroute to or from the runway. From the centerline of the apron edge taxiway, a controlling distance of 180 feet is proposed to the obstacle clearance line around the terminal concourses. This obstacle clearance line, in the scheme which has been adopted, will restrict the point at which aircraft can



MASTER PLAN STUDY

QUINTON-BUDLONG

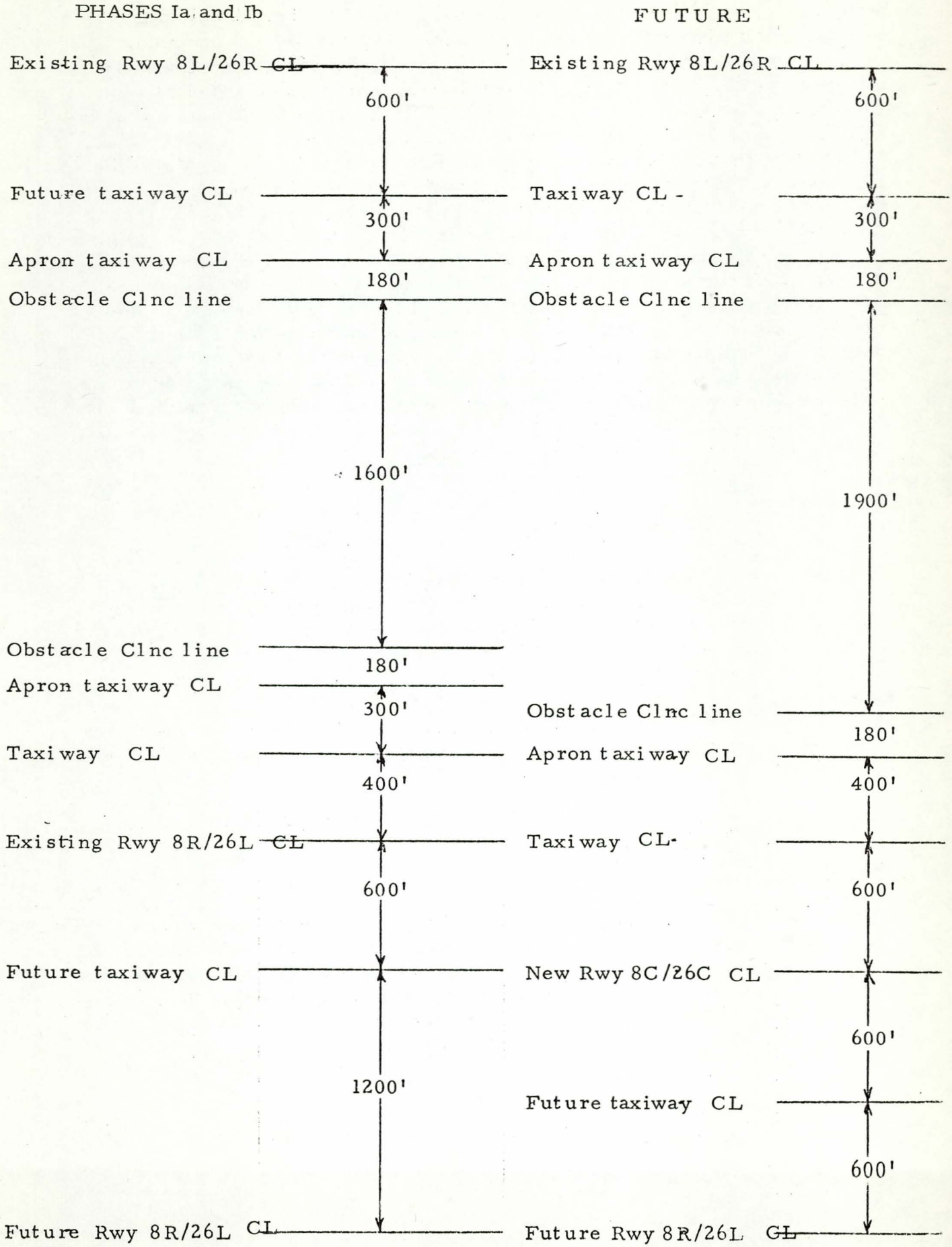
OBSTRUCTION MAP - FUTURE
F A R PART 77

ALAN M. VOORHEES AND ASSOCIATES, INC.

JOHN CARL WARNECKE & ASSOCIATES

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

CONTROLLING DIMENSIONS



be parked around the various terminal concourses. This 180 foot dimension was extracted from FAA Advisory Circular 150-5335-1A. In designing the gate positions at each of the terminal piers, flexibility was again one of the keynotes for planning. With the exception of the two innermost gate positions (which will accommodate only 707 type aircraft) all gate positions will accommodate the wide bodied jets or the stretched versions of these wide bodied jets. Around a standard terminal pier, the design allows for eight aircraft of maximum size. If, however, an airline desires to use a pier for minimum size aircraft (such as the Boeing 727 or 737) 12 aircraft can be accommodated around the pier. In all probability, the average pier will contain a mixture of all aircraft types and will probably have around ten gate positions of mixed sizes. In order to allow aircraft to be pushed back from the gate position and from that point to taxi under power out to the runway complex, a careful study was made to determine the distance that would be necessary between each set of terminal concourses. It was found that a distance of 1,250 feet (centerline to centerline) between the terminal piers would provide sufficient room for the maneuvering of aircraft on the apron space. This would allow two wide bodied jets to pass with safety to or from any of the interior gate positions.

Fuel System

The master plan also provides for the installation of an underground fuel dispensing system throughout the apron area. It is recognized, however, that the flexibility gained by allowing any size of aircraft to be positioned at any point along the terminal face, causes a design problem in positioning the fuel hydrant outlets. At the present time these hydrants are generally serviced by a small service vehicle which connects a hose to the fuel hydrant and a second hose to the aircraft fueling point. In order to maintain the desired flexibility in concourse design these connected hoses may have to be somewhat longer in the future. As an alternative to this problem it is possible to install additional fuel hydrant locations on a modular basis in the apron area thus permitting gate positions to be modified in the future with a minimum amount of reconstruction of the fuel dispensing network.

Fuel Storage Sites

At the present time there are several fuel storage sites located on the airport. A small one is located next to the intersection of Sky Harbor Boulevard and 40th Street, and several others are located in the maintenance area south of Buckeye. The master plan provides for a single large satellite fuel storage area south of Airlane and west of 44th Street. From this satellite facility, distribution lines can be run to the apron area.

During the interim the fuel lines can be run to a proposed interim fuel dispensing station located adjacent to taxiway X and south of the existing Sky Chef In-Flight Meal Packing Kitchen facility. The multiplicity of fuel dispensing sites located around the airport at the present time should be phased out as soon as possible.

Air Cargo Area

Another area directly related to the airside operations of the airport is the air cargo center. In reviewing the forecast of air cargo tonnages to be enplaned at Phoenix, it was estimated that the percentage of total cargo being moved via all-cargo flights would increase from the present level to approximately 55% by the year 2015. A parallel assumption was also made that the number of tons of Phoenix cargo that would be enplaned on each flight would increase from approximately 6 tons in 1975 to 20 tons by the year 2015. This conservative approach to establishing the air cargo apron requirements would indicate that approximately 6 all-cargo gate positions will be needed to move this amount of express, freight and mail. Cargo which is not carried in the all-cargo flights is normally carried in the belly compartments of the passenger aircraft. At the present time the carriers tend to favor continuation of this policy since it means better utilization of their fleets. The cargo center, therefore, has been designed in a modular form so that it can be responsive to the changing air cargo handling techniques used by the airlines.

TABLE 20

FORECAST OF AIR CARGO AND AIR MAIL

	Enplaned Tons	
Year	Air Cargo	Air Mail
1975	17,900	7,700
1980	32,600	12,300
1985	47,300	16,900
1990	62,000	21,500
1995	76,700	26,100
2000	91,400	30,700
Saturation	135,500	44,500

Source: Letter Report, Landrum and Brown, September 17, 1971

Although it is felt that the ultimate need for six all-cargo gate positions will be realized only after the year 2000, there is no way to forecast unusual or unexpected changes in the Phoenix economy which would result in an unusually heavy demand for air cargo facilities. Should such an event materialize, the master plan is capable of modification to accommodate three additional all-cargo gate positions along the extension of Pima Street.

Airline Maintenance Areas

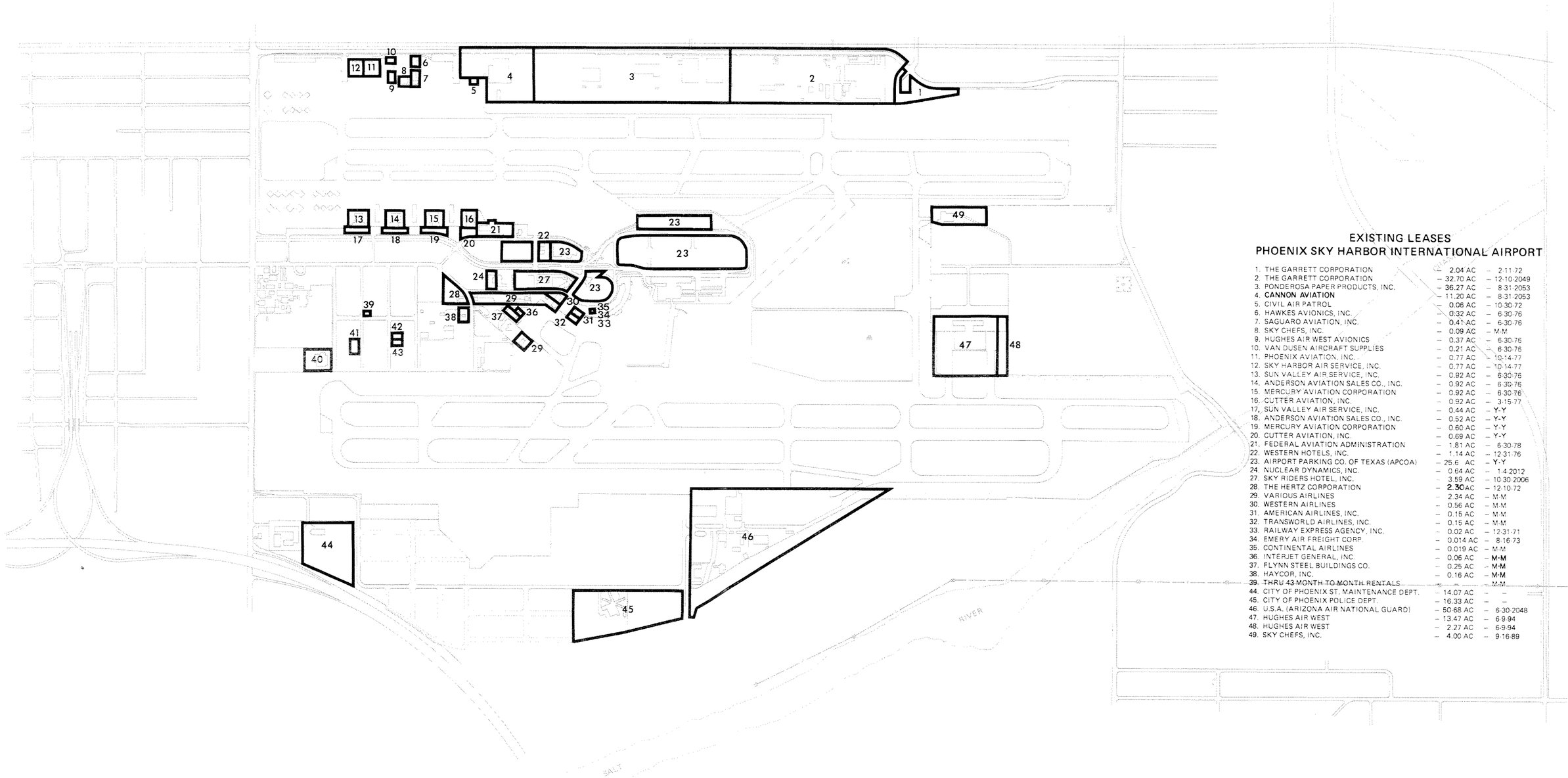
The present major airline maintenance area lies just east of taxiway X. Minor maintenance facilities are located west of the existing West Wing terminal building. The master plan provides for an airline maintenance center to be located to the east of future taxiway Z. Although the design which has been shown in this report indicates three airline maintenance hangars, it should be realized that these are simply shown as schematic hangars and should not be considered as recommended configurations for the hangar structures. There is sufficient room for expansion in this area between the terminal complex and the Hohokam Freeway. Minor maintenance facilities, wash racks, and overnight parking positions are located at the outboard positions from Modules No. 1 and No. 6. There are sufficient areas between these two modules and the crossover taxiways Y and Z for some minor airline facilities.

Fixed Base Operator Areas

For the general aviation fleet, the entire fixed base operations area is located in the northwest corner of the airport, adjacent to the threshold of Runway 8L. Facilities located on the north side of this runway will remain virtually intact during the entire expansion program for the airport. A few of the T-hangars will need to be removed in order to meet the 50:1 approach zone clearance criteria.

On the south side of Runway 8L/26R, however, the fixed base operator facilities will need to be removed in the ultimate plan. When Modules #1 and #2 are completed, it will be necessary to extend future taxiway B through this area in order to provide the necessary clearance for air carrier aircraft. There is an area set aside on the far south side of the airport adjacent to the future Runway 8R/26L for fixed base operators.

Space is provided in the extreme corner of the approach to Runway 8L for one latively large general aviation hangar. This hangar is programmed to replace some of the T-hangars which will be removed for clearance criteria. On the far south side of the airport, a large general aviation apron



EXISTING LEASES
PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

1.	THE GARRETT CORPORATION	– 2.04 AC	– 2-11-72
2.	THE GARRETT CORPORATION	– 32.70 AC	– 12-10-2049
3.	PONDEROSA PAPER PRODUCTS, INC.	– 36.27 AC	– 8-31-2053
4.	CANNON AVIATION	– 11.20 AC	– 8-31-2053
5.	CIVIL AIR PATROL	– 0.06 AC	– 10-30-72
6.	HAWKES AVIONICS, INC.	– 0.32 AC	– 6-30-76
7.	SAGUARO AVIATION, INC.	– 0.41 AC	– 6-30-76
8.	SKY CHEFS, INC.	– 0.09 AC	– M-M
9.	HUGHES AIR WEST AVIONICS	– 0.37 AC	– 6-30-76
10.	VAN DUSEN AIRCRAFT SUPPLIES	– 0.21 AC	– 6-30-76
11.	PHOENIX AVIATION, INC.	– 0.77 AC	– 10-14-77
12.	SKY HARBOR AIR SERVICE, INC.	– 0.77 AC	– 10-14-77
13.	SUN VALLEY AIR SERVICE, INC.	– 0.92 AC	– 6-30-76
14.	ANDERSON AVIATION SALES CO., INC.	– 0.92 AC	– 6-30-76
15.	MERCURY AVIATION CORPORATION	– 0.92 AC	– 6-30-76
16.	CUTTER AVIATION, INC.	– 0.92 AC	– 3-15-77
17.	SUN VALLEY AIR SERVICE, INC.	– 0.44 AC	– Y-Y
18.	ANDERSON AVIATION SALES CO., INC.	– 0.52 AC	– Y-Y
19.	MERCURY AVIATION CORPORATION	– 0.60 AC	– Y-Y
20.	CUTTER AVIATION, INC.	– 0.69 AC	– Y-Y
21.	FEDERAL AVIATION ADMINISTRATION	– 1.81 AC	– 6-30-78
22.	WESTERN HOTELS, INC.	– 1.14 AC	– 12-31-76
23.	AIRPORT PARKING CO. OF TEXAS (APCOA)	– 25.6 AC	– Y-Y
24.	NUCLEAR DYNAMICS, INC.	– 0.64 AC	– 1-4-2012
27.	SKY RIDERS HOTEL, INC.	– 3.59 AC	– 10-30-2006
28.	THE HERTZ CORPORATION	– 2.30 AC	– 12-10-72
29.	VARIOUS AIRLINES	– 2.34 AC	– M-M
30.	WESTERN AIRLINES	– 0.56 AC	– M-M
31.	AMERICAN AIRLINES, INC.	– 0.15 AC	– M-M
32.	TRANSWORLD AIRLINES, INC.	– 0.15 AC	– M-M
33.	RAILWAY EXPRESS AGENCY, INC.	– 0.02 AC	– 12-31-71
34.	EMERY AIR FREIGHT CORP.	– 0.014 AC	– 8-16-73
35.	CONTINENTAL AIRLINES	– 0.019 AC	– M-M
36.	INTERJET GENERAL, INC.	– 0.06 AC	– M-M
37.	FLYNN STEEL BUILDINGS CO.	– 0.25 AC	– M-M
38.	HAYCOR, INC.	– 0.16 AC	– M-M
39.	THRU 43 MONTH TO MONTH RENTALS	– –	– M-M
44.	CITY OF PHOENIX ST. MAINTENANCE DEPT.	– 14.07 AC	– –
45.	CITY OF PHOENIX POLICE DEPT.	– 16.33 AC	– –
46.	U.S.A. (ARIZONA AIR NATIONAL GUARD)	– 50.68 AC	– 6-30-2048
47.	HUGHES AIR WEST	– 13.47 AC	– 6-9-94
48.	HUGHES AIR WEST	– 2.27 AC	– 6-9-94
49.	SKY CHEFS, INC.	– 4.00 AC	– 9-16-89

MASTER PLAN STUDY

QUINTON-BUDLONG

LEASE MAP

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PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

has been designated for major fixed base operator facilities. No T-hangars have been shown on the master plan. However, there is no reason why T-hangars could not be built on the apron area if desired. The airport presently has parking positions for slightly over 600 general aviation aircraft. In the ultimate development, Sky Harbor will continue to have the space for over 600 general aviation aircraft even though some reduction in this number will be necessary in Phase I.

Military Aviation

The Arizona Air National Guard Facility is presently located just south of the existing Runway 8R/26L. This facility consists of two major hangars and a number of support buildings on approximately 50 acres of land. It is anticipated that the future expansion of the airport will give the Air National Guard an opportunity to relocate their facilities to another airport in the Phoenix area. Sky Harbor's master plan has made no provision for relocating the Guard facilities.

Crash/Fire/Rescue Station

The existing crash/fire/rescue site is located west of the existing West Wing terminal building. The master plan makes provision for two permanent sites to be located adjacent to Taxiways Y and Z. During the phased construction stages, it is possible to install an interim crash/fire/rescue station at the point where Sky Harbor Boulevard intersects the existing Taxiway X. This facility will be usable for a substantial time before relocation to a permanent site is required. (This situation is discussed in detail in the construction phasing portion of the report.) Each site on the master plan has been designed in such a manner that it will accommodate up to 10 pieces of equipment, together with associated maintenance and housing facilities for the crews.

Water System

Potable water supply for the airport is provided by and purchased from the City of Phoenix municipal water system. A 54-inch transmission main is located in Air Lane, bordering the north side of the airport. A 12-inch main in 24th Street provides service on the westerly perimeter. A major transmission main is programmed from the Val Vista Treatment Plant by 1975. This line will be installed immediately east of the airport. Nominal service pressure on the airport is 55 p. s. i. Services and repairs for the airport water system are provided by the City and paid for by the Airport.

An adequate and dependable source of water is assured to meet the future expansion requirements of the Master Plan. No change in the current procedures or policy appear warranted.

Construction of additional mains and improvements within the airport can be accomplished in a logical phased program without any disruption of service.

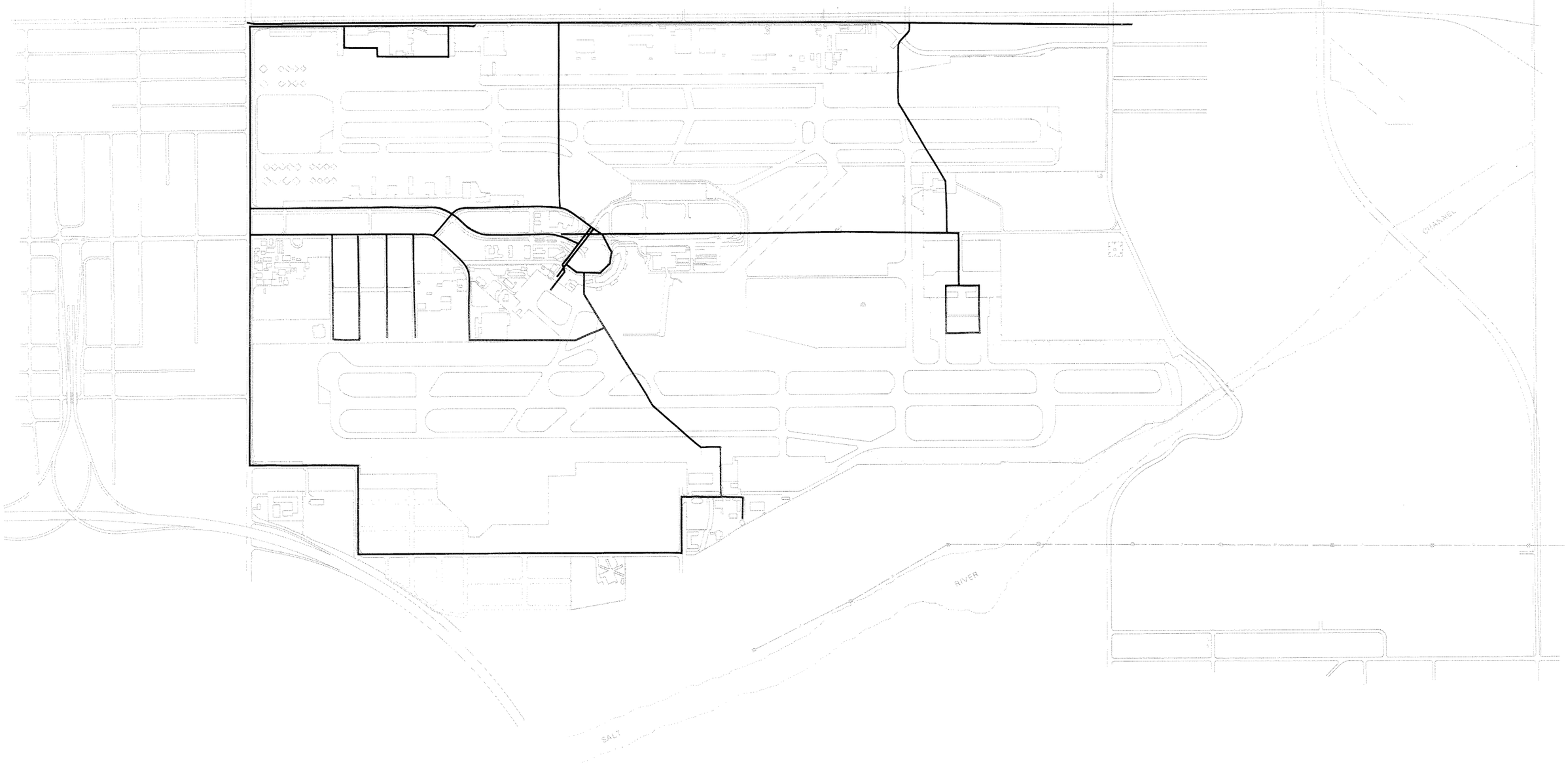
Design of distribution mains within the airport must include provision for fire flows in addition to reasonable service demands. Primary structures, such as the new terminal buildings and large hangars, represent a tremendous capital investment. Fire insurance underwriters are very demanding with respect to the capacity of water supply and fire fighting systems when insuring such structures. Premium rates vary sharply in direct relationship to the level of protection provided.

Fire flows need not be computed for more than one major structure. This demand is not considered excessive when added to the total normal service requirement. With the ability to supply from three sides of the airport, pressure losses can be reduced. Substantial cost savings in new mains may be realized. Other connections could be available only for emergency service during system repairs or fire emergency.

With multiple source connections and several sources of supply for the City water system, it is not expected that a secondary water supply, such as tank storage, will be required on the field. Before detail design of new mains is undertaken, however, this assumption should be verified by consultation with insurance underwriters. If a standby system is deemed necessary or more economical over the long term, comparative systems should be evaluated. Possible designs could include separate storage, pumping and main systems for specific structures (i. e., hangars), storage and pumping into a common fire system for the entire airport, etc.

Anticipated cost of water system improvements has been included in the construction cost estimates of each project, where applicable.

Availability of high capacity fire fighting equipment on the field at crash-rescue stations is of great value. While this equipment is not designed for use on structural fires in buildings, it could and would provide a high level of effectiveness in many instances. The immediate availability of trained personnel is also of immense value.



MASTER PLAN STUDY

QUINTON-BUDLONG

WATER DISTRIBUTION SYSTEM

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Sewer System

The City of Phoenix sanitation system receives airport sewage in a 24-inch main located in Air Lane, northerly of the airport and in a 30-inch main located in 24th Street on the west side of the airport. The system flows west and south, by gravity. The City has a 5.0 M.G.D. discharge agreement into the 69-inch Four Cities Sewer which is located on the southerly side of the airport. A new 24-inch interceptor sewer is under study. This main would serve areas north of the airport and provide a measure of relief to the existing system. An alignment through the westerly side of the airport is one alternative under consideration.

Extension of the existing sewer mains within the airport and continued use of segments of the present system is contemplated. With the complexity of proposed construction, it is possible that some pumping may be required. However, at present, a completely gravity operated system is anticipated. Flow will be divided among all existing mains. A total discharge approaching 4 cfs may be expected for design purposes.

No treatment of sanitary waste on the airport is proposed. Waste from aircraft will be discharged directly into the system at buildings designed to provide this service. In the event international flights are to be serviced, special facilities will be required to meet health standards.

Telephone

Service is provided by Mountain Bell. It is expected that telephone circuits will be installed in the proposed utility tunnel. Individual terminals will receive all telephone, telex and related telephone company services from this common source. Security and maintenance will both be enhanced by such an installation.

Electric Power and Gas

Electric power and gas service are provided by Arizona Public Service Company. Design concepts envision load centers in each terminal complex. High voltage transmission lines would be installed in the service tunnel. The utility will install high voltage facilities and substations. The cost of service from the customer service side of the substation is included in building costs.

Gas service is installed to the customer meter location. From this point, gas lines are included in building costs. Main pressure is presently 27 psi.

Airport Maintenance Center

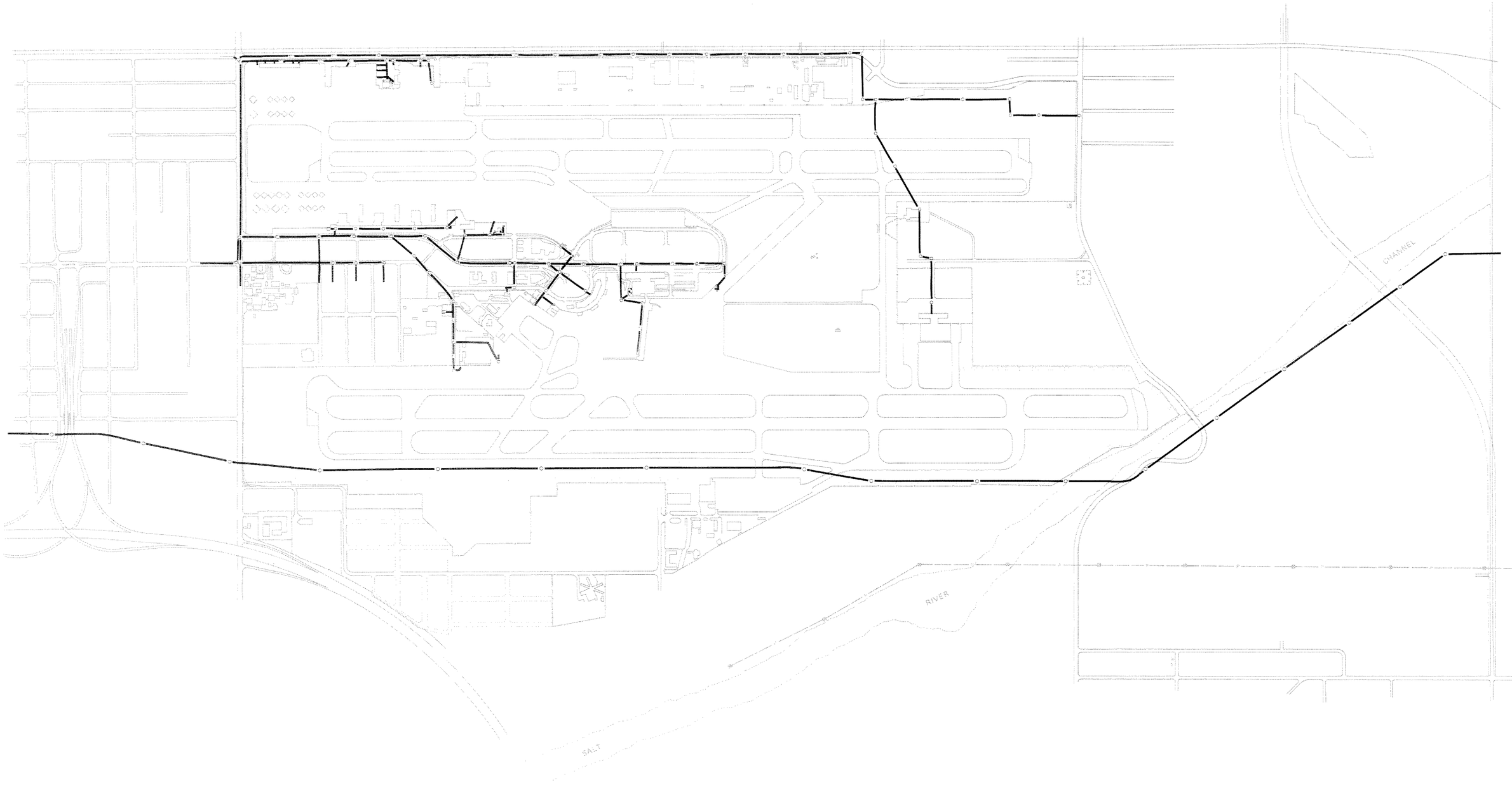
The airport building and field maintenance center is presently located adjacent to 27th Street. The airport master plan makes provision for a large airport maintenance center to be located on the east side of the airport in the vicinity of the future Central Power Plant. This new maintenance center will have a maintenance building, associated storage yard, parking places for maintenance employees, and will also be connected to the airfield system by a small driveway. This will allow the maintenance center personnel to control those vehicles which are permitted on the airfield itself.

Commercial and Industrial Sites

A number of sites have been set aside on the master plan for commercial and industrial uses. Along the north boundary of the airport is the existing Garrett AirResearch manufacturing facility. There is no need foreseen to relocate any of this industrial property. Some additional commercial sites will be available along the access routes into the airport from each end. A few small commercial sites will also be available on the south side of the airport for airport related activities. In the approach zones, it is possible to have some type of commercial or agricultural activity which would be compatible with the approach zone clearance criteria. Any activity which takes place in the approach zone area must recognize the right of aircraft to make noise in that area.

Special Problems

In designing the master plan for the airport, a number of special problem areas have been identified and have been taken into consideration during all future expansion programs. The most obvious of these is the Salt River relocation. Present Corps of Engineers studies have indicated a proposed low flow channel to be constructed south and east of the airport to contain the water released upstream during rainfall times. It is not anticipated, according to the Corps of Engineers, that waters will exceed the boundaries of the low flow channel during normal conditions. Some further relocation of this flow channel may have to be studied by the Corps of Engineers in order to provide sufficient clearance around the far south runway as it has been designed. The best estimates that have been given thus far indicate that the low flow channel will be operational in the mid 1980's. This will coincide with the airport's construction program which indicates a need for expansion into the existing Salt River river bed at about the same time.



MASTER PLAN STUDY

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SEWER SYSTEM

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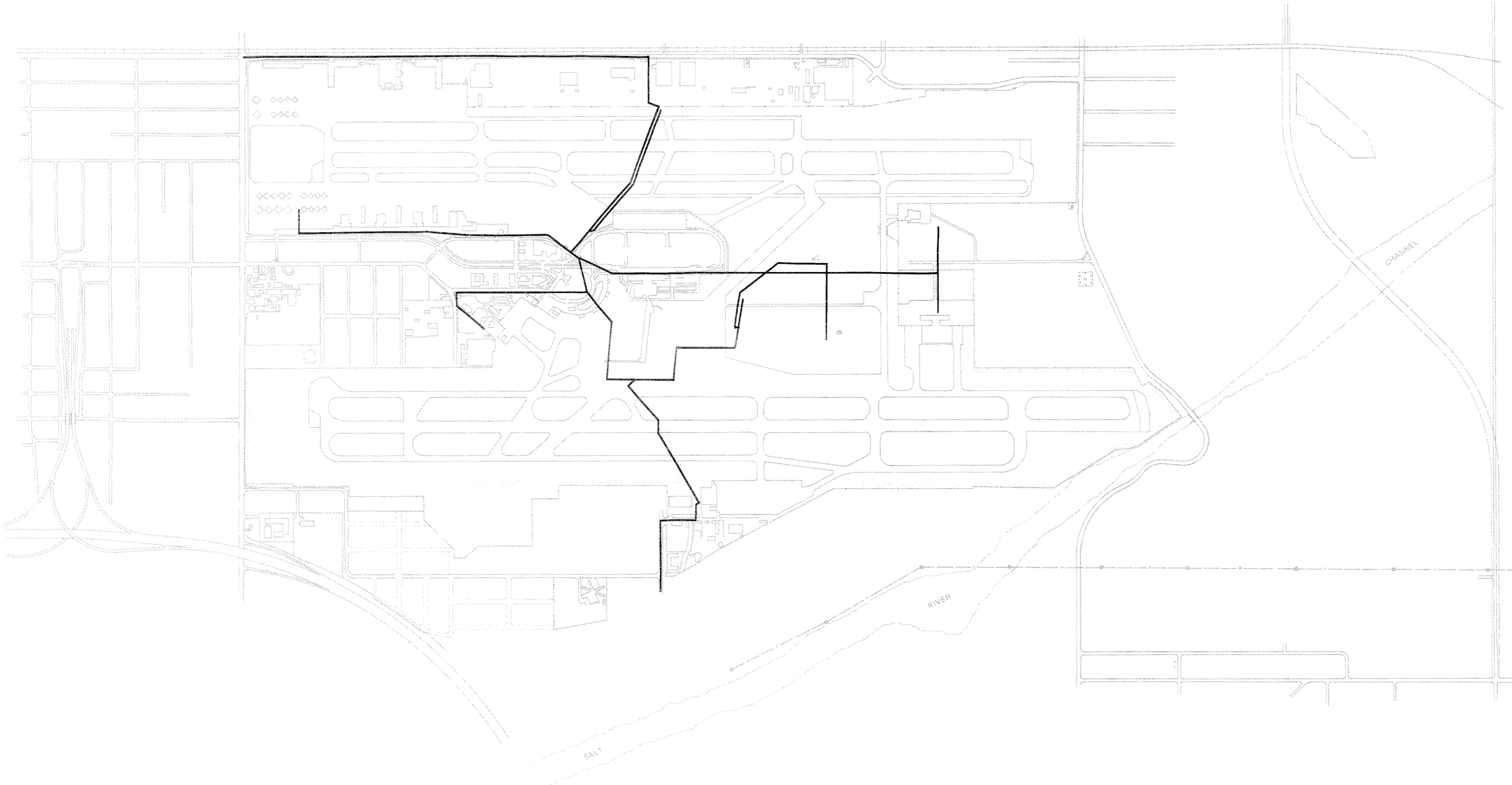

MASTER PLAN STUDY

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TELEPHONE DISTRIBUTION SYSTEM

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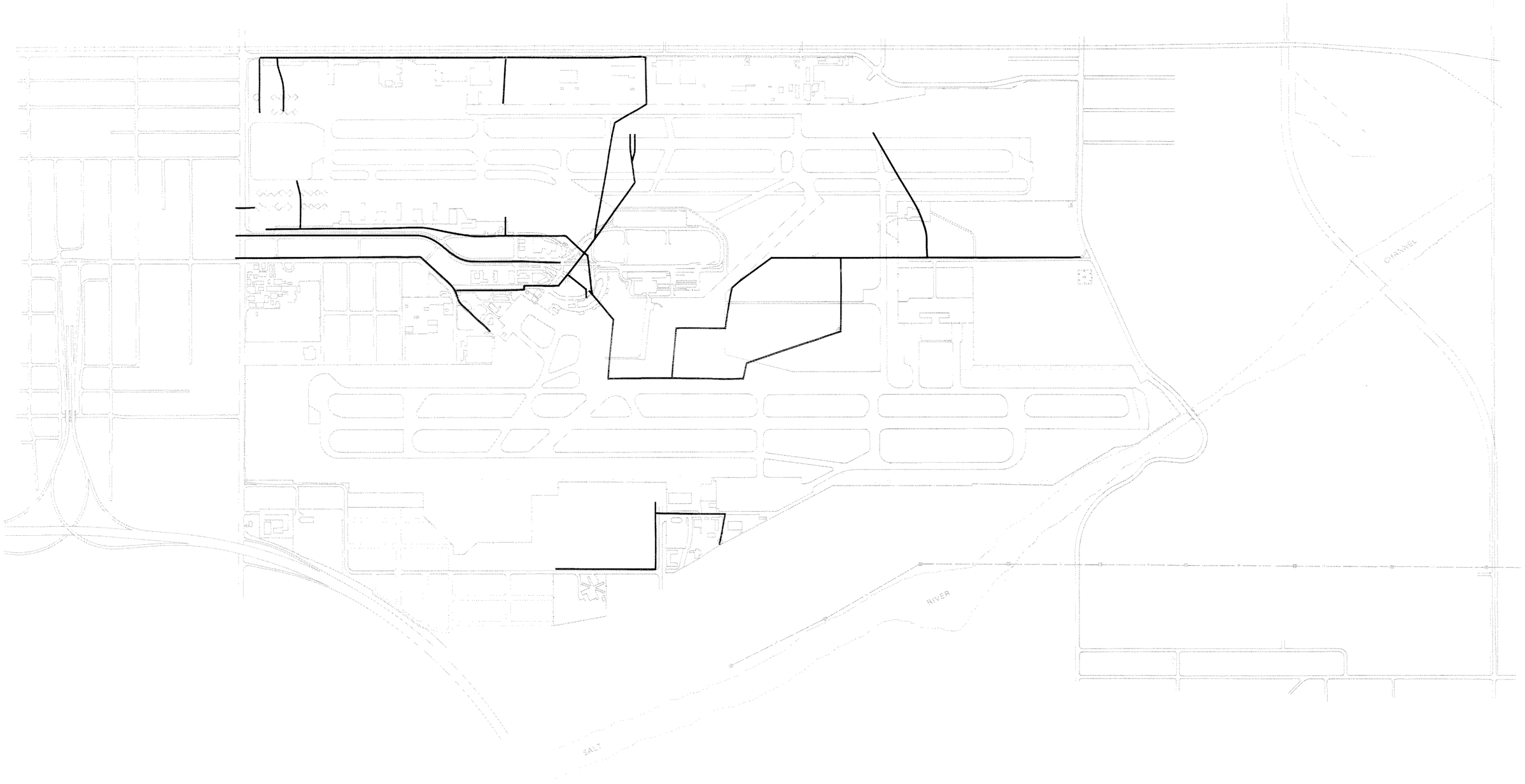

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MASTER PLAN STUDY

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POWER DISTRIBUTION SYSTEM

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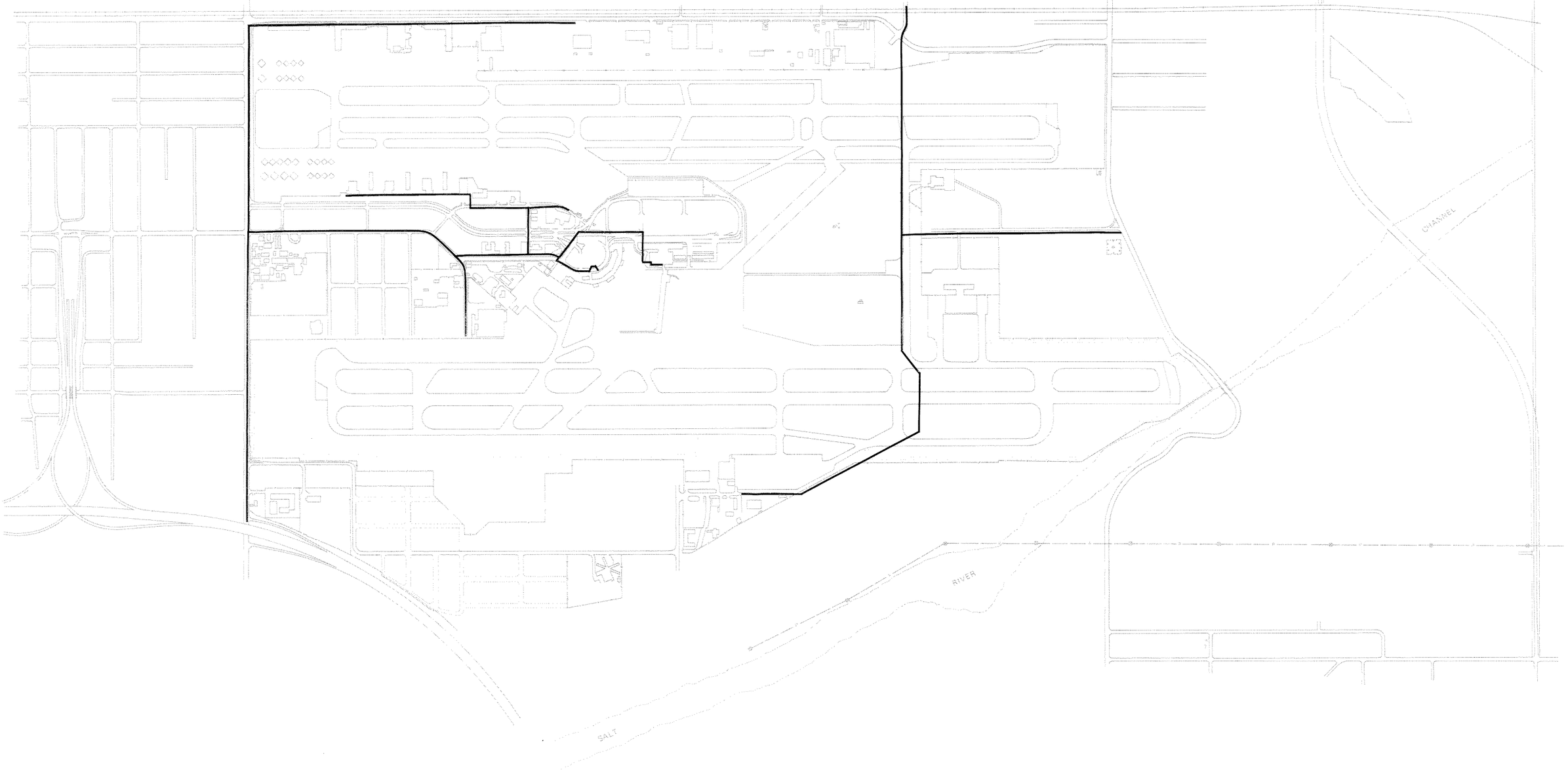

MASTER PLAN STUDY

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GAS DISTRIBUTION SYSTEM

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STORM DRAINAGE SYSTEM

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PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Another problem area which was given consideration in laying out the master plan was the existence of the Park of the Four Waters. This archeological site, located in the approach to Runway 26R has been specifically excluded from any type of airport development.

One particular problem that was encountered in designing the terminal complex was the existence of a 90" storm drainline crossing the airport from north to south. This large line creates some problems in designing the terminal since it affects the depth to which the first level of the terminal can be established. At the present time it is not felt that this storm drain line will have to be modified, although detail engineering studies will have to be made at the time the terminals are being designed.

One additional problem which exists in the Phoenix area is that of dust. All construction programs on the airport should take into consideration the dust problem for the neighborhood and control should be exercised to minimize any type of dust from aircraft or construction operations as has been the practice.

TERMINAL FACILITIES

Throughout the world today there are four basic types of airline terminals. The first basic type is the single sided facility. In this design the terminal building acts as a transition point between the aircraft on one side and the vehicles on the other. The second basic type is the double-sided terminal facility. In this design, aircraft park on both sides of the terminal building and the central core is reserved for limited vehicular activity.

The third basic type of terminal facility is the satellite design. Los Angeles International is an example of multiple satellites being serviced by one or more core buildings. The fourth basic type is the mobile lounge approach to passenger handling. Dulles International is an example of the mobile lounge concept.

Each of these basic types was evaluated for the Phoenix situation. Each terminal concept has its own advantages and disadvantages when applied to the limitations existing at Sky Harbor. It was found that the single sided terminal, such as Phoenix has today, does not lend itself to expansion to the 84 gate requirement. It also provides an imbalance on the aircraft operations to the runways.

The double sided terminal, also known as a linear terminal, eliminates a lot of the problems inherent in the single sided design. The linear terminal also is a better utilization of space when the parallel runways, such as those at Phoenix, are close together.

The satellite concept and the mobile lounge concept also have certain advantages inherent in their design, however, because of a number of other factors these particular concepts were not felt to provide the greatest number of advantages to the Phoenix situation.

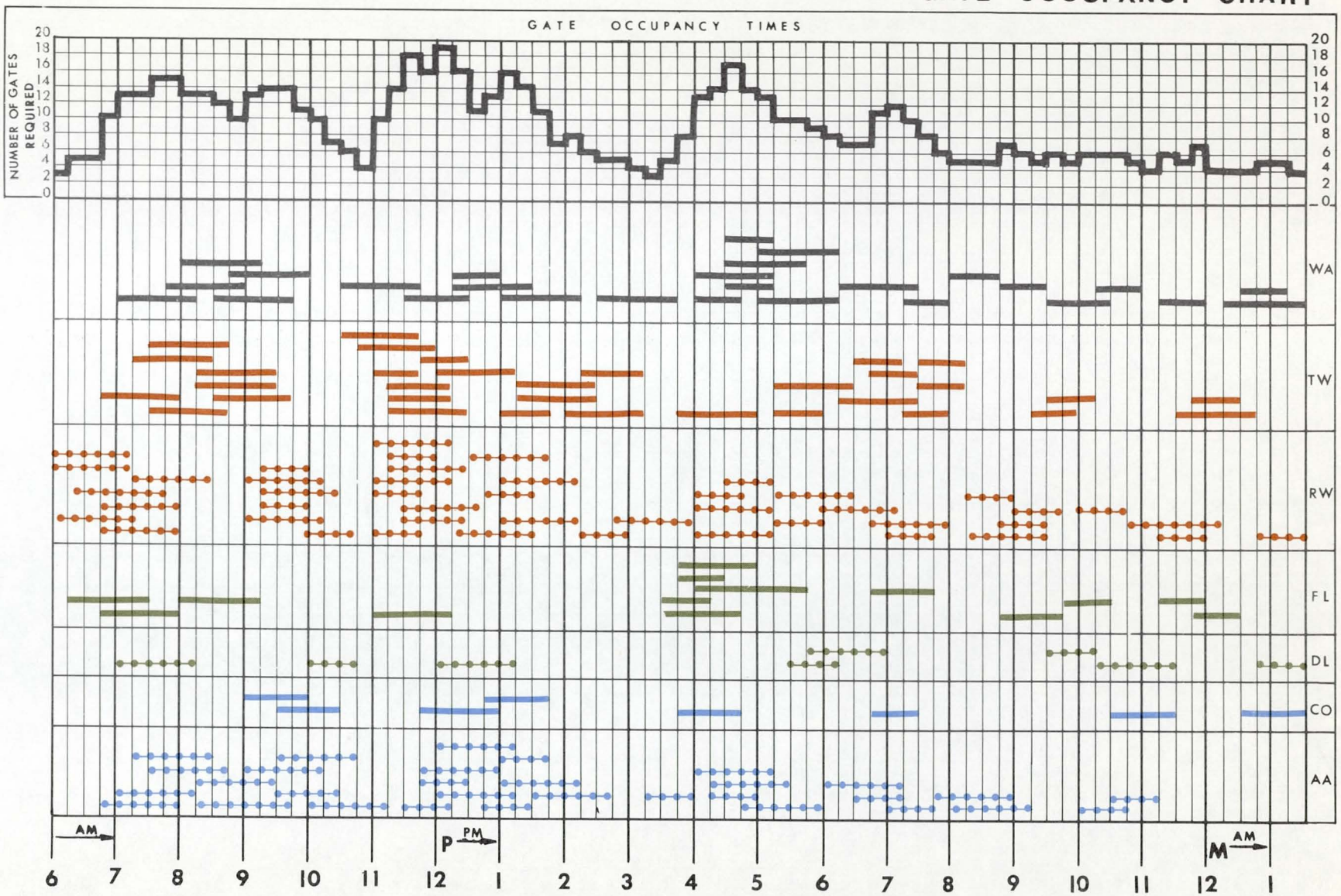
The terminal design which has been adopted for Phoenix Sky Harbor International Airport is the linear design. In adapting this particular design to the Phoenix situation, it was found that six terminal modules would be adequate to meet the projected demands for aircraft and passenger travel. Each of the terminal modules contain three floors - two of which are utilized by the public and the third exclusively by the tenants and concessionaires. Each of the terminal modules have two connecting piers used primarily as holding rooms for the gate positions. One pier would ultimately be used as an international facility. At such time as all six terminal modules are completed, the terminal facility will be able to accomodate up to 100 large bodied aircraft positions around the 12 connecting piers.

It can also be pointed out that the flexibility inherent in the linear design allows the airlines to adapt the piers to various combinations of airline aircraft. For example, if every airline flying into Phoenix were to use the smaller jet equipment such as the DC-9 or Boeing 727, it would be possible to build the terminal piers to accommodate up to 144 of these aircraft. This, naturally, will not be the case, but it does highlight the flexibility which this design offers.

From the passengers point of view there are a number of distinctive advantages to linear concept. Each of the terminal modules alternates with the parking structure, thus keeping walking distances to a minimum for those driving to the airport in their own automobiles. The terminal design provides for seven of these parking structures. The terminal modules and the parking structures are repeating elements in the design and conceivably could be continued even beyond the six modules shown in this master plan. By providing right hand loading and unloading of passengers the safety of operations is enhanced for the traveling public. Automobiles can approach the airport from either the east or the west using the existing and the future freeway networks. By providing a one way loop road system interfacing with the north and south sides of the terminals and garages, drivers can use any side of the terminal, yet be able to return with ease in the direction from which they came. Turn-arounds are provided between each of the modules to facilitate this reverse traffic.

Over 6000 lineal feet of curb space has been provided to facilitate the right hand loading and unloading of passengers. This distance does not include any additional curb space which is available along the face of the garage structures.

GATE OCCUPANCY CHART



MASTER PLAN STUDY

GATE OCCUPANCY TIMES

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For taxis, buses or limousines, there has been designed into the plan sufficient space for these commercial vehicles to park alongside the garage structures from which point they can move to the terminal building on a call-up basis.

Terminal Core Building, First Level. This level of the terminal building, which is depressed 17 feet below the aircraft apron level, is used primarily for airline ticketing and baggage reclaim facilities. In addition, this level would be used for insurance counters, rental car facilities, and some public storage lockers. There is direct passenger access from the roadway to the ticketing counters and from the baggage reclaim areas to the curb side.

This level of the terminal is designed primarily to serve vehicular traffic for the air carrier passengers. This particular feature separates all automobile traffic from the service vehicles and allows the uninterrupted movement of traffic.

An analysis of curb frontage for enplaning passengers reveals that there will be over 500 lineal feet of frontage per terminal - or, for six terminals, 3,000 feet. This results in curb space for 120 autos based upon an estimate of 20 cars per terminal (10 on each side) with each automobile using approximately 25 feet of space. On each side of the terminal there would be curb-side baggage check-in positions.

For the deplaning passengers there is 500 lineal feet of curb frontage per terminal for passengers wanting to load their cars at curb side. This is again based upon an estimate 20 cars per terminal using 25 lineal feet of curb each, for a total of 3000 lineal feet for the entire complex. The curb frontage is based upon a standard of 3 minute curb occupancy time even though it is recognized that some automobiles will exceed this time limit. When calculated on 4 minute overall occupancy time for the automobiles, the total curb space is still adequate.

Inside of the terminal building passengers will find that the simplicity of the design eliminates confusion and congestion. For the enplaning passengers approximately 340 lineal feet of ticket counter has been designed into each terminal module. Linear counters have been shown on the drawings. However, other configurations can also be incorporated into the basic design. Other configurations which have been used successfully by various airlines include the flow-thru ticketing counter and the wrap-around ticketing counters. Behind the ticketing area airline operations space has been provided. This office space is approximately 33 feet deep and extends the full length of the ticket counters thus providing flexibility to the airlines in arranging the areas to meet their various operational methods. Incoming baggage is processed vertically to the second level of the terminal from the ticketing counter. Direct vertical flow of baggage from the curb side is an option which is possible depending upon the desires of the individual airline.

At the other end of the first level is the baggage claim area. In each of the terminal buildings eight baggage claim device positions have been provided (48 total for the entire complex). These eight circular devices provide a total of 3840 lineal feet of display space for arriving baggage. Other configurations can be incorporated into the space that has been provided. Such other methods would include the r ace track device or other belt type moving systems. Baggage flows vertically from the second level directly down to the baggage claim area.

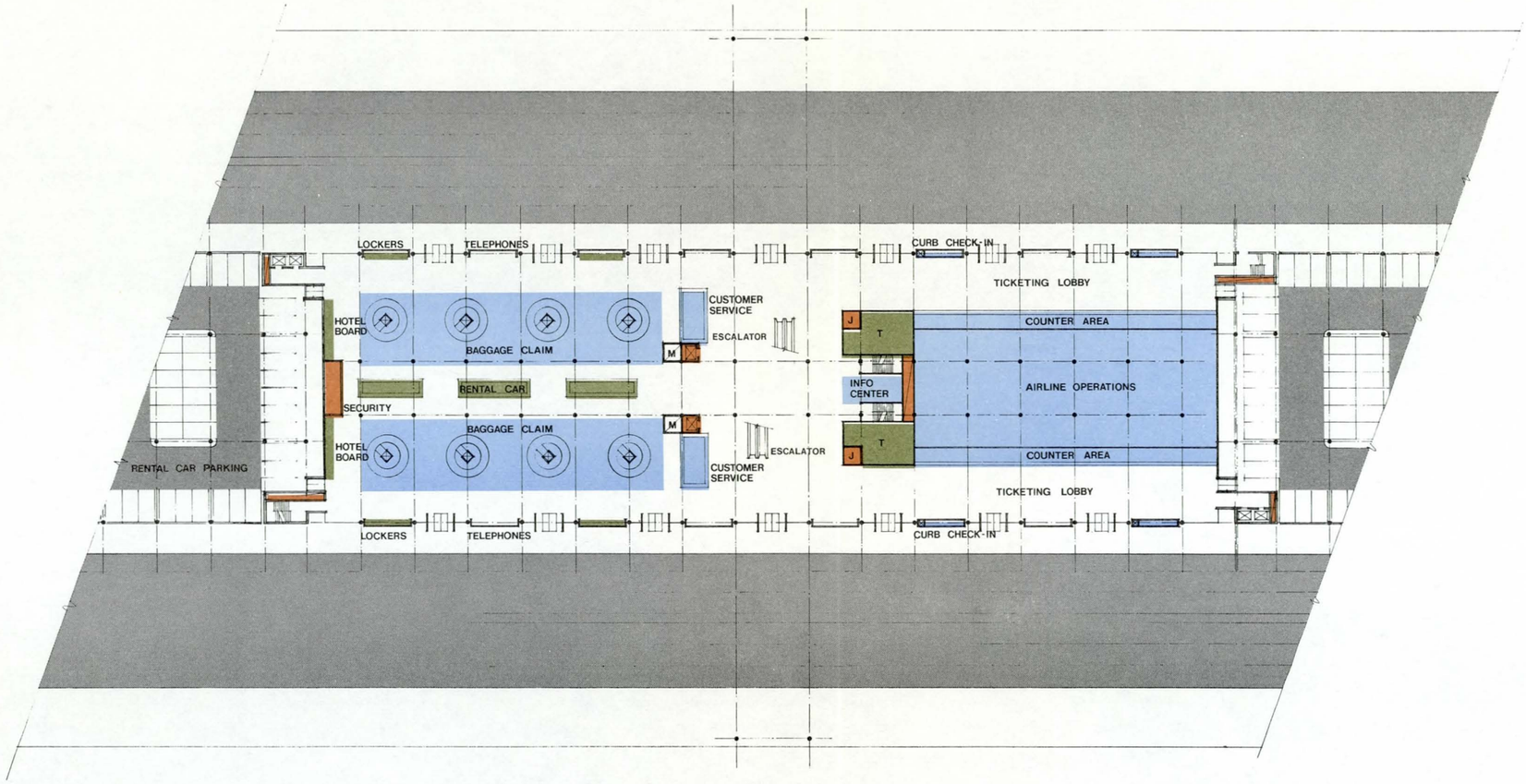
By reducing the number of airport functions taking place in this part of the terminal, security of the baggage claim area can be maintained. By requiring passengers to pass by a security guard, theft of public baggage is reduced to a minimum. The design also allows for direct public access to the customer service functions, such as public storage lockers and the lost and found office. Centrally located within this level of the terminal building is the airline information booth. It is also possible that the insurance counter might be located in this same area of the first level, together with hotel reservations display boards and telephones. The rental car counters also have direct access to the baggage claim area and to the ready car parking lot.

Public telephones and baggage lockers are provided in convenient spaces.

The vertical circulation of passengers by means of an escalator will take place at the central point in the first level and provide direct flow from the ticketing to the concourse level (third level). In addition, two elevators and two stairways are planned in each terminal building. Elevators in the parking structures adjacent to the terminals will give passengers th^ opportunity to travel to any level of the terminal or parking structure.

One additional feature is the view the passengers have from the first level. By having landscaped slopes across the roadway system, an "oasis feeling" is created which lessens the need of seeing aircraft on the apron. These landscaped slopes also are valuable from a standpoint of erosion control and general aesthetic appearance of the buildings.

Terminal Core Building, Second Level. This level of the terminal building, which is located at the apron level of the airport, contains the general service functions for the terminal activity. Inbound and outbound baggage facilities and baggage/cargo transfer areas are among the major activities taking place on this level. In addition, concessionaires can have storage and receiving docks on this level. The second level also contains mechanical space and some airport operations space.



MASTER PLAN STUDY

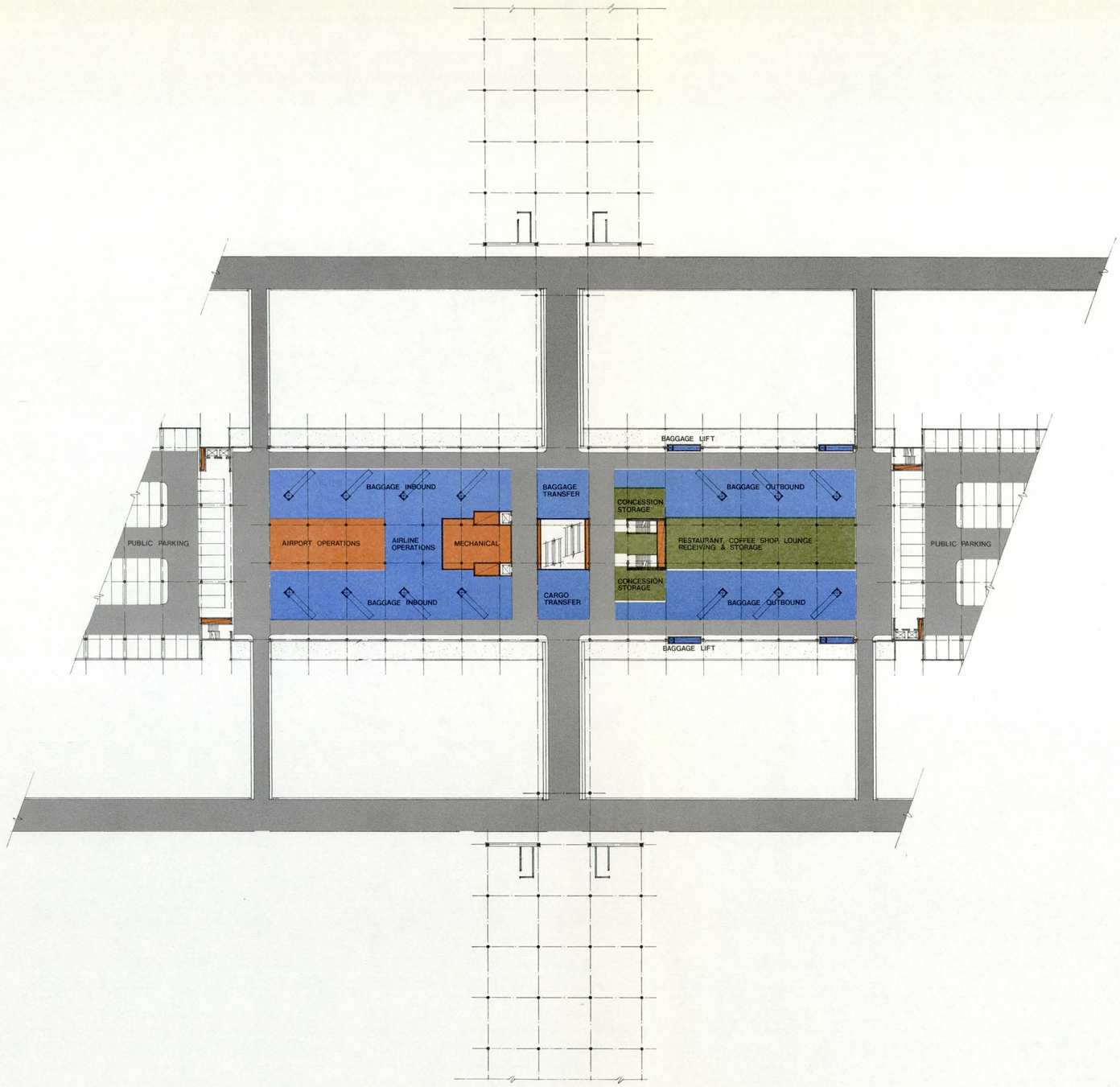
QUINTON-BUDLONG

TERMINAL CORE STREET LEVEL

ALAN M. VOORHEES AND ASSOCIATES, INC.

JOHN CARL WARNECKE & ASSOCIATES

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT



MASTER PLAN STUDY

QUINTON-BUDLONG

TERMINAL CORE RAMP LEVEL

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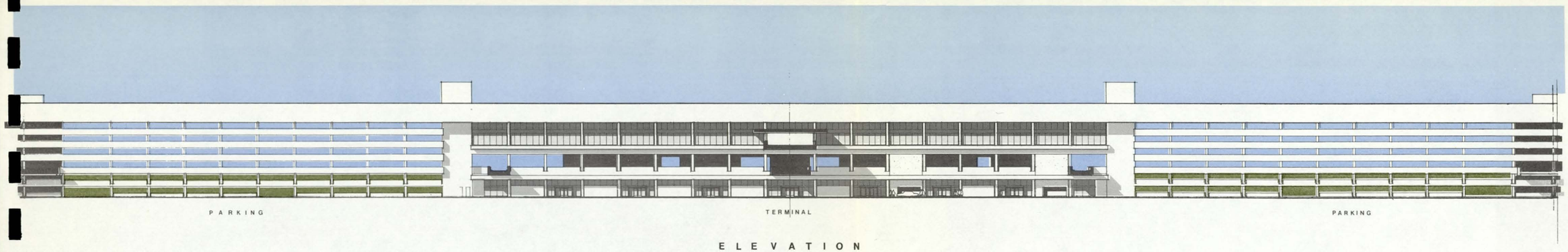
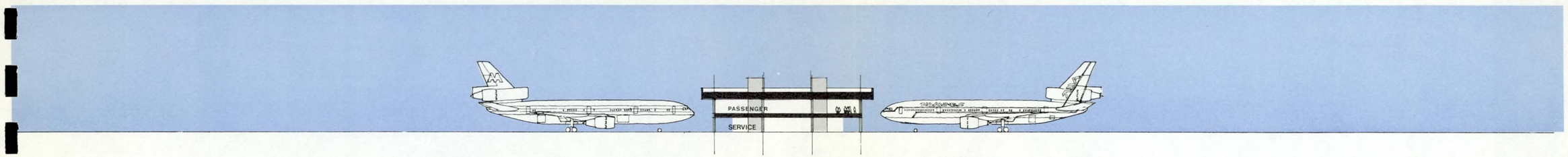
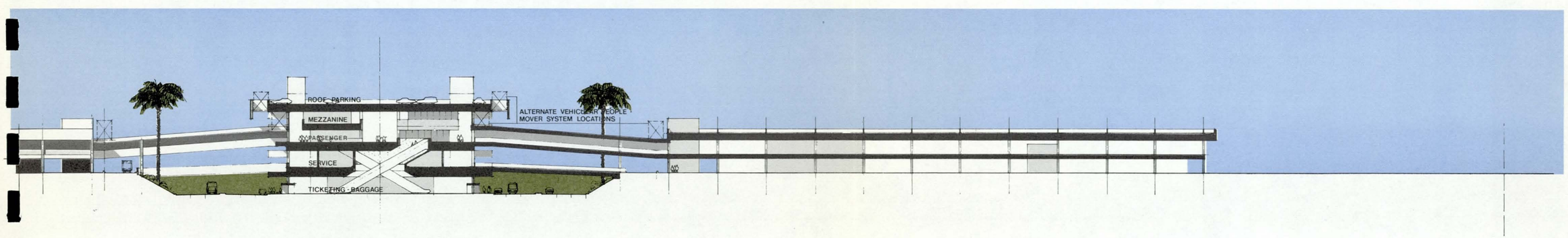


ELEVATION



PIER SECTION



TERMINAL SECTION

MASTER PLAN STUDY

QUINTON-BUDLONG

ELEVATION AND SECTIONS

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The placement of this service level at apron level was one of the specific objectives of this terminal design. This eliminates the up and down ramps that are typical of so many airports for airline baggage vehicles. It also allows for the complete separation of commercial vehicles from the public or passenger vehicles. It also permits the mid-level feed between the ticketing and baggage levels below and the concourse level above. Restaurant receiving and storage areas can be located directly beneath the restaurant area in order to minimize their use of the prime third level space. By keeping most of this floor as an open air activity, it will be more economical to construct since enclosed space is reduced to a minimum. The location of the second level also permits the elimination of crawl spaces and extensive furred areas and reduces conveyor and utility runs. This level can be expanded and modified without extensive excavations and costly operational interruptions to other airport functions.

Terminal Core Building, Third Level. This is the upper level of the passenger core building and contains the main lobby, the concourse level, concessions, airline and administrative offices and general public amenities. The direct flow of passengers to and from the central core circulation area allows maximum exposure to all concessionaires on this third level. The third level provides an excellent view of all airside operations. The concessionaires located on this floor should be visually open and only furniture or fixtures should define the various areas. Some types of concessions which can be included on this level are the restaurant, coffee shop and cocktail lounge. There can also be banking facilities, news stands, sundry or gift shops, flower shops, game rooms and post office facilities. Elevators installed on the third level will allow the public to travel directly from this level to any level in the parking structure or to the first level of the terminal core building.

The installation of a mezzanine level above the third level is an option in the terminal design. This would allow for the expansion of office space and create the possibility of providing the transfer point for an externally installed people mover system.

Concourse Building, First Level. The first level of the concourse building is at the apron level of the airport. Located here are the various service facilities, airline operations, some maintenance space and some equipment and mechanical space. Direct access to all apron activities and services is possible. Open areas beneath the buildings can be used by airline operations, if desired. This level is completely compatible with the second level of the terminal core building since they are adjacent to each other, thus permitting airlines to enjoy a more efficient utilization of personnel and equipment. Enclosed space on this first level will be needed only for offices or security areas. The remainder of this space can be left open.

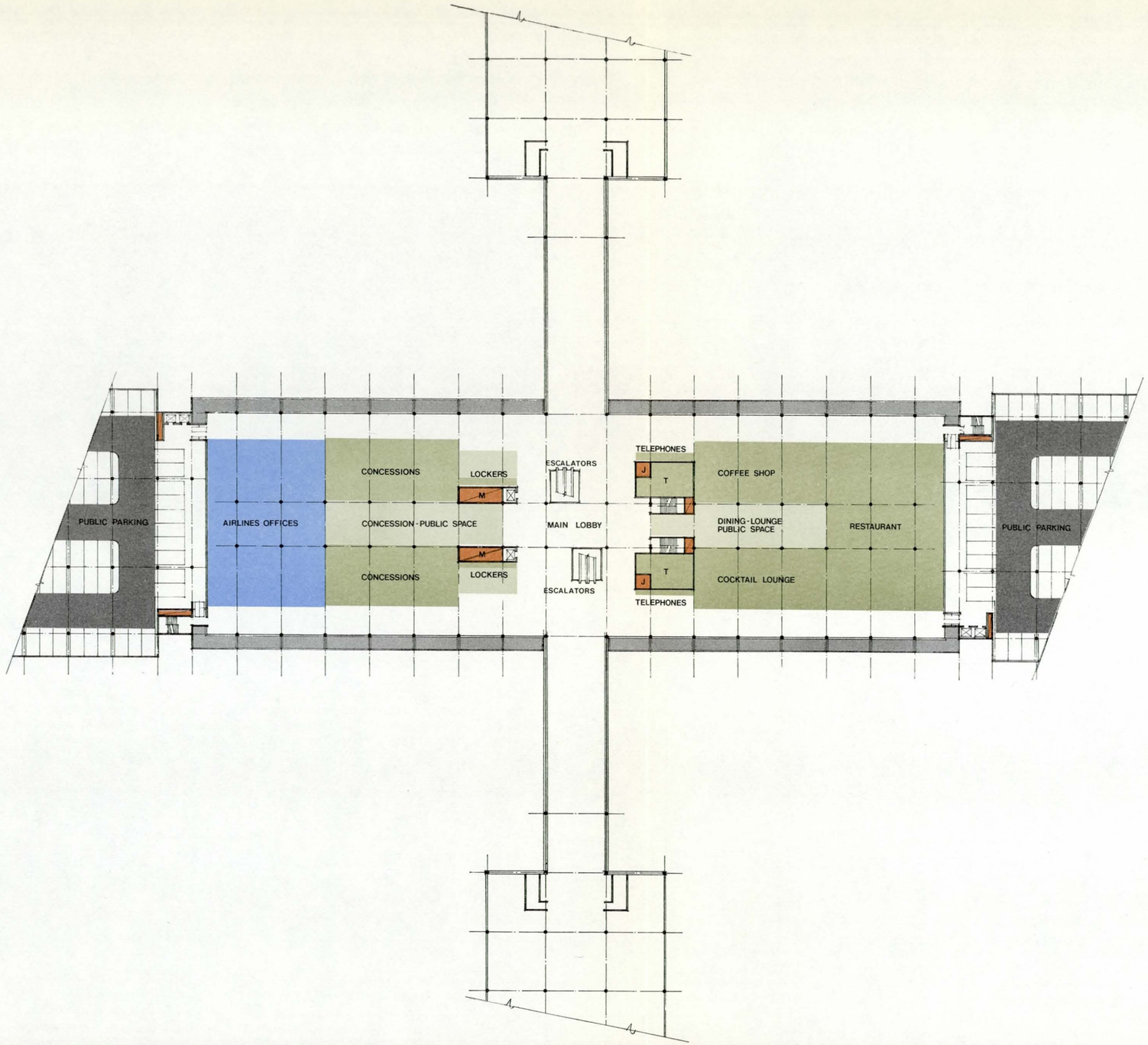
Concourse Building, Second Level. This is the upper level of the concourse building and corresponds to the third level of the terminal core building. Located on this level are the holding rooms, a few concessions and some of the circulations space for the public. This level is located some 15 feet above the apron level. It consists of open holding rooms for airline passengers waiting to board aircraft. It is envisioned at this point that no partitions or railings be installed and that space areas within the concourse be defined by informal seating arrangements, planters, miscellaneous furniture and fixtures. All concourse buildings are designed in a modular manner thus permitting only as much of each building to be constructed as is necessary. This is one of the key items to provision of flexibility and ease of meeting airlines' particular operating needs and future growth patterns. It is anticipated that all aircraft park perpendicular to the terminal build and be serviced by jet loading bridges to facilitate passenger loading and unloading. For those airlines not wishing to install telescoping or extra jet loading bridges it is possible to install stairs and/or escalators to the ground level to permit ground level loading of adjacent aircraft. Wide body aircraft have been assumed for the majority of all aircraft parking positions, but provision has been made for these positions to accept stretched versions of all known aircraft. The holding rooms do not surround the nose of any aircraft. Plane positions and gate locations and type of aircraft can be changed to meet the needs of airlines over the years. This is one of the key items in the modularity and flexibility criteria adopted for the concourse design.

Graphics

A consistent graphics system should be established for all signs and markings to be used throughout the terminal complex. These signs and graphics should be an integral part of the overall design of the terminal. There should also be a common flight information system in order to minimize confusion of passengers. Design standards for all tenant occupied space should be established in order to insure design coordination, continuity and consistency. The concessions in the holding room areas in the concourse buildings should remain visually open. Furniture, seating arrangements, planters and fixtures should be used to define the various areas in this space.

Landscaping

Landscaping has been concentrated on the sloping sides of the passenger roadway system. This landscaping should consist of ground cover, some flowering shrubs and palm trees. This maximizes the impact of the green area and creates a pleasant outdoor vista from the ticketing and baggage levels. The palm trees provide foreground interest for the apron activity. This landscaping minimizes maintenance and should be easily achieved with economical native plants that thrive in the warm, dry climate of Phoenix.



MASTER PLAN STUDY

QUINTON-BUDLONG

TERMINAL CORE
PASSENGER LEVEL

ALAN M. VOORHEES AND ASSOCIATES, INC.

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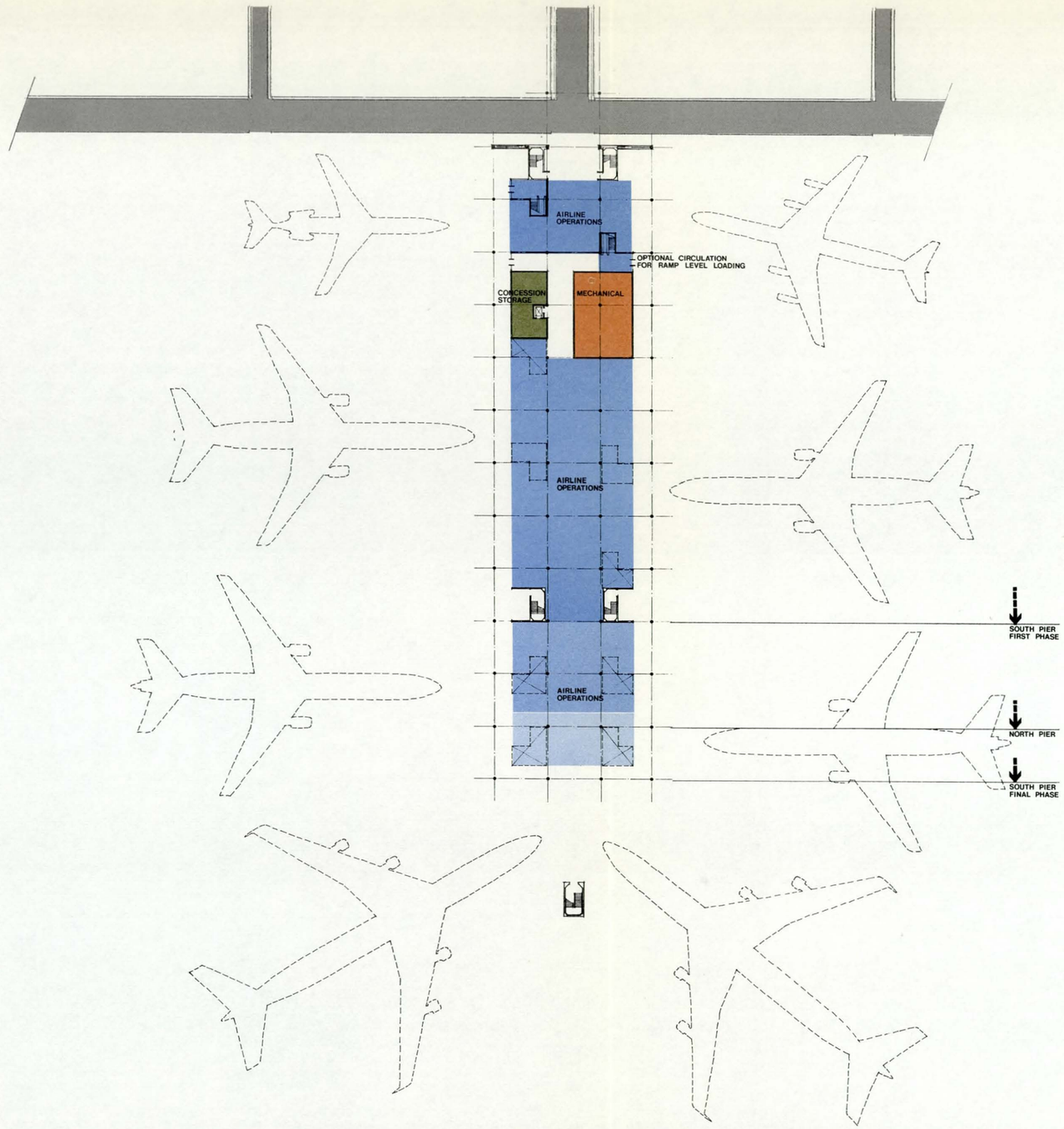


MASTER PLAN STUDY

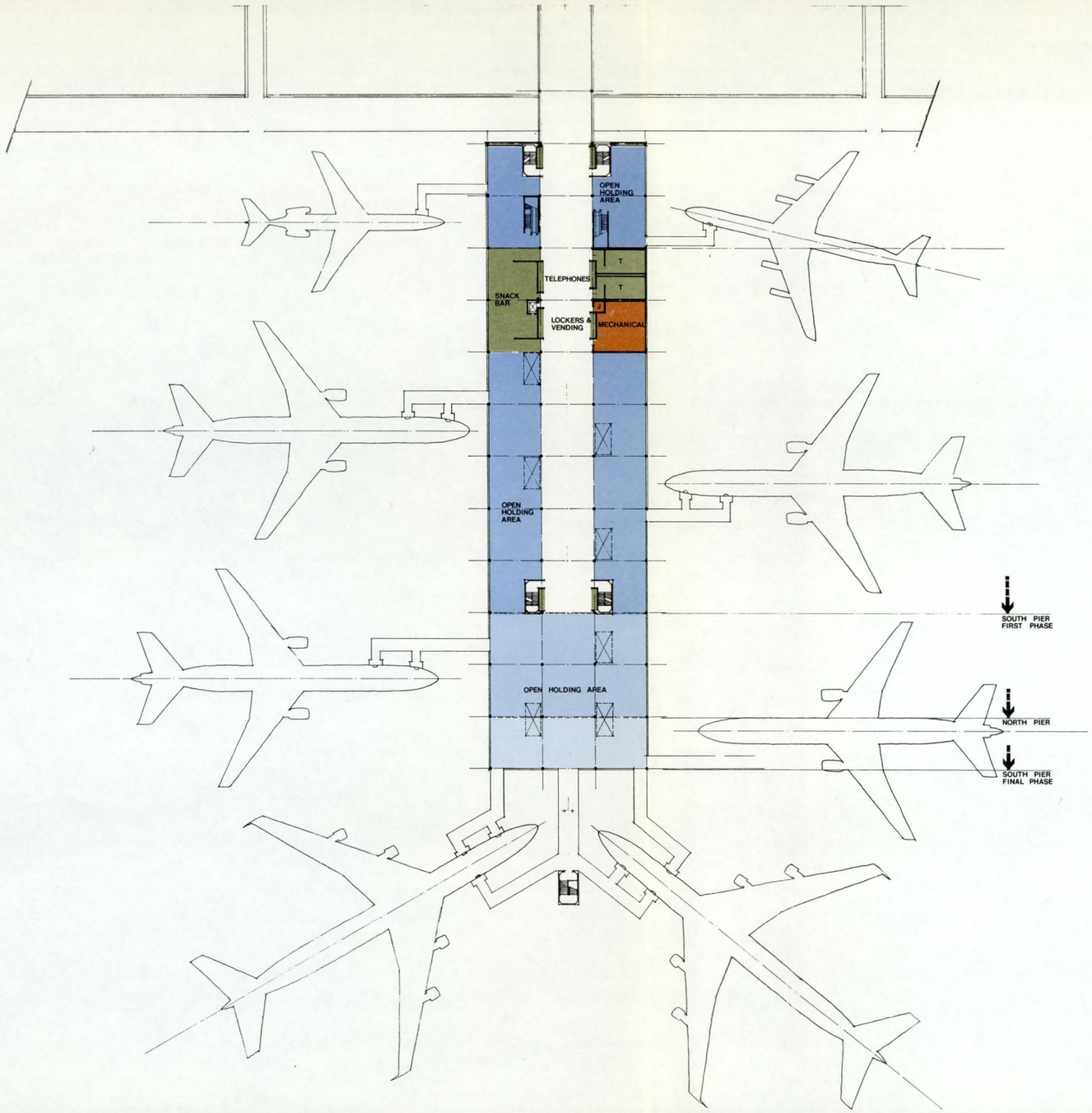
QUINTON·BUDLONG

CONCOURSE BUILDING
RAMP LEVEL

ALAN M. VOORHEES AND ASSOCIATES, INC.

JOHN CARL WARNECKE & ASSOCIATES

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT



MASTER PLAN STUDY

QUINTON-BUDLONG

CONCOURSE BUILDING PASSENGER LEVEL

ALAN M. VOORHEES AND ASSOCIATES, INC.

JOHN CARL WARNECKE & ASSOCIATES

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Piers vs. Pods

Offering the pod as an alternate design to the pier configuration was intended to provide each airline with the maximum choice of gate arrangements, passenger convenience, and flexibility. Either design can grow in regular, orderly increments. The pier offers maximum apron space for a limited choice of aircraft without reducing the number of gates. The pod offers more restricted apron space but virtually unlimited ability to handle any size of aircraft without reducing the number of gates. The alternatives are not mutually exclusive. It is possible for the airport authorities to allow the airlines to build either kind of holding area according to the individual airline's desires. The central linear spine is such a strong design element and establishes such a clear circulation pattern that the development of the satellite structures can be free to vary within the general guidelines of a standard structure.

Construction Techniques

The master plan concept shown on the pages in this report provides for a structural grid system of modular design. This is not meant to be a final recommendation, but is intended to indicate the wisdom of developing a structural system that can be repetitive and responsive to all alternate building functions. The parking structure, the terminal core buildings and concourses/pods are all areas which are subject to modular growth. The development of a standard structural module could lead to cost savings and more flexibility for the space. Adoption of a standard module will permit the use of prefabricated structural construction material and use of these prefabricated units should result in cost savings to the airport because of the reusable nature of the material.

Central Power Plant

The master plan provides for a Central Power Plant to be built just east of the future Module #6. Engineering study will reveal which of the power and utility requirements will be most economically provided through this central location. By purchasing power from the utilities in large quantities it is possible to take advantage of discount rates, thus effecting savings to the airport operation. The location of the Central Power Plant was given careful analysis and the site which has been shown on the master plan is felt to be the most feasible one available. Placing the Central Power Plant to the west of the terminal complex has a number of drawbacks. First, the Modules #1 and #2 will probably be the last ones to be built, thus requiring a longer utility run from the Central Power Plant to the easternmost Module #6 for the longest period of time. Furthermore, the location of the Central Power Plant in this area would necessitate

costly circuitous routing of utility lines through the areas now occupied by lessees and the existing terminal facilities. Sites located north or south of the airport offer no distinct advantage since long utility runs would have to be made before the distribution system would become possible. By placing the Central Power Plant at the east end of the airport, the distribution line is acknowledged to be a long run to Module #3. However, it offers the opportunity to place junction boxes at the location of each of the future terminal modules, thus eliminating the need to modify the system each time a terminal module is built.

Utility Tunnels

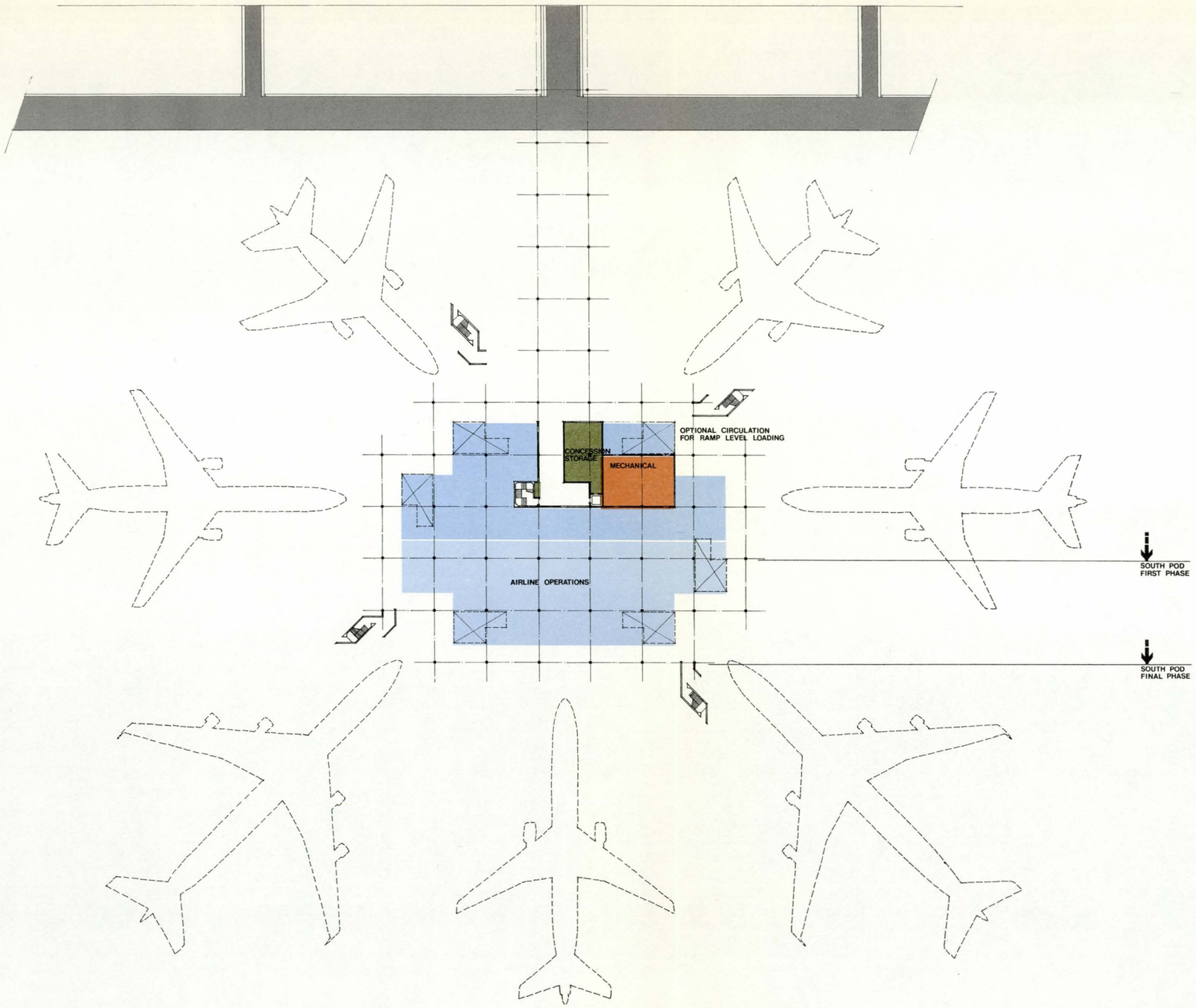
Included within the master plan of the airport is a utility tunnel extending from the Central Power Plant along the spine of the terminal complex from Module #6 to Module #1. The tunnel is programmed to be extended as each terminal module is built, thus maintaining a continuous link with the power plant. The tunnel is presently envisioned as being beneath one of the sidewalks on the lower level; however, detailed architectural studies may find a better location. This tunnel would house the heating and cooling lines to each terminal, as well as power lines, water lines, and telephone and communication lines.

FAA Control Tower

After careful consideration of the potential sites around the airport at which a control tower could be located, it was decided that the most logical location was in the terminal spine. Basic studies indicate that a facility can be developed in a portion of the parking structure adjacent to Module #3. This site will allow the control tower to have the best possible view of all aircraft operating surfaces. When the terminal building and garage structure are completed, FAA personnel can be allocated a few reserved parking places in the garage structure for the government automobiles. This also allows the FAA personnel to have access to the terminal amenities That portion of the control tower which is to be included within the terminal spine would have to be rectangular construction with floor levels designed to be compatible with the future structure which will be built around it. Above the terminal level the standard FAA control tower design can be erected.

Other Facilities

Hotels and Motels. There is one hotel facility presently on the airport land. This is the Sky Riders Hotel occupying some 3.6 acres of land adjacent to Sky Harbor Boulevard. This facility provides a needed service for airport users. The ground lease for this facility expires in 2006.



MASTER PLAN STUDY

QUINTON-BUDLONG

POD
RAMP LEVEL

ALAN M. VOORHEES AND ASSOCIATES, INC.

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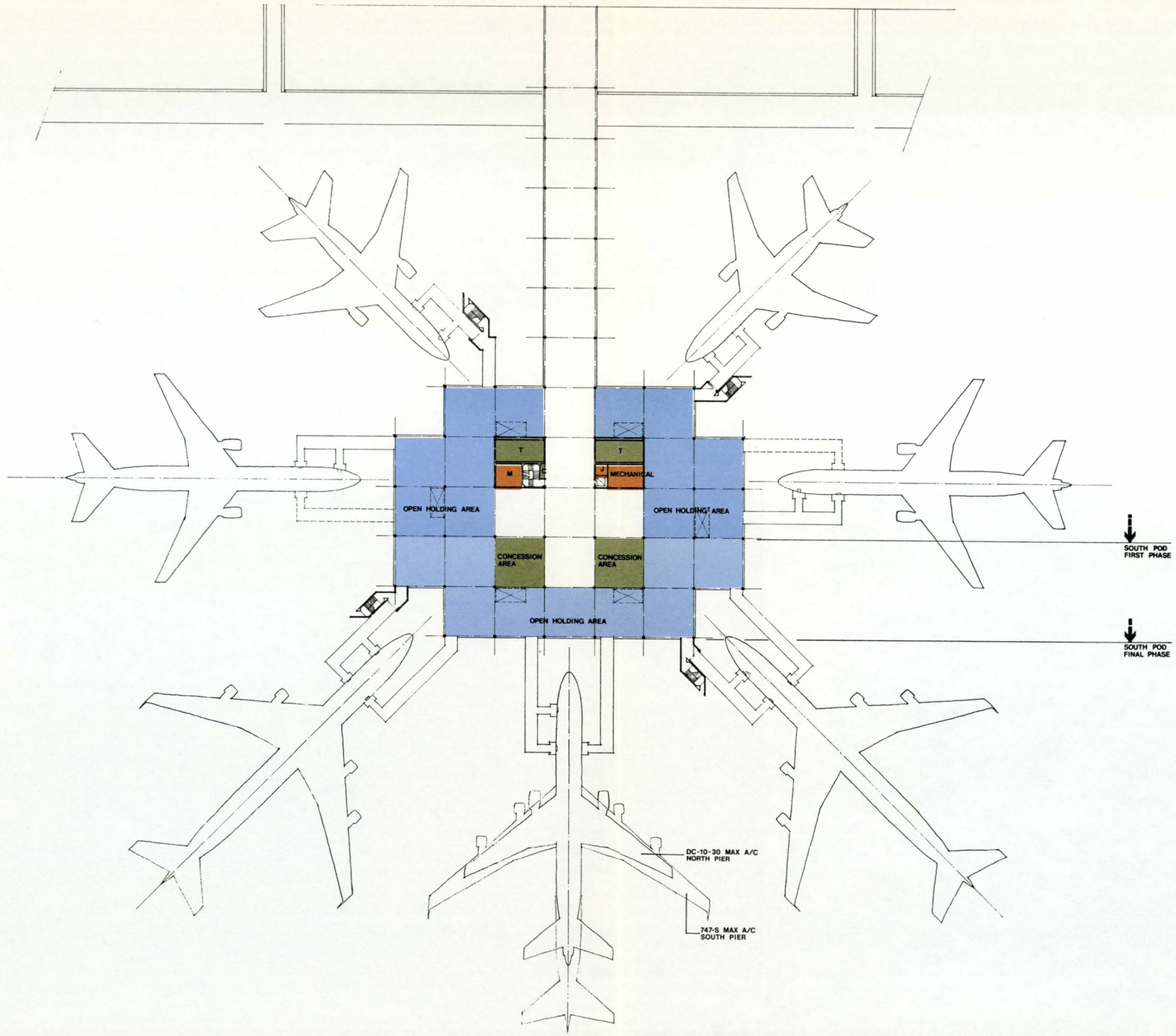

MASTER PLAN STUDY

QUINTON-BUDLONG

POD
PASSENGER LEVEL

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PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Service Station. No public use service stations have been shown on the master plan for the area occupied by the airport itself. The access roads have been designed to enhance the flow of passenger traffic, and locations on these roads would not be desirable for service stations which need exposure to general street traffic. There are a number of potential service station sites available in the land to the west of 24th Street (which will be needed for noise protection or clear zone uses). The desirability of locating a service station in this area will have to be evaluated by the various oil companies.

Recreational Land. The land which is being acquired for clear zone protection and noise areas may lend itself in certain instances to use for recreational purposes. The exact types of recreational activity which would be compatible with aircraft noise should be carefully evaluated by the Parks and Recreation Department.

Commercial Uses. The major commercial user of land at the airport at the present time is the Garrett AirResearch Facility on the north side of the airfield. This manufacturing facility has been maintained on the master plan since no direct aeronautical use is required for that area.

Other aviation related activities include the fixed base operators in the northwest corner of the airport, the airline maintenance facility and the Sky Chef In-flight Meal Packing Kitchen facility located to the east of Taxiway X, the air cargo and airline maintenance facilities located to the west of the existing west wing terminal building, the Arizona Air National Guard facility located on the south side of the airport, and aviation fuel storage areas occupied by the oil suppliers. These have all been discussed elsewhere in this report.

Other commercial uses of airport land include the motel, valet parking facility, public parking lot, car rental agencies, office space, and ground and building space occupied by federal agencies.

In developing the master plan for the airport, all forecasted commercial activity which is aviation oriented has been allocated space on the airport. These commercial activities range from the Garrett AirResearch Facility to the fixed base operators. Space not needed for aviation related activity can be utilized by other commercial operators.

Roads and Parking

An airline passenger - vehicular traffic survey was prepared by the City Traffic Engineering Department and the Airport Master Plan Study Team for Sky Harbor during April of 1971. In this particular research document, the present airline passenger origins were plotted on a Phoenix map and the percentage of origins generated in the various sub-elements of the map were identified. This research showed that over 80% of the passenger originations were within ten miles of the airport, and most of these were in the immediate area to the north of the airport. The three largest single areas generating airport traffic were (1) the airport itself, (2) the north Phoenix area, (3) and the Scottsdale area.

Projections of airline passenger origins were made based upon survey data. In this projection the areas that will generate airline passengers expand to approximately a 15-mile radius from the airport but, again, most of the traffic is generated north and east of the airport. It is projected that there will be some 16 areas in the Phoenix region that will generate over 85% of the airline passenger traffic compared to 14 areas generating an almost equal amount of traffic at the present time. These maps also indicate that the perimeter districts around Phoenix will begin to generate greater percentages of passenger traffic by the time the horizon year has occurred. Some of the areas which show significant gains in passenger generation percentages are the Paradise Valley area, the Scottsdale area, the Tempe and the Mesa areas. Some of the other outlying districts which at the present time are generating less that 2% of the origins will increase their share of the market to over 2% during the intervening years. Those areas which will experience some percentage decline in origins are those districts which are closest to the airport, such as the Central Phoenix area, the central business district, the east Phoenix district, and the airport district.

This study also indicates that when the street and freeway system has been completed in the Phoenix area, some 65% of the Sky Harbor surface traffic will enter the airport from the west and 35% from the east. By the time the saturation year arrives, the passenger forecast indicates that nearly 28 million passengers will be using Sky Harbor annually and will produce around 95,000 daily vehicle two-way trips.

Because of its widely dispersed urban growth patterns, Phoenix has developed into a predominantly auto-oriented community. This is evidenced in the low residential and business density land use. Because of this wide dispersion pattern, the automobile is the only logical means of transportation for a large percentage of the population. Projections of urban growth in

the Phoenix area indicate that this low density land use and expanding urban growth will continue, and the emphasis on automobile travel will not diminish in the future. It appears, then, that the master plan for the airport must continue to make provision for a large number of automobiles to serve the Phoenix community.

In the vicinity of the airport the only completed freeway system is the Maricopa Freeway (Interstate 10) which provides excellent access to the airport from the east and from the northwest part of the community. The southern half of the Squaw Peak Freeway has been completed and the interchange with the Maricopa Freeway allows a large percentage of the public to use these two freeway networks to reach the entrance to Sky Harbor. The completion of the Squaw Peak Freeway to the north will ease the traffic loads on city streets from the north Phoenix and Paradise Valley areas. The completion of the Hohokam Freeway will make travel to the airport easier for people from the Scottsdale, Tempe and Mesa areas as well as some people from the area just to the northeast of the airport. The completion of the Papago Freeway, which is an east-west freeway, will allow greater access to the airport from most of the areas lying to the north of the airport.

The only public transportation system which now provides transportation to the airport is the bus system. Very few riders use this method of reaching the airport, and the studies conducted by the Planning Team indicate that only 0.2% of the passengers use this system. It is possible that a future bus system will provide better service to Sky Harbor since improvements in the system are now being implemented. Even with these improvements the number of passengers using the bus system is not expected to grow materially. Private automobiles, on the other hand, provide almost two-thirds of the passenger's travel method.

Future Mass Transit System. Will the terminal facility as designed here be compatible with any type of future mass transit system? The answer is 'yes' since this is one of the advantages of linear concept as it has been developed for the Phoenix situation. What can be foreseen at this time is that in the near term future any type of mass transit system would be a rubber-tired vehicular system using the street and highway system. The use of a rubber-tired system - let's call them buses - will function in the same manner as the existing public transportation system does today.

Technologically, there are many companies working on ways to solve mass transit vehicle and facility problems throughout the country. These companies are working on ways to reduce the capital and construction costs as well as the operating costs for the various systems under study. All are intended to attract riders in low density areas, such as Phoenix, and to provide structures

of a more aesthetic appearance. Under study by these firms are systems which function above ground, on the surface, and underground. For Phoenix any future system must be adaptable to the highway system or highway right-of-ways since autos will serve Phoenix for a long time to come and the automobile facilities and right-of-way could provide the best corridors for any type of mass transit system.

Since Phoenix is of such low density land use it can be expected that in the future some of these land uses will change. This means that any type of mass transit system that is evolved for the area must be flexible enough to permit routes to be moved as needed. Fixed rail types of mass transit are not flexible. Since a future mass transit system for Phoenix and Sky Harbor is difficult to forecast, the airport must be designed so that it is flexible enough to accommodate any future type of mass transit system. This has been achieved in the design of the facility since there are a number of methods of serving the terminal facilities at the airport.

Access Routes. Upon completion of the freeway system surrounding the airport, access routes into the terminal facility will be second to none. The roadway system which runs parallel to the terminal spine provides a minimum of confusion and circuitous routing for the airport traveller. There is a minimum amount of back-tracking necessary for those passengers wishing to approach the airport from one direction and depart in the other direction. Furthermore, for those passengers who do desire to approach the airport from one direction and return the same way, the provision of turn-arounds at frequent intervals in the terminal spine allows these people to easily return in the direction from whence they came. Yet this parallel road system adjacent to the terminal spine is not so attractive and free-flowing that non-airport traffic would use it for short cuts. The roadway system will provide for future daily and hourly airport volumes of 95,000 and 9,180 two-way trips respectively. These 9,180 peak-hour two-way trips will impose a load on the west access road of only 3,000 hourly one-way trips per direction. This is well within the design limits for the access roads that have been planned. The access routes have been designed in such a manner that they can be phased over the years with the existing system of roadways. Interim routes can easily be developed using some new roadway surfaces and some existing roadway surfaces. This provides a most economical way to accomplish the bi-directional access road system. It will create a minimum amount of disruption to airside, terminal and roadway facilities in use at any point of time.

The circulation of automobiles within the terminal spine and access to the parking structures has been designed in such a manner as to provide total freedom of flow (travel from anywhere to anywhere) within the airport terminal area. Phoenecians will like this since there are no restrictions placed on auto travel within the area.

The plan provides for generous parking within structures along the terminal spine. Seven garage structures have been designed which will accommodate over 21,000 vehicles. It is estimated that some 17,000 long term parking spaces, 3,000 short term spaces and approximately 1,000 rental car spaces will be necessary. The design of these parking structures is such that a reallocation of these parking volumes can be made at any time.

By having a multi-level parking garage instead of a large, open lot, the walking distances into the terminal module are held to a minimum. Furthermore, the use of the parking structure allows the people to walk directly from any floor of the parking structure directly into the adjacent terminal core building and use vertical transportation to the ticketing level or to the third level passenger floor. This can also be accomplished with elevators or other moving belts or sidewalks. The parking structures are designed so that phased construction of more floors than are necessary will not be required. At such time as demand increases, additional floors may be added to any parking garage until it reaches its maximum elevation.

The use of structures vs. surface lots has been taken into consideration in this master plan study. Surface lots can not provide enough spaces near the terminals to accommodate the volume of automobiles that will be anticipated in the future. Furthermore if sufficient land were available to construct these enormous parking lots the walking distances would be extreme for those parking in the more remote areas. Furthermore, structures protect the automobiles from extreme weather conditions and are generally aesthetically pleasing and are more desirable to the public for their automobiles. The use of surface lots, therefore, should be restricted to interim facilities to solve overflow or excess growth situations.

The parking structures are designed in such a manner that valet parking can be provided remotely away from the terminal complex or on the higher floors of the parking structures if desired. This is another flexible feature of the terminal spine scheme. The parking structures are also flexible in that the methods of entering the upper floors provides an option to the traveling public to approach them directly from the outside ramps and enter on the third level, or to use the spiral ramps in the center of the terminal. Short term parking spaces are the first areas that drivers would come to

after leaving the curb space. These are also the closest parking spaces to the ticketing and baggage handling. (In the event short-term space is needed in the future the redesign of the second or third floors can easily be made to accommodate this type of parking usage.) The longer term parkers would drive to the higher floors. This is justified since they have lower traffic turnover and may have more time to drive the somewhat greater distance in the building.

Horizontal walking distances are relatively the same regardless of which floor is used. Therefore, the fees that are charged for parking the automobiles can be equated to the character of the parking. The longer term (and lower cost) parking spaces will be on the upper floors and the short term (and more expensive parking spaces) would be on the lowest floors. The numbers of each type of parking will be determined by experience in the long run. However, estimates have been made in this report of the expected distribution of long-term short-term parking requirements.

The optimization of the parking efficiency will be realized by:

a. The cost/revenue relationship.

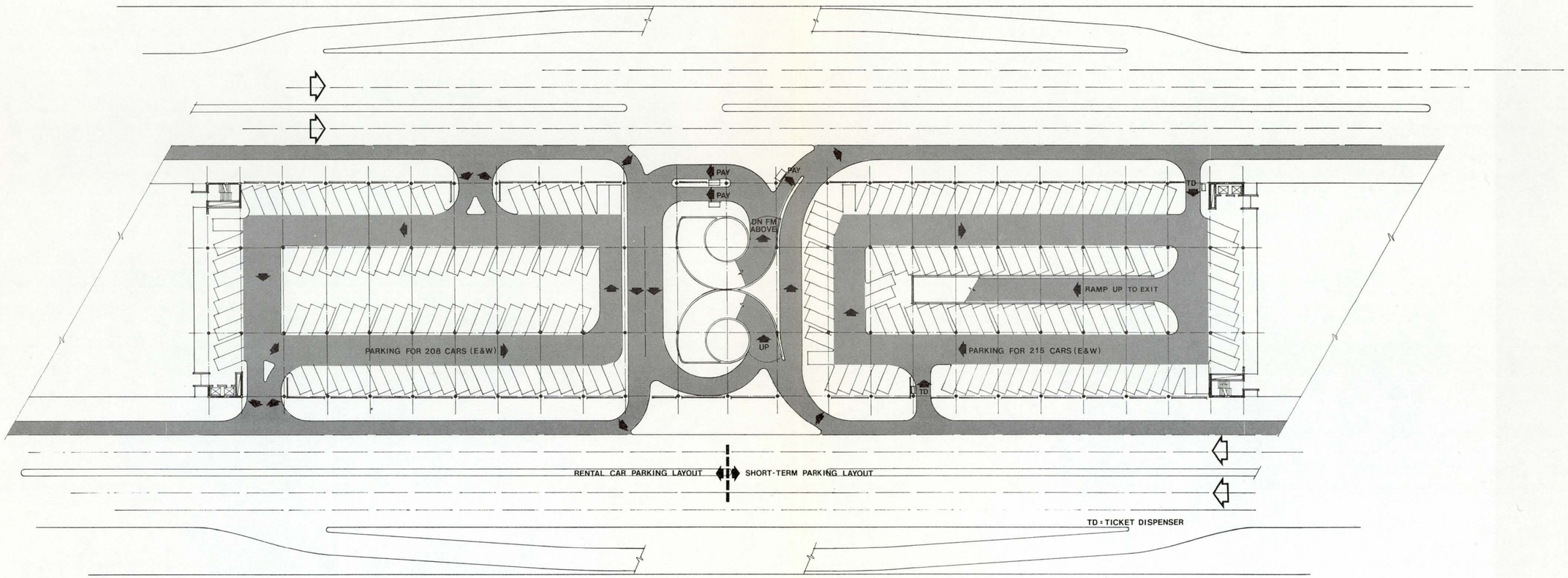
b. By designing the garages with one-way aisles, angle parking, self parking stalls, and express exit ramps.

c. By using "ticket spitters" and cashiers rather than parking meters.

d. By using loop detector counters and "full" signs on each floor so parkers don't circulate looking for non-existent spaces, but can continue on the spiral ramps to the next upper floor.

e. By using color coded tickets and adequate interior informational signs.

Taxis and limousines, by their very nature, must be close to the first level ticketing and baggage reclaim areas. Rental car space also needs to be close to these airline functions. It has been estimated that ultimately 875 spaces will be needed for ready cars and an additional 175 spaces for check-in. Rental car spaces will be given preferential locations over other parking areas since they are a higher generator of revenue. Taxis and limousines can be provided space on the ground floors, or along the curbs adjacent to the parking structures. The flexibility that is inherent in the terminal spine schemes will permit taxi and limousine curb space to be designed with ease. The spine scheme also provides for the free flow feature for taxis, limousines and rental cars just as it does for private automobiles. This allows commercial vehicles to conduct loading and unloading operations along the terminal modules as necessary.



MASTER PLAN STUDY

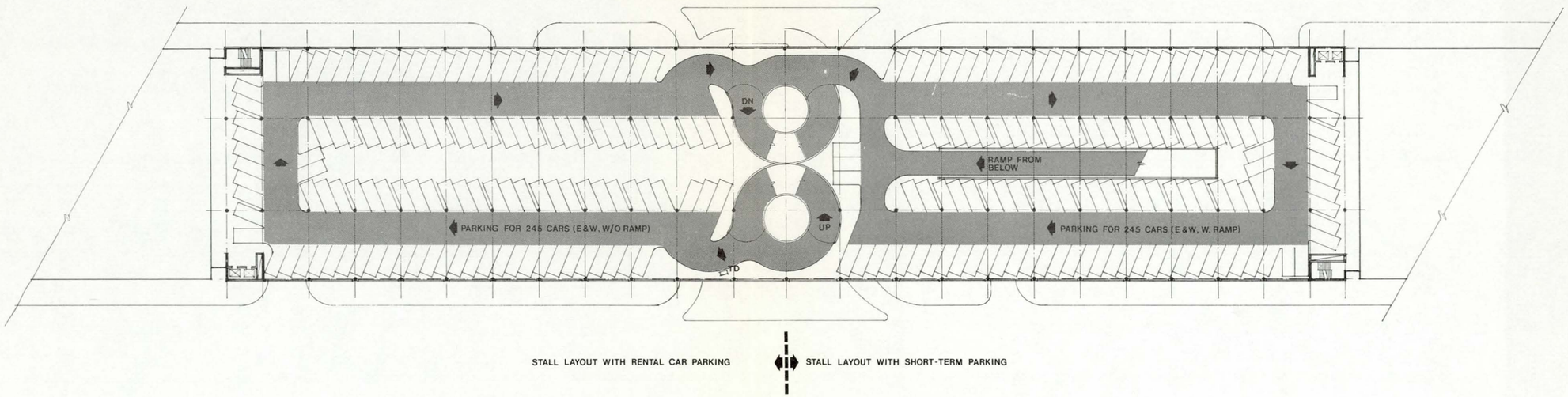
QUINTON-BUDLONG

PARKING STRUCTURE FIRST LEVEL

ALAN M. VOORHEES AND ASSOCIATES, INC.

JOHN CARL WARNECKE & ASSOCIATES

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT



MASTER PLAN STUDY

QUINTON-BUDLONG

PARKING STRUCTURE SECOND LEVEL

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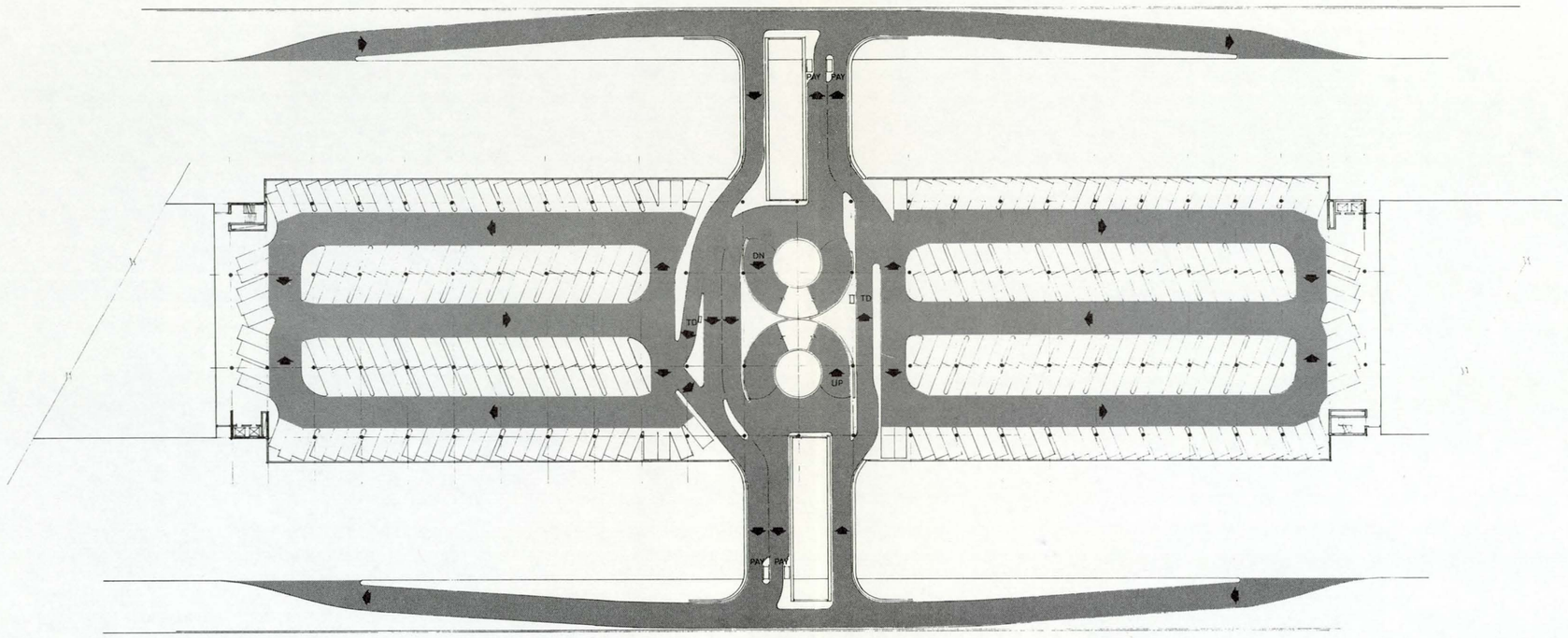
PHOENIX SKY HARBOR INTERNATIONAL AIRPORT



PARKING FOR 308 CARS

MASTER PLAN STUDY

QUINTON-BUDLONG

PARKING STRUCTURE THIRD LEVEL

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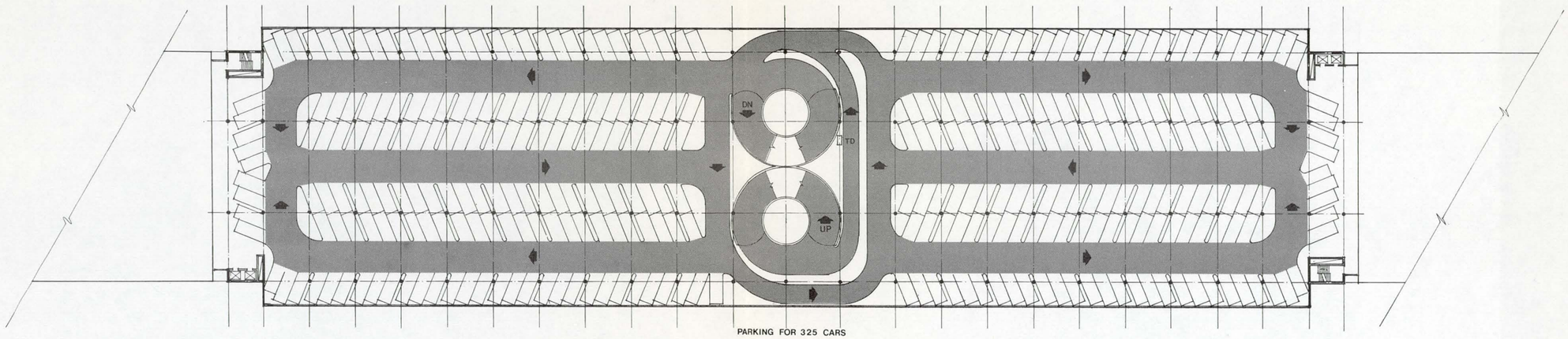
PHOENIX SKY HARBOR INTERNATIONAL AIRPORT



MASTER PLAN STUDY

QUINTON-BUDLONG

PARKING STRUCTURE TYPICAL LEVEL

ALAN M. VOORHEES AND ASSOCIATES, INC.

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PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Pedestrian Considerations. The scheme will eliminate pedestrian conflicts with vehicles by bridging traffic ways and by having right-hand loading and unloading for those arriving by vehicle. Pedestrians will have the shortest possible walking distances because of the compact nature of the entire modular scheme. Elevators and escalators will provide vertical systems to those passengers not wanting to use the stairs. Moving belts, ramps and possibly people movers (or mini buses) will be available for horizontal assistance to the pedestrian. All avenues used by pedestrians should be well marked with signs and floor markings giving instructions or information on routes and destinations.

Public Transportation. Since the spine scheme fulfills so well the free flow concept (from everywhere to everywhere) and since it provides for straight through movements (no U-turns out of direction), it is ideally adaptable to service by a bus system with many routes passing through the airport itself. It is hoped that an improved bus system will be in Phoenix's near future. This free flow aspect also makes it possible for airport limousine and/or buses to serve the airport from any origin, such as a hotel or central business district airport terminal, in the most efficient and economical manner.

With direct access from the freeway system, the scheme is able to accept any transitional phase of mass transit, such as increased use of high speed buses on freeway lanes or exclusive freeway right-of-ways into which the surface bus system for Phoenix may evolve. Mass rapid transit can also be well accommodated. The provision of a ground transportation center at each end of the airport would permit the interface of any form of mass transit, a people mover system, and pedestrian pathways. The center would most logically be located at the west end of the airport, in the initial term between the roadways and possibly underground. With regard to the future mass transit systems now in various stages of study and development throughout the world, Phoenix will be able to choose from any number of systems, all of which will be compatible with the airport. People mover systems are evolving into the smaller trains, vehicles, capsules or belts. Mass rapid transit hardware is under intensive study and experimentation in order to improve on existing fixed rail or guide beam equipment, whether it be above ground, on the surface, or underground in a tunnel or tube. Much work is being done on trying to solve monorail switching problems. Much work is being done using a combination of an air cushion vehicle for a smooth ride on an exclusive guideway and a linear induction motor to propel it. Other experiments are being conducted on various forms of tube trains underground with numerous types of propulsion.

Special Considerations

The use of automated equipment is possible in the terminal configuration. Such equipment could include special devices to handle baggage, moving it from either the parking structure or the curb side area directly to the second floor for processing by the airlines. Furthermore, the garage structures permit electronic credit cards or computerized parking fee collection to be handled at central points.

Baggage handling for passengers is one of the real restraints in the total transportation picture. It limits the use of mass transit because of the clumsy nature of handling baggage on vehicles which are primarily designed for people. It forces many passengers to drive to the curb side of the terminal to unload baggage before proceeding directly to a parking space. This new terminal design provides an unusually high amount of curb space and is adaptable to any type of future baggage handling developments by utilizing the space that is open at the second level of the terminal. It can be seen, therefore, that baggage handling problems, which will always be a constraint on passenger travel, have been minimized in the scheme developed for Phoenix.

The installation of signs to guide drivers is particularly easy since they can be installed on the various overhead ramps. From the standpoint of airport design, the long linear nature of the terminal minimizes confusion and avoids congestion around a single terminal. Because the route to and from the various terminal modules is not complicated, the installation of signs will insure the smooth flow of traffic in the airport.

Pedestrian walkways can be provided within the terminal to give access from any point of terminal to almost any other point. Walking is still the preferred mode for some people, particularly those not in a hurry. On the ground levels, sidewalks are shaded by cantilever awnings which protect the passengers from the weather. It is also possible to install high level promenades along the top of the terminal facility which would provide a spectacular view of the Phoenix area as well as the entire airside activity. Pedestrian walkways are separated from vehicular routes, thus avoiding conflicts and increasing the safety aspects of the terminal.

The last special consideration that is necessary is the circulation patterns that are used by non-passenger vehicles. These include service vehicles, food supply vehicles, cargo, refuse collection, and general delivery trucks and baggage carts. All of these will use the special roadway at apron level and will have access to the service level of the terminal. None of this commercial or airline traffic will need to mix with the general public traffic on the lower level.

III

CHAPTER III

PHASING

In the Recommended Plan Report submitted on October 25, 1971, a preliminary phasing schedule was included which gave a broad-brush treatment to the implementation of the construction schedule for the terminal modules. In developing that preliminary phasing schedule, the time periods which were utilized generally ran in five-year increments. Since then, a more detailed analysis has been given to the phasing of construction for the airport. The time periods now utilized in the

phasing vary from four years to fifteen years, depending upon the forecasted demands that will be placed upon the facility as a whole. At the present time the phasing of airport construction has been broken down into the following time increments:

Phase	Fiscal Years
Ia	1972/73 - 1975/76
Ib	1976/77 - 1983/84
II	1984/85 - 1991/92
IIIa	1992/93 - 1995/96
IIIb	1996/97 - 2005/06
IV	2006/07 - 2015/16
V	Beyond 2015/16

Each of these phases has been structured around the addition of a terminal module or concourse to the overall complex. It is recognized that the dates established for each of these phases are subject to revision in the future as circumstances might dictate. The addition of each module to the terminal should be based upon the demand which has developed and should not be programmed merely to conform to a present time schedule.

The two busiest phases of the entire construction program are Phase Ia and Phase II. In Phase Ia the entire airport is subject to bringing the runway and taxiway network into conformity with the overall master plan program. It brings the raodway and freeway access route network into conformity with the future alignments of the terminal complex. This, naturally, results in a heavy construction program to remove those facilities which are no longer needed or will be in the way of scheduled construction, as well as adding to the airport the first phase facilities of the development program. In Phase II, most of the activity centers around the addition and reconstruction of the runway and taxiway networks. In Phase II the new runways 8C/26C and 8R/26L are scheduled to be added to the airport complex, together with the conversion of the existing 8R/26L into a parallel taxiway. Other phases of the airport program will tend to center around the addition of terminal modules to the overall complex.

Phase Ia - 1972/73 - 1975/76

In this report we are going to treat this phase of the airport construction in the same broad manner as all phases. A detailed report has been prepared which gives greater detail for Phase Ia. This marks the beginning of a long-term redevelopment program for the airport. New facilities are needed, and many older facilities are excess to the needs of the airport. Some roads and parking lots need to be realigned to bring them into conformity with the master plan. Some interim facilities will need to built to insure continuity of the activity - both of the public and of the aircraft. Most of the interim facilities will remain in service over a reasonably long period of time - long enough to amortize their cost. In the following sections a brief description of each work element is given, some requiring explanation, others needing little or no explanation. The various elements are given, insofar as is practicable, in the chronological sequence that they should occur. Variations from this sequence may be desirable as time goes on, but to begin the planning process some sequential listing is necessary.

1) Buy Land. Three tracts have been identified which need to be added to the airport. The first is the land adjacent to the Wilson School area. The second tract is the land on the south side of the field, north of Watkins Road. The third tract is in the approach to Runway 26R.

2) Extend East Sky Harbor Blvd. to Hohokam Freeway. On the east side of the airport, there is a small section of Sky Harbor Blvd. which is to serve as an interim roadway. This roadway connects the new passenger terminal with the Hohokam Freeway at a 'T' intersection. Until such time as the freeway interchange is constructed, this 'T' intersection will adequately handle the traffic. This element of work begins at the new bridges under Taxiway X, extends to the Hohokam Freeway and includes one fly-over bridge.

3) Build service road. This is the airport service road and is intended for use by authorized vehicles only; it is not a public road. This road, protected by gates where necessary, begins in the vicinity of the Sky Harbor Blvd. connection to the Hohokam Freeway, extends parallel to and west of the Hohokam Freeway until reaching the satellite Fuel Storage Area, whence it turns westward and parallels the new Taxiway A until connecting to the aircraft apron on the northwest corner of the field.

4) Establish fuel storage area, north side of airport. This is the satellite fuel area mentioned in 13) above. This 12-acre area is located adjacent to the Southern Pacific Railroad right-of-way. Fuel from the bulk storage plant on 51st Avenue can be shipped by rail, by pipeline or by truck on Airlane. A seven-day supply of fuel should be sufficient to handle normal aircraft requirements, and this amount of fuel can be adequately accommodated in the 12 acres provided. A seven-day supply will amount to approximately 160,000 gallons in 1975, increasing reasonably uniformly to 300,000 gallons by 2000.

5) Construct interim fuel dispensing station. In the area adjacent to Taxiway X, south of the Sky Chef kitchen facilities, is an area that will not be needed for twenty years. The location of the satellite fuel storage area is on the north boundary of the airport, near 44th Street. It is suggested that a pipeline be constructed from the satellite fuel area to this interim fuel dispensing station. In the future, when this facility is removed, the pipeline can be used to connect to the in-pavement fuel hydrant system that is recommended for installation around the terminal concourses.

It is recommended that this fuel dispensing station be available for all aircraft refueling trucks so that they will not have to use the city streets carrying aviation fuel from the bulk storage plant near 16th Street.

6) Close 40th Street, vicinity of Runway 8L/26R. The only expense involved here is the removal of the pavement so that the runway extension can be accommodated. The service road constructed in 3) above may be used to route traffic around the end of the runway extension until such time as the Hohokam Freeway is opened for traffic.

7) Build underpasses beneath Taxiway X. As mentioned earlier, the depressed roadway adjacent to the terminal module and its parking structure is some 17 feet below apron level. This provides an excellent configuration to allow the roadway to pass beneath the aircraft taxiway. These two bridges will be three lanes wide each and will probably remain in service into the 1990's. This should be sufficient time to amortize their cost.

8) Extend Runway 8L/26R to 11,500 feet. This will bring this runway up to its ultimate length. The present 8,750 feet has been strengthened to meet 747 standards, and the new extension should also be built to the stronger pavement requirements. The extension is scheduled to be 200 feet wide, with the runway lights set in to match the alignment of the lights on the 150 foot wide pavement. In a later expansion program the widening of the original 8,750 feet to the full width of 200 feet is scheduled. In the event that construction of this pavement to the initial width of 200 feet is not eligible for federal fund participation, then it should be constructed to 150 feet to match the existing width, and later widened to 200 feet. However, we recommend that the extension of the runway also include the construction to the 200 foot width, thus saving the expense and trouble of widening the pavement at a later time. This recommendation recognizes the minor trouble of resetting the lights in the future.

9) Build portion of Taxiway B. This is the taxiway connecting to the new extension of 8L/26R. This taxiway should be built to its ultimate width of 100 feet and located 600 feet center-to-center from the runway centerline. This will require a small jog in the pavement where it joins the existing parallel taxiway. In the future, when the ultimate extension of Taxiway B is completed, this jog will be removed and the entire length of Taxiway B will be 600 feet from the runway. In this phase of construction, however, there is no need to relocate the entire taxiway to the 600 foot clearance.

It is worth noting here that the west end of Taxiway B is to remain as is. It is recognized that the clearance from the runway is non-standard for 747 operations, and a waiver of the clearance will be necessary until such time as the fixed base operators are moved to their new location on the south side of the airport. This will be in Phase II. A small blast fence to protect light aircraft from turning 747's may be necessary in the vicinity of the threshold of 8L.

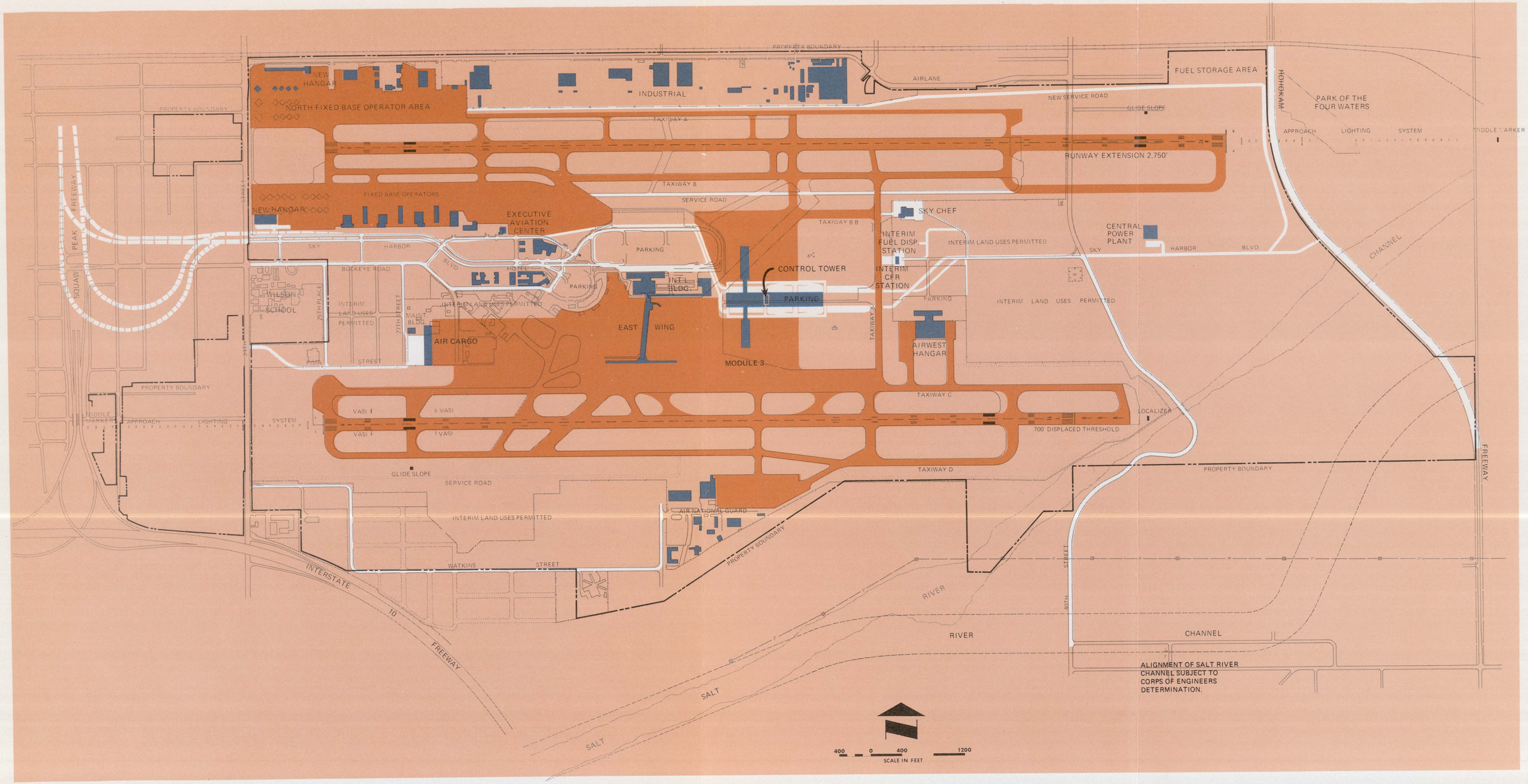
10) Construct interim crash/fire/rescue station. This facility, located in the same area as the fuel dispensing area above, will also have a twenty-year life expectancy. At the end of the present Sky Harbor Blvd. is an area ideally suited for this building. Access to the landing area can be via Taxiway X. Access to the road network will be via Sky Harbor Blvd. This location is important to the safety of aircraft, since it is midway between the runways and approximately at the midpoint of the runway system. Ground access time to the farthest points will be minimized from this position.

11) Build cargo building. A cargo facility (located in the vicinity of 28th Street) has been planned to serve the airlines, the freight forwarders, and the Post Office, if they wish. Aircraft will have access to the east face of this building and the truck docks will be on the west side. This cargo facility is located adjacent to the apron constructed during the 1971/72 fiscal year. The apron extension connected the aircraft apron area adjacent to the old West Wing to the air cargo facility. Two aircraft parking positions are planned regardless of which side is being used.

12) Construct Pima Street. This is an extension of an existing street. Located south of the Wilson School tract, this road will give access to the cargo area and provide a better circulation pattern for truck traffic which must now use Buckeye exclusively. Location of this road will have to skirt the new FAA radio transmitter site on the south side. This part of the street, and its extension to the cargo building, will be an interim facility. Later, in the late 1980's, this road will be straightened out and merely connect with 25th Street. It will still provide a better circulation system, although it will not connect with the east cargo building.

13) Revise road system to terminals. The existing Sky Harbor Blvd. will continue to bring traffic into the airport. However, a division of traffic is necessary, since part of the traffic must go to the existing East Wing and part must go to new Module #3. Some re-routing of traffic lanes is necessary, plus the construction of a "fly-over" bridge to insure the smooth flow of traffic. Transition roads connecting the East Wing with Module #3 are also necessary. Revision of the parking lots will be required where the new connector roads cross the corner of the lots. After the area south of Buckeye Road is cleared out, some clean up of the roadway system will be needed in this area.

14) Build Module #3. This is the first of the new terminal modules to be built. Located adjacent to the existing International Building, it poses a few challenges with regard to road alignment. The first level is approximately 17 feet below apron level, thus necessitating a depressed roadway system. The depressed roadway area must be extended to Taxiway X. This, however, allows some of the depressed space to be used as interim parking until it is needed at a later time. The module consists of a central core building and two concourses, one extending south 432 feet and one extending north 480 feet. One of the interior aircraft gate positions on the north side will be "closed" as long as the interim roadway connections are utilized. At that time, the gate positions will be fully available to all aircraft. Preliminary estimates indicate that about seven gate positions will be installed on the north, and six on the south.



MASTER PLAN STUDY

QUINTON-BUDLONG

DEVELOPMENT PLAN PHASE IA

ALAN M. VOORHEES AND ASSOCIATES, INC.

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15) Build parking structure. Adjacent to Module #3 is a multi-level parking garage. This structure is needed to accommodate the passenger cars, visitor cars, and rental cars. It will be built concurrently with Module #3.

16) Build Control Tower (FAA). Before the existing West Wing can be razed, a new Federal Aviation Administration (FAA) facility must be provided. Funds have already been requested by the FAA for a new control tower. The location recommended is in the terminal spine, adjacent to Module #3. Construction could be scheduled to begin before Module #3 is started. However, it appears that the lead time for the tower may coincide with the lead time for the terminal module, thus allowing each to built simultaneously.

17) Build Central Power Plant. This is the power hub of the airport complex. Located in this plant will be the heating and cooling equipment, as well as central distribution of certain utilities. Although this plant is located east of 40th Street, its location is planned to be in the optimum place when the terminal spine is complete. All development of the terminal spine will be toward the plant for the next 20 to 25 years, hence the utility becomes more efficient as each new terminal element is added. The plant should be constructed in such a manner that it can be easily expanded to meet the needs of new mechanical equipment as the airport grows. A modular type of building may be the solution, thus allowing the structure to be responsive to the type of equipment purchased in the future. Utility runs should be made in a tunnel to enhance maintenance and to simplify adding new runs in the future. A location beneath the sidewalk adjacent to the first level of the terminal may prove to be the best location.

18) Raze West Wing and other buildings. When the new Module #3 is in service, the air carriers will vacate the West Wing, thus allowing it to be torn down. The FAA control tower will also be completed in its new location, hence there will be no need for this building. It should be torn down and the area leveled and paved for employee parking or possibly long-term public parking. Other buildings located in the area south of Buckeye Road should be torn out and the area cleaned up and prepared for its ultimate uses. The construction of interim buildings, wash racks, maintenance sheds, etc. can be permitted, but should not be a cost to the airport.

19) Remove Tee Hangars. The square tee hangars located in the vicinity of the threshold to 8L will interfere with the instrument clear zone for this runway. All the tee hangars, except the last row on the north side, will need to be removed since they violate the 50·1 approach or the 7·1 side slopes established in Part 77 of the Federal Aviation Regulations. These hangars can be relocated to another part of the airport, or moved to another field.

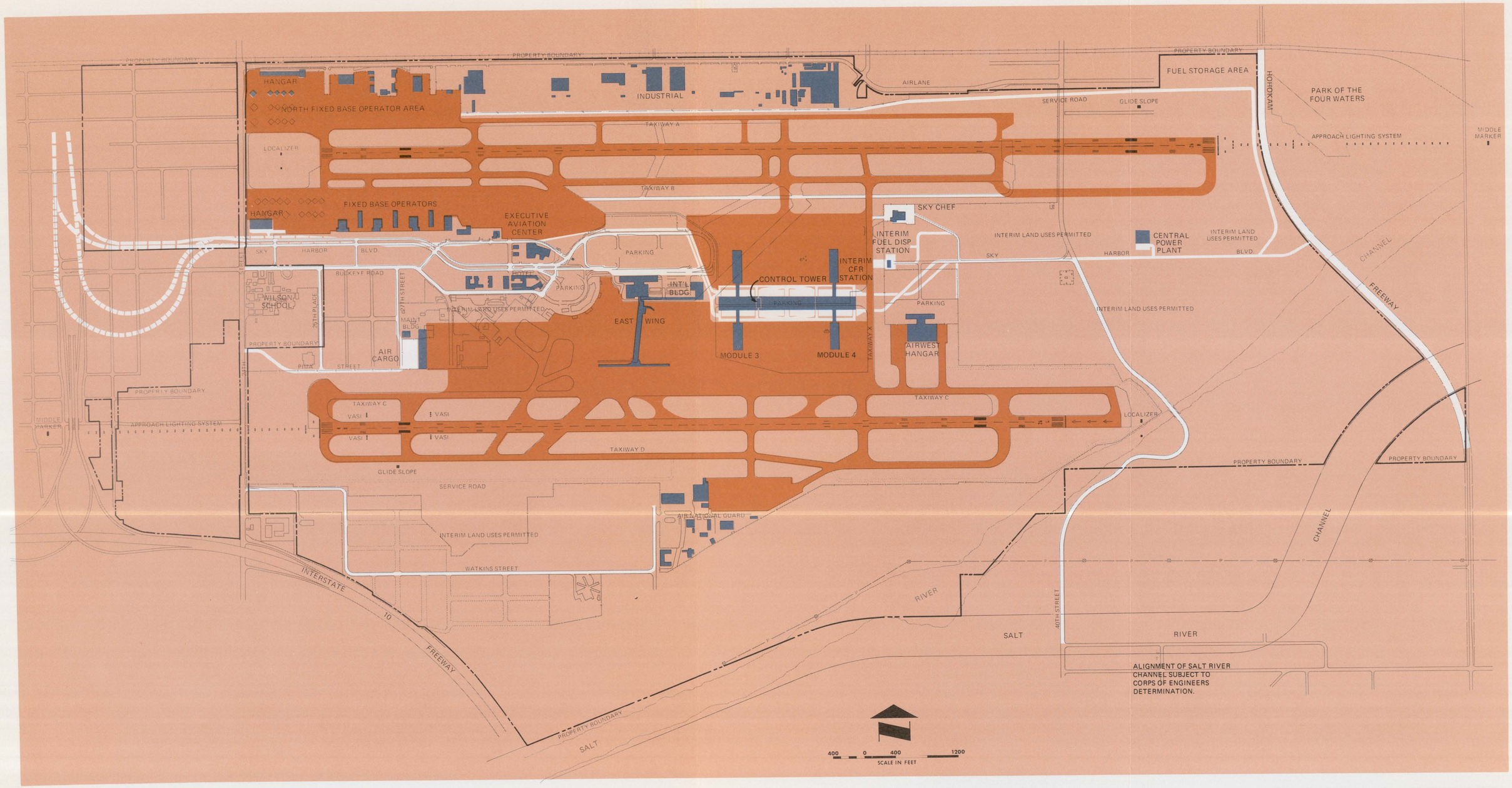
20) Build general aviation hangar. This is a new 140 foot by 280 foot hangar which has been located south of the threshold to 8L, but far enough away to be under the 7:1 side slopes discussed in 21) above. It is estimated that the roof of this hangar will be no higher than 30 feet above pavement, and it would be located close to 24th Street. There is sufficient room behind this hangar for auto parking, and parking can be permitted alongside the hangar. This hangar is intended to replace some of the indoor storage facilities lost when the tee hangars are removed. The use of this facility by multi-engine aircraft should be encouraged.

Phase Ib - 1976/77 - 1983/84

This phase is concerned primarily with meeting the needs of the travelling passengers. There is no airside construction programmed, and the only major terminal construction is the addition of Module #4 to the terminal. Some roadwork is scheduled.

1) Buy land. Two parcels are scheduled to be added to the airport property. One is to purchase the land south of Watkins Road. The other is the land in the approach to Runway 8L, completing the land purchase program protecting the approach zones to this instrument runway.

2) Build Module #4. This module and its two concourses is the second one to be added to the terminal complex. Preliminary estimates have placed one wide body jet on the north concourse with eight 737 or DC-9 type aircraft. On the south concourse, six 737 or 727 type aircraft, plus two "commuter" size aircraft can be easily accommodated. This particular mix is not a recommended configuration but rather illustrates the versatility of the concourse design to accommodate a wide mix of aircraft types.



MASTER PLAN STUDY

QUINTON-BUDLONG

DEVELOPMENT PLAN PHASE IB

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PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

When Module #3 will have been built, the land between it and the crossover taxiway will have been excavated to the lower level. Interim parking lots in the space to be occupied by Module #4 will have to be abandoned. The one parking structure, which holds 2,800 cars will not be sufficient to handle all the parking demands generated by two modules. It will be necessary, therefore, to augment the surface parking in the vicinity of the East Wing, and to provide some interim surface parking to the east of Taxiway X. The existing surface lots, plus the parking structure will accommodate approximately 4,200 cars, but will still fall 2,700 short of meeting the demand. Approximately 800 car spaces can be created in the vicinity of the old West Wing by re-arranging the service streets and mall areas. The remaining 1,900 cars will need to be accommodated on the interim parking lot east of the Taxiway X. During these first phases of the terminal development, the use of a small tram or bus to circulate around the terminals is recommended. This will provide the link between the terminals until such time as an integral people-mover system is installed, and can also provide the link to the parking lots. The use of this small tram or bus requires no new technology and is similar to operating procedures at most large airports today.

The existing underpass beneath Taxiway X is to be used by the contractors during Phases Ia and Ib to gain access to the construction sites so that construction vehicles and equipment will not need to use the aircraft aprons and areas. When Module #4 is completed and the apron is ready for completion, this existing underpass (located next to the Sky Chef kitchen) will have to be filled in and abandoned.

3) Complete connection to Squaw Peak Freeway. A portion of the elevated roadway connection to the Squaw Peak Freeway lies on airport land and a cost item has been included for all roadway construction east of 24th Street. Cost of construction west of 24th Street is assumed to be covered by the Highway Department.

4) Add Employee and Public Parking. As the terminal grows, so does the level of employees, hence the need to add to the various employee parking lots.

5) Remove Arizona Air National Guard facilities. In order for the runway construction program to begin, the Air Guard facilities must be removed. Conversations with airport authorities indicate that the Air Guard will be relocated to another airport in the Phoenix area. No provision, then, will have been included in the south fixed base operator area for Air Guard facilities.

6) Build 4200' of 8R/26L. This is the initial part of the far south runway and is scheduled to be constructed as soon as the channelization of the Salt River is completed and the power line south of the airport is moved. This short runway will be used by the aircraft to be based at the new South Fixed Base Operator area as soon as it is completed. For a more thorough discussion, see #9 in Phase II.

7) Raze Unnecessary Structures and City Prison Compound. In order to clear the landing area and approach zones for the new runway construction, these facilities will need to be removed. All unnecessary structures between the landing area and the Salt River/ Maricopa Freeway will not have been removed to make way for airfield improvements.

Phase II -1984/84 - 1991/92

During the two preceding phases, most of the "old" part of the airport will have been cleared of unnecessary buildings and structures, and the roadway system "cleaned up". This phase sees the beginning of the major airside construction program. Not only is another module to be built, but the runway and taxiway system on the south side of the airport undergoes its greatest transformation. It is assumed, naturally, that the completion of the Salt River Channelization has taken place, or will be nearing completion in the vicinity of the airport. This will allow the construction of the runways to take place during the 1983 to 1985 time period. For the purposes of this phasing schedule, it is assumed that the new runways will be in service by 1985. This date is not mandatory, but it is possible that by this time the need will have warranted the new runway system. Again, it should be pointed out that a few years delay will not overtax the system, should the Salt River Channelization be incomplete in 1985 or thereabouts.

The key item to be watched during this time frame is the build-up of general aviation activity. During the early years, the aircraft hangared in the square tee hangars will have been relocated. The total number of based aircraft will have dropped from the 620 level to around 512. This lower number will have existed until completion of the south fixed base operator area concurrent with the new runway system. At such time as the south FBO area is completed, around 250 of the aircraft based adjacent to Runway 8L/26R will have to be moved to the south FBO area. An additional 150 aircraft can now "come back" to Sky Harbor because of the increased ability of the airport to handle their operations.

Additional land is shown in the 'buy' category. It is anticipated that some of this land will already be owned by the airport, but for the purposes of this study, the "purchase" of the land is shown in this phase. Land will have been added to the airport as facilities dictated, not necessarily as it might become available, although this does not preclude the airport purchasing land in advance of its need. In fact, such advance purchase may prove more economical in the long run since inflation and increased value will not have taken place.

1) Buy land. Four areas are shown for purchase. The first is in the Module #6 area and it extends to the Hohokam Freeway. Part of this land may, in fact, be purchased prior to this time frame, but its need will at this time, become necessary. The second parcel is in the southeast corner of the airport. This area is now dominated by the flood plain of the Salt River. The land for the channel of the Salt River has been excluded from this purchase, since it is assumed that ownership will involve other agencies.

   This completes the land buying requirements for airport development. Additional parcels may be added to airport ownership in noise sensitive areas, but they are not included in this tabulation since they are not directly related to airport development.

2) Remove 40th Street to River Channel. That portion of 40th Street north of Magnolia Street will have to be removed to make way for the construction of the runway complex. Actually, this portion of the street may have been removed at the time the Salt River channelization was accomplished, but for the purposes of this report it is assumed that the airport will have been responsible for the removal of the pavement. Hohokam Freeway replaces this artery.

3) Relocate power line south of airport. The relocation of this high voltage line will be necessary before any runway construction can begin. A suggested route for the relocated line is south of the revised channel alignment of the Salt River. At the time this line is to be moved, it is advisable that electronics engineers from the Federal Aviation Administration check the alignment to insure that its location will not interfere with any ILS equipment that may be installed on Runway 8R/26L.

4) Route public road around Airwest Hangar; redesign parking lot. As one of the elements of this phase of construction, it will be necessary to straighten the alignment of the access road between the Hohokam Freeway and Taxiway X. This element of work will bring the alignment close to its ultimate location (subject only to embankment requirements) and will, therefore, require a new parking lot to be paved for the Airwest employees adjacent to the hangar.

5) Build Module #6. Concurrent with the straightening of the access road mentioned above, will be the excavation of the area for the terminal and parking structures. Module #6 may then be constructed. Both north and south concourses, and associated aircraft apron, will complete this end of the terminal complex.

Two parking structures will be constructed with Module #6 to accommodate the demand for approximately 6,000 additional spaces. When this module is complete, the interim parking lots constructed during Phase Ib will be closed and the area cleaned up.

It should be noted that the Airwest Hangar, the Sky Chef In-Flight Meal Packing Kitchen, the interim Fuel Dispensing Station, and the interim Crash/Fire/Rescue Station have been kept in service. Access to these facilities is via the ramps into the parking structure. There will not be heavy traffic demands to these facilities, hence the connection to the ramps should not impose any burdens on the design of that facility.

6) Build aprons and east crossover taxiway (Taxiway Z). Concurrent with the construction of Module #6 is the construction of the aircraft aprons and the east crossover taxiway. This will be first time that two crossover taxiways have been available for aircraft. Note that the existing crossover taxiway (Taxiway X) will have been kept in service during this phase. This completes all the apron construction on the east end of the airport.

7) Build access connections to Hohokam Freeway. At the same time as the access road around Airwest Hangar is being straightened and the Module #6 area is being constructed, the access roads, including overpasses, to Hohokam Freeway should be built. Up to this time the intersection has been a 'T' intersection with signalization. With the construction of this free-flowing ramp system, traffic into and out of the airport should be easier and faster.

8) Build Runway 8C/26C. This runway, to be 200 feet wide by 11,500 feet long, will be located 600 feet south of the existing Runway 8R/26L. One of the primary reasons for building this runway farther to the south is to open up the terminal complex, thus allowing the south concourses to be extended to their full length. Relocating this runway 600 feet south also allows the taxiway-to-runway separation to be established at the recommended distance for wide body jet operations. Construction to the 200 foot width is recommended for heavy jet aircraft operations. Provision has been made on the Airport Layout Plan for the installation of ILS equipment on this runway with the approach to Runway 8C. This is not to be construed as a recommendation for the installation of ILS equipment, but is in recognition of the fact that air traffic control demands may dictate the need for positive controlled approaches. In this event, the installation of ILS equipment on Runway 8C will impose certain siting requirements for the electronic equipment to function properly. The master plan, therefore, reserves this land for ILS equipment even though no immediate need is forecast. It would be extremely difficult, in the future, to "clean up" an area for the installation of such equipment; therefore, the reservation of this land will insure adequate protection when such an installation is programmed.

9) Build Runway 8R/26L. This is the far south runway, and is designed to be 200 feet wide by 9,200 feet long. The width, again, is recommended since this runway will be used by wide bodied jet aircraft. The length is dictated, not by take-off requirements, but by landing requirements of all known aircraft. This runway will be an operational replacement runway for those times when one of the other two is out of service. It will also be available during peak operating hours to relieve the demand on Runway 8C/26C.

For the most part, however, this runway will be used by the general aviation aircraft based in the south fixed base operator area. The length of 9,200 feet is ample for all general aviation aircraft and will permit general aviation pilots to operate in a pattern essentially independent from the air carriers. This runway will be located 1,200 feet south of the new Runway 8C/26C. thus allowing for a parallel taxiway to be installed at the mid-point. This satisfies the 600 foot clearance requirement for wide bodied jet operations. This location is also some 5,350 feet south of Runway 8L/26R, thus allowing for the installation of dual ILS equipment should it be desired to provide the capability for dual, simultaneous ILS approaches. For this reason, land should be reserved for the installation of ILS equipment on this runway.

Again, this is not to be construed as a recommendation to install such equipment, since justification for ILS transmitters will have to be made on the basis of air traffic control demands. This decision point will be reached at some time in the future; therefore, the reservation of land protects the airport should such a decision be made in the future to install ILS equipment. It should be noted that the front course approach has been set up for Runway 8R, but there is sufficient room to reverse this and install the equipment on Runway 26L if desired.

Taxiways associated with these two runways will also be built at this time. High-speed exits, which spiral off the runway, have not been designed into the master plan since pilots show a definite reluctance to initiate an exit at 60 miles per hour. They will, however, exit at 40 miles per hour, and the "angled" exits illustrated on the master plan have been placed at those points along the runway which will "intercept" the greatest number of aircraft. The remaining connecting taxiways will be standard 90° exits with wide fillets.

10) Build South FBO Area. On the south side of the airport is a triangular tract which has been reserved for the Fixed Base Operators (FBO). Three hangars have been shown, one for each of the fixed base operators which will have been "displaced" from the area south of Runway 8L/26R. More hangars can be built, and tee hangars can be added as desired. Aprons and taxiways south of Runway 8R/26L will be built to general aviation standards. This area has been designed to accommodate 400 based aircraft. Only experience will indicate whether the operations generated by 400 aircraft exceed the predicted levels. If the fleet is not generating the predicted levels, then more based aircraft can be allowed into this area; but at this point in time, no more than 400 are recommended.

11) Convert old Runway 8R/26L into a taxiway. As the new Runway 8C/26C is finished, the conversion of the old Runway 8R/26L into a taxiway will provide the parallel taxiway necessary for the smooth flow of traffic to and from the runways. Basically, all that is required is to re-mark the pavement as a taxiway and to move the light fixtures inboard to indicate a 100 foot wide taxiway. If high intensity light fixtures are installed, they will have to be converted to the standard taxiway light fixture.

12) Complete service road on east and south sides of airport. Beginning at the service road parallel to the Hohokam Freeway access road, the new service road will turn south, parallel the Salt River channel, cross behind the new fixed base operator area, parallel the Maricopa Freeway, and join 24th Street in the vicinity of the present Holiday Inn. With the completion of this service road, the airport will have an access route to any part of the landing area for maintenance or emergencies. This is not intended to be a public road, and gates should be installed at locations where the public could inadvertently turn on to it. Use of the road should be by authorized vehicles only.

13) Remove old FBO area south of Runway 8L/26R. As soon as the new FBO area on the south side of the airport is completed and the operators and aircraft have moved into the new location, the old facilities fronting on the south side of Runway 8L/26R should be razed. With the completion of this demolition, the only structure remaining in this area will be the new hangar in the extreme western corner and it will not violate any clearance criteria.

14) Complete Taxiway B. With the removal of the FBO facilities mentioned in 14) above, the way is now clear to complete Taxiway B. At this time, the strength of the pavement should be tested to determine if an overlay will be necessary. Re-marking of the taxiway centerline and edges will need to be done. Taxiway lights will need to be installed or relocated from the old alignment of this taxiway.

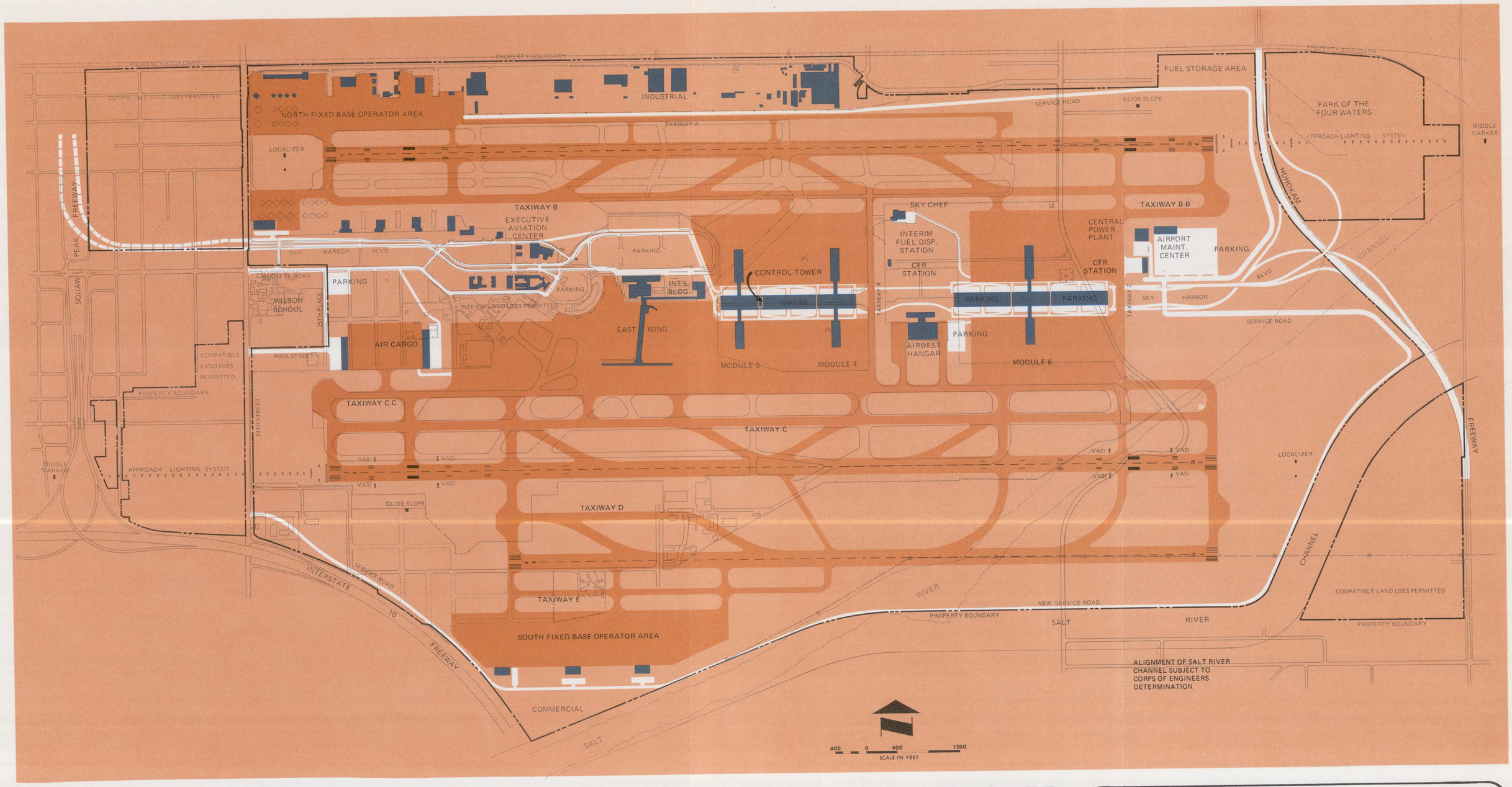
15) Widen Runway 8L/26R to 200 feet. In order to bring this runway up to the same standards as the new Runways 8C/26C and 8R/26L, the 8,750 foot original portion of the runway will need to be widened from 150 feet to 200 feet. Concurrent with this widening will be new and improved fillet connections to the taxiways, relocation of the lighting fixtures, new runway marking and shoulder stabilization. With the completion of this widening program, the improvements to the landing area, both north and south, will be complete. The entire airside of the airport will be built to its ultimate configuration and no further improvements or additions are anticipated, based upon today's criteria and standards.

16) Build air cargo apron. Up until this point the air cargo facility will have been facing the existing terminal apron. Two gate positions for all cargo aircraft will have been available and trucks will have been able to reach the building from (temporary) Pima Street. See comments in 18) and 19) below. The air cargo apron, together with an access taxiway to Taxiway C, is to be built in the area between 26th Street and 28th Street. This apron, approximately 500 feet wide, will serve the existing air cargo building and the new air cargo building (see 18) below . The strength of the pavement will be determined by the "critical" aircraft that will be expected to use the air cargo facilities. The desirability of installing in-pavement fueling facilities can be decided at the time the air cargo apron is programmed for construction. No cost of in-pavement fueling has been included in this report.

17) Build air cargo building. On the west edge of the air cargo apron mentioned above, the second air cargo building is to be constructed. This building, approximately 100' by 500', will double the freight and express capacity of the field. Truck access will be from 25th Place and Pima Street. It should be noted here that Pima Street, which had been connected to the original air cargo facility, will now be relocated into its permanent alignment adjacent to the Wilson School property. It will terminate at 25th Place, thus providing a loop road system for trucks in this area.

18) Switch sides on original air cargo building. As mentioned in the discussion on constructing this building in Phase Ia, this building was to be constructed in such a manner that its functions could be reversed. At this time, the truck activities and the aircraft gate positions will need to switch sides. Aircraft which used to park on the east face of the building will now park on the west face. The only structural work that is contemplated at this time is the rebuilding of the truck docks. Otherwise, all functions in the building should be able to reverse with a minimum of rehabilitation. The new access road to Buckeye Road will need to be completed, thus completing this portion of the air cargo center.

19) Add employee parking as necessary. Expansion of the employee parking lots south of Buckeye Road on the west end of the field, and north of Sky Harbor Blvd. on the east end of the field be necessary to keep available parking spaces in balance with the expected demand.



MASTER PLAN STUDY

QUINTON-BUDLONG

DEVELOPMENT PLAN PHASE II

ALAN M. VOORHEES AND ASSOCIATES, INC.

JOHN CARL WARNECKE & ASSOCIATES

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Phase IIIa - 1992/93 - 1995/96

This phase of construction will see the removal of the last of the facilities in the terminal area that have influenced the design of the terminal spine. From this point on, the terminal spine is "cleaned up" and the addition of new elements is relatively simple.

1) Remove Airwest Hangar. The hangar, its associated office structure, and parking lots will need to be removed to make way for the construction of the next element of the terminal building.

2) Remove Sky Chef In-Flight Meal Packing Kitchen. This unit also, will need to be removed and relocated. Although no specific site has been designated for the relocated facility, ample space is available in the airline hangar area for such a facility. It is also possible that the airlines may wish to handle the food preparation from one of the central kitchens in a terminal module.

3) Remove interim Fuel Dispensing Station. This is an optional item at this point. The space occupied by this facility has been designed in such a manner that it can remain in this location during this Phase. The parking structure located between Modules #4 and #5 is not to be built at this time (in order to keep Taxiway X open), and the continued use of the fuel dispensing station is an option available to the airport authorities.

4) Remove interim Crash/Fire/Rescue Station. This is also an optional item. This facility, together with the fuel dispensing station above, has been designed in such a manner that it can continue to function during this phase if desired. Access to these two facilities is by ramp from the roadway system.

5) Build airline hangar. In order to replace the Airwest Hangar which will be removed in this phase, a replacement hangar has been programmed to be built in the new airline maintenance hangar area. Cost of this hangar has been included in the cost estimates.

6) Build Crash/Fire/Rescue Station, adjacent to Taxiway Z. This is the permanent location of the east CFR station and is intended to supplement the interim station adjacent to the existing Taxiway X. This location, adjacent to the Central Power Plant, will serve the east end of the field and provide back-up service to the other station.

7) Build Module #5. It might be wise to point out again that the design of the terminal concourses is flexible and modular. The master plan shows the rectangular concourses, but there is nothing to prevent the construction of the rotunda type of holding area if it is desired by the airlines. With the construction of this module and the razing of the East Wing (see 10) below) the airport has the potential of providing 63 to 94 gate positions, depending on the mix of aircraft. It is estimated that 70 gate positions will be the probable result of the anticipated mix of airline aircraft.

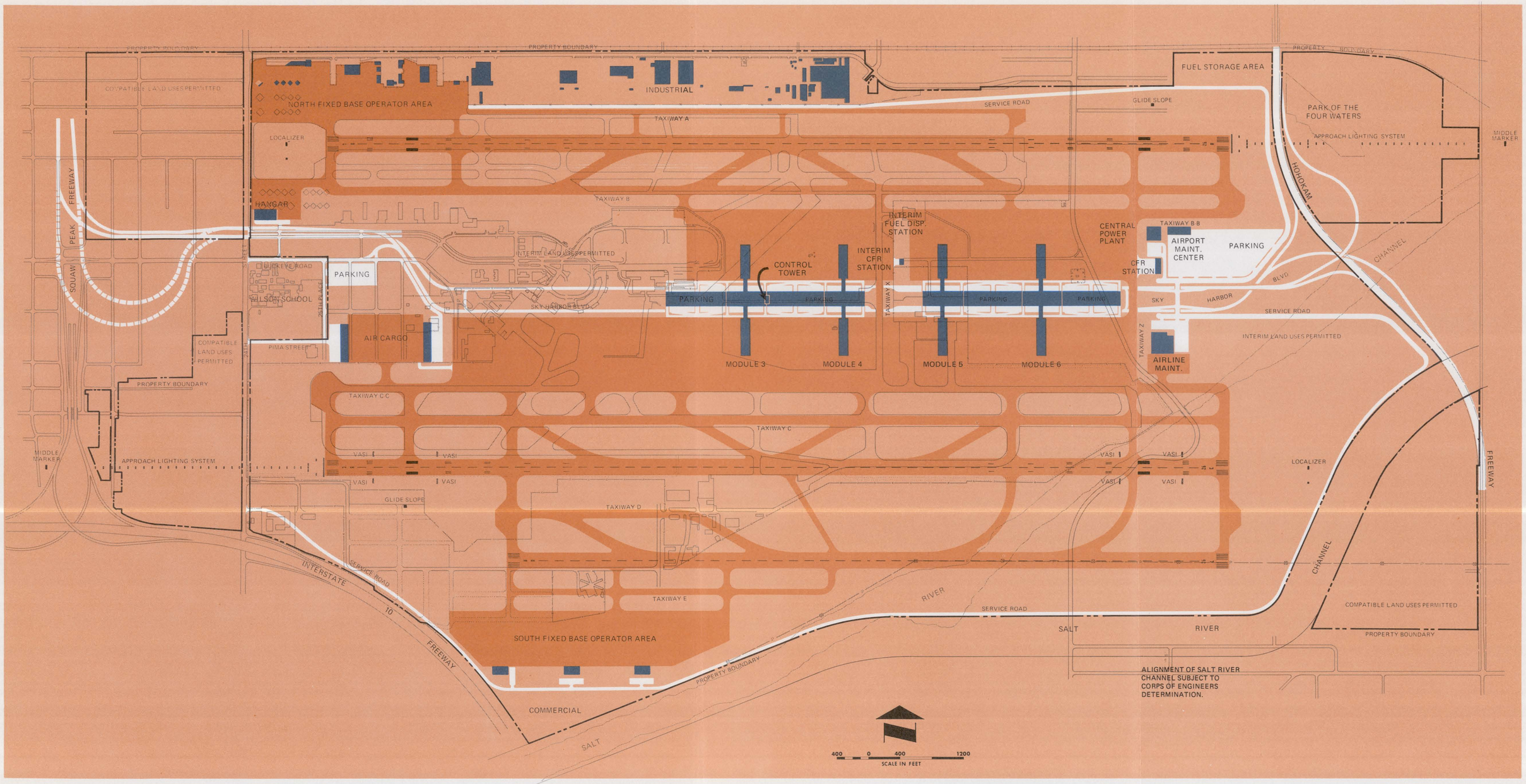
8) Build parking structure. This parking structure is not the one adjacent to the Module #5 constructed above. It is the one to the west of Module #3 and is to be built as soon as that area is "cleaned up" as discussed below. It is important, at this point, to keep two crossover taxiways open for aircraft; and the construction of Taxiway Y, the west crossover taxiway, will not occur until the next phase. Furthermore, the construction of this particular parking structure will result in each terminal module having an adjacent parking structure, bringing the availability of parking stalls more into balance with the demand centers.

9) Add employee parking. Again, this element is intended to keep the availability of parking lots for employees in balance with the expected growth in number of employees on the airport.

10) Raze East Wing Terminal Building. This building, which at this time will have seen at least thirty years of service, will be obsolete and will have been replaced with the newer Module #5. With the removal of this building and the International Arrivals Building, the last remaining obstacle to the completion of the access road system to the west will be eliminated.

11) Complete road network to west. Demolition of the East Wing will remove the last obstacle to completion of the road network and temporary and interim land uses can be realigned or removed.

12) Extend South Concourses, Modules #3, #4, and #6. At the time these three concourses will have been built, the old Runway 8R/26L and its associated taxiways will have placed restrictions on the space available for these buildings. Since the runway and restriction lines will have been relocated, the concourse may then be extended to their full design length. This full length will match the full length just completed on Module #5. This extension of the concourses is optional, depending on the demand for gate positions at the time. It is anticipated, however, that the extension will be needed and this construction has been included in the cost estimates.



MASTER PLAN STUDY

QUINTON-BUDLONG

DEVELOPMENT PLAN PHASE IIIA

ALAN M. VOORHEES AND ASSOCIATES, INC.

JOHN CARL WARNECKE & ASSOCIATES

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Phase IIIb - 1996/97 - 2005/06

The growth of the airport from this point on will involve only the extension of the terminal complex. Little will remain to be done in the way of airfield improvements except as shown below. Undoubtedly, minor alterations and adjustments to the master plan will be required as the years pass, but these will have to be evaluated as they arise. The items listed from here on reflect the known growth requirements.

1) Build Module #2. Actually, the demands placed on the airport during this time frame are not expected to be great, thus allowing the construction of the south concourse, but not the north concourse. The core building, of course, should be constructed in its entirety. It can be pointed out here that as each module is added to the terminal spine, it is possible that the airlines may wish to play 'musical chairs' and realign their terminal space. This may seem wasteful, but in practice is more economical since it allows airline space to "grow" by trading for larger space, or space in a new building. Smaller airlines can then "grow" into the space vacated by the larger airline, and the process of realignment thus keeps the demand in balance with the space available.

2) Build parking structures. Two parking structures, adjacent to Module #2 and between Modules #4 and #5 are to be built at this time. This will add 4925 parking spaces to the terminal spine. This will also require the closure of Taxiway X and the removal of any interim land uses that may have been left in the area.

3) Extend employee parking lots. As employment in the airport grows, additional parking for these employees becomes necessary. Off-site parking (say across 24th Street) is also possible, but tram or bus service is generally necessary from the remote lots. If a mass transit system is operational by this time, the need for additional employee lots may be lessened since employees are logical users of a mass transit system.

4) Build West crossover Taxiway Y. At this point in time a new crossover taxiway at the west end will become feasible and necessary. With the closure of Taxiway X, the terminal spine will be complete. and aircraft needing to transit from the north side of the field to the south, or vice versa, will need two taxiways to insure smooth flow of traffic.

Phase IV - 2006/07 - 2015/16

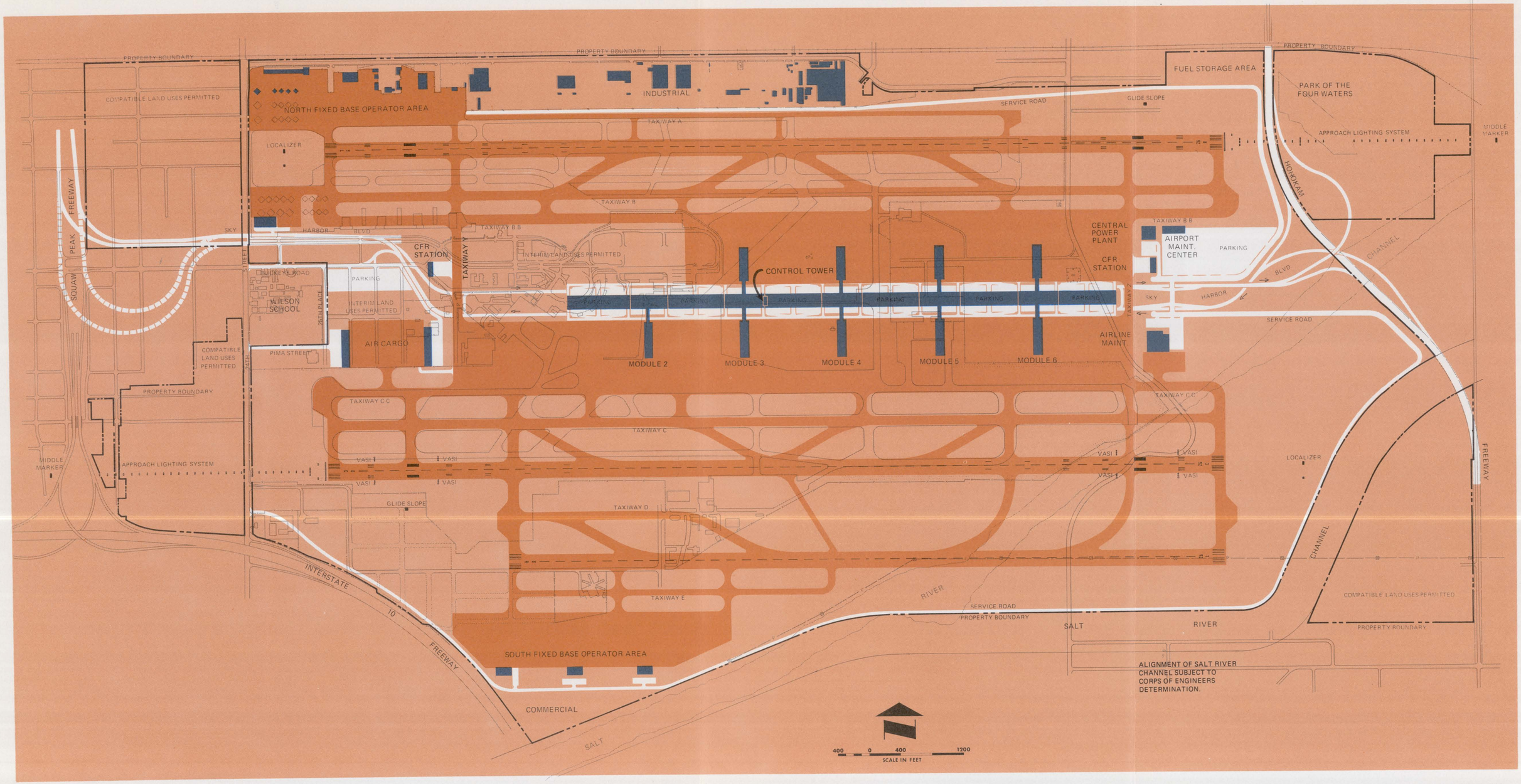
This phase takes the master plan up to the end of the forecasts. 28,000,000 passengers are forecast to arrive and depart the Phoenix terminals during this target year of 2015. If gate utilization and passenger densities prove to be close to those estimated in this report, then five full modules should suffice to meet this passenger and aircraft demand.

1) Build North Concourse, Module #2. This addition to the existing terminal building will provide the 84-gate-requirement forecast to be necessary to handle the 294,000 annual air carrier movements.

2) Complete the air cargo area. Two additional aircraft parking positions are to be added to the cargo terminal. The extension of the cargo apron and the west cargo building will provide the ultimate six aircraft parking positions forecast to be needed. As mentioned earlier, this does not preclude the use of land adjacent to Pima Street in the event demand far exceeds the forecasted growth to 135,500 tons of air cargo.

3) Complete employee parking lots. Again, the expansion of employee parking lots is assumed to be required since the number of employees that would be using a mass transit system is unknown. Therefore, sufficient parking space is provided to accommodate all airport employees.

4) Add airline hangars. The addition of two airline maintenance hangars on the east end of the airport has been shown on the master plan. It is not known at this time whether or not the airlines will actually want these two hangars. They have been shown to illustrate the fact that sufficient space is available in the area to accommodate at least three normal type hangars and associated office and auto parking space. It is conceivable that one or both of these hangars would be built in an earlier phase, or may never be built.



MASTER PLAN STUDY

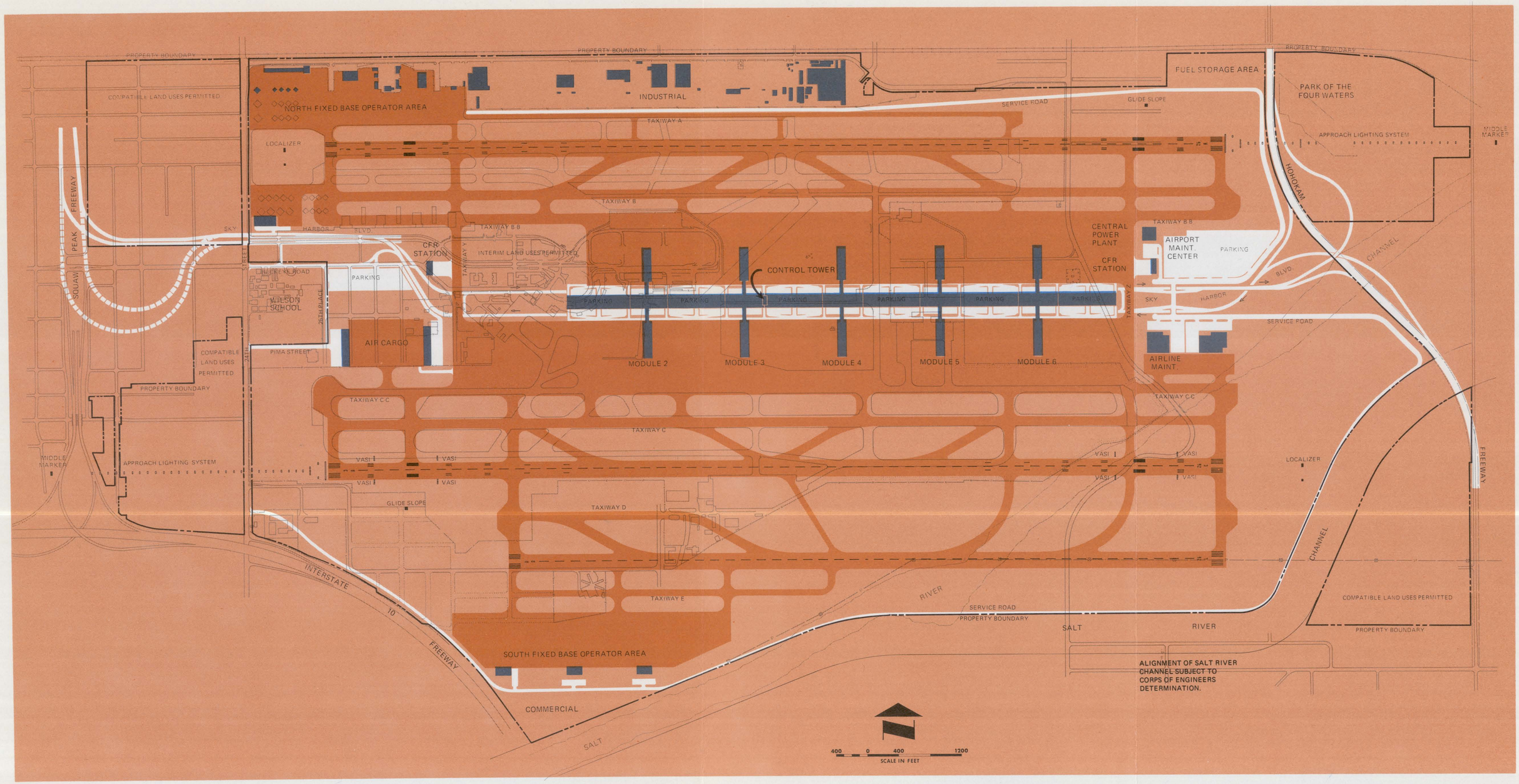
QUINTON-BUDLONG

DEVELOPMENT PLAN PHASE IIIB

ALAN M. VOORHEES AND ASSOCIATES, INC.

JOHN CARL WARNECKE & ASSOCIATES

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT



MASTER PLAN STUDY

QUINTON-BUDLONG

DEVELOPMENT PLAN PHASE IV

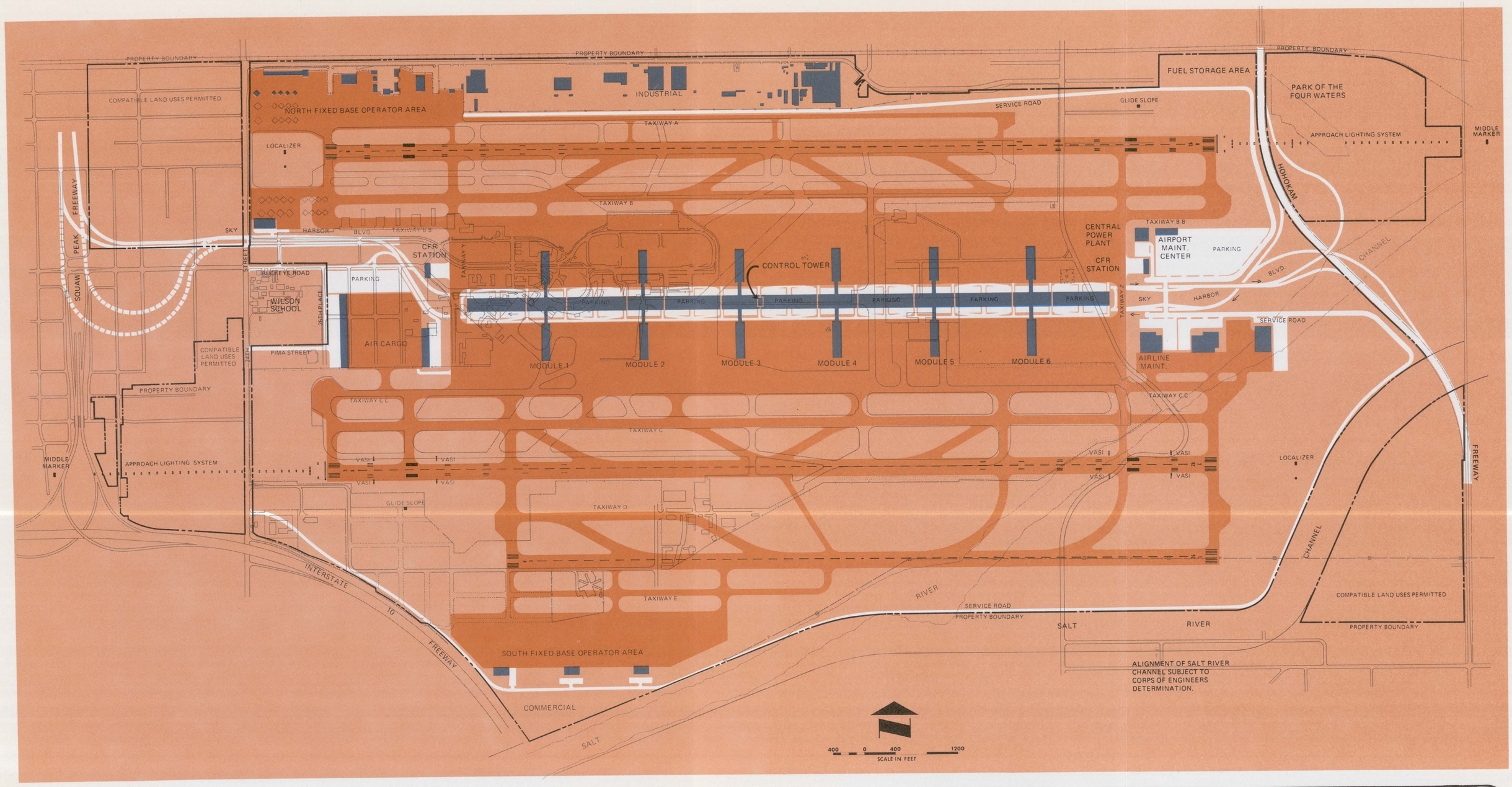
ALAN M. VOORHEES AND ASSOCIATES, INC.

JOHN CARL WARNECKE & ASSOCIATES

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT

Phase V - Beyond 2015/16

Although the master plan is not required to cover any period beyond 2015, the flexibility of the terminal design allows additional terminal facilities to be added as demand increases. Module #1 and its adjacent parking structure can be added when needed. It is even conceivable that additional modules could be added; however, this would entail the relocation of the air cargo center and the Wilson School. To pursue this idea for a moment, it could be conceivable that 24th Street could be re-routed closer to the Squaw Peak Freeway, thus opening up additional terminal space. The air cargo center could be redesigned to fit into the new space, and the terminal modules could be continued as necessary. That is one of the benefits of this flexible, modular terminal design.



MASTER PLAN STUDY

QUINTON-BUDLONG

DEVELOPMENT PLAN PHASE V

ALAN M. VOORHEES AND ASSOCIATES, INC.

JOHN CARL WARNECKE & ASSOCIATES

IV

CHAPTER IV

COST ESTIMATES

In developing the cost estimates for the recommended program of development for Sky Harbor, consideration was given to several elements. First, naturally, was the primary cost of the facility or item itself. In addition, consideration was given to the ancillary costs which often are associated with a facility, such as fencing, landscaping, driveways, utility connections, etc. These extra costs have been included in the cost of construction of the primary facility, hence the "unit costs" of any single element may seem to be high.

The tables which follow present the construction program by Phase and all the major construction items are listed. The dashed lines preceding each time period represent the time necessary for engineering or architecture. The solid lines represent the time necessary for actual construction.

With one exception, all the costs shown on the table are to be counted. The exception is the numbers shown in parenthesis next to each cost figure for the terminal modules. This number represents the estimated amount of the terminal costs that would be eligible for federal aid and is primarily apron paving costs.

The costs included for the terminal modules is the estimated cost of the building structure only, and does not include interior partitions or other tenant-installed material.

Land Costs

In Phase Ia the cost of purchasing land in fee or easement has been estimated to range from a low of $2,000,000 per year to a high of $4,183,000 or more. Fee simple ownership is not necessary for all parcels and where ownership is deemed to be unnecessary, aviation easements should be secured. For cost estimating purposes, the high figure has been included in the cost summaries for each year.

In all subsequent phases where land purchase is included, only the high figure is included.

It would be wise for the city to pursue a program of early land acquisition to preserve the airport's integrity and ability to expand.

Financing

The portion of each year's costs that are the city's share will need to be included in the airport's capital construction budget. Typically these are funded from internally generated funds or from revenue bond financing. The city should, however, explore all possible means of alternate financing to insure that the best possible debt structure can be created.

Federal Aid

The Airport and Airway Development Act of 1970 provides for funding by the federal government of a portion of the cost of eligible land and construction items. All facilities that are eligible for federal participation have been identified in the tables which follow. For Arizone, the federal share of costs is 60.8%. All costs are given in 1971 dollars and no element has been included for inflation.

Table 21

DEVELOPMENT COST SCHEDULE

PHASE Ia	Federal Participation (Yes or No)	Amounts Shown are in Thousands of Dollars			
YEARS		1972/73	1973/74	1974/75	1975/76
Passengers				6,000,000	
Aircraft Operations				364,000	
Gate Requirements				35	
Buy land or easements (Probable range of costs)	Y	2000 - 4183	2000 - 4383	2000 - 4383	2000 - 5503
Extent Sky Harbor to Hohokam Freeway	N	23 35	152		
Build Service Road, East and North sides of field	Y	28	235		
Establish fuel storage area, vicinity Airlane	N	75 777			
Establish Interim Fuel Dispensing Station, Taxiway X	N	75 500			
Close 40th St. between Sky Harbor and Airlane	N				
Build bridges under Taxiway X	Y	48 267	133		
Extend utilities, including tunnels	Y	232	232	232	232
Extend Runway 8L/26R to 11,500'	Y	128	600	600	
Build extension to Taxiway B	Y	78	323	323	
Build Interim C.F.R. Station adjacent to Taxiway X	Y	13	13 175		
Build Cargo building	N	135	900		
Build Pima Street on airport	N	4 19	9		
Revise road system in vicinity of terminals	Y	167 278	1112		
Build Module #3	Y (Apron only)	(215) 1544	(778) 4828	(1342) 7772	(671) 3886
Build parking structure	N			822	8220
Build FAA Control Tower	Y		12	13	
Build Central Power Plant	Y		600	3334	1670
Raze West Wing and other buildings	N				10
Remove tee hangars	N			3	56
Build 140' x 280' general aviation hangar	N				176

PROJECT COST	8609	13095	17482	19753
Contingency @ 10%	861	1310	1748	1975
Sub-total	9470	14405	19230	21728
FAA Eligible	5637	7984	10227	8076
FAA Participation @ 60.8%	3427	4854	6218	4910
Contingency @ 10%	343	485	622	491
FAA Share	3770	5339	6840	5401
Sponsor's Share	5700	9066	12390	16327

LEGEND
Engineering/Architecture Planning Time - - - - - - -
Construction/Demolition Time _____

DEVELOPMENT COST SCHEDULE - CONTINUED

PHASE Ib

Amounts Shown are in Thousands of Dollars

YEARS	Federal Participation (Yes or No)	1976/77	1977/78	1978/79	1979/80	1980/81	1981/82	1982/83	1983/84
Passengers					9,000,000				
Aircraft Operations					388,000				
Gate Requirements					45				
Buy land or easements (possible maximum)	Y	5503	7536	4033	4034	1936		314	1314
Build access connections to Squaw Peak Freeway	Y		19	20 108	218				
Build Employee and Public parking	N						35 287		
Build Module #4	Y (Apron only)					(238) 1500	(992) 7491	(993) 7491	
Miscellaneous utilities	N	10	10	10	10	10	10	10	10
Remove Arizona Air National Guard facilities	N						12	13 539	
Remove structures on south side of field	N								5 100
Build 4200' west part of 8R/26L	Y							308	1285
Raze West Wing and other buildings	N	200							
Build 140' x 280' general aviation hangar	N	1175							
PROJECT COST		6888	7565	4171	4262	3446	7,835	8675	2714
Contingency @ 10%		689	756	417	426	345	784	868	271
Sub-total		7577	8321	4588	4688	3791	8,619	9543	2985
FAA Eligible		5503	7555	4161	4252	2174	992	1615	2599
FAA Participation @ 60.8%		3364	4593	2530	2585	1322	603	982	1580
Contingency @ 10%		335	459	253	259	132	60	98	158
FAA Share		3681	5052	2783	2844	1454	663	1080	1738
Sponsor's Share		3896	3269	1805	1844	2337	7,956	8463	1247

GENERAL NOTES

1) Costs include design, administration, soils, supervision, etc. @ 15% for Buildings, 12% for civil projects and 5% for demolition.
2) Figures in ( ) are amounts eligible for FAA funding and are included in adjacent totals. This is only where a fraction of total cost is eligible.
3) Where Federal participation is indicated, 60.8% is assumed

DEVELOPMENT COST SCHEDULE - CONTINUED

Amounts Shown are in Thousands of Dollars

PHASE II YEARS	Federal Participation (Yes or No)	1984/85	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92
Passengers		12,000,000					15,000,000		
Aircraft Operations		438,000					485,000		
Gate Requirements		55					63		
Buy land or easements (possible maximum)	Y	1314	1000						
Reroute Sky Harbor Blvd. around Airwest hangar	N		4 17	18					
Build access connections to Hohokam Freeway	Y		80	80 660	659				
Remove 40th St. between Sky Harbor and Magnolia	N	3 60							
Complete service road on East and South sides of field	Y	72 559							
Build south F.B.O. area	N	500	3350						
Complete 4200' of 8R/26L	Y	1285							
Reroute Pima St.	N	3 10	20						
Build Runway 8C/26C to 11,500'	Y	530	2213	2212					
Convert old Rwy 8R/26L to a taxiway	Y			29	237				
Complete Runway 8R/26L to 9,200'	Y		368	1530	1530				
Complete taxiway B	Y				322	2690			
Widen Runway 8L/26R to 200'	N				59	491			
Build aprons and east crossover Taxiway Z	Y					400	400 1769	3540	
Add employee parking	N				11	87			
Build air cargo apron	N	308	1285	940					
Build south part of West Air Cargo Bldg.	N		72	720					
Switch sides on East Air Cargo Bldg.	N			7	60				
Build Module #6	Y (Apron only)					(74) 1361	(307) 6806	(308) 6806	
Build parking structures	N				732 3660	3660	366	3660	
Add employee parking	N								5 46
Build airline hangar	N								675 4500
Build C.F.R. station adjacent to Taxiway Z	Y								26
Extend south concourses of Modules #3, 4 and 6	N								228
Build parking structure adjacent to Module 3	N								366
Miscellaneous utilities	Y	10	10	10	10	10	10	10	10
Remove facilities	N	5	100 5	100					
PROJECT COST		4659	8524	6306	7280	8,699	9,351	14,016	5,856
Contingency @ 10%		466	852	631	728	870	935	1,402	585
Sub-total		5125	9376	6937	8008	9,569	10,286	15,418	6,441
FAA Eligible		3770	3671	4521	2758	3,164	2,476	3,848	26
FAA Participation @ 60.8%		2292	2232	2749	1677	1,924	1,505	2,339	15
Contingency @ 10%		229	223	275	167	192	151	234	2
FAA Share		2521	2455	3024	1844	2,116	1,656	2,573	17
Sponsor's Share		2604	6921	3913	6164	7,453	8,630	12,845	6,424

DEVELOPMENT COST SCHEDULE - CONTINUED

Amounts Shown are in Thousands of Dollars

PHASE IIIa	Federal Participation (Yes or No)	1992/93	1993/94	1994/95	1995/96
YEARS					
Passengers				18,000,000	
Aircraft Operations				489,000	
Gate Requirements				69	
Build C.F.R. Station adjacent to Taxiway Z	Y	175			
Remove Airwest Hangar	N	4 75			
Remove Interim Fuel Dispensing Station	N	1 5			
Remove Interim C.F.R. Station adjacent to Taxiway X	N	3 50			
Extend South Concourses of Modules #3, #4, and #6	N	1455			
Build Module #5	Y (Apron Only)	(381) 1667	(1589) 8333	(1589) 8332	
Raze East Wing and International Building	N			10	200
Build Parking Structure	N	3600			822 4110
Revise Road System , West End of Terminal Area	Y			12	67
Miscellaneous Utilities		10	10	10	10
Remove Sky Chef Kitchen		2 40			
PROJECT COST		7,147	8,343	8,364	5,209
Contingency @ 10%		715	834	836	521
Sub-total		7,862	9,177	9,200	5,730
FAA Eligible		556	1,589	1,601	67
FAA Participation @ 60.8%		338	966	973	41
Contingency @ 10%		34	97	97	4
FAA Share		372	1,063	1,070	45
Sponsor's Share		7,490	8,114	8,130	5,685

D E V E L O P M E N T C O S T S C H E D U L E - C O N T I N U E D

Amounts Shown are in Thousands of Dollars

PHASE IIIb YEARS	Federal Participation (Yes or No)	1996/97	1997/98	1998/99	1999/2000	2000/01	2001/02	2002/03	2003/04	2004/05	2005/06
Passengers					21,000,000						
Aircraft Operations					494,000						
Gate Requirements					74						
Revise Road System West End of Terminal Area	Y	33									
Add Employee Parking	N			11 93							
Build West Crossover Taxiway Y	Y			24	196						
Remove Crossover Taxiway X	N						5	100			
Build Module #2 (Core and South Concourse Only)	Y (Apron Only)				(13) 681	(524) 3403	(524) 3403				
Build Parking Structure	N			822	8220	822	8220				
Build Parking Structure	N	4110					461	461 4610	4610		
Miscellaneous Utilities	N	10		10	10	10	10	10	10		
Complete Utility Tunnel	Y					72	72				
PROJECT COST		4,153	-0-	960	9,107	4,307	12,171	5,181	4,620	-0-	-0-
Contingency @ 10%		415	-0-	96	911	431	1,217	518	462	-0-	-0-
Sub-total		4,568	-0-	1,056	10,018	4,738	13,388	5,699	5,082	-0-	-0-
FAA Eligible		33	-0-	24	209	596	596	-0-	-0-	-0-	-0-
FAA Participation @ 60.8%		20	-0-	14	127	362	362	-0-	-0-	-0-	-0-
Contingency @ 10%		2	-0-	2	13	36	36	-0-	-0-	-0-	-0-
FAA Share		22	-0-	16	140	398	398	-0-	-0-	-0-	-0-
Sponsor's Share		4,546	-0-	1,040	9,878	4,340	12,990	5,699	5,082	-0-	-0-

DEVELOPMENT COST SCHEDULE - CONTINUED

Amounts Shown are in Thousands of Dollars

PHASE IV YEARS	Federal Participation (Yes or No)	2006/07	2007/08	2008/09	2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Passengers										28,000,000
Aircraft Operations										---
Gate Requirements										84
Build North Concourse, Module #2	Y (Apron Only)			(13) 681	(1048) 6806					
Complete Employee Parking	N						18 146			
Miscellaneous Utilities	N			10	10	10	10			
Complete Air Cargo Apron	N				76	633				
Build North Half of West Air Cargo Building	N					135 900				
Build Airline Hangar	N					675	4500			
Build Module #1 *										
Build Parking Structure *										
Build Airline Hangar *										
PROJECT COST		-0-	-0-	691	6,892	2,353	4,674	-0-	-0-	-0-
FAA Eligible		-0-	-0-	69	689	235	467	-0-	-0-	-0-
FAA Participation		-0-	-0-	760	7,581	2,588	5,141	-0-	-0-	-0-
Sponsor Funds										
Contingency @ 10%		-0-	-0-	13	1,048	-0-	-0-	-0-	-0-	-0-
TOTAL BUDGET		-0-	-0-	8	636	-0-	-0-	-0-	-0-	-0-
		-0-	-0-	1	64	-0-	-0-	-0-	-0-	-0-
		-0-	-0-	9	700	-0-	-0-	-0-	-0-	-0-
TOTAL BUDGET PER PHASE		-0-	-0-	751	6,881	2,588	5,141	-0-	-0-	-0-
FAA Participation + 10% Contingency										
Sponsor Budget + 10% Contingency										
Sponsor Budget Assuming only 50% FAA Grants Received										

*Beyond the Year 2015

App

APPENDIX

DEFINITION OF WEATHER MINIMA

All Wx is the total number of observations.

VFR is all weather observations when the ceiling is equal to or greater than 1000 feet and the visibility is equal to or greater than 3 miles.

CIR corresponds to "circling minima" and consists of all observations when the weather is less than VFR, but equal to or greater than 800 foot ceilings, and/or equal to or greater than 2 miles visibility.

VOR corresponds to "VOR minima" and consists of all observations when the weather is less than CIR, but equal to or greater than 500 foot ceilings, and/or equal to or greater than 1 mile visibility.

ILS corresponds to the instrument landing system minima, and consists of all observations when the weather is less than VOR, but equal to or greater than 200 foot ceilings and/or equal to or greater than 1/2 mile visibility.

TWO corresponds to Category II ILS minima, and consists of all observations when the weather is less than ILS, but equal to or greater than 100 foot ceilings and/or 1/4 mile visibility.

CLO corresponds to the time when the airport would be closed, or possibly instrumented for Category III ILS minima, and consists of all the observations when the weather is less than TWO.

TABLE A-1

POPULATION

Census Year	Population				
			Phoenix		
	Arizona	Metro-Area*	Total	% of State	% of Metro
1910	204,000	34,488	11,134	5.5%	32.3%
1920	334,000	89,576	29,053	8.7	32.4
1930	436,000	150,970	48,118	11.0	31.9
1940	499,000	186,193	65,414	13.1	35.1
1950	750,000	331,770	106,818	14.2	32.2
1960	1,302,000	663,510	439,170	33.7	66.2
1970	1,752,000	963,132	580,275	33.1	60.2

* Metro-Area is the same as Maricopa County.

Source: City of Phoenix, Official Revenue Bond Statement, January 1971

TABLE A-2

AIRCRAFT OPERATIONS

Year	Air Carrier	General Aviation		Military		Total
		Local	Itinerant	Local	Itinerant	
1960	53,518	83,203	135,431	7,208	14,684	294,044
1961	49,418	77,594	139,725	7,498	14,352	288,587
1962	51,266	72,902	140,279	3,273	7,178	274,898
1963	54,216	74,873	145,202	5,747	8,169	288,207
1964	57,423	78,507	151,980	4,609	7,133	299,652
1965	54,597	80,268	151,246	5,225	7,103	298,439
1966	56,540	91,381	176,319	4,916	6,351	335,507
1967	66,701	105,587	197,396	4,063	5,781	379,528
1968	78,224	71,043	196,015	2,371	5,723	353,376
1969	82,966	73,932	182,324	3,642	5,000	347,864
1970	83,462	62,672	190,978	3,060	4,766	344,938

Sources: 1960 - 1969 FAA Air Traffic Activity
1970 City of Phoenix, Activity Report

TABLE A-3

FORECAST OF POTENTIAL AIRCRAFT OPERATIONS

Year	Air Carrier	General Aviation*	Military	Total
1975	140,000	392,700	8,000	540,700
1980	180,000	478,000	8,000	666,000
1985	218,000	572,000	8,000	798,000
1990	250,000	667,000	8,000	925,000
1995	274,000	755,000	8,000	1,037,000
2000	294,000	864,000	8,000	1,166,000

*Unrestricted growth of general aviation activity.

Source: Letter report, Landrum and Brown, April 1, 1969

TABLE A-4

UNITED STATES TOTALS
FOR AIR CARGO AND AIR MAIL

Year	Originating Tons	
	Air Mail	Air Cargo
1950	69,672.5	289,490.6
1951	90,056.6	286,836.4
1952	98,052.0	296,468.5
1953	100,341.3	316,580.2
1954	113,607.6	310,894.3
1955	124,263.2	389,307.9
1956	132,112.7	422,517.1
1957	142,052.3	434,788.4
1958	150,788.3	431,562.3
1959	164,216.2	501,713.6
1960	183,663.1	510,492.5
1961	201,875.7	553,465.2
1962	221,676.7	646,663.1
1963	230,878.5	701,990.3
1964	250,369.0	863,811.4
1965	296,102.8	1,080,239.3
1966	369,631.8	1,242,338.6
1967	528,667.0	1,337,894.9
1968	718,530.1	1,588,325.1

Sources: Air Commerce Traffic Pattern, Federal Aviation Agency.
Airport Activity Statistics of Certificated Route Air Carriers, Federal Aviation Administration.

TABLE A-5

AIR CARGO

Year	Tons of Originating Cargo	Percent of U.S.
1950	406.0	0.140%
1951	686.2	0.239
1952	718.7	0.242
1953	719.0	0.227
1954	873.6	0.280
1955	902.0	0.231
1956	1,048.0	0.248
1957	1,117.4	0.256
1958	1,250.8	0.289
1959	1,341.3	0.267
1960	1,547.7	0.303
1961	1,522.6	0.275
1962	2,069.31	0.319
1963	2,489.25	0.354
1964	2,852.22	0.330
1965	3,279.12	0.303
1966	4,231.00	0.340
1967	4,711.11	0.352
1968	6,304.80	0.396
1969	7,208.75	0.414

Sources: Airport Activity Statistics of Certificate Route Air Carriers, Federal Aviation Administration
Air Commerce Traffic Pattern, Federal Aviation Agency.

TABLE A-6

AIR CARGO BY CARRIER

Year	Type	Tons of Originating Cargo							
		AA	RW	CO	DL	FL	TW	WA	Total
1962	Freight	944.28	255.39	107.63	--	99.86	208.23	110.15	1725.54
	Express	186.17	32.63	32.15	--	26.86	42.52	23.44	343.77
1963	Freight	1091.70	312.87	121.83	--	134.51	296.34	142.31	2099.56
	Express	182.04	29.55	46.78	--	49.60	59.41	22.31	389.69
1964	Freight	1192.14	390.43	139.33	--	191.94	341.68	193.77	2449.29
	Express	157.02	28.00	41.14	--	76.28	78.76	21.73	402.93
1965	Freight	1321.20	422.71	199.22	--	180.32	430.54	265.08	2819.07
	Express	162.58	41.22	46.82	--	63.47	121.08	24.88	460.05
1966	Freight	1787.93	519.56	211.86	--	284.80	548.68	355.04	3707.87
	Express	201.37	55.75	55.30	--	63.03	97.52	50.16	523.13
1967	Freight	1880.54	481.12	301.50	--	377.52	613.02	525.91	4179.61
	Express	189.69	46.86	37.07	--	63.18	117.14	77.56	531.50
1968	Freight	2468.09	784.71	366.95	--	428.94	664.98	978.95	5692.62
	Express	223.10	76.57	54.55	--	59.16	108.87	89.93	612.18
1969	Freight	2656.06	866.78	521.55	--	441.34	882.27	1136.69	6504.69
	Express	236.53	60.67	76.25	21.83	55.60	149.83	103.35	704.06

Source: Airport Activity Statistics of Certificated Route Air Carriers, Federal Aviation Administration

TABLE A-7

FORECAST OF AIR CARGO

Year	Tons of Enplaned Cargo
1975	17,900
1980	32,600
1985	47,300
1990	62,000
1995	76,700
2000	91,400
Sat'n	135,500

Source: Letter report, Landrum and Brown, September 17, 1971

TABLE A-8

AIR MAIL

Year	Tons of Originating Mail	Percent of U.S.
1950	226.4	0.324%
1951	298.9	0.331
1952	352.3	0.359
1953	346.3	0.345
1954	395.6	0.348
1955	406.1	0.326
1956	398.8	0.301
1957	418.0	0.294
1958	457.7	0.303
1959	529.9	0.322
1960	625.6	0.340
1961	784.6	0.388
1962	827.31	0.373
1963	802.08	0.347
1964	908.54	0.362
1965	1,186.34	0.400
1966	1,628.88	0.440
1967	2,471.19	0.467
1968	3,514.16	0.489
1969	3,562.31	0.473

Source: Airport Activity Statistics of Certificate Route Air Carriers, Federal Aviation Administration, and Air Commerce Traffic Pattern, Federal Aviation Agency

TABLE A-9

FORECAST OF AIR MAIL

Year	Tons of Enplaned Mail
1975	7,700
1980	12,300
1985	16,900
1990	21,500
1995	26,100
2000	30,700
Sat'n	44,500

Source: Letter report, Landrum and Brown, September 17, 1971

TABLE A-10

AUTO TRAFFIC DESIRE LINES

Flow	Percent
1. Directly into the parking lot	63%
2. To the curb front, then to the parking lot	19
3. To the curb fron, then leave the airport	18
	100
4. Directly from the parking lot.	38%
5. From the parking lot to the curb front, then exit.. .	44
6. Same as #3 above.	18
	100

Source: Report No. 2, Terminal Area Evaluation, City of Phoenix, February, 1971

TABLE A-11

CURB FRONTAGE

Year	Peak Hr. Pax. Total	Peak Hr. Pax. Less 15% Transfers	Lineal Feet of Curb Needed @ 3 min.	Lineal Feet of Curb Needed @ 4 min.	Lineal Feet of Curb Needed @ 5 min.
1975	2,000	1,700	1,040'	1,390'	1,730'
1980	2,800	2,380	1,460	1,940	2,430
1985	3,500	2,975	1,820	2,420	3.030
1990	4,100	3,485	2,130	2,840	3,550
1995	4,800	4,080	2,500	3,330	4,160
2000	5,500	4,675	2,860	3,810	4,770
Sat'n	7,100	6,035	3,700	4,920	6,160

Based on: 1) 0.49 vehicles using loading zone per passenger*
2) 3 min. = 1/20th hour at curbside
4 min. = 1/15th hour at curbside
5 min. = 1/12th hour at curbside
3) 25' per vehicle, average

Example: 1700 pax x 0.49 x 1/20 x 25' = 1,040'

* Page 32, Report No. 3, Airline Passenger - Vehicular Traffic Survey, City of Phoenix, April 1971

TABLE A-12

FORECASTED AUTO PARKING REQUIREMENTS

Year	Public		Employee	Rental Car		
	Short Term	Long Term		Ready	Check-in	Storage
1975	640	3,360	1,586	286	48	884
1980	900	5,100	2,366	430	75	1,300
1985	1,360	7,140	3,250	550	100	1,610
1990	1,760	9,240	4,400	668	114	1,950
1995	2,100	11,900	5,400	740	120	2,200
2000	2,400	13,600	6,318	795	140	2,340
Sat'n	3,000	17,000	7,280	875	175	2,500

Source: Report No. 1, General Plan for Ultimate Land Development, City of Phoenix, December, 1970

TABLE A-13

INSTRUMENT FLIGHT ACTIVITY

Year	Instrument Operations	Instrument Approaches			
		Air Carrier	Military	Gen. Avn.	Total
1958	43,500	744	874	74	1,692
1959	40,177	589	612	40	1,241
1960	24,243	373	53	38	464
1961	28,994	575	79	101	755
1962	27,659	630	108	165	903
1963	27,960	329	27	53	409
1964	32,608	481	44	94	619
1965	38,191	1,305	71	304	1,680
1966	48,122	372	35	105	512
1967	62,944	504	25	96	625
1968	79,091	414	13	62	489
1969	86,587	611	18	187	816

Source: FAA Air Traffic Activity Report, Federal Aviation Administration

TABLE A-14

FORECAST AIRCRAFT MIX

Year	Aircraft Mix (%)*						Remarks
	AA	A	B	C	D	E	
1968	9	61	17	13	-	-	Actual Air Carrier mix
	-	-	-	2	13	85	Actual General Aviation mix.
1980	18	11	38	33	-	-	Air carrier at peak hour
	-	-	-	5	20	75	General aviation during VFR
2000	30	-	45	25	-	-	Air carrier at peak hour
	-	-	-	15	35	50	General aviation during VFR

Source : Landrum and Brown

* AA	New Category for aircraft over 300,000 lbs.
A	Includes some 707, DC-8, etc.
B	727, 737, DC-6, 7, 9
C	F-27, DC-3, Lear Jets
D	Light Twins
E	Single Engine Aircraft

TABLE A-15

AIRCRAFT UTILIZATION

Type of Aircraft	Average Hours Flown Per Year By Registrant Type					
	Individual	Partnership	Corporation	Coownership	Government	Average
Single Engine 1-3 Seats	150	63	487	150	450	244
Single Engine 4+ Seats	150	137	284	195	376	197
Multi-Engine	243	153	267	75	400	251
Rotorcraft	*	*	423	*	*	423
Others	17	*	*	*	*	17
Average	151	127	357	179	396	229

* None reporting, or data base too small.

Source: Quinton-Budlong (FAA Aircraft Computer Tapes)

TABLE A-16

TERMINAL PHASING

Phase and Terminal Buildings		Gates Potential	Gates Estimated
Phase Ia 1972 - 1975			
East Wing	South side 22		
Module 3	North Side 7 to 10		
	South Side (short) 6 to 8	35 to 40	30
Phase Ib 1976 to 1983			
East Wing	South Side 22		
Module 3	North Side 7 to 10		
	South Side (short) 6 to 8		
Module 4	North Side 8 to 12		
	South Side (short) 6 to 8	49 to 60	53
Phase II 1984 to 1991			
East Wing	South side 22		
Module 3	North Side 7 to 10		
	South Side (short) 6 to 8		
Module 4	North Side 8 to 12		
	South Side (short) 6 to 8		
Module 6	North Side 8 to 12		
	South Side (short) 6 to 8	63 to 80	64
Phase IIIa 1992 to 1995			
Module 3	North Side 7 to 10		
	South Side (full) 8 to 12		
Module 4	North Side 8 to 12		
	South Side (full) 8 to 12		
Module 5	North Side 8 to 12		
	South Side (full) 8 to 12		
Module 6	North Side 8 to 12		
	South Side 8 to 12	63 to 94	70
Phase IIIb 1996 to 2005			
Module 2	South Side (only) 8 to 12		
Module 3	North Side 8 to 12		
	South Side 8 to 12		
Module 4	North Side 8 to 12		
	South Side 8 to 12		
Module 5	North Side 8 to 12		
	South Side 8 to 12		
Module 6	North Side 8 to 12		
	South Side 8 to 12	72 to 108	78

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Table A-16 (Continued)

Phase IV	2006 to 2015			
	Module 2	North Side 8 to 12		
		South Side 8 to 12		
	Module 3	North Side 8 to 12		
		South Side 8 to 12		
	Module 4	North Side 8 to 12		
		South Side 8 to 12		
	Module 5	North Side 8 to 12		
		South Side 8 to 12		
	Module 6	North Side 8 to 12		
		South Side 8 to 12	80 to 120	84
Phase V	Beyond 2015			
	Module 1	North Side 8 to 12		
		South Side 8 to 12		
	Module 2	North Side 8 to 12		
		South Side 8 to 12		
	Module 3	North Side 8 to 12		
		South Side 8 to 12		
	Module 4	North Side 8 to 12		
		South Side 8 to 12		
	Module 5	North Side 8 to 12		
		South Side 8 to 12		
	Module 6	North Side 8 to 12		
		South Side 8 to 12	96 to 120	100

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TABLE A-17

TERMINAL SPACE BREAKDOWN

TERMINAL CORE BUILDINGS	Space in Square Feet Single Terminal	All 6 Terminals
Airline Space		
Ticketing Area		
Counter areas	3,400	20,400
Operations Space	11,220	67,320
Curb Check-in	448	2,688
Information Center	544	3,264
Sub-total	15,612	93,672
Baggage Area		
Claim Areas	13,600	81,600
Customer Service	960	5,760
Sub-total	14,560	87,360
Service Level		
Baggage, Outbound Make-up	13,360	80,160
Baggage, Inbound	14,800	88,800
Baggage/Cargo Transfer	2,400	14,400
Operations Space	1,800	10,800
Sub-total	32,360	194,160
Concourse Level		
Offices	9,200	55,200
Sub-total	9,200	55,200
Total *	71,732	430,392
Concession Space		
Ticketing Areas		
Toilets	900	5,400
Sub-total	900	5,400
Baggage Areas		
Toilets	900	5,400
Lockers/Telephones	448	2,688
Rental Cars	1,160	6,960
Hotel Boards	340	2,040
Sub-total	2,848	17,088

TABLE A-17 (Continued)

Service Level		
Receiving/Storage	2,544	15,264
Restaurant/Coffee Shop Storage	6,000	36,000
Sub-total	8,544	51,264
Concourse Level		
Miscellaneous Concessions	7,650	45,900
Restaurant/Coffee Shop/Bar	16,400	98,400
Restaurant/Coffee Shp Public Sp.	3,180	19,080
Toilets	1,800	10,800
Telephones	800	4,800
Sub-total	29,830	178,980
Total *	42,122	252,732
Management Space		
Baggage Areas		
Police/Security	300	1,800
Sub-total	300	1,800
Service Level		
Airport Operations	3,600	21,600
Sub-total	3,600	21,600
Concourse Level		
Nursery	450	2,700
Sub-total	450	2,700
Total	4,350	26,100
Mechanical Space		
Ticketing Area		
Janitor	100	600
Duct Space	216	1,296
Sub-total	316	1,896
Baggage Areas		
Janitor	100	600
Duct Space	200	1,200
Sub-total	300	1,800

TABLE A-17 (Continued)

Service Level		
Mechanical Equipment	2,400	14,400
Duct Space	216	1,296
Sub-total	2,616	15,696
Concourse Level		
Janitor	200	1,200
Duct Space	720	4,320
Sub-total	920	5,520
Total	4,152	24,912
Public Circulation Space		
Ticketing Area		
Ticketing Lobby	12,688	76,128
Circulation	7,432	44,596
Sub-total	20,120	120,720
Baggage Area		
Claim Area	6,688	40,128
Circulation	14,252	85,512
Sub-total	20,940	125,640
Service Level		
Non-Public, Open Space	25,600	153,600
Public Circulation	2,280	13,680
Sub-total	27,880	167,280
Concourse Level		
Main Lobby	12,000	72,000
Circulation	22,600	135,600
Sub-total	34,600	207,600
Total	103,540	621,240
Terminal Core Building Total	225,896	1,355,376
* Rental Space	113,854	683,124
Non-Rental Space	112,042	672,252

TABLE A-17 (Continued)

CONCOURSE BUILDINGS (PIER DESIGN)

Airline Space		
Upper Level		
Holding Rooms, North Side	27,800	166,800
Holding Rooms, South Side	31,900	191,400
Optional Passenger Circulation for Ramp Level Loading, North	2,800	16,800
Optional Passenger Circulaion for Ramp Level Loading, South	3,500	21,000
Sub-total	66,000	396,000
Ground Level		
Offices, Operations, Lounges, North Side	13,020	78,120
Offices, Operations, Lounges, South Side	13,020	78,120
Ground Equipment, Cargo, North	9,735	58,410
Ground Equipment, Cargo, South	13,515	81,090
Optional Passenger Circulation for Ramp Level Loading, North	4,680	28,080
Optional Passenger Circulation for Ramp Level Loading, South	5,850	35,100
Sub-total	59,820	358,920
Total *	125,820	754,920
Concession Space		
Upper Level		
Snack Bar, North Side	2,892	17,352
Snack Bar, South Side	2,892	17,352
Telephone/Lockers, North Side	736	4,416
Telephone/Lockers, South Side	736	4,416
Toilets, North Side	1,488	8,928
Toilets, South Side	1,488	8,928
Sub-total	10,232	61,392
Lower Level		
Receiving/Storage, North Side	1,150	6,900
Receiving/Storage, South Side	1,150	6,900
Sub-total	2,300	13,800
Total *	12,532	75,192

TABLE A-17 (Continued)

Mechanical Space		
Upper Level		
Mechanical Equipment, North	1,404	8,424
Mechanical Equipment, South	1,404	8,424
Janitor, North Side	100	600
Janitor, South Side	100	600
Sub-total	3,008	18,048
Ground Level		
Mechanical Equipment, North	2,925	17,550
Mechanical Equipment, South	2,925	17,550
Sub-total	5,850	35,100
Total	8,858	53,148
Public Circulation Space		
Upper Level, North Side	21,980	131,880
Upper Level, South Side	21,980	131,880
Ground Level, North Side	3,375	20,250
Ground Level, South Side	3,375	20,250
Un-rented Ground Level, North Side	17,915	107,490
Un-rented Ground Level, South Side	17,765	106,590
Sub-total	86,390	518,340
Total	86,390	518,340
Concourse Building (Pier Design) Total	233,600	1,401,600
* Rental Space	138,352	830,112
Non-rental Space	95,248	571,488

TABLE A-17 (Continued)

CONCOURSE BUILDING (ALTERNATE POD DESIGN)

Airline Space		
Upper Level		
Holding Rooms	31,800	381,600
Optional Passenger Circulation for Ramp Level Loading	1,800	21,600
Sub-Total	33,600	403,200
Ground Level		
Offices, Operations, Lounges, Etc.	25,460	305,520
Ground Equipment, Cargo		
Optional Passenger Circulation for Ramp Level Loading	4,830	57,960
Sub-total	30,290	363,480
Total *	63,890	766,680
Concession Space		
Upper Level		
Snack Bar/ Bar	3,256	39,072
Telephone/Lockers		
Toilets	1,600	19,200
Sub-total	4,856	58,272
Ground Level		
Receiving/Storage	1,506	18,072
Sub-total	1,506	18,072
Total *	6,362	76,344
Mechanical Space		
Upper Level		
Mechanical Equipment	1,040	12,480
Janitor	100	1,200
Sub-total	1,140	13,680
Ground Level		
Mechanical Equipment	2,200	26,400
Total	3,340	40,080

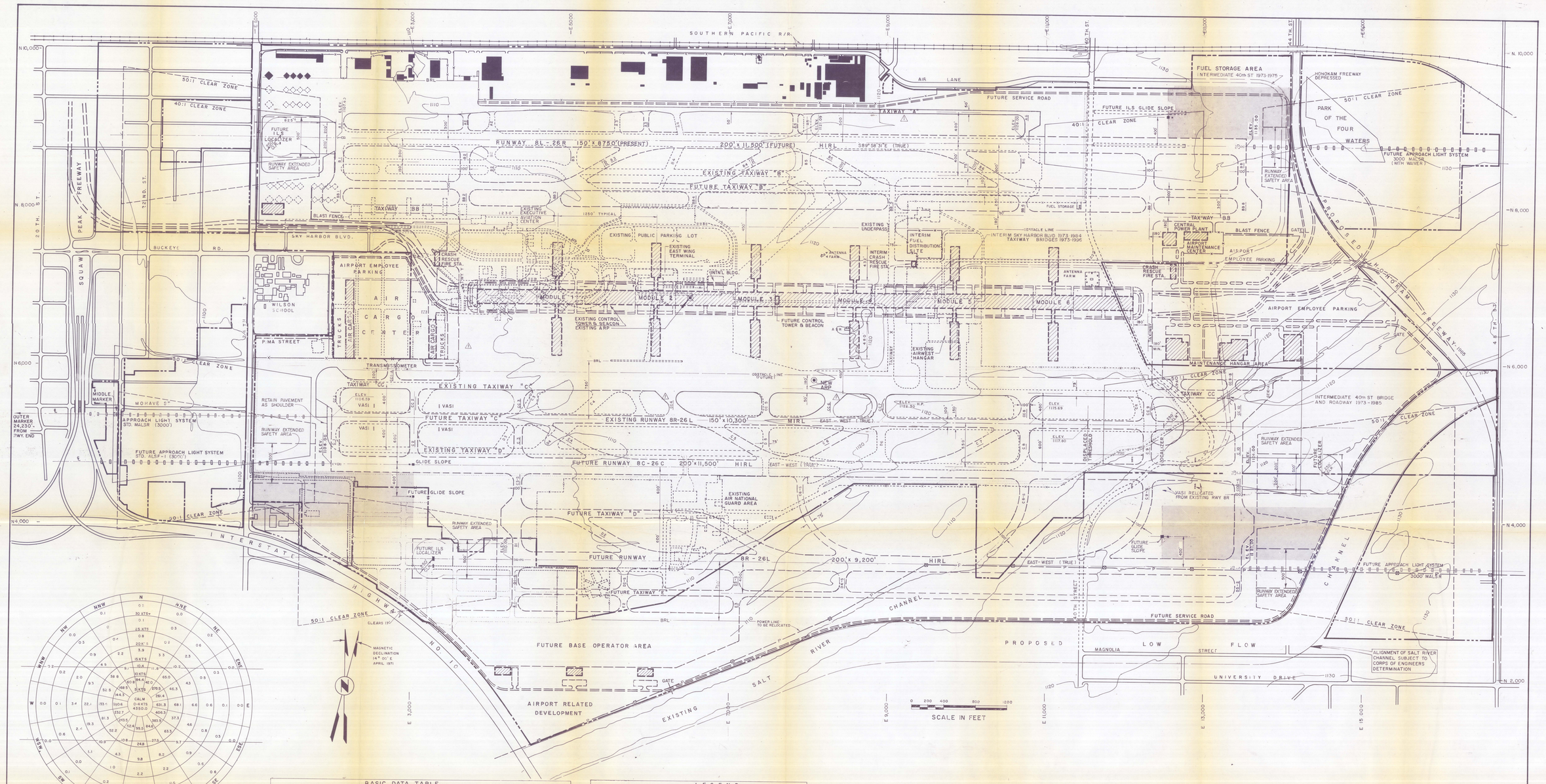
TABLE A-17 (Continued)

Public Circulation Space		
Upper Level	24,404	292,848
Lower Level	2,104	25,248
Un-rented Open Space	21,500	258,000
Total	48,008	576,096
Concourse Building (Alternate Pod Design)		
Total	121,600	1,459,200
* Rental Space	70,252	843,024
Non-Rental Space	51,348	616,176

Table A-18

CORRELATION BETWEEN FORECAST DATA AND PHASING SCHEDULE

Forecast Data				Phasing Schedule				
Year	Airline Pax	Air Carrier Operations	Gates	Year	Phase	Airline Pax	Air Carrier Operations	Gates
1975	6,000,000	140,000	35	1975	Ia	6,000,000	140,000	30
1980	9,000,000	180,000	45					
				1983	Ib	10,800,000	202,800	53
1985	12,000,000	218,000	55					
1990	15,000,000	250,000	63					
				1991	II	15,600,000	254,800	64
1995	18,000,000	274,000	69	1995	IIIa	18,000,000	274,000	70
2000	21,000,000	294,000	74					
				2005	IIIb	23,300,000	314,000	78
2015	28,000,000	n.a.	84	2015	IV	28,000,000	n.a.	84
				2015+	V	n.a.	n.a.	100+



NUMBERS SHOWN ARE AVERAGE ANNUAL HOURS, NOT PERCENTAGES

WIND ROSE

LOCATION MAP

BASIC DATA TABLE

RUNWAY DATA

	RUNWAY 8L - 26R		RUNWAY 8C-26C	RUNWAY 8R-26L		
	EXISTING	ULTIMATE	EXISTING	ULTIMATE	EXISTING	ULTIMATE	TO 1985
EFFECTIVE GRADIENT (IN %)	0.23	–	–	–	0.11	–	0.11
% WIND COVERAGE	98.75	98.75	——	98.75	98.75	98.75	98.75
INSTRUMENT RUNWAY	——	YES	——	YES	YES	YES	YES
PAVEMENT STRENGTH	100/200/300	——	——	100/200/300	100/200/300	——	100/200/300
APPROACH SURFACES	40:1	50:1	——	50:1	50:1	50:1	50:1
RUNWAY LIGHTING	MIRL	HIRL	——	HIRL	MIRL	HIRL	HIRL
RUNWAY MARKING	N PRECINST	PREC. INST.	——	PREC. INST.	PREC. INST.	PREC. INST.	PREC. INST.
NAVIGATIONAL AIDS	——	ILS	RVR	VASI, ILS	VASI, ILS	ILS	VASI, ILS

VALUES GIVEN ARE THE GROSS WEIGHT IN 1,000 LBS. FOR SINGLE (S), DUAL (D), AND DUAL TANDEM (DT) GEAR AIRCRAFT

AIRPORT DATA

	EXISTING	ULTIMATE
AIRPORT ELEVATION	1,128 FT.	1,135 FT. EST.
AIRPORT REFERENCE POINT (ARP) COORDINATES	LAT. 33°26'07.7" LONG. 112°00'37.7"	LAT. 33°26'57.6" LONG. 112°00'19.1"
AIRPORT AND TERMINAL NAV. AIDS	VASI, ASR, CONTROL TOWER	VASI, ASR, CONTROL TOWER
MISCELLANEOUS FACILITIES	TAXIWAY LIGHTING CENTERLINE MARKING AND SIGN SYSTEM	TAXIWAY LIGHTING CENTERLINE MARKING AND SIGN SYSTEM

WEATHER DATA

	TOTAL	RWY 8	CALMS	RWY 26	RWY 8/26
ALL WEATHER COVERAGE	8761.8	4545.6	1098.8	3041.7	8686.1
VFR => 1000' => 3 MI.	8739.1	4539.2	1094.1	3033.9	8667.2
CIR => 800' => 2 MI.	7.0	2.1	1.2	2.9	6.2
VOR => 500' => 1 MI.	6.3	1.4	1.3	2.9	5.6
ILS => 200' => 1/2 MI.	3.5	1.2	0.4	0.7	2.3
TWO => 100' => 1/4 MI.	2.3	0.8	0.5	0.5	1.0
CLO => 0' => 0 MI.	3.6	0.9	1.3	0.8	3.0

NUMBERS SHOWN ARE AVERAGE ANNUAL HOURS, NOT %. CALMS ARE ZERO WIND.
PERIOD OF RECORD: JAN. 1954 THRU DEC. 1963
SOURCE: U.S. WEATHER BUREAU
MEAN MAX. TEMP. OF HOTTEST MONTH: 106.3° F. JULY

LEGEND

INTERMEDIATE	EXISTING	ULTIMATE	
	—x—x—	—x—x—	FENCE
	1000	1000	GROUND CONTOURS
			AIRPORT PROPERTY LINE
			LEASED AREA LINES
	⊠	◉	AIRPORT REFERENCE POINT
	BRL	BRL	BUILDING RESTRICTION LINE
			PAVEMENT TO BE ABANDONED
			RAILROAD
			PAVEMENT
	—P—		TRANSMISSION LINE
	A1	A1	TAXIWAY DESIGNATION
			GLIDE SLOPE CRITICAL AREA
			NEW STRUCTURE
			STRUCTURE TO BE REMOVED
			STRUCTURE TO REMAIN
			APPROACH LIGHTS W/SFL

NO.	REVISIONS	BY	APPR.	DATE
1	Scheduled completion by March 1973			

PHOENIX SKY HARBOR INTERNATIONAL AIRPORT
CITY OF PHOENIX, ARIZONA AIRPORTS DEPARTMENT

AIRPORT LAYOUT PLAN

SUBMITTED BY: QUINTON-BUDLONG — DATE 7/26/72
APPROVED: AIRPORT DIRECTOR — DATE 8-1-72
James V. Mottley, FEDERAL AVIATION ADMINISTRATION — DATE 11-24-72

QUINTON-BUDLONG, Los Angeles, California 90017
DESIGNED — DATE 2-28-72 TRACED — DATE
DRAWN — DATE 2-28-72 CHECKED — DATE
JOB NO. 118201 DRAWING NO. SCALE AS SHOWN SHEET 1 OF 3

RECEIVED JAN 18 1973 FLOOD CONTROL DISTRICT

AIR PORT LOW FLOW