Chapter Three

FACILITY REQUIREMENTS

FACILITY REQUIREMENTS

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

The objective of this effort is to identify, in general terms, the adequacy of the existing airport facilities, outline what new facilities may be needed, and when they may be needed to accommodate forecast demands. Having established these facility

requirements, alternatives for providing the facilities will be evaluated in Chapter Four to determine the most reasonable and feasible means for implementation.

PLANNING HORIZONS

Cost-effective, safe, efficient, and orderly development of an airport should rely more upon actual demand than a time-based forecast figure. In order to develop a master plan that is demand-based rather than time-based, a series of planning horizon milestones have been established that take into con-

sideration the reasonable range of aviation demand projections.

It is important to consider that over time, the actual activity at the airport may be higher or lower than what the annualized forecast portrays. By planning according to activity milestones, the resultant plan can accommodate unexpected shifts or changes in the area's aviation demand. It is important to plan for these milestones so that airport officials can respond to unexpected changes in a timely fashion. As a result, these milestones provide flexibility, while potentially extending this plan's useful life if aviation trends slow over the period.

The most important reason for utilizing milestones is to allow the airport to develop facilities according to need generated by actual demand levels. The demand-based schedule provides flexibility in development, as the schedule can be slowed or expedited according to actual demand at any given time over the planning period. The resultant plan provides airport officials with a financially responsible and need-based program. **Table 3A** presents the planning horizon milestones for each activity demand category.

TABLE 3A
Aviation Demand Planning Horizons
Kona International Airport at Keahole

	Base Year (2006)	Short Term	Intermediate Term	Long Term
Annual Passengers	3,033,212	3,472,000	3,819,000	4,721,000
Annual Air Cargo (Tons)	32,390	39,000	45,000	62,000
Based GA Aircraft	61	102	118	160
Annual Operations				
Airline	37,436	39,800	41,400	45,800
Air Cargo	4,372	4,700	5,100	6,100
Other Air Taxi	9,116	15,500	18,000	24,000
GA Itinerant	18,340	31,000	36,000	48,000
GA Local	54,650	89,000	101,000	134,000
Military	19,304	30,000	30,000	30,000
Total Operations	143,218	210,000	231,500	287,900

ATCT COUNT ADJUSTMENT

The planning horizon operational activity levels in **Table 3A** represent the airport's aircraft operations as counted by the airport traffic control tower (ATCT). They will remain the milestones for monitoring growth and activity because the tower count is readily available.

The ATCT at KOA is not a 24-hour tower, so the count is not all-inclusive of operations at the airport. Certain elements of the planning analyses, however, require that all the airport activity be considered. For these evaluations, it is necessary to estimate and adjust for operations that occur when the tower is closed.

The ATCT hours are from 6:00 a.m. to 10:00 p.m. daily. The passenger airline and air cargo operations were derived from the landing reports of the airlines and do not need to be adjusted. The other operations were adjusted by three percent to account for operations that occur overnight while the tower is closed. This is based upon estimates from ATCT personnel. **Table 3B** outlines the adjusted operations.

TABLE 3B
Adjusted Aircraft Operations
Kona International Airport at Keahole

	Base Year (2006)	Short Term	Intermediate Term	Long Term
Airline	37,436	39,800	41,400	45,800
Air Cargo	4,372	4,700	5,100	6,100
Other Air Taxi	9,424	16,000	18,500	24,700
General Aviation				
Itinerant	18,890	31,900	37,100	49,400
Local	56,290	91,700	104,000	138,000
Military	19,883	30,000	30,000	30,000
Total Adjusted Operations	146,295	214,100	236,100	294,000

Aircraft operations adjusted to account for those that occur overnight when ATCT is not in operation.

PEAKING CHARACTERISTICS

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

- **Peak Month** - The calendar month in which traffic activity is highest.

- **Average Day Peak Month (ADPM)** - The average day in the peak month. This indicator is easily derived by dividing the peak month activity by the number of days in the month.

- **Design Day** - The busy day of a typical week in the peak month. This descriptor is used by the Hawaii Department of Transportation Airports Division (DOT-A) for terminal facilities planning. It is also used to determine general aviation transient ramp parking requirements.

- **Design Hour** - The busiest hour within the design day or busy day.

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

Airline Peak Periods

The summer months are typically the busiest time for airline activity at Hawaii airports, and Kona International Airport at Keahole is no exception. Each year, DOT-A prepares a snapshot of peaking activity for each of the five major commercial service airports in the state. Titled *Gate Utilization Survey*, the report provides a look at overseas and interisland aircraft and passenger activity on a typical busy day during the peak season. The day used in this analysis was August 18, 2006. The following discussion of peaking factors for passengers and airline operations is primarily based upon this survey.

Peak Passenger Activity

The peak month overseas passenger demand at KOA is typically 11.0 percent of the annual passengers. The peak month for interisland traffic averages 9.6 percent of the annual interisland passengers. The DOT-A has established the design day as 1.12 times the ADPM as its statistical reference for facilities planning.

Hourly passenger activity is examined as a percentage of the daily activity. This can be greatly affected by the number of flights and the aircraft seats available during the design hour. According to the *Gate Utilization Survey*, the design hour for arriving (deplaning) passengers began at 10:34 a.m. and accounted for 19.6 percent of the daily arrivals. The design hour for departing (enplaning) passengers began at 12:28 p.m. and accounted for 16.7 percent of the daily departures. **Table 3C** outlines the peak activity passengers forecast for each of the planning horizons.

Peak Airline Operations

As with passengers, airline operations also are highest during the summer months. The peak month is typically 9.7 percent of the annual airline operations.

On August 18, 2006, KOA had 58 daily flights, spread throughout the day. These included 48 interisland flights and 12 overseas flights (one of which was an international arrival). The peak for departures was eight beginning at 12:28 p.m. The peak for arrivals was seven, beginning at 10:34 a.m. The peak hour for total operations (arrivals and departures) was 12 and occurred twice in the day; the first beginning at 11:48 a.m., and the second at 4:40 p.m. **Table 3D** outlines the peak airline operations forecast for each of the planning horizons.

TABLE 3C
Peak Passenger Activity Characteristics
Kona International Airport at Keahole

	Base Year (2006)	Short Term	Intermediate Term	Long Term
ANNUAL				
Total Passengers (includes transits)	3,033,212	3,472,000	3,819,000	4,721,000
Enplaned Passengers (Departures)				
Overseas	497,060	628,000	753,000	1,077,000
Interisland	1,025,378	1,098,000	1,138,000	1,251,000
Total Enplaned	1,522,438	1,726,000	1,891,000	2,328,000
Deplaned Passengers (Arrivals)				
Overseas (includes international)	520,969	653,000	768,000	1,078,000
Interisland	958,941	1,055,000	1,115,000	1,251,000
Total Deplaned	1,479,910	1,708,000	1,883,000	2,329,000
International Arrivals	69,650	91,000	108,000	151,000
PEAK MONTH				
Enplaned Passengers (Departures)				
Overseas	59,828	69,100	82,800	118,600
Interisland	98,094	105,400	109,200	120,100
Total Enplaned	157,922	174,500	192,000	238,700
Deplaned Passengers (Arrivals)				
Overseas	61,750	71,800	84,500	118,500
Interisland	92,739	101,300	107,000	120,100
Total Deplaned	154,489	173,100	191,500	238,600
International Arrivals	7,303	9,100	10,800	15,100
DESIGN DAY				
Enplaned Passengers (Departures)				
Overseas	2,162	2,497	2,991	4,285
Interisland	3,544	3,808	3,945	4,339
Total Enplaned	5,706	6,305	6,937	8,314
Deplaned Passengers (Arrivals)				
Overseas	2,231	2,594	3,053	4,281
Interisland	3,351	3,660	3,866	4,339
Total Deplaned	5,582	6,254	6,919	8,620
International Arrivals	264	329	390	546
DESIGN HOUR				
Enplaned Passengers (Departures)				
Overseas	614	709	850	1,217
Interisland	439	472	489	538
Total Enplaned	953	1,053	1,158	1,440
Deplaned Passengers (Arrivals)				
Overseas	738	859	1,011	1,417
Interisland	486	531	561	629
Total Deplaned	1,094	1,226	1,356	1,690
International Arrivals	240	329	350	450

TABLE 3D
Airline Operations Peak Activity Forecasts
Kona International Airport at Keahole

	Base Year (2006)	Short Term	Intermediate Term	Long Term
ANNUAL				
Operations				
Overseas	6,770	8,000	9,000	11,900
Interisland	30,666	31,800	32,400	33,900
Total Operations	37,436	39,800	41,400	45,800
Departures				
Overseas	3,385	4,000	4,500	5,950
Interisland	15,333	15,900	16,200	16,950
Total Departures	18,718	19,900	20,700	22,900
PEAK MONTH				
Operations				
Overseas	704	832	936	1,238
Interisland	2,924	3,022	3,078	3,222
Total Operations	3,628	3,854	4,014	4,460
Departures				
Overseas	352	416	468	619
Interisland	1,462	1,511	1,540	1,612
Total Departures	1,814	1,888	2,008	2,231
DESIGN DAY				
Operations				
Overseas	24	30	32	44
Interisland	98	102	104	110
Total Operations	122	132	136	154
Departures				
Overseas	12	15	16	22
Interisland	49	51	52	55
Total Departures	61	66	68	77
DESIGN HOUR				
Departures				
Overseas	3	4	4	6
Interisland	5	5	5	6
Total Departures	8	9	9	10
Arrivals				
Overseas	4	5	5	7
Interisland	5	5	5	6
Total Arrivals	7	8	8	9
Combined Operations				
Arrivals/Departures	12	14	14	16

Itinerant General Aviation/ Other Air Taxi Peaks

The peak month for general aviation and other air taxi itinerant operations at KOA is typically March or August. In the five years from 2002 through 2006, the peak month averaged 9.9 percent of the annual general aviation/air taxi itinerant operations.

Daily operational counts from the ATCT were utilized to determine a design day factor for itinerant general aviation/other air taxi activity. During the peak month in 2006, the peak day of each week averaged 18.7 percent of the operations for the week. This equates to a design day factor of 1.31 times higher than the average day of the peak month.

The design hour for itinerant operations was determined from ATCT hourly counts during a week in the middle of August 2006. The design hour averages 15 percent of the daily itinerant operations. This percentage is expected to slowly decrease as operations increase and peaks spread. **Table 3E** summarizes the peak activity projections for each planning horizon.

TABLE 3E
Air Taxi and Itinerant General Aviation Operational Peaks
Kona International Airport at Keahole

	Base Year (2006)	Short Term	Intermediate Term	Long Term
AIR TAXI				
Annual	9,116	15,500	18,000	24,000
Peak Month	1,003	1,705	1,980	2,640
Design Day	42	72	84	112
Design Hour	8	14	17	22
ITINERANT GENERAL AVIATION				
Annual	18,340	31,000	36,000	48,000
Peak Month	1,816	3,069	3,564	4,752
Design Day	77	130	151	201
Design Hour	12	19	22	29

Total Operations Peak Periods

The peaking characteristics of total aircraft operations are utilized in examining the operational capacity of the airfield. The peak month for total operations averaged 9.7 percent over the five years between 2002 and 2006. The peak month is typically during the summer months.

Design hour operations were determined from the ATCT hourly data to average 13.3 percent of the daily operations. This can be expected to decline slightly as activity increases. **Table 3F** also summarizes the peak activity projections for total operations over the planning horizons.

TABLE 3F
Total Operations Peak
Kona International Airport at Keahole

	Base Year (2006)	Short Term	Intermediate Term	Long Term
Annual	143,218	210,000	231,500	287,900
Peak Month	14,379	20,400	22,500	27,900
ADPM*	464	658	726	900
Design Hour	62	86	94	115

*Average Day of the Peak Month

AIRFIELD CAPACITY

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

- **Runway Configuration** – KOA operates in a single runway configuration (Runway 17-35) with a full-length parallel taxiway. The instrument landing system (ILS) on Runway 17 provides instrument approach capabilities down to a half-mile visibility. Runway 35 has minimums down to one-mile visibility.

- **Runway Use** – Runway 17 is used for 70 percent of the airport's operations.

- **Exit Taxiways** - Based upon mix, taxiways located between 3,500 and 6,500 feet from the landing threshold count in the exit rating for each runway. There are currently two exits available within this range for each runway. Therefore, the exit rating is two in each direction.

- **Weather Conditions** – Visual meteorological conditions (VMC) are defined as conditions when cloud ceilings are 1,000 feet or above and/or visibility is at least three statute miles. Instrument meteorological conditions (IMC) occur when cloud ceilings are between 500 and 1,000 feet and visibility is between one and three statute miles. Poor visibility conditions (PVC) apply for minimums below 500 feet and one mile. Weather data indicates that KOA is in VMC over 99 percent of the

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AIRFIELD LAYOUT

Runway Configuration

Runway Use

Number of Exits

WEATHER CONDITIONS

VMC

IMC

PVC

AIRCRAFT MIX

A&B

C

D

OPERATIONS

Arrivals and Departures

Total Annual Operations

Touch-and-Go Operations

time. The minimal amount of instrument weather makes it almost inconsequential to the capacity analysis.

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

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

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

- **Operational Levels -** Operational planning horizons were outlined in the previous section of this chapter. The peak month averages 9.7 percent of the year. The peak hour averages 13.0 percent of the operations in a day.

TABLE 3G
Aircraft Operational Mix – Capacity Analysis
Kona International Airport at Keahole

Aircraft Classification	Base Year (2006)	Short Term	Intermediate Term	Long Term
VMC				
Classes A & B	57.3%	60.5%	62.3%	61.9%
Class C	36.1%	28.4%	27.3%	27.6%
Class D	6.5%	11.2%	10.4%	10.5%
IMC				
Classes A & B	24.6%	31.0%	25.3%	35.4%
Class C	67.5%	60.3%	63.3%	54.4%
Class D	7.8%	8.7%	11.3%	10.1%
Touch-and-Go's	39.4%	44.0%	44.0%	44.6%

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

HOURLY RUNWAY CAPACITY

Based upon the input factors, current and future hourly capacities for the various operational scenarios at KOA were determined. The base year and future hourly capacities are depicted in **Table 3H**. The base year hourly capacity was 71 operations. This capacity is expected to grow slightly as the mix and touch-and-go factors do not change dramatically. This will be reached before the short term planning horizon milestone. The long term design hour operations of 115 will exceed the hourly capacity by 58 percent.

TABLE 3H
Airfield Demand/Capacity Summary
Kona International Airport at Keahole

	PLANNING HORIZON			
	Base Year (2006)	Short Term	Intermediate Term	Long Term
Operational Demand				
Annual (Adjusted)	143,218	214,100	236,100	294,000
Design Hour	62	86	94	115
Capacity				
Annual Service Volume	168,000	179,000	180,000	186,000
Weighted Hourly Capacity	71	72	72	73
Delay				
Per Operation (Minutes)	1.8	9.5	12.8	19.5
Total Annual (Hours)	4,300	33,300	49,200	93,600

ANNUAL SERVICE VOLUME

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

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

C = weighted hourly capacity;

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

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

The ratio of annual demand to average daily demand (D) at KOA was determined to remain relatively constant in the future at 320. The ratio of average daily demand to average peak hour demand (H) was determined to be 7.67 in 2006. This ratio will grow to 7.99 over the long term as peaks spread slightly with increased operations.

The 2006 ASV was determined to be 168,000 operations. The changes in the daily and hourly demand ratios result in an increase in the ASV as activity increases. The ASV for the long term was calculated to be 186,000.

Annual operations for the long term planning horizon are 294,000, which would be 158 percent of the airport's ASV. **Table 3H** and **Exhibit 3B** summarize and compare the airport's ASV and projected annual operations over the planning horizons.

AIRCRAFT DELAY

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

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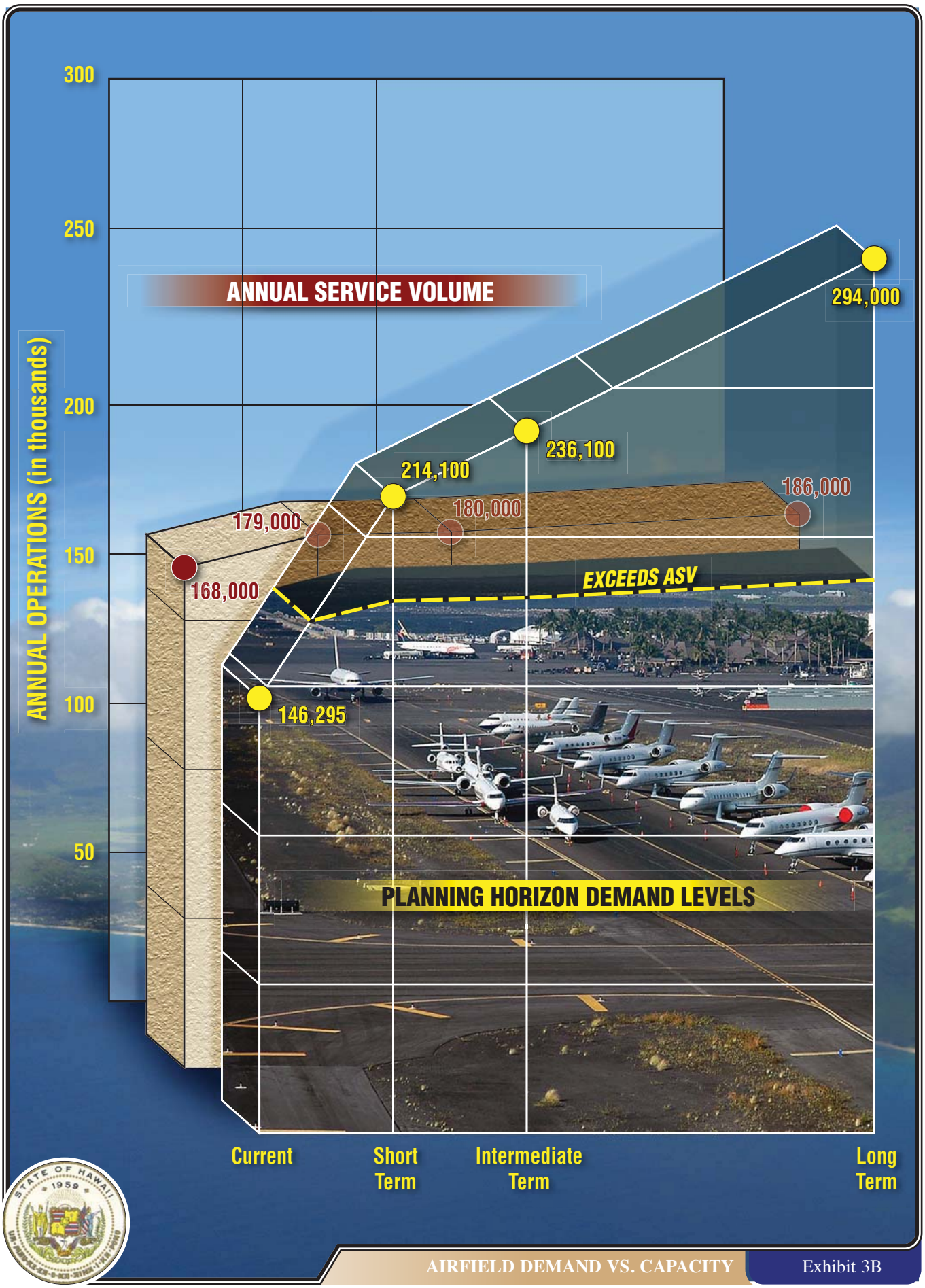

AIRFIELD DEMAND VS. CAPACITY

Exhibit 3B

Table 3H summarizes the aircraft delay analysis conducted for Kona International Airport at Keahole. The delay per operation represents an average delay per aircraft. It should be noted that delays of five to ten times the average could be experienced by individual aircraft during peak periods. In the base year of 2006, total annual aircraft delay was 4,300 hours. As an airport's operations increase toward the annual service volume, delay increases exponentially. Analysis of delay factors for the long term planning horizon indicates that annual delay can be expected to exceed 20,000 hours in the short term if capacity improvements are not implemented.

CAPACITY ANALYSIS CONCLUSIONS

Exhibit 3B compares annual service volume to existing and forecast operational levels at KOA. The 2006 operations level equated to 87 percent of the airfield's annual service volume. The ASV will essentially be reached by the short term planning horizon. By the long term planning horizon, total annual operations are expected to represent 158 percent of annual service volume.

FAA Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems* (NPIAS), indicates that improvements for airfield capacity purposes should begin to be considered once operations reach 60 to 75 percent of the annual service volume. KOA has already surpassed this range. Therefore, planning efforts should be considering airfield capacity improvements beginning in the short term.

CRITICAL AIRCRAFT

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

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

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

Category A: Speed less than 91 knots.

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

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

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

Category E: Speed greater than 166 knots.

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

Group I: Up to but not including 49 feet.

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

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

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

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

Group VI: 214 feet or greater.

Exhibit 3C summarizes representative aircraft by ARC.

At commercial service airports such as KOA, the critical aircraft typically come from the passenger or cargo airline fleets. While the large majority of airline operations are by narrow-body commercial jets flying interisland routes within ARC C-III, wide-body aircraft conduct well over 500 annual operations at the airport. In 2006, operations by commercial aircraft in ARC D-V conducted 1,256 operations at KOA to qualify as the current critical ARC. These included passenger operations by Boeing 747 and 777 aircraft as well as cargo operations by Boeing 747 aircraft. **Thus, the base year airport reference code for Kona International Airport at Keahole is ARC D-V.**

Larger aircraft are now entering the global commercial service fleet. The largest is the Airbus A380-800 super jumbo freighters. This aircraft has a payload capacity of 330,000 pounds and wingspan of 261.8 feet. The A380-800 and the Boeing 747-8 are both in ARC D-VI. The initial deliveries of these aircraft are now in service.

These aircraft are expected to be used primarily on international routes. Honolulu International Airport is being planned to ARC D-VI. KOA has been approved as an alternate landing site for the A380. **For planning purposes, it is recommended that the airfield continue to be planned to accommodate at least ARC D-V, but consider the design ramifications necessary to accommodate ARC D-VI aircraft in the future.**

06MP06-3C-6/22/07

A-I

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

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

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

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

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

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

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

A-III, B-III

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

C-I, D-I

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

C-II, D-II

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

C-III, D-III

- ERJ-170, 190
- Boeing Business Jet
- B727-200
- **B737-300 Series**
- MD-80, DC-9
- Fokker 70, 100
- A319, A320
- Gulfstream V
- Global Express

C-IV, D-IV

- **B757**
- B767
- B787
- C-130
- DC-8-70
- DC-10
- MD-11

D-V, D-VI

- **B747** Series
- B777
- A380-800

Note: Aircraft pictured is identified in bold type.

AIRFIELD REQUIREMENTS

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

RUNWAY CONFIGURATION

Key considerations in the runway configuration of an airport involve the orientation for wind coverage and the operational capacity of the runway system. FAA Advisory Circular 150/5300-13, Change 1, *Airport Design*, recommends that a crosswind runway should be made available when the primary runway orientation provides less than 95 percent wind coverage for any aircraft forecast to use the airport on a regular basis.

The 95 percent wind coverage is computed on the basis of the crosswind component not exceeding 10.5 knots (12 mph) for ARC A-I and B-I; 13 knots (15 mph) for ARC A-II and B-II; and 16 knots (18 mph) for ARC A-III, B-III, and C-I through D-II; and 20 knots (23 mph) for ARC C-III through D-IV.

A wind rose is a tool used to calculate the wind coverage of an airport. The all-weather wind rose for Kona International Airport at Keahole is presented on **Exhibit 3D**. The orientation of Runway 17-35 provides 97.3 percent coverage for 10.5 knot crosswinds, and 98.8 percent coverage for 13 knot crosswinds. Coverage for the higher design crosswinds is over 99.9 percent. Thus, the single runway orientation available at KOA provides adequate wind coverage for all aircraft types.

According to FAA Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems* (NPIAS), capacity development should be recommended when activity approaches the 60 percent level. This is an approximate level to begin the detailed planning of capacity improvements. Actual implementation may be deferred until such time that the improvement is considered timely and cost-beneficial. The earlier airfield capacity analysis indicated that, in 2006, the airfield was already operating at 88 percent of its annual service volume and will reach its ASV by the short term planning horizon. Consideration for capacity improvements should be considered in the near term.

Examples of potential capacity improvements that may be considered in the alternatives analysis include additional taxiway exits and/or a parallel runway. The high number of helicopter operations suggests that an independently operational helicopter touchdown and lift-off (TLOF) area should also be considered.

While a parallel runway is a means to increase capacity, a second runway to provide back-up capability is an important factor to the DOT-A and commercial service on the islands. KOA is the only one of Hawaii's five small hub or larger airports that does not have a second runway available.

Kona International Airport at Keahole is being considered as a site for a new

C-17 Globemaster II pilot proficiency training runway. Such a runway would allow the current fleet of C-17s based at Hickam Air Force Base (AFB) to certify pilots locally rather than incur high expenses of flying to and training at facilities on the U.S. mainland.

A new Kona Auxiliary Training Runway (KATR) would be utilized to certify air crews of C-17s (and potentially other USAF aircraft) operating military cargo aircraft into short or austere landing strips.

RUNWAY DIMENSIONAL REQUIREMENTS

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

Runway Length

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

The airport elevation at Kona International Airport at Keahole is 47.1 feet above mean sea level (MSL). The temperature commonly used for design is the mean maximum daily temperature during the hottest month. According to the National Climatic Data Center, that is 86.9 degrees Fahrenheit (F) at KOA during the month of August. The change in elevation (gradient) varies by 10 feet along the runway (0.09 percent gradient). This information is utilized in the following runway length analyses.

The airport should have the capability to handle the most demanding aircraft with regards to runway length. Thus, the following discussion considers the most demanding runway length requirements now and in the future.

The aircraft load is dependent upon the payload of passengers and/or cargo, plus the amount of fuel it has on board. For departures, the amount of fuel varies depending upon the length of non-stop flight or trip length. As of June 2007, the longest daily non-stop commercial flights were to Chicago (4,208 miles) and Narita, Japan (3,976 miles). The Chicago flight is by a Boeing 777-200 aircraft. The Narita flight is listed as a Boeing 767, but landing reports over the past year indicate

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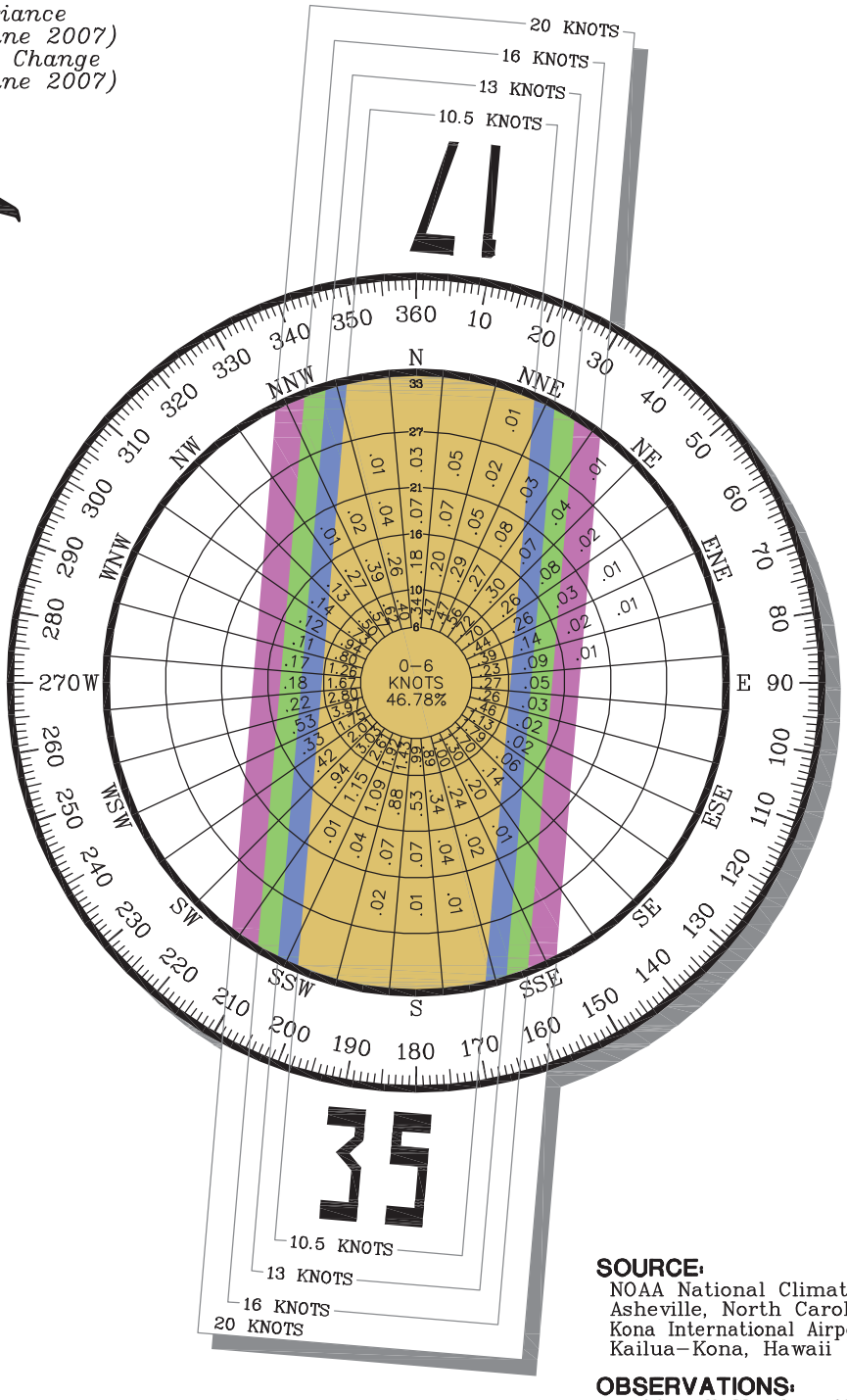
ALL WEATHER WIND COVERAGE

Runway	10.5 Knots	13 Knots	16 Knots	20 Knots
Runway 17–35	*97.30%*	*98.81%*	*99.94%*	*99.97%*

Magnetic Variance
09° 50' West (June 2007)
Annual Rate of Change
00° 00' West (June 2007)



SOURCE:
NOAA National Climatic Center
Asheville, North Carolina
Kona International Airport at Keahole (KOA)
Kailua–Kona, Hawaii

OBSERVATIONS:
74,064 All Weather Observations
1998–2006

that a Boeing 747 is sometimes substituted on this flight.

Table 3J outlines the runway length requirements at maximum takeoff weight (MTOW) for key passenger and cargo commercial jets at KOA's design temperature and airport elevation. The still air (zero wind) range in nautical miles is also given for each aircraft listed. The available runway length of 11,000 feet meets the existing needs of the commercial passenger and cargo aircraft. The present length of 11,000 feet would be adequate for the newer A380-800 and B747-8 jumbo jets.

TABLE 3J
Ultimate Takeoff Length Requirements
Kona International Airport at Keahole

Aircraft	MTOW Length (ft.)	Still Air Range (nm)
B767-300	8,800	4,675
B767-300ER	10,300	6,105
B767-400ER	12,500	5,645
B777-200	9,800	5,210
B777-200ER	11,500	7,730
B777-300ER	12,400	8,258
B747-400	11,500	4,260
B747-400ER	12,600	7,670
B747-400F	11,700	4,445
B747-8	11,200	8,000
B747-8F	11,200	4,475
A380-800	10,800	8,000
A380-800F	10,800	6,500

MTOW –Maximum Takeoff Weight
Design Criteria: Elevation – 47.1 ft. MSL; Temperature – 86.9F; Gradient – 0.09%

As is evident from the table, however, additional runway length would be necessary to accommodate the maximum range of several of the long range wide body aircraft. The maximum length required would be 12,600 feet for the B747-400ER to fly its maximum range of 7,670 miles. A future need for this range by this particular aircraft is not foreseen. To ensure viability for the future, however, an ultimate runway length of 12,000 feet could be planned. Such an extension would not be developed until such time it could be justified as expressly seeded on a regular basis by one or more operators.

Table 3K outlines the runway length requirements for various groupings of general aviation aircraft. It is evident that the current runway length is more than adequate to accommodate 100 percent of the business jet fleet at 90 percent useful load. Business jet aircraft weighing over 60,000 pounds have a range of more than 5,000 nautical miles from the current runway.

The capacity analysis earlier in this chapter suggests planning for a future parallel runway. To serve a sufficient back-up to the existing runway, the parallel runway should ultimately be planned to at least the 11,000-foot length. This would maintain uninterrupted service whenever the primary runway is temporarily shut down for any reason. An interim length sufficient for at least a portion of the general aviation aircraft would provide capacity relief. While the parallel runway has been and should continue to be planned for an ultimate length of 11,000 feet, an initial length of 4,200 feet would accommodate small general aviation and air taxi aircraft weighing 12,500 pounds or less. A minimum length of 5,000 feet is required for interisland cargo aviation. An interim length of 7,000 feet would accommodate most interisland commercial and general aviation flights.

TABLE 3K
General Aviation Runway Length Analysis
Kona International Airport at Keahole

AIRPORT AND RUNWAY DATA	
Airport elevation	47.1 feet
Mean daily maximum temperature	86.9 F
Maximum different in runway centerline elevation	10 feet
Length of haul for airplanes of more than 60,000 pounds	5,000 miles
Wet and slippery runways	
RUNWAY LENGTHS RECOMMENDED FOR AIRPORT DESIGN	
Small airplanes with less than 10 passenger seats	
75 percent of these small airplanes	2,500 feet
95 percent of these small airplanes	3,100 feet
100 percent of these small airplanes	3,600 feet
Small airplanes with 10 or more passenger seats	4,200 feet
Large airplanes of 60,000 pounds or less	
75 percent of these large airplanes at 60 percent useful load	5,400 feet
75 percent of these large airplanes at 90 percent useful load	7,000 feet
100 percent of these large airplanes at 60 percent useful load	5,500 feet
100 percent of these large airplanes at 90 percent useful load	8,100 feet
Airplanes of more than 60,000 pounds	Approximately 10,800 feet

Reference: Chapter 2 of AC 150/5325-4A, Runway Length Requirements for Airport Design, no Changes included.

According to the Environmental Assessment prepared for the Department of Defense in 2004, the KATR for the C-17 is be planned to be 4,250 feet in length with 300-foot paved overruns at each end.

Runway Design Standards

Runway design standards define the widths and clearances required to optimize safe operations in the landing and takeoff area. These dimensional standards can vary depending upon the ARC for each runway. **Table 3L** outlines key design standards for the airport reference codes most applicable to Kona International Airport at Keahole presently and in the future. As indicated earlier, the ARC for the airport is currently D-V. An initial parallel general aviation runway should consider ARC B-II standards. As evidenced from the table, KOA meets or exceeds all D-V design stan-

dards with the exception of the parallel taxiway to taxilane separation. These are currently adequate because of the limited operations by D-V aircraft. Adequate D-V separation, however, should be considered in future terminal and apron planning.

While D-V is expected to remain as the ARC for KOA in the future, ARC D-VI standards are also listed in the table for comparison. These design standards would need to be addressed if the airport were to ever accommodate the A380-800 and the B747-8. Critical standards that would need to be addressed for the A380 are widening the runway to 200 feet and the taxiways to 100 feet. If use is occasional as an alternate service location, the runway would not need to be widened. A taxiway route for the large aircraft, however, would still need to be addressed. In addition, taxiway fillets would have to be addressed to accommodate the wheel track of a turning aircraft. The taxiway/taxilane separation and the taxilane separation from fixed or movable objects would also have to be addressed.

TABLE 3L
Airfield Design Standards
Kona International Airport at Keahole

Design Standard	Existing	Airport Reference Code: Current D-V (ft.)	Ultimate D-VI (ft.)	Initial Parallel B-II (ft.)
RUNWAYS				
Runway Length	11,000	11,000	12,000	4,200
Runway Width	150	150	200	75
Runway Shoulder Width	35	35	40	10
Runway Safety Area				
Width	500	500	500	150
Length Beyond End	1,000	1,000	1,000	300
Runway Object Free Area				
Width	800	800	800	500
Length Beyond End	1,000	1,000	1,000	300
Runway Blast Pad				
Width	200	220	280	95
Length	200	400	400	150
Runway Centerline to:				
Holding Position	280	280	280	200
Parallel Taxiway	881	400	500	240
Parallel Runway	NA	1,200	1,200	700
TAXIWAYS				
Taxiway Width	75	75	100	35
Taxiway Centerline to:				
Fixed or Movable Object	193	160	193	66
Parallel Taxilane	215	267	324	105
Taxilane Centerline to:				
Fixed or Movable Object	112	138	167	57.5
Parallel Taxilane	220	245	298	97
RUNWAY PROTECTION ZONES				
Category I				
Inner Width	1,000	1,000	1,000	NA
Length	2,500	2,500	2,500	NA
Outer Width	1,750	1,750	1,750	NA
One mile visibility				
Inner Width	500	500	500	500
Length	1,700	1,700	1,700	1,000
Outer Width	1,010	1,010	1,010	700

PAVEMENT STRENGTH

The most important feature of airfield pavement is its ability to withstand repeated use by aircraft of significant weight. At Kona International Airport at Keahole, pavement must be able to support multiple operations of large commercial and military jet aircraft on a daily basis.

The current strength rating of the runway is 750,000 pounds single wheel loading (SWL), 200,000 dual wheel loading (DWL), 400,000 pounds dual tandem wheel loading (DTL), and 850,000 pounds double dual tandem wheel loading (DDTL). The existing pavement strengths of the runway are adequate to accommodate these aircraft.

A pavement design analysis will be necessary to determine if additional pavement strengthening will be required for regular operations by this aircraft. The A380-800 has a maximum weight of up to 1.3 million pounds on DDT gear. A pavement design analysis will be necessary to determine if additional pavement strengthening would be required for regular operations by this aircraft.

An initial parallel general aviation runway would need to be designed to at least 12,500 pounds single wheel gear. Pavement strength would increase depending upon the design aircraft for further development of the parallel runway.

TAXIWAYS

Taxiways are primarily constructed to facilitate aircraft movements to and from the runway system. Parallel taxiways greatly enhance airfield capacity and are essential to aircraft movement on the ground. Some taxiways are necessary simply to provide access to apron and terminal areas, while others are designed to facilitate the movement of aircraft to and from the runways. As activity increases, additional taxiways become necessary to provide for safe and efficient use of the airfield. The taxiway system at KOA consists of a full-length parallel taxiway long the east side of the runway, exit taxiways, and access taxiways connecting the airfield to the various terminal and general aviation ramps. A partial parallel taxilane also aids with circulation near the ramps.

Parallel Taxiway A maintains an 881-foot centerline separation from Runway 17-35 along the entire length of the runway. Besides the exits at each end, there are two right-angle exits (Taxiways G and H) and one angled exit (Taxiway C) along the length of the runway. The angled exit is most suitable for use by aircraft arriving on Runway 17.

Ideally, each runway should be planned with full-length parallel taxiways on the same side as the landside interface facilities. Since the landside facilities are all located on the east side of the airfield, the current loca-

tion is adequate. If a parallel runway is developed, a second parallel taxiway should be considered to provide circulation and access along it.

As the landside facilities develop and traffic increases, a dual parallel taxiway system may need to be considered along the east side of Runway 17-35 to enhance circulation.

Exit taxiways provide a means to enter and exit the runways at various points on the airfield. The type and number of exit taxiways can have a direct impact on the capacity and efficiency of the airport as a whole. As indicated earlier in the capacity analysis, the runway's exit rating is two in both directions of traffic flow, with four being the optimum. For example, the first exit taxiway is approximately 4,700 feet from the runway threshold in both directions. An additional exit approximately 1,000 feet closer to the threshold would permit many landing propeller aircraft to exit the runway sooner.

High speed exits provide a means for aircraft to clear the runway at higher speeds, thus reducing runway occupancy time. This is especially advantageous for higher performance aircraft that approach at greater speeds, and then must slow to 10 to 15 miles per hour to exit at a right angle exit. Depending upon its design, a high speed exit can allow the aircraft to exit the runway at speeds as high as 60 miles per hour.

Locations for high speed exits to accommodate Categories C and D aircraft were calculated for KOA's average temperature and elevation. Based upon the ICAO standard deceleration rate of 4.1 feet per second per second, the optimum exit locations were determined to be at 5,700 feet for Approach Category C aircraft and 7,600 feet for Approach Category D. Currently, the only high speed exit available is Taxiway C, which is located approximately 9,000 feet from the Runway 17 threshold. The potential locations and efficiency of additional exits will be considered in **Chapter Four - Alternatives**.

Holding aprons and bypass taxiways can also improve the efficiency of the taxiway system. Each runway end has a holding apron available. They are only large enough to store no more than two aircraft larger than Group IV due to insufficient wingtip clearances. The same should be considered with the development of a parallel runway.

HELICOPTER TOUCHDOWN AND LIFTOFF AREA (HELIPORT)

The airport does not have a designated heliport. There are designated helicopter parking areas on the south general aviation ramp. Itinerant helicopters utilize the same runway procedures as fixed-wing aircraft. Helicopter training operations use areas at the north and south ends of the parallel taxiway, but these are not specifically marked or truly independent from other airfield operations. Helicopter and fixed-wing aircraft should be segregated to the greatest extent possible.

Facility planning should include establishing a designated helicopter

landing and takeoff area or heliport on the airport. The heliport facilities should be planned with up to three independent touchdown and lift-off areas (TLOFs), each with access to helicopter parking, hangars, and a passenger terminal facility. These landside needs are discussed later in the chapter.

At a minimum, an area for segregation of training touch-and-go's and autorotations is needed. A training strip 1,500 feet long and between 50 and 300 feet wide should be planned.

NAVIGATIONAL AIDS AND INSTRUMENT APPROACH PROCEDURES

Navigational Aids

Navigational aids are electronic devices that transmit radio frequencies which properly equipped aircraft and pilots translate into point-to-point guidance and position information. The types of electronic navigational aids available for aircraft flying to or from Kona International Airport at Keahole include the very high frequency omnidirectional range/distance measuring equipment (VOR/DME) facility, global positioning system (GPS), area navigation (RNAV), and for the military, tactical air navigation (TACAN). These systems are sufficient for navigation to and from the airport; therefore, no other navigational aids are needed at the airport.

The VOR and TACAN are FAA and DOD facilities that are currently colocated off-site south of the airport. For security reasons, the FAA is considering relocating the facility to airport property. This is being coordinated with this Master Plan.

GPS was developed and deployed by the United States Department of Defense as a dual-use (civil and military) radio navigation system. GPS initially provided two levels of service: the GPS standard positioning system (SPS), which supported civil GPS uses; and the GPS precise positioning system (PPS), which was restricted to U.S. Armed Forces, U.S. federal agencies and selected allied armed forces, and government use.

The differences in GPS signals have been eliminated and civil users now access the same signal integrity as federal agencies. A GPS modernization effort is underway by the FAA and focuses on augmenting the GPS signal to satisfy requirements for accuracy, coverage, availability, and integrity.

For civil aviation use, this includes the continued development of the Wide Area Augmentation System (WAAS), which was initially launched in 2003. The WAAS uses a system of reference stations to correct signals from the GPS satellites for improved navigation and approach capabilities. Where the present GPS provides for enroute navigation and limited instrument approach (nonprecision) capabilities, WAAS provides for approaches with both course and vertical navigation. This capability was historically only provided by an instrument landing system (ILS), which requires extensive on-airport facilities.

The WAAS upgrades are expected to allow for the development of ap-

proaches to most airports with cloud ceilings as low as 200 feet above the ground and visibilities restricted to ½ mile, after 2015. KOA should plan for this potential at least in the long term.

Instrument Approach Procedures

Instrument approach procedures have been established for the airport using GPS, RNAV, VOR/DME, TACAN, as well as the instrument landing system (ILS). The ability to access the airport using different navigational aids allows the most flexibility for aircraft operators, by not requiring that they have a specific navigational aid on board to access the airport. This also provides significant levels of redundancy should a primary navigational aid fail.

A Category I ILS approach is available to Runway 17. The Category I approach provides for landing when the cloud ceilings are as low as 200 feet above the ground and visibility is restricted to ½-mile.

An RNAV approach with a GPS overlay is available to each runway end. GPS approaches are currently categorized as to whether they provide only lateral (course) guidance or a combination of lateral and vertical (descent) guidance. An approach procedure with vertical navigation guidance (VNAV) GPS approach provides both course and descent guidance. A lateral navigation approach (LNAV) approach only provides course guidance. Both runways have VNAV and LNAV available.

In the future as WAAS is upgraded, precision approaches similar in capability to the existing ILS will become available. These approaches are currently categorized as the Global Navigation Satellite System (GNSS) Landing System (GLS). A GLS approach may be able to provide for approaches with ½ mile visibility and 200-foot cloud ceilings. A GLS would supplement the existing ILS approach to the Runway 17. A GLS should be planned for Runway 35 as well. A GLS approach requires an approach lighting system that is already available for the Runway 17 end, and would be needed for Runway 35.

The initial parallel runway can be developed as a visual runway. The parallel runway should ultimately have at least non-precision GPS instrument capability to serve as a back-up to the primary runway.

LIGHTING AND MARKING

Currently, there are a number of lighting and pavement marking aids serving pilots using KOA. These lighting systems and marking aids assist pilots in locating the airport at night or in poor weather conditions, and assist in the ground movement of aircraft.

Identification Lighting

The airport is equipped with a rotating beacon to assist pilots in locating the airport at night. The existing rotating beacon is located on top of the airport traffic control tower. The

rotating beacon is sufficient and should be maintained through the planning. It is required for the airport to maintain its certification for scheduled airline activity. The FAA is relocating the control tower in 2012, and the rotating beacon will be relocated to the top of the new tower.

Runway and Taxiway Lighting

Runway 17-35 is equipped with high intensity runway lights (HIRL). The runway is also equipped with threshold lights, which indicate the location of the runway threshold at night. These lighting aids are required to maintain the ILS approach to Runway 17.

Any future parallel runway should be equipped with medium intensity runway lights (MIRL) to allow nighttime and instrument operations.

Effective ground movement of aircraft at night and during instrument conditions can be enhanced by taxiway lighting. Currently, all airfield taxiways are equipped with medium intensity taxiway lights (MITL). An upgrade to an LED system could be considered to reduce maintenance and energy costs.

KOA is equipped with pilot-controlled lighting (PCL). PCL allows pilots to activate the HIRL and MITL from dusk to dawn using the radio transmitter in the aircraft. This system should be maintained through the planning period.

Airfield Signs

Lighted airfield signage currently conforms with FAR Part 139 standards. Lighted directional and hold signs are installed at the airport. This signage identifies runways, taxiways, and apron areas. These aid pilots in determining their position on the airport and provide directions to their desired location on the airport.

The runway is also equipped with distance remaining signs. These lighted signs are placed in 1,000-foot increments along the runway to notify pilots of the length of runway remaining and should be maintained in the future.

This airfield signage is sufficient and should be maintained through the planning period, and included with any future parallel runway development.

Visual Approach Lighting

The landing phase of most flights to the airport must be conducted visually. Visual glide slope indicators provide visual descent guidance information during approach. There are two forms of these aids that have been regularly installed by the FAA at airports. They include precision approach path indicators (PAPI) and visual approach path indicators (VASI). PAPI-4's are in use at KOA, and should be planned for the parallel runway as well.

Approach Lighting

Approach lighting systems consist of a configuration of signal lights extending into the approach area from the runway threshold to aid pilots transitioning from instrument flight to visual flight and landing. A medium intensity approach lighting system with runway alignment indicator lights (MALSR) is installed on the Runway 17 end to assist pilots in landing during inclement weather conditions. A similar lighting system would be needed on Runway 35 to support a future GLS approach.

Runway End Identification Lighting

Runway end identification lighting provides the pilot with rapid and positive identification of the runway end. The most basic system involves runway end identifier lights (REILs). As REILs provide pilots with the ability to identify the runway ends and distinguish the runway end lighting from other lighting on the airport and in the approach areas. There are currently no REILs in service at KOA. REILs are typically not needed when another approach lighting system is in operation. REILs may be considered for any future parallel runway.

Pavement Markings

Pavement markings are designed according to the type of instrument approach available on the runway. FAA AC 150/5340-1H, *Markings of Paved Areas on Airports*, provides the guidance necessary to design an airport's markings. The Runway 17 and 35 ends are equipped with precision runway markings. A future parallel runway should be equipped with nonprecision runway markings.

Taxiway and apron areas also require marking to assure that aircraft remain on the pavement. Yellow centerline stripes and taxiway edge markings are currently painted on all taxiway and apron surfaces at the airport to provide this guidance to pilots. Besides routine maintenance, these markings will be sufficient through the planning period.

WEATHER REPORTING

Kona International Airport at Keahole is equipped with an Automated Surface Observation System (ASOS). The ASOS provides automated aviation weather observations 24 hours-a-day. The system updates weather observations every minute, continuously reporting significant weather changes as they occur. The ASOS reports cloud ceiling, visibility, temperature, dew point, wind direction, wind speed, altimeter setting (barometric pressure), and density altitude (airfield elevation corrected for temperature). This system is essential for aircraft operations and should be maintained through the planning period.

The airport is equipped with three lighted wind cones providing visual wind direction and speed information to pilots. The wind cones are near each runway end as well as with the segmented circle near midfield. These

wind cones are required for the airport's certification and should be maintained through the planning period.

A segmented circle identifies the proper landing pattern for each runway. This segmented circle is required for the airport's certification and should be maintained through the planning period.

AIRPORT TRAFFIC CONTROL TOWER

The existing airport traffic control tower (ATCT) is located on the east side of the airfield, south of the terminal building and north of the aircraft rescue and firefighting facility. The current wood structure is old and out of date. The cab height is not sufficient to provide line-of-sight for all airfield operating areas. A northern section of Taxiway A, a small portion of Taxiway G, and much of the terminal apron are not visible from the tower. The FAA began construction of a new ATCT at KOA in 2010. Completion and commissioning is scheduled for 2012. This has been coordinated with this Master Plan.

An airport traffic control beacon interrogator (ATCBI-5) is located on the airport. The FAA owned and operated ATCBI-5 is a long-range radar used in enroute air traffic control. The radar will be maintained by the FAA through the planning period. Upgrades to this system will be the responsibility of the FAA.

The ATCBI-5 has a critical area encompassing a 1,500-foot radius around the facility. Objects within this radius should be at or below the elevation of the radar, or 159 feet above mean sea level (MSL).

PASSENGER TERMINAL COMPLEX REQUIREMENTS

Requirements for the passenger terminal complex include aircraft gate positions, terminal building facilities, access and parking. This section identifies the facilities required to meet the airport's terminal complex needs through the planning horizons. The review of the capacity and requirements for various terminal complex functional areas was performed with the guidance of FAA Advisory Circular 150/5360-13, *Planning and Design Guidelines for Airport Terminal Facilities*, the *TSA Recommended Security Guidelines for Airport Planning, Design and Construction*, and *IATA Level of Service Standards*.

TERMINAL GATE ANALYSIS

Gate Capacity and Utilization

Currently, the airport is divided into two separate air terminals: North and South. Both have five gates for a total of 10 gates at the airport. In the base year of 2006, the North Terminal was served by United Airlines, Aloha Airlines, US Airways, Delta Airlines, Go!, and Japan Airlines (JAL). There is an aircraft mix of wide-body, narrow-

body, and regional jets serving this concourse. The South Terminal was served by American Airlines, Hawaiian Airlines, Northwest Airlines, Delta, and Island Air.

In comparison, the South Terminal served fewer wide-body flights. This accounts for the higher passenger traffic levels at the North Terminal. According to the August 18, 2006, flight schedule, there were a total of seven wide-body flights at the North Terminal and four at the South Terminal. **Exhibit 3E** presents the gate occupancy based upon the August 18, 2006 flight schedule.

In order to calculate the average gate utilization at the airport, dwell times were averaged for the four major aircraft types from the design day flight schedule: large wide-body, wide-body, narrow-body, and regional jets. Applying these dwell times to the number of aircraft types per gate and dividing by the airport operating hours provides the average utilization per gate.

The average gate utilization for both North and South Terminals was 30 percent. It is important to note that the total gate usage was 32 hours for the North Terminal and 21 hours for the South Terminal. This further indicates that one terminal has been used more heavily than the other, resulting in the disproportionate demands. When a new carrier enters the airport or an existing airline increases flights, a rebalancing of gate utilization should be considered.

Aircraft Gate Position Requirements

According to the airline operations forecast in the previous chapter, the airport can expect a gradual decline in service from narrow-body aircraft and growth in regional jets and wide-body aircraft. The aircraft gates requirements are calculated based on the current and forecast design day peak hour operations. The average dwell times as determined from the 2006 design day flight schedule were 30 minutes for regional jets, 30 minutes for narrow-body, 150 minutes for wide-body, and 90 minutes for large wide-body. Gate requirements are based on peak hour operations, so dwell times greater than 60 minutes were assumed to require one gate for the full hour.

Industry standard dwell times were used for future gate requirements in order to optimize the use of existing facilities. The requirements are also based on peak hour operations and fleet mix forecasts. Finally, the base year gate utilization factor of 30 percent was applied to determine the number of gates required to accommodate the projected operations at the same activity level as in the current base schedule. There are 10 aircraft gates available, with five at each terminal.

Based on this utilization factor, the resulting base year requirements were 12 gates, short term is 12 gates, intermediate is 12 gates, and long range is 14 gates. There has been joint usage on some, but not all, gates. If

joint usage continues, utilization can be increased, thereby requiring fewer gates. **Table 3M** presents the aircraft gate position requirements.

TABLE 3M
Aircraft Gate Position Requirements
Kona International Airport at Keahole

Demand Level	Dwell Minutes	2006	Optimized Dwell Time	Short Term	Inter. Term	Long Term
Annual Aircraft Operations		37,436		38,986	40,554	44,824
Peak Month Operations		3,628		3,776	3,932	4,364
Design Day Operations		122		128	134	148
Aircraft Gates						
Peak Hour Operations		12		13	14	16
Average Gate Utilization		30%		30%	30%	30%
Large Wide-body (B747,B777)	60	0	60	1	1	1
Wide-body (B757,B767)	60	3	45	3	3	4
Narrow-body (B717,B737)	30	5	30	5	5	6
Regional Jets (CRJ)	30	3	25	3	3	4
Total Gates		**12**		**12**	**12**	**14**

TERMINAL BUILDING CAPACITY

The facility requirements determination for the passenger terminal begins with a demand-capacity analysis of existing facilities. This analyzes the current capacity of key processing areas and compares that to the passenger demand at the airport. The purpose of the analysis is to quantify and qualify the level that the existing terminal facilities satisfy the current demand of the traveling public at Kona International Airport at Keahole. The objectives of this analysis are as follows:

- Quantify the levels of activity related to the combined capacity of the individual passenger processing elements of the terminal.

- Determine what additional facilities would be required to optimize passenger processing by balancing the flow of the processing with the efficiency of space utilization.

- Analyze the terminal building to identify physical conditions that may currently exist, or are likely to develop with increased demand, that will compromise functional efficiency. In addition, existing vacant space and area for expansion are identified.

- Provide the planning team with a comprehensive understanding of the existing terminal facilities as the basis to optimize the facilities and to develop alternatives for meeting future needs at KOA.

With the demand capacity analysis serving as a basis, the terminal facilities requirements quantify and qualify the facilities that would be required to accommodate the forecast demand. The terminal facilities requirements also serve as a base for the development of alternatives.

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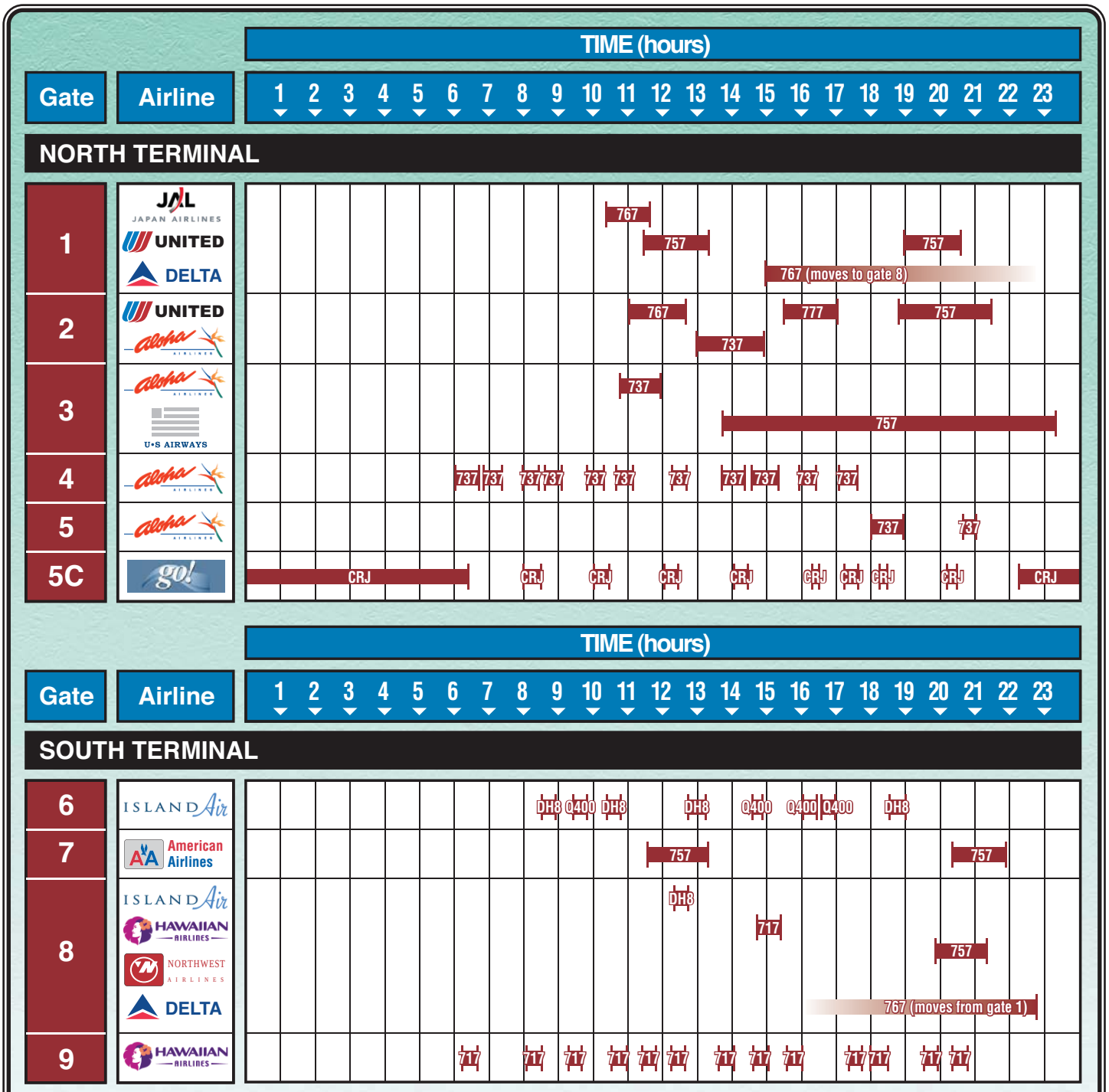

AIRCRAFT KEY

- 717 - Boeing 717
- 737 - Boeing 737
- 747 - Boeing 747
- 757 - Boeing 757
- 767 - Boeing 767
- 777 - Boeing 777
- CRJ - Canadair Regional Jet
- DH8/Q400 - De Havilland Dash-8

LEGEND

Aircraft Departure | Aircraft Arrival | Aircraft at Gate

Source: Gate Utilization Survey, August 18, 2006; Hawaii DOT-Airports Division

Note: Aloha Airlines ceased all operations March 31, 2008

Methodology

A spreadsheet model is the tool used for accomplishing the terminal demand-capacity analysis. The model is based on industry standards and is calibrated specifically to represent this terminal and its operations. The physical aspects of the terminal, including numbers of processing units and function areas for all processing and support spaces, were derived from Chapter One - Inventory.

The demand input used for the model is based on the peak hour of the August 18, 2006 flight schedule. The operational input for processing of passengers is derived from observations, airport staff, and other tenants. Calculations are based on the standard queuing theory, which simply stated is: passengers arriving minus passengers processed equals passengers in queue.

The evaluation of individual processing elements is based on industry standards and formulas. Computer simulations are not employed in these evaluations. Building information modeling (BIM), however, has been integrated as a planning tool into this master plan methodology.

The existing airport terminal and its individual facilities have been modeled in a 3D virtual model. Each facility (such as ticket lobbies, security checkpoints, etc.) has been modeled as a separate object with attributes attached that contain information relevant to this study, such as area, volume, cost estimates, passenger demand, and applicable facility processing information. In this chapter, the model is linked to the spreadsheets to provide the necessary information for the demand capacity evaluation. In the next chapter, alternatives that fulfill the facility requirements will be evaluated utilizing the BIM.

The spreadsheet model used to determine the terminal facilities requirements is an extension of the demand-capacity analysis model. The former utilizes the same industry standards that include service goals, functional space standards, and operational parameters.

The terminal facilities requirements are based on the forecasts that have been developed for three future planning horizon activity levels. Calibrations for operational processing utilize on-site observed and measured rates for the base year demand-capacity analysis. However, industry standards and anticipated calibrations due to industry changes have been included in the facility requirements calculations in order to arrive at an optimized facility condition.

Passenger Demand and Peak Hour

The current passenger demand was derived from the August 2006 consolidated flight schedule for the average day of the peak month. August is considered part of the peak period of the year and the flight schedule provides a reasonable basis for design demand. When this demand is coupled with a level of service that is supportive, effi-

cient, and economical to functions of the airport, appropriate requirements for future facilities can be forecast. The flight schedule is used to estimate the total daily departing and arriving passengers and to determine the daily traffic pattern and peaking conditions that produce the largest demands on the facilities.

As indicated earlier, Kona International Airport at Keahole is essentially comprised of two independently functioning terminals. The North and South Terminal each have their own processing facilities, including a ticket lobby, security checkpoint, concourse, and baggage claim. Since the aircraft and airlines serving each terminal are different, the passenger demand on each side will also be different. Thus, to effectively evaluate the capacity of the facilities, it was necessary to determine the passenger demand on each terminal separately.

Based on the flight schedule for departing flights, the North Terminal has experienced more aircraft operations and more passenger demand than the South Terminal. From the 2006 flight schedule, it was determined that the North Terminal serviced the majority of the larger widebody aircraft for overseas flights operated by United, US Airways, Delta and JAL. The total passenger demand, including departures and arrivals on the design day, was 6,366 at the North Terminal.

In contrast, the South Terminal handled 4,517 on the design day. Since Japan Airlines arriving passengers are processed in the separate Customs Border Protection (CBP) facility (formerly U.S. Immigrations and Customs), that arrivals demand has been separated from the above figures. The passenger arrival demand for this daily flight was 237 passengers. **Table 3N** outlines the passenger demand by terminal.

TABLE 3N
Passenger Demand Analysis
Kona International Airport at Keahole

	North Terminal	%	South Terminal	%	CBP Facility	%	Totals
Departing Passengers							
Design Day	3,283	58%	2,419	42%	N/A	N/A	**5,702**
Arriving Passengers							
Design Day	3,083	57%	2,098	39%	237	4%	**5,418**
Total Passengers	**6,366**	57%	**4,517**	41%	**237**	2%	**11,120**

**Based on August 2006 flight schedule*

As shown in the table, there was a significant difference in the passenger demand handled by the two terminals. The North Terminal handled 58 percent of the departing passenger demand compared to 42 percent in the South Terminal. While four percent of the arriving passengers were processed through the Customs and Border Protection (CBP) facility, 57

percent were handled in the North Terminal, and 39 percent in the South Terminal. Overall, the North Terminal processed 57 percent and the South Terminal 41 percent of the total passenger demand.

These proportions were applied to the passenger peak hour demand forecasts in order to establish a baseline for evaluating the requirements of individual facilities within the North and South Terminals. As explained later in this chapter, the facility requirements were determined based on the scenario that the airport will continue to operate as two separate terminals throughout the future planning horizons as established by the forecasts. This assumption serves as a baseline to allow for further analysis and evaluation of the need to merge whole or specific facility components of the airport.

The peaking conditions that are important to the evaluation of the terminal are: arrivals peak hour, departures peak hour, and the combined peak hour. The peak hour demand is derived from the flight schedule and is basically defined as the number of passengers utilizing the airport within a one-hour period. Each peak places demands on the various functions and different areas within the terminal. The peaks are also expressed as numbers of passengers as well as aircraft operations.

Departures Peak Hour - The departures peak hour occurred from 12:30 p.m. to 1:30 p.m. and consisted of eight total flights. The flights were split evenly between the two terminals. The flights that occurred in the North Terminal were serviced by United, Aloha, and Go! Airlines. The two United flights during this peak hour were wide-body aircraft with overseas destinations. The flights that occurred in the South Terminal were serviced by American, Hawaiian, and Island Air. The one American flight was a wide-body aircraft with an overseas destination. By applying the terminal demand proportions as explained above, the departures peak hour for the North Terminal was 553 passengers, and 400 passengers for the South Terminal.

Arrivals Peak Hour - The arrivals peak hour occurred from 10:30 a.m. to 11:30 a.m. and consisted of seven flights. Four of those flights occurred in the North Terminal and were operated by United and Aloha. Two of the United flights were by wide-body aircraft. The other three flights occurred in the South Terminal and were operated by American and Hawaiian. The American flight was a wide-body aircraft. By applying the terminal demand proportions as explained above, the arrivals peak hour for the North Terminal was 656 passengers, and 438 passengers for the South Terminal.

Combined Peak Hour - The combined peak hour occurred from 2:30 p.m. to 3:30 p.m. and consisted of 13 departing flights. These flights were operated by United, Delta, Island Air, Go!, Aloha, and Hawaiian. The combined departures and arrivals peak hour demand was 1,247 passengers.

Table 3P presents the base year passenger demand as well as the demand

for the three planning horizons. The demand and forecast have been determined for both the North and South Terminals individually according to the proportions shown above.

Demand-Capacity Factors

Passenger Profiles - The passenger demand is accommodated in various ways. For example, the departing passengers may or may not have baggage and may check in for a flight in the ticketing lobby or remotely with e-tickets. As such, the number of options for processing passengers and the percentage of passengers exercising each option are determined by the passenger profiles. A basic profile that considers all possible inputs was developed to represent departing and arriving passengers at the airport. The profiles also include the ratio of well-wishers and greeters who accompany the passengers. **Table 3Q** presents the passenger profiles for KOA.

TABLE 3P
Passenger Demand
Kona International Airport at Keahole

	Base Year (2006)	Short Term	Intermediate Term	Long Term
NORTH TERMINAL				
Departing				
Annual	883,014	1,001,080	1,096,780	1,350,820
Design Hour (Ticket Lobby)	553	611	672	835
Design Hour (Hold room)	553	611	672	835
Design Hour (Mainland)	356	411	493	706
Design Hour (Interisland)	255	274	284	312
Arriving				
Annual	887,946	1,024,800	1,129,800	1,396,800
Design Hour	656	736	814	1,013
Total Passengers				
Annual	1,770,960	2,025,880	2,226,580	2,747,620
Design Hour (Ticket Lobby)	1,209	1,347	1,486	1,848
Design Hour (Hold room)	1,209	1,347	1,486	1,848
Peak 20 Min.	617	660	730	900
SOUTH TERMINAL				
Departing				
Annual	639,424	724,920	794,220	978,180
Design Hour (South Ticket Lobby)	338	373	411	511
Design Hour (Central Ticket Lobby)	62	69	76	94
Design Hour (Hold room)	400	442	487	605
Design Hour (Mainland)	258	298	357	511
Design Hour (Interisland)	184	198	205	226
Arriving				
Annual	591,964	683,200	753,200	931,200
Design Hour	438	490	542	676
Total Passengers				
Annual	1,231,388	1,408,120	1,547,420	1,909,380
Design Day	4,441	4,830	5,300	6,540
Design Hour	838	932	1,029	1,281
CUSTOMS & BORDER PROTECTION				
Arriving				
Design Hour (International)	237	329	350	450

TABLE 3Q
Peak Hour Passenger Demand Profile
Kona International Airport at Keahole

	Factor %	2006	Factor %	Short Term	Factor %	Inter. Term	Factor %	Long Term
NORTH TERMINAL								
Departing Passengers								
Curbside	0	0	0	0	0	0	0	0
Counter/Kiosk Check-in	90	498	80	489	75	504	70	585
Remote Check-in	10	55	20	122	25	168	30	251
Subtotal	100	553	100	611	100	672	100	835
Arriving Passengers								
Claiming	90	590	90	662	90	733	90	912
Bypass Claim	10	66	10	74	10	81	10	101
Subtotal	100	656	100	736	100	814	100	1,013
Well-wishers	20	111	20	122	20	134	20	167
Greeters	20	131	20	147	20	163	20	203
SOUTH TERMINAL								
Departing Passengers								
Curbside	0	0	0	0	0	0	0	0
Counter/Kiosk Check-in	90	360	80	298	75	308	70	358
Remote Check-in	10	40	20	75	25	103	30	153
Subtotal	100	400	100	373	100	411	100	511
Arriving Passengers								
Claiming	90	394	90	441	90	488	90	608
Bypass Claim	10	44	10	49	10	54	10	68
Subtotal	100	438	100	490	100	542	100	676
Well-wishers	20	80	20	75	20	82	20	102
Greeters	20	88	20	98	20	108	20	135

Processing Parameters - The processing parameters consist mostly of transaction times for the processing of passengers for departing or arriving flights. Some of these functions, like baggage claim, are dependent on the time it takes to process an entire aircraft load of passengers. **Table 3R** provides a list of the parameters that determine the number of processing facilities required for the peak conditions of the design day.

Space Standards - The space standards are a dimensional requirement that represent the elements of the terminal or are determined to be desirable alternatives to existing dimensions. For example, the depth of the baggage claim lobby may be inadequate and a larger depth may be specified as optimal to be added in the future. **Table 3R** outlines the facilities input variables used in the analysis.

TABLE 3R
Terminal Facilities Input Variables
(Service Levels, Space Standards, and Processing Rates)
Kona International Airport at Keahole

Function/Facility	Standard Units	Space Project Factor		Optimized Future Factor	Description/Comments
		North	South		
Terminal Design Activity Level		**85%**		**85%**	The processing level established for balanced operations for the peak hour average day peak month (% of total capacity)
Departures Processing					
Agricultural Check					
Inspection Rate Pax/Hour	Pax/ Hr	**200**	**200**		Pax checked through Agricultural check per hour per x-ray unit.
% of Mainland People checking bags	%	**0.80**	**0.80**		
Ticket Counters					
Ticketing Utilization Level (TUF)	%	**0.85**	**0.66**	**1.00**	Percentage of Counter positions used during the peak hour peak period.
% of Peak Hour Demand	% Pk.Hr.	**50**	**50**		% of total Peak Hour Passengers demand in Peak Period
Domestic/Mainland Ticketing rate	Min/ Pax	**1.3**	**1.3**		Average agent ck-in or ticketing rate for transaction
International Ticketing rate	Min/ Pax	**n/a**	**1.3**		Average agent ck-in or ticketing rate for transaction
Frontage / Agent Position	Ft.	**5.3**	**5.3**		3'-6" Desk Positions with half of 3'-6" bag well
Depth Ticket Counter	Ft.	**11**	**11**		Includes counter depth, standing work area and circulation behind
North/South Ticket Lobby (Queueing)					
Domestic/Mainland Service Goal Min.	Min	**15.0**	**15.0**		Maximum average waiting time for passenger in queue.
International Service Goal Min.	Min	**n/a**	**15.0**		Maximum average waiting time for passenger in queue.
Outbound Baggage Depth	Ft.	**68**	**107**		Average Depth of baggage handling space
Queuing Area / Person	Ft^2	**16.1**	**16.1**		Level Of Service C+
Queuing Area Depth	Ft.	**24.3**	**24.3**		
Airline Ticket Office Depth	Ft.	**43**	**29**		Average Depth of ATO space
Ticket Lobby circulation	Ft.	**22.0**	**20.5**		
Central Ticket Lobby (Queueing)					
Domestic/Mainland Service Goal Min.	Min	**n/a**	**15.0**		Maximum average waiting time for passenger in queue.
Outbound Baggage Depth	Ft.	**n/a**	**0**		Average Depth of baggage handling space
Queuing Area / Person	Ft^2	**n/a**	**16.1**		Level Of Service C+
Queuing Area Depth	Ft.	**n/a**	**18.1**		
Airline Ticket Office Depth	Ft.	**n/a**	**15**		Average Depth of ATO space
Ticket Lobby circulation	Ft.	**n/a**	**4.5**		

TABLE 3R (Continued)
Terminal Facilities Input Variables
(Service Levels, Space Standards, and Processing Rates)
Kona International Airport at Keahole

Function/Facility	Standard Units	Space Project Factor		Optimized Future Factor	Description/Comments
		North	South		
Public Area					
Circulation area per person	Ft^2	**116**	**349**		Calculated from drawings
Security					
Inspection Rate Pax/Hour	Pax/ Hr	**104**	**104**	**200**	Pax checked through security per hour per x-ray unit.
Security Service Goal Minutes	Min	**7**	**7**	**10**	Maximum wait in queue
Security Station Width	Ft.	**11.5**	**11.5**	**12.5**	Width of x-ray plus passing lane with magnetometer
Security Station Length	Ft.	**24**	**24**		Length of x-ray station input to reclaim
Area/Station	Ft^2	**277**	**277**		
Queuing Area / Pax	Ft^2	**16.1**	**16.1**		Level Of Service C+
ARRIVAL FACILITIES					
Baggage Claim					
Device Utilization Factor (DUF)	%	**50%**	**100%**		Percentage of the peak hour that all devices are in use.
Checked Bags per passenger	#	**1.8**	**1.8**		Average number of Checked bags per Passenger.
Frontage/Bag	Ft.	**2.5**	**2.5**	**1.5**	Average frontage for bags on claim device.
% Total Bags Displayed	% Pk.Hr.	**30%**	**30%**		% of total Hourly bags displayed.
Flat Bed Device Length	Ft.	**52**	**53**		Average for existing space from drawings
Claim device Area	Ft^2	**1,701**	**797**		Calculated
Device frontage per Flat Bed Device	Ft.	**133**	**133**	**185**	Existing = flat plate; Optimized = sloped plate 185 lf
Claim Lobby					
Claim Area	Ft^2/ Pax	**18.3**	**18.3**		IATA service level C+
Service Goal Minutes	Minutes	**20**	**20**		Delivery cycle of single flight bags to device
Public Area					
Ticket Lobby Circulation Length	Ft.	**204.9**	**194.0**		Calculated from drawings
Concourses					
Passenger Holdrooms					
Area S.F./ Occupant	Ft^2	**14**	**14**		Based on 60% seating @15sf, 40% standing @10sf + 10% for circ.
Airline Operations	Ft^2	**500**	**500**		Per peak hour departure (AC150-5360-13)
Area allowance for podiums & AC exit	Ft^2	**350**	**350**		Per gate
Airline Clubrooms					
Clubroom % of total holdroom area	%	**6**	**10**		Percentage of total passengers using clubs
Holdrooms / Clubroom	#	**5**	**5**		Ratio of gate to Club rooms
Average Clubroom area	Ft^2	**525**	**825**		Clubroom size

TABLE 3R (Continued)
Terminal Facilities Input Variables
(Service Levels, Space Standards, and Processing Rates)
Kona International Airport at Keahole

Function/Facility	Standard Units	Space Project Factor		Optimized Future Factor	Description/Comments
		North	South		
Concourse Circulation					
Circulation length	Ft^2	**132.2**	**132.0**		Calculated from drawings
Public Spaces					
Rest Rooms					
Area per peak hour passenger	Ft^2	**2,400**	**2,400**		Area/ 500 peak hour pax (AC150-5360-13 =1800, add for current standard)
Distance between restrooms	Ft.	**312**	**312**		To farthest restroom
Concessions		**8.40**	**8.40**		Area per 1,000 annual enplaned passenger (inc, 15% support area)
Food and Beverage	Ft^2/K ann.	**5.46**	**5.46**		Area per 1,000 annual enplaned passenger (inc, 15% support area)
Retail	Ft^2/K ann.	**2.94**	**2.94**		Area per 1,000 annual enplaned passenger (inc, 15% support area)

Level of Service - Table 3S presents the level of service standards used in the capacity analysis. Levels of service designations are of relevance to the comfort and quality of the passenger experience. One measurement of level of service is the desired personal space to be provided at peak passenger occupancy during a queuing situation, such as ticketing, baggage claim, or a gathering place such as the hold room and circulation areas.

Because of the large proportion of tourist passengers with a high number of checked and carry-on baggage, a level of service C+ was selected as appropriate for projections of the facilities at Kona International Airport at Keahole. This is slightly higher criteria for determining demand than standard planning practice, but is considered appropriate due to the nature of the tourism and visitor industry served by KOA.

Capacity Evaluation

Each of the processing functions was evaluated using the inputs and demand described above. Related processing functions were evaluated in the sequential experience by passengers. Only those functions for which user demand can be determined were evaluated. Secondary facilities that support processing were sized either in proportion to the existing ratio, or the ratio was altered to correct imbalances. The demand-capacity evaluations of related sequential functions were averaged to indicate the overall performance of the facilities. All facilities were adjusted to process a balanced capacity for the entire terminal.

A level of 85 percent of capacity was set up as the design utilization factor (DUF). This design level of activity is chosen as a “trigger” to initiate design

and construction of new facilities. The excess of 15 percent capacity allows for continuing growth during the design and construction period until new expanded facilities come on line.

TABLE 3S
Level of Service Standards (in square feet)
Kona International Airport at Keahole

	Area per Occupant							
Level of Service Standards	**A**	**B**	**C+**	**C**	**C-**	**D**	**E**	**F**
Check-in Queue Area	19.4	17.2	16.1	15.1	14.0	12.9	10.8	System Failure
Wait/Circulate	29.1	24.8	22.6	20.4	18.3	16.1	12.8	
Hold Room	15.1	13.5	12.8	12.0	11.3	10.5	8.0	
Bag Claim Area (excludes claim device)	21.5	19.4	18.3	17.2	16.1	15.1	12.9	
Federal Inspection Services	15.1	12.9	11.8	10.8	9.7	8.6	6.5	

Legend
A. Excellent level of service; conditions of free flow; excellent level of comfort.
B. High level of service; condition of stable flow; very few delays; high level of comfort.
C. Good level of service; condition of stable flow; acceptable delays; good level of comfort.
D. Adequate level of service; condition of unstable flow; acceptable delays for short periods of time; adequate level of comfort
E. Inadequate level of service; condition of unstable flow; unacceptable delays; inadequate levels of comfort
F. Unacceptable levels service; conditions of cross flows, system breakdown and unacceptable delays; unacceptable levels of comfort

Departure Processing Evaluation

Table 3T summarizes the demand capacity analysis for departure processing at the North and South Terminals. The following paragraphs discuss each of the components of departure processing.

USDA Agricultural Check – All passengers departing to the mainland are required to have bags inspected by the United States Department of Agriculture (USDA) prior to checking them to their destination. The ratio of departing mainland passengers during peak hour demand that would check their bags is 80 percent. Floor area calculations and agent positions are based on existing facilities. The capacity of the current facility was based on the existing number of stations and the passenger processing rate for a one hour period.

The USDA agricultural check stations at the North Terminal were found to be operating at 142 percent capacity in 2006. The South Terminal stations were operating at 52 percent capacity. The extreme difference is due to the fact that there are two USDA agricultural check stations at the South Terminal, but only one at the North Terminal even though passenger demand is higher.

Ticket Counters – The percentage of the departing passenger peak hour demand that would check in at the ticket lobby is 90 percent. The remaining 10 percent account for passengers that would have checked in on the web prior to arriving at the airport. Active ticket agent positions, frontage, workspace floor area, and vacant counters are based on existing facilities.

TABLE 3T
Existing Demand Capacity Analysis – Processing Facilities
Kona International Airport at Keahole

Facility Title	Units	Existing 2006	Existing Processing Capacity	Existing % of Capacity	Cap. Inc. (Dec.)	2006 Required Facilities	Required Facilities at 85% DUF
NORTH TERMINAL							
Planning Activity Level		**1,770,960**					
Departures Processing (peak hour demand)							
Agricultural Check (pre-security)	Pax	**285**	**200**	**142%**	**85**	**285**	**170**
Number of Stations	#	1			1	1	1
Area of Queuing	Ft^2	317			216	535	319
Ticket Counters	Pax	**498**	**667**	**75%**		**498**	**567**
Agent Positions (Active)	#	17			(2)	13	14
Frontage	Ft.	110			(9)	67	76
Area	Ft^2	1,269			(99)	713	812
Vacant Counter	#	3					
Ticket Lobby	Pax	**553**	**551**	**100%**		**553**	**469**
Queuing Area	Ft^2	2,219			340	2,226	1,886
Outbound Baggage	Ft^2	12,389			947	6,206	5,259
Airline Ticket Office	Ft^2	4,419			601	3,939	3,338
Ticket Lobby Circulation	Ft^2	2,111			307	2,015	1,708
Public Area	Pax.	**664**	**821**	**81%**		**664**	**698**
Ticket Lobby Public Circ.	Ft^2	3,058			(128)	2,472	2,600
Security Station	Pax	**553**	**208**	**266%**		**553**	**177**
Number of Stations	#	2			4	5	2
Area of Queuing	Ft^2	1,256			707	1,039	332
Average Utilization (% of Capacity)	%			**133%**			
Area Total	Ft^2	**27,040**				**19,143**	**16,254**
SOUTH TERMINAL							
Planning Activity Level		**1,231,388**					
Departures Processing (peak hour demand)							
Agricultural Check (pre-security)	Pax	**206**	**400**	**52%**	**85%**	**206**	**340**
Number of Stations	#	2			(1)	1	2
Area of Queuing	Ft^2	415			(251)	388	639
Ticket Counters	Pax	**360**	**777**	**46%**		**360**	**660**
Agent Positions (Active)	#	26			(10)	12	22
Frontage	Ft.	189			(52)	62	114
Area	Ft^2	2,939			(554)	664	1,218
Vacant Counter	#	4					
South Ticket Lobby	Pax	**338**	**544**	**62%**		**333**	**463**
Queuing Area	Ft^2	2,191			(502)	1,360	1,863
Outbound Baggage	Ft^2	15,212			(2211)	5,990	8,202
Airline Ticket Office	Ft^2	3,597			(599)	1,624	2,223
Ticket Lobby Circulation	Ft^2	1,750			(424)	1,148	1,571
Central Ticket Lobby	Pax	**62**	**355**	**17%**		**62**	**302**
Queuing Area	Ft^2	1,429			(965)	250	1,214
Outbound Baggage	Ft^2	0			0	0	0
Airline Ticket Office	Ft^2	375			(800)	207	1,006
Ticket Lobby Circulation	Ft^2	361			(240)	62	302
Public Area	Pax.	**418**	**654**	**64%**		**418**	**556**
Ticket Lobby Public Circ.	Ft^2	9,634			(2033)	6,155	8,189
Security Station	Pax	**394**	**208**	**189%**		**394**	**177**
Number of Stations	#	2			2	4	2
Area of Queuing	Ft^2	1,119			419	751	332
Average Utilization (% of Capacity)	%			**72%**			
Area Total	Ft^2	**39,023**				**18,599**	**26,758**

The capacity of the ticket counters was calculated using the passenger processing rate derived from observation averages. The capacity was also based on the ticketing utilization factor which represents the percentage of counter positions used during the peak period. The ticket counters were operating at 75 percent of capacity at the North Terminal and 46 percent of capacity at the South Terminal.

Ticket Lobby – The adequacy of the ticket lobby floor area was evaluated to determine whether base year demands result in an acceptable level of service. The ticket lobby demand included a percentage of well-wishers in addition to the passengers. Industry standards assume that some passengers enter the queuing area with their family or friends for assistance. The evaluation was based on a service goal of a 15-minute maximum wait in queue, and a Level of Service C+ of 16 square feet per person in queue with baggage.

There are three separate locations of ticket lobbies at KOA: one at the North Terminal, one at the South Terminal, and another central location behind the Onizuka Space Center. The peak hour demand on each of the ticket lobbies was determined and the ticket lobby space was evaluated. The North Terminal ticket lobby was operating at 100 percent capacity, the South Terminal ticket lobby at 62 percent, and the central ticket lobby was operating at 17 percent.

Baggage Security Screening – The current state of the outbound baggage screening system includes explosive detection systems that are located within the ticket lobby at the North and South Terminals and adjacent to the ticket lobby at the North Terminal. Baggage screening at the American Airlines counters is accomplished by electronic trace detection (ETD) screening. Locating baggage screening within the ticket lobbies poses problems of passenger congestion since there are already queues associated with agricultural check for overseas baggage and ticketing.

Public Areas – The public areas are the spaces in front of ticketing, the security checkpoint, and the baggage claim area that are utilized by departing and arriving passengers for circulation space, as well as by meeters/greeters and well-wishers. This area also includes seating space around the planters. Therefore, the demand is based on the combined peak hour passenger numbers, and the capacity is based on the level of service standard for circulation space and the rate of passengers leaving the space.

It was determined that the public area at the North Terminal was operating at 81 percent of capacity and the South Terminal at 64 percent. This is consistent with observations of the space, confirming that during combined peak times there is sufficient space relative to the level of service.

Passenger Security Screening – Based upon on-site observations, the average processing rate at the security checkpoint is 104 passengers per hour. With two stations at each terminal, the capacity is 208 passengers per hour at both the North and South Terminals. It was calculated that the

security checkpoints at both the North and South Terminals were operating at 266 percent and 192 percent capacity respectively. The required queuing area for the checkpoint was determined based on 10 minutes as the TSA standard waiting time service goal and an area of 16 square feet per person at a level of service C+. This is in keeping with observations of the space, validating that the areas for queuing at both terminals are insufficient for the current demand level during peak times.

Arrival Processing Evaluation

Table 3U summarizes the demand-capacity analysis for arrivals processing at the North and South Terminals.

Baggage Claim – Because the majority of passengers are tourists at this airport, it is estimated that 90 percent of the arriving peak hour passengers claim their checked baggage. The remaining 10 percent of the passengers bypass the baggage claim areas and go directly to the curb or other ground transportation facilities. In order to determine the peak hour number of bags, it was estimated that each passenger checks an average of 1.8 bags. The bag claim capacity was based on the device frontage, frontage per bag, percentage of total bag displayed, and the design utilization factor (DUF).

The capacity based on the current available devices at the North Terminal is 355 peak hour bags and was operating at 300 percent of capacity in 2006. At the South Terminal, the capacity is 177 peak hour bags and was operating at 400 percent of capacity. The current number of bag claim devices as well as the claim frontage were both deficient for the base year demand at both terminals.

This claim device evaluation was based on characteristics of the existing flat plate baggage claim devices. Sloped plate devices would provide greater capacity due to their ability to display baggage vertically and to stack baggage. In calculating the claim device and claim frontage requirements, sloped plate device characteristics were used to present an optimized condition for evaluation.

Claim Lobby – The lobby area surrounding the flat bed claim devices is 9,604 square feet for the North Terminal and 5,334 square feet for the South Terminal. This area excludes the area of the device, but includes the active claim area and circulation space from the edge of the device to the low partition walls defining the baggage claim area. With the level of service C+ area of 18 square feet per person, the capacity for the claim device lobby space is 525 persons at the North Terminal and 291 persons at the South Terminal. As a result, the North Terminal claim lobby was operating at 137 percent capacity and at the South Terminal at 165 percent capacity in 2006.

TABLE 3U
Existing Demand Capacity Analysis Bag Claim and Lobby
Kona International Airport at Keahole

Facility Title	Units	2006	Existing Processing Capacity	Existing % of Capacity	Cap. Incr. (Decr.)	2006 Re-quired Facilities	Required Facilities at 85% DUF
NORTH TERMINAL							
Planning Activity Level		1,770,960					
Baggage Claim	Bags	1,063	355	300%		1,063	301
Devices	#	2			2	4	2
Device Frontage	Ft.	266			571	797	226
Inbound Baggage	Ft^2	17,738			35,475	52,213	17,738
Baggage Services Office	Ft^2	549			1,098	1,646	549
Claim Lobby	Pax+Gr.	722	525	137%		722	446
Area Excluding Devices	Ft^2	9,604			5,042	13,205	8,164
(inc. active claim & circ.)							
Public Area	Pax.	**722**	**570**	**127%**		**722**	**485**
Claim Lobby Public Circulation	$Ft.^2$	6,509				8,240	5,533
Average utilization (% of Capacity)	%			188%			
Area Total	Ft^2	34,400				76,304	31,893
SOUTH TERMINAL							
Planning Activity Level		1,231,388					
Baggage Claim	Bags	710	177	400%		710	151
Devices	#	1			3	4	1
Device Frontage	Ft.	133			419	532	113
Inbound Baggage	Ft^2	16,956			33,912	50,868	16,956
Baggage Services Office	Ft^2	157			313	470	157
Claim Lobby	Pax+Gr.	482	291	165%		482	248
Area Excluding Devices	Ft^2	5,334			4,283	8,817	4,534
(inc. active claim & circ.)							
Public Area	Pax.	**482**	**955**	**50%**		**482**	**812**
Claim Lobby Public Circulation	$Ft.^2$	9,782				4,935	8,314
Average utilization (% of Capacity)	%			170%			
Area Total	Ft^2	32,229				65,090	29,961
CUSTOMS AND BORDER PROTECTION							
CBP Facility	Pax.	**237**	**418**	**57%**	**85%**	**237**	**355**
Area	$Ft.^2$	18,130			(5,124)	10,287	15,411

Customs and Border Protection (CBP) – The current CBP facility is located at the north end of the terminal area in a white fabric strung structure. This facility processes international arriving passengers including the primary functions of passport control, baggage claim, and customs/agricultural check. The facility currently encompasses 18,130 square feet.

In assessing the capacity of the CBP facility, the "Airport Technical Design Standards" published by the CBP was consulted. The design standards indicated that an area of 8,362 square feet is necessary to handle 400 peak hour

passenger arrivals. This does not include baggage claim, so an additional 9,000 square feet was assumed for this function. This resulted in a CBP space requirement of 17,362 square feet. It was determined that the existing facility was operating at 57 percent of capacity in 2006. It should be recognized, however, that the facility was constructed as a temporary solution and a permanent state-of-the-art CBP facility should be planned.

Post-Security Facilities

Table 3V summarizes the demand capacity analysis for post-security facilities at the North and South Terminals.

Holdrooms – The holdroom capacity is based on the area required for seating 60 percent of the passengers, plus an additional 10 percent of the area for general circulation. Using the aggregate area of all holdroom space in each terminal, the base year capacity was 711 peak hour passengers in each terminal. This results in the total holdroom area operating at 78 percent and 56 percent capacity at the North and South Terminals, respectively.

The holdroom evaluation excludes the space necessary for podium functions and aircraft exit space. This space is required per the functionality of each gate and is not related to passenger demand. The capacity of the holdroom space was based on the assumption that the entire holdroom area is shared by all gates and can be occupied by any outbound passenger. However, the current operation of the space segregates holdroom areas to confine mainland-bound passengers after their carry-on baggage has been processed through the agricultural check. This makes the holdroom space inadequate during peak hours. Consideration should be given to relocating the agricultural check function to better optimize the space available.

Circulation – The departures holdroom areas at KOA are not configured like those typically found in rectilinear corridor concourses. The five gates at each terminal surround a central hold room area that is partitioned into smaller areas defined by the edge of the roof lines and sometimes by low or full height partitioning. Because of the centralized holdroom space, the circulation area is defined as the space that allows passengers to travel from the end of the security checkpoint to the holdroom area and vice versa.

In evaluating the capacity of the current public circulation space, the guide "Pedestrian Planning and Design" by John J. Fruin was referenced for levels of service areas. This data was used in calculating the number of passengers that could circulate through the space within a one-hour period. As a result, the capacity of the North Terminal holdroom circulation area is 3,638 passengers and 3,577 for the South Terminal. The circulation area was operating at 15 percent of capacity at the North Terminal and 11 percent of capacity at the South Terminal in 2006.

TABLE 3V
Existing Demand Capacity Analysis – Post-Security Facilities
Kona International Airport at Keahole

Facility Title	Units	Existing 2006	Existing Processing Capacity	Existing % of Capacity	Inc. (Dec.)	2006 Required Facilities	Required Facilities at 85% DUF
NORTH TERMINAL							
Planning Activity Level		**1,770,960**					
Passenger Holdrooms	Pax.	**553**	**711**	**78%**		**553**	**604**
Passenger Holdroom Area	Ft^2	10,163			(731)	7,908	8,639
Airline Operations	Ft^2	682			1,697	2,500	803
Clubrooms	Ft^2	525					
Public Area (post-security)	Pax.	**553**	**3,638**	**15%**		**553**	**3,093**
Circulation Area	Ft^2	17,462			(12,188)	2,654	14,842
Average Utilization (% of Capacity)	%			**40%**			
Area Total	Ft^2	**28,832**				**13,062**	**24,284**
SOUTH TERMINAL							
Planning Activity Level		**1,231,388**					
Passenger Holdrooms	Pax.	**400**	**711**	**56%**		**400**	**604**
Passenger Holdroom Area	Ft^2	10,163			(2,919)	5,720	8,639
Airline Operations	Ft^2	222			1,239	1,500	261
Clubrooms	Ft^2	825					
Public Area (post-security)	Pax.	**400**	**3,577**	**11%**		**400**	**3,041**
Circulation Area	Ft^2	17,125				1,915	14,556
Average Utilization (% of Capacity)	%			**34%**			
Area Total	Ft^2	**28,335**				**9,135**	**23,456**

Public Space

Table 3W outlines the demand capacity analysis for public spaces at the North and South Terminals.

Restrooms - Restrooms are located near the baggage claim in the non-secure area of both terminals. On the secure side, there are restrooms adjacent to the restaurants in both terminals. Because of the configuration of the terminal, the distance between the two sets of restrooms is not significant and was measured at 312 feet.

Restroom capacity was calculated based on a square-foot per peak hour passenger. The number has been adjusted to current standards that include wider and deeper stalls to accommodate baggage and stall doors that swing out. The restroom capacity was determined to be sufficient to accommodate a peak hour passenger level of just 393 in each terminal. The restrooms were operating at 307 percent of capacity at the North Terminal and 213 percent of capacity at the South Terminal. The evaluation confirms the spatial deficiency for current demand at both terminal areas.

TABLE 3W
Existing Demand Capacity Analysis - Public Spaces
Kona International Airport at Keahole

Facility Title	Units	Existing 2006	Existing Processing Capacity	Existing % of Capacity	Inc. (Dec.)	2006 Required Facilities	Required Facilities at 85% DUF
NORTH TERMINAL							
Planning Activity Level		**1,770,960**					
Restrooms	Pax.	**1,209**	**393**	**307%**		**1,209**	**334**
Restrooms area	Ft^2	1,889			4,198	5,803	1,605
Concessions	Pax.	**883,014**	**378,679**	**233%**		**883,014**	**321,878**
Food & Beverage	Ft^2	2,068			**3,064**	4,821	1,757
Concessions	Pax.	**883,014**	**529,762**	**167%**		**883,014**	**450,298**
Retail	Ft^2	1,558			**1,272**	2,596	1,324
Average Utilization (% of Capacity)				**236%**			
Area Total	Ft^2	**23,923**				**13,221**	**4,687**
SOUTH TERMINAL							
Planning Activity Level		**1,231,388**					
Restrooms	Pax.	**838**	**393**	**213%**		**838**	**334**
Restrooms area	Ft^2	1,888			2,418	4,022	1,604
Concessions	Pax.	**639,424**	**543,271**	**118%**		**639,424**	**461,780**
Food & Beverage	Ft^2	2,966			970	3,491	2,521
Concessions	Pax.	**639,424**	**551,340**	**116%**		**639,424**	**468,639**
Retail	Ft^2	1,621			(502)	1,880	1,378
Average Utilization (% of Capacity)				**149%**			
Area Total	Ft^2	**6,475**				**9,394**	**5,504**

Concessions and Retail - There are concessions and retail on both the secure and non-secure sides of the terminals. The total aggregate area of concessions at the North Terminal is 2,068 and 1,558 square feet respectively for retail areas. The South Terminal has concessions and retail areas of 2,966 and 1,621 square feet, respectively. Based on industry standards, the North Terminal was at 233 percent capacity for concessions and 167 percent capacity for retail in 2006. The South Terminal was at 118 percent capacity for concessions and 116 percent capacity for retail.

TERMINAL FACILITIES REQUIREMENTS

Departure Processing Facilities

The facility requirements projected here are based on the assumption that the passenger profiles will change over time. It takes into consideration the industry changes in passenger processing in the ticketing lobbies. As a result of technology, the percentage of passengers that are checking-in and printing boarding passes at home or at the hotel is increasing. Consequently, the future will see a lower proportion of passengers checking in for their flight in the airport ticket lobby.

The requirements are also based upon the premise that the airport will continue to operate two separate terminals. This assumption serves only to establish a baseline from which to evaluate the alternatives against the facility requirements. Therefore, the proportion of passengers between the two terminals derived from the August 2006 flight schedule was applied to the facility requirements throughout the planning horizon activity levels. The assumption was also based upon the airlines or similar replacement airlines continuing to serve the same terminals and the aircraft mix at each terminal remaining the same.

During the peak hour there has been an imbalance of originating passengers between the North and South Terminals ticket lobbies. The North Terminal has served a greater passenger demand, and on-site observations confirmed its ticket lobby was more crowded.

The facility requirements show the spaces associated with queuing for both agricultural check and ticket counter check-in, and airline ticket offices at the North Terminal would require additions to accommodate the future demand. The calculation shows, however, the space for ticket lobby at the South Terminal will be underutilized. Future requirements can be achieved by either physical space additions at the North Terminal, or by re-balancing airline operations between the two terminals.

Due to the configuration of the facilities within the departures processing facility, passenger disorientation and crowding easily occur. The location of the agricultural check station within the ticket lobby entrance and its proximity to the security checkpoint create a queuing convergence. It has been observed during peak hours that passengers often find themselves in the wrong queue.

There are many ways to relieve this issue in the near term without expansion of facilities. The agricultural check can be relocated or the planter immediately in front of ticketing could be relocated to provide more space for organized queuing. These solutions will be investigated in more detail in the Alternatives chapter.

Table 3X summarizes the facility requirements for departing processing at the North and South Terminals.

Passenger Security Screening - The on-site measured security checkpoint processing rate was 104 passengers per hour and was used in the existing demand capacity analysis. By comparison, the checkpoint processing rate was 160-180 passengers per hour at Honolulu International Airport and 220 at the Kahului International Airport.

The TSA standard rate of 200 passengers per hour was used for the facility requirements calculations to arrive at an optimized facility condition. The current passenger security screening positions and queuing areas do not have adequate processing capacity at either terminal. The projection assumes that the two main security screening positions will remain with additional stations and queuing spaces to satisfy the future demand.

TABLE 3X
Departure Processing Facility Requirements
Kona International Airport at Keahole

Facility Title	Standard Units	Existing 2006	2006 Required Facilities	Required Facilities at 85% DUF	Short Term	Inter. Term	Long Term
NORTH TERMINAL							
Planning Activity Level		**1,770,960**			**2,025,880**	**2,226,580**	**2,747,620**
Agricultural Check (pre-security)	Pax	**285**	**285**	**170**	**329**	**394**	**565**
Number of Stations	#	1	1	1	2	2	3
Area of Queuing	Ft^2	317	535	319	618	741	1,061
Ticket Counters	Pax	**498**	**498**	**567**	**489**	**504**	**585**
Agent Positions (Active)	#	17	13	14	11	11	13
Frontage	Ft.	110	67	76	56	57	66
Area	Ft^2	1,269	713	812	595	613	711
Vacant Counter	#	3					
Ticket Lobby	Pax	**553**	**553**	**469**	**550**	**571**	**668**
Queuing Area	Ft^2	2,219	2,226	1,886	2,213	2,299	2,689
Outbound Baggage	Ft^2	12,389	6,206	5,259	6,171	6,410	7,496
Airline Ticket Office	Ft^2	4,419	3,939	3,338	3,917	4,068	4,758
Ticket Lobby Circulation	Ft^2	2,111	2,015	1,708	2,004	2,081	2,434
Public Area	Pax.	**664**	**664**	**698**	**733**	**806**	**1,002**
Circulation Area	Ft^2	3,058	2,472	2,600	2,731	3,004	3,732
Security Station	Pax	**553**	**553**	**177**	**611**	**672**	**835**
Number of Stations	#	2	5	2	3	3	4
Area of Queuing	Ft^2	1,256	1,039	332	1,640	1,803	2,241
Area Total	Ft^2	**27,040**	**19,143**	**16254**	**19,888**	**21,020**	**25,122**
SOUTH TERMINAL							
Planning Activity Level		**1,231,388**			**1,408,120**	**1,547,420**	**1,909,380**
Agricultural Check (pre-security)	Pax	**206**	**206**	**340**	**238**	**286**	**409**
Number of Stations	#	2	1	2	1	1	2
Area of Queuing	Ft^2	415	388	639	448	536	768
Ticket Counters	Pax	**360**	**360**	**660**	**298**	**308**	**358**
Agent Positions (Active)	#	26	12	22	6	7	8
Frontage	Ft.	189	62	114	34	35	41
Area	Ft^2	2,939	664	1,218	363	375	435
Vacant Counter	#	4					
South Ticket Lobby	Pax	**338**	**338**	**463**	**373**	**411**	**511**
Queuing Area	Ft^2	2,191	1,360	1,863	1,501	1,654	2,057
Outbound Baggage	Ft^2	15,212	5,990	8,202	6,611	7,284	9,057
Airline Ticket Office	Ft^2	3,597	1,624	2,223	1,792	1,974	2,455
Ticket Lobby Circulation	Ft^2	1,750	1,148	1,571	1,267	1,396	1,735
Central Ticket Lobby	Pax	**62**	**62**	**302**	**69**	**76**	**94**
Queuing Area	Ft^2	1,429	250	1,214	278	306	378
Outbound Baggage	Ft^2	0	0	0	0	0	0
Airline Ticket Office	Ft^2	375	207	1,006	230	254	314
Ticket Lobby Circulation	Ft^2	361	62	302	69	76	94
Public Area	Pax.	**418**	**418**	**556**	**448**	**493**	**613**
Circulation Area	Ft^2	9,634	6,155	8,189	6,591	7,263	9,030
Security Station	Pax	**400**	**400**	**177**	**373**	**411**	**511**
Number of Stations	#	2	4	2	2	2	3
Area of Queuing	Ft^2	1,119	751	332	1,001	1,103	1,371
Area Total	Ft^2	**39,023**	**18,599**	**26,758**	**20,150**	**22,221**	**27,693**

Baggage Security Screening - The amount of space required for outbound baggage operations is largely dependent on the processing characteristic of the system. Since this information is not available, the facility requirement for this area has been related to the capacity of the ticket lobby.

Arrival Processing Facilities

The passenger arrivals process consists primarily of those facilities and functions that provide means to reunite the arriving passenger with the items that were checked in at the origin of the flight. The current terminal was originally designed to accommodate 130-seat interisland aircraft. The existing claim devices and claiming area around the devices at both terminals are insufficient to serve the current wide-body aircraft. There will be an increase in this type of aircraft in the future due to forecasted mainland passenger demand.

The low walls surrounding the claim lobby and their proximity to the device create crowding at the end of the devices. This can be relieved by some modifications such as removing or relocating the walls surrounding the claim lobby. Additional new claim devices should be designed to accommodate the future demand at both the North and South Terminals.

According to the passenger demand forecast, the peak hour international arriving passengers will increase to 329 in the short term, 350 in the intermediate term, and 450 in the long range. CBP design standards indicate 17,362 square feet are needed to process a peak hour demand of 400 passengers. The current facility will satisfy the short and intermediate term demand, but 19,532 square feet will be necessary to meet the long term planning horizon.

All passengers and baggage that arrive from Overseas (non-inter island passengers) aircraft are subject to inspection by the Hawaii Department of Agriculture (HDOA). Other inspections that are conducted are done by the United States Department of Agriculture (USDA) and their Animal and Plant Health Inspection Service, Plant Protection and Quarantine Division (APHIS-PPQ). Much of their inspection deals with outgoing overseas passengers. In certain conditions, HDOA and USDA share or overlap their inspection duties.

Currently, HDOA has one inspection counter in the north terminal baggage claim area and an office located in the administrative building. HDOA also does agriculture cargo inspection and uses a temporary cooling facility (note: this has been displaced and HDOA is currently using the triturator) that is undersized for their requirements. HDOA operational needs include inspection counters and each baggage claim area. Several small inspection/holding/quarantine facilities that allow for plant and animal inspection should be located in the terminal, general aviation and commuter areas. A dog holding area should be centrally located to the main terminal baggage claim areas as well as the general aviation and commuter terminals.

There will also be a need to have offices for both HDOA and USDA staff and inspectors with quick access to staff vehicles. The detailed program requirements for these facilities will be developed with both the HDOA and USDA during the design phase.

Table 3Y summarizes the facility requirements for arrivals processing at the North and South Terminals.

Holdroom and Concourse Circulation

The holdroom capacity requirements are based on the mix of aircraft during the peak hour and the number of gates required serving the combined peak hour operations. The size for holdrooms at both terminals is adequate for base year and future demand, except that the holdroom area will need to increase at the North Terminal in the long-term.

TABLE 3Y
Arrival Processing Facility Requirements
Kona International Airport at Keahole

Facility Title	Standard Units	Existing 2006	2006 Required Facilities	Required Facilities at 85% DUF	Short Term	Inter. Term	Long Term
NORTH TERMINAL							
Planning Activity Level		**1,770,960**			**2,025,880**	**2,226,580**	**2,747,620**
Baggage Claim	Bags	**1,063**	**1,063**	**301**	**1,192**	**1,319**	**1,641**
Devices	#	2	6	2	3	3	4
Device Frontage	Ft.	266	797	226	537	593	738
Inbound Baggage	Ft^2	17,738	53,213	17,738	26,606	26,606	35,475
Baggage Services Office	Ft^2	549	1,646	549	823	823	1,098
Claim Lobby	Pax+Gr.	**722**	**722**	**446**	**810**	**895**	**1,114**
Area Excluding Devices	Ft^2	9,604	13,205	8,164	14,816	16,386	20,392
Public Area	Pax.	**722**	**722**	**485**	**810**	**895**	**1,114**
Claim Lobby Public Circulation	$Ft.^2$	6,509	8,240	5,533	9,245	10,224	12,724
Area Total	Ft^2	**34,400**	**76,304**	**31,983**	**51,490**	**54,040**	**69,688**
SOUTH TERMINAL							
Planning Activity Level		**1,231,388**			**1,408,120**	**1,547,420**	**1,909,380**
Baggage Claim	Bags	**710**	**710**	**151**	**794**	**878**	**1,095**
Devices	#	1	4	1	2	2	3
Device Frontage	Ft.	133	532	113	357	395	493
Inbound Baggage	Ft^2	16,956	50,868	16,956	33,912	50,868	50,868
Baggage Services Office	Ft^2	157	470	157	313	470	470
Claim Lobby	Pax+Gr.	**482**	**482**	**248**	**539**	**596**	**744**
Area Excluding Devices	Ft^2	5,334	8,817	4,534	9,864	10,910	13,608
Public Area	Pax.	**482**	**482**	**812**	**539**	**596**	**744**
Claim Lobby Public Circulation	$Ft.^2$	9,782	4,935	8,314	5,521	6,107	7,617
Area Total	Ft^2	**32,229**	**65,090**	**29,961**	**49,610**	**68,356**	**72,563**
CUSTOMS AND BORDER PROTECTION							
CBP Facility	Pax.	**237**	**237**	**355**	**329**	**350**	**450**
Area	$Ft.^2$	18,130	10,287	15,411	14,280	15,192	19,532

Within the holding areas at both terminals, there are spaces where mainland and international passengers are required to be contained by security barriers after agricultural inspection. These barriers prevent passengers from having the advantage of flexible use of holdrooms jointly as common holding area. The passengers who need access to concessions and restrooms are required to either use them before agricultural inspection or leave the holdroom area and then reprocess through inspection. **Table 3Z** presents the facilities requirements for the holdrooms.

TABLE 3Z
Holdroom and Concourse Facility Requirements
Kona International Airport at Keahole

Facility Title	Standard Units	Existing 2006	2006 Required Facilities	Required Facilities at 85% DUF	Short Term	Inter. Term	Long Term
NORTH TERMINAL							
Planning Activity Level		**1,770,960**			**2,025,880**	**2,226,580**	**2,226,580**
Passenger Holdrooms	Pax.	**553**	**553**	**604**	**611**	**672**	**835**
Passenger Holdroom Area	Ft^2	10,163	7,908	8,639	8,737	9,610	11,941
Airline Operations	Ft^2	682	2,500	803	794	722	581
Clubrooms	Ft^2	525					
Public Area (post-security)	Pax.	**553**	**553**	**3,093**	**611**	**672**	**835**
Circulation Area	Ft^2	17,462	2,654	14,842	17,462	17,462	17,462
Area Total	Ft^2	**28,832**	**13,062**	**24,284**	**26,993**	**27,793**	**29,983**
SOUTH TERMINAL							
Planning Activity Level		**1,231,388**			**1,408,120**	**1,547,420**	**1,909,380**
Passenger Holdrooms	Pax.	**400**	**400**	**604**	**442**	**487**	**605**
Passenger Holdroom Area	Ft^2	10,163	5,720	8,639	6,321	6,964	8,652
Airline Operations	Ft^2	222	1,500	261	357	324	261
Clubrooms	Ft^2	825					
Public Area (post-security)	Pax.	**400**	**400**	**3,041**	**442**	**487**	**605**
Circulation Area	Ft^2	17,125	1,915	14,556	17,125	17,125	17,125
Area Total	Ft^2	**28,335**	**9,135**	**23,456**	**23,803**	**24,413**	**26,038**

Public Spaces

Table 3AA summarizes the facilities requirements for public spaces.

Restrooms – The restroom area is not adequate at either terminal and will require substantial space increases to serve the existing and future demand. In addition to increasing capacity, the current restrooms need to be modernized and new restrooms will need to be designed to meet current airport restroom standards. To accommodate passenger roller bags, new standards include wider circulation spaces, larger stalls, and doors that swing out.

Concessions – The projections indicate that the space for concessions at the South Terminal is adequate for base year and future demand, while the concessions at the North Terminal will require additional space to accommodate future demand. Observations indicate that larger floor area and variety would improve passenger experience at post-security concessions. There is also a lack of concessions to serve passengers departing or arriving on evening flights as most concessions are closed during the evening hours.

TABLE 3AA
Public and Support Facility Requirements
Kona International Airport at Keahole

Facility Title	Standard Units	Existing 2006	2006 Required Facilities	Required Facilities at 85% DUF	Short Term	Inter. Term	Long Term
NORTH TERMINAL							
Planning Activity Level		**1,770,960**			**2,025,880**	**2,226,580**	**2,747,620**
Restrooms	Pax.	**1,209**	**1,209**	**334**	**1,347**	**1,486**	**1,848**
Restrooms area	Ft^2	1,889	5,803	1,605	6,466	7,133	8,870
Concessions	Pax.	**883,014**	**883,014**	**321,878**	**1,001,080**	**1,096,780**	**1,350,820**
Food & Beverage	Ft^2	2,068	4,821	1,757	5,466	5,988	7,375
Concessions	Pax.	**883,014**	**883,014**	**848,638**	**1,001,080**	**1,096,780**	**1,350,820**
Retail	Ft^2	1,558	2,596	1,324	2,943	3,225	3,971
Public Area (pre-security)	Pax.	**1,451**			**1,616**	**1,783**	**2,218**
Ancillary Circulation Area	$Ft.^2$	18,409			21,059	23,913	28,539
Area Total	Ft^2	**23,923**	**13,221**	**4,687**	**35,934**	**40,259**	**48,756**
Aviation Department							
Administrative/ Operations Space (16%)	Ft^2	23,128	24,654	15,637	27,201	28,985	35,149
Building Systems/Support Space							
Building Systems/ Support Space (5%)	Ft^2	723	770	489	850	906	1,098
SOUTH TERMINAL							
Planning Activity Level		**1,231,388**			**1,408,120**	**1,547,420**	**1,909,380**
Restrooms	Pax.	**838**	**838**	**334**	**932**	**1,029**	**1,281**
Restrooms area	Ft^2	1,888	4,022	1,604	4,474	4,939	6,149
Concessions	Pax.	**639,424**	**639,424**	**461,780**	**724,920**	**794,220**	**978,180**
Food & Beverage	Ft^2	2,966	3,491	2,521	3,958	4,336	5,341
Concessions	Pax.	**639,424**	**639,424**	**468,639**	**724,920**	**794,220**	**978,180**
Retail	Ft^2	1,621	1,880	1,378	2,131	2,335	2,876
Public Area (pre-security)	Pax.	**1,006**			**1,105**	**1,220**	**1,518**
Ancillary Circulation Area	$Ft.^2$	15,004			15,306	15,994	20,536
Area Total	Ft^2	**6,475**	**9,394**	**5,504**	**10,563**	**11,611**	**14,366**
Aviation Department							
Administrative/ Operations Space (16%)	Ft^2	21,481	20,702	17,353	21,089	25,641	28,488
Building Systems/Support Space							
Building Systems/ Support Space (5%)	Ft^2	671	647	542	659	801	890

TERMINAL REQUIREMENTS SUMMARY

Table 3BB presents a summary of the terminal requirements. The total combined occupiable space of the existing terminal is 296,935 square feet. The demand-capacity analysis indicated that the terminal would require 221,597 square feet at 85 percent utilization. This represents when the level of service during peak periods is beginning to drop below the desired C+ level. It is also an indicator to initiate a design and construction of new facilities.

TABLE 3BB
Terminal Facility Requirements Summary
Kona International Airport at Keahole

	Available		Planning Horizons by Terminal (million passengers)					
			Short Term		Inter. Term		Long Term	
Category	North	South	North 2.0	South 1.4	North 2.1	South 1.6	North 2.5	South 2.0
Agricultural Check Processing								
Number of Stations	1	2	2	1	2	1	3	2
Area of Queuing (Ft.^{2})	317	415	618	448	741	536	1,061	768
Airline Counter/Office								
Ticket Counter Frontage (Ft.)	110	189	56	34	57	35	66	41
Counter Area (Ft.^{2})	1,269	2,939	595	351	613	356	711	417
Queuing Area (Ft.^{2})	2,219	3,620	2,213	1,779	2,299	1,960	2,689	2,435
Outbound Baggage (Ft.^{2})	12,389	15,212	6,171	6,611	6,410	7,284	7,496	9,057
Airline Ticket Office (Ft.^{2})	4,419	3,972	3, 917	2,022	4,068	2,228	4,758	2,769
Ticket Lobby Circulation (Ft.^{2})	2,111	2,111	2,004	1,336	2,081	1,472	2,434	1,829
Public Circulation	3,058	9,634	2,731	6,591	3,004	7,263	3,732	9,030
Security Processing								
Number of Stations	2	2	3	2	3	2	4	3
Area of Queuing (Ft.^{2})	1,256	1,119	1,640	1,001	1,803	1,103	2,241	1,371
Baggage Claim								
Devices	2	1	3	2	3	2	4	3
Device Frontage (Ft.)	266	133	537	357	593	395	738	493
Inbound Baggage (Ft.^{2})	17,738	16,956	26,606	33,912	26,606	50,868	35,475	50,868
Baggage Services Office (Ft.^{2})	549	157	823	313	823	470	1,098	470
Area Excluding Device (including active claim) (Ft.^{2})	9,604	5,334	14,816	9,864	16,386	10,910	20,392	13,608
Public Circulation (Ft.^{2})	6,509	9,782	9,245	5,521	10,224	6,107	12,724	7,617
Concourses								
Passenger Holdroom Area (Ft.^{2})	10,163	10,163	8,737	6,321	9,610	6,964	11,941	8,652
Airline Operations (Ft.^{2})	682	222	794	357	722	324	581	261
Public Spaces								
Restrooms Area (Ft.^{2})	1,889	1,888	6,466	4,474	7,133	4,939	8,870	6,149
Food & Beverage (Ft.^{2})	2,068	2,966	5,466	3,958	5,988	4,336	7,375	5,341
Retail (Ft.^{2})	1,558	1,621	2,943	2,131	3,225	2,335	3,971	2,876
International Arrivals Processing								
Customs and Border Protection (Ft.^{2})	18,130		14,280		15,192		19,532	

Although the total terminal area required at 85 percent utilization is less than the currently available facilities, several areas of the terminal were found deficient for the 2006 base year levels of demand. They included ticket lobby queuing, airline ticket offices, queuing space for pre-security agricultural check, baggage claim area, holdroom areas, restrooms, and concessions spaces.

At 3.4 million total annual passengers in the short-term, a total of 317,003 square feet will be required. This is six percent more than the currently available facilities. At 3.7 million total annual passengers in the intermediate term, a total of 340,580 square feet will be required. This requirement is 15 percent more than currently available facilities. At 4.5 million total annual passengers in the long-term, a total of 423,342 square feet will be required, or an increase of 126,407 square feet to the existing terminal.

TERMINAL ACCESS AND PARKING

Since the terminal building serves primarily as the interface between air and ground transportation, terminal access and vehicle parking are important components of the terminal complex. The components to be examined here are:

- Terminal Curb Frontage
- Vehicle Parking
- Terminal Access Road

Terminal Curb Frontage

The terminal curb element is the direct interface between the terminal building and the ground transportation system. The length of the curb available for loading and unloading passengers and baggage is determined by the type and volume of ground vehicles anticipated during the peak period on the design day. The airport presently has approximately 690 feet of curb frontage directly in front of each terminal (1,380 feet total) available for enplaning (departing) and deplaning (arriving) passengers from private vehicles. Three sections of median curb provide an additional 850 feet of frontage available for passenger loading and unloading from commercial vehicles.

A common problem for terminal curb capacity in the past has been the length of dwell time for vehicles utilizing the curb. At airports where the curb front has not been strictly patrolled, vehicles have been known to be parked at the curb while the driver and/or riders are at the terminal checking in, greeting arriving passengers, or awaiting baggage pick-up. Since most curbs are not designed for vehicles to remain curbside for more than two to three minutes, capacity problems can ensue. Since the events of September 11, 2001, most airports police the curb front much more strictly for security reasons. This alone has eliminated, or at least significantly reduced, the curb front capacity problems at most airports.

KOA has a staff of traffic personnel that strictly polices the curb during

busy periods of the day. The curbside staff assists with traffic flow and pedestrian crossing, as well as maintaining vigilance for unattended vehicles and extended parking at the curb.

A terminal curb survey was conducted during peak traffic periods at the North and South Terminals on November 14 and 15, 2006. This included a survey of the vehicle dwell times at the arrival and departure curbs at both terminals. The average dwell times varied between terminals and between the arrival and departure curbs. The dwell times at the North Terminal were higher, averaging 2.3 minutes per vehicle at the arrival curb and 2.2 minutes per vehicle at the departure curb. At the South Terminal, the average dwell times were 1.4 minutes at the arrival curb and 2.0 minutes at the departure curb. Thus, it is apparent that the curb enforcement is maintaining reasonable curb dwell times at both terminals.

Table 3CC outlines the terminal curb requirements based upon the curb surveys. The existing curb front as well as the commercial median curb should be adequate through the long term planning horizon.

TABLE 3CC
Terminal Curb Requirements
Kona International Airport at Keahole

		Planning Horizons			
	Available	Base Year (2006)	Short Term	Inter. Term	Long Term
Annual Passengers		3,033,212	3,472,000	3,819,000	4,721,000
Public Curb					
Departure Curb (ft.)	690	440	490	540	670
Arrival Curb (ft.)	690	400	440	490	610
Total Public Curb (ft.)	1,380	840	930	1,030	1,280
Commercial Median (ft.)	850	490	550	610	760
Total Terminal Curb (ft.)	2,230	1,330	1,480	1,640	2,040

Terminal Vehicle Parking

Vehicle parking in the airline passenger terminal area of the airport includes those spaces utilized by passengers, visitors, and employees of the airline terminal facilities. Parking spaces are classified as public and employee.

Public parking is located in the area enclosed by the terminal loop road and is directly east of the North and South Terminals. There are a total of 706 spaces in the public lot. The employee lot is currently being expanded. When all phases are complete there will be 758 spaces in this area for employee and long term (monthly pass) parking. In addition, there will be 432 spaces available in the Pao`o Street (Road N) lot.

As an airport serving primarily visitors and tourists, the ratio of public parking spaces per enplaned passenger is lower than that experienced at mainland airports. Peak parking lot usage tends to be highest on holiday weekends.

The ratio of parking to enplaned passengers utilized in the previous master plan was 521 spaces per 1.0 million enplanements. Since 9/11, however, stricter enforcement at the curb for security purposes has helped to alleviate extended curb parking and increased the use of the parking lot.

In 2006, the airport was providing just 471 public spaces per million enplanements. Based upon observations and interviews of parking lot usage in 2006-07, the available public parking is undersized during peak periods nearly every month. It was estimated that public parking was approximately 30 percent undersized for peak month demand levels. Thus, a more reasonable parking ratio for KOA would be 620 spaces per million enplanements. Monthly parking passes are issued to long term or frequent parking. These passes allow for parking in the employee lot or the Pao`o Street lot. The passes average approximately 80 spaces per million enplanements, for a combined public parking requirement of 700 spaces per million annual enplanements.

Table 3DD presents the parking requirements for the planning horizons. As indicated above, the main public lot is undersized. Assuming the Pao`o Street lot is used for overflow, parking will be marginally sufficient through the short term. By the long term, nearly over 1,650 public parking spaces will be needed.

TABLE 3DD
Terminal Vehicle Parking
Kona International Airport at Keahole

		Planning Horizons			
	Available	Base Year (2006)	Short Term	Inter. Term	Long Term
Annual Enplanement Level (millions)		1.52	1.74	1.91	2.36
Public Parking Requirements					
Public Lot	706	944	1,076	1,184	1,464
Monthly Parking*	432	122	139	153	189
Total Public Parking	1,138	1,066	1,215	1,337	1,652
Employee Parking	758	457	521	573	708
Rental Car Facilities (ac.)	14.0	12.2	13.9	15.3	18.9

* Assumes Pao`o Street Lot as Monthly Parking and Overflow Lot

The recently expanded employee parking lot provides 758 spaces. Future needs were based upon a ratio of 300 spaces per million annual enplaned passengers. Based upon this ratio, the expanded employee parking lot should be adequate through the planning horizons.

Rental Cars

The rental car operations are located at the remote rental car facilities along the airport access road. Each rental car maintains its own ready/return, service and storage on its individual lease hold. Each com-

pany shuttles customers to and from the terminal. Based upon observations and interviews with the rental car operators, rental car facility needs at KOA were estimated at 8.0 acres per million annual enplanements. Maintaining this ratio, and assuming no additional on-site rental car agencies, additional space will be needed after the short term planning horizon. The DOT-A is currently undertaking planning studies for consolidated rental car facilities at each of its major airports.

Airport Access

In terminal facility planning, both on- and off-airport vehicle access is important. For the convenience of the traveler (and to provide maximum capacity), access to the terminal should include (to the extent practical) connections to the major arterial roadways near the airport. The primary access to Kona International Airport at Keahole is Queen Ka`ahumanu Highway. This road extends north and south along the airport's eastern property line. The intersection of the highway and the airport access road is signalized with a left turn lane into the airport.

The highway is integral to the commuting pattern in North and South Kona. Traffic on the highway backs up most in the morning and late afternoon rush hours.

As tourism and population in West Hawaii grow, so does traffic on Queen Ka`ahumanu Highway. The road is presently being widened to four lanes from Henry Street to Kealakehe Parkway. Phase II of the project is planned to extend the four-lane widening project to Kona International Airport at Keahole.

While the widening project will improve highway capacity in the short term, traffic is expected to continue to grow. While the airport's vehicle traffic will be part of this growth, it is certainly not the only contributing factor. Development all along the highway is a contributor, as are the other employment centers that rely on employees to traverse the highway to and from work.

Keahole Street is currently the only public entrance to the airport. The two-lane rural design roadway carries over 900 vehicles per hour during peak periods. The rental car facilities are located along this road. As a result, there are several left turns both out of the facilities to the west and into the facility east from the terminal.

According to FAA AC 150/5360-13, *Design Guidelines for Airport Terminal Facilities*, a rural two-lane access road would have a capacity of approximately 1,500 vehicles per hour both ways for at-grade interrupted flow conditions. While capacity is marginally adequate for base year traffic levels, additional capacity will need to be considered by the intermediate planning horizon.

As traffic increases along the entrance road, left turn lanes should be considered for the major traffic movements into the rental car facility and other side roads that may have significant traffic levels in the future. A secondary access road to separate general

aviation traffic from commercial service traffic entering the airport would assist in relieving capacity and enhancing safety in the earlier planning horizons. Ultimately, however, the commercial service entrance roadway should be planned as a four-lane facility with turning lanes.

The terminal frontage road is often a section of the terminal road system that creates bottlenecks. With vehicles stopping for enplaning and deplaning passengers at the terminal curb, this portion of the terminal roadway has a high potential for congestion and reduced levels of capacity. Therefore, the capacity of the terminal loop is most commonly measured in this area.

Using guidance provided in FAA AC 150/5360-13, *Design Guidelines for Airport Terminal Facilities*, the capacity of the terminal loop road at the terminal curb was estimated.

Directly in front of the terminal, the roadway includes two through lanes, a maneuvering lane, plus a curb lane. On the opposite side of the median curb, there is a second curb lane and another through lane. The lanes closest to the curb lanes are affected by the maneuvering at the curb front, and provide a limited service volume of 300 vehicles per hour. The outside lanes can accommodate up to 600 vehicles per hour. By combining the capacity of these three available through lanes, there is an effective capacity of 1,800 vehicles per hour along the front of the terminal. During peak periods, however, the outside lane between the terminal and the median curb is typically cordoned off for the safety of passengers on the median curb awaiting the rental car shuttles. This reduces the effective capacity to 1,200 vehicles per hour.

The terminal curb study also included an updated count of the traffic passing in front of the terminal. During the peak periods counted on November 14 and 15, 2006, traffic averaged 366 vehicles per hour. Since November traffic was 40 percent lower than during the peak month in 2006, the design hour traffic for the average day of the peak month was estimated at 502 vehicles per hour. By the long term planning horizon, this can be expected to reach 741 vehicles per hour. Therefore, the current terminal frontage configuration should be adequate for the planning horizons.

The highest traffic levels are currently experienced at the south end of the loop. At this point, all of the traffic that has passed by the terminal plus traffic exiting the public parking and traffic leaving U`u Road are merging into an area where the number of available lanes is reduced to two. Because of the weaving and merging in this area, the capacity is estimated at 900 vehicles per hour. Design hour traffic in this area is currently 580 vehicles per hour. By the long term planning horizon, the southern end of the loop will be carrying 850 vehicles per hour and nearing its capacity.

AIR CARGO REQUIREMENTS

The primary cargo-related facilities requiring analysis include the cargo apron, building space, and truck/automobile parking area. Air cargo facilities at KOA currently con-

sist of two cargo buildings and associated parking located south of the passenger terminal and the existing T-hangars. The two buildings total 40,310 square feet with 104,400 square feet on the landside for parking, truck docks, and circulation. Some of the cargo building space is currently used for general aviation purposes.

Ground support equipment (GSE) storage and staging is located in two areas totaling 51,500 square feet. This includes the area between the cargo buildings, and an area located immediately north of the buildings. There is approximately 19,300 square yards of apron area on the airside of the cargo buildings. The depth of this ramp is only 200 feet, which limits its use to smaller cargo aircraft. Subsequently, some of the apron area is used for GSE staging and general aviation and air taxi parking. All-cargo commercial jet aircraft currently park on the terminal ramp.

Cargo Building Requirements

The annual tons of air freight and air mail handled in 2006 at the airport (32,390 tons) was compared to the combined total square footage of dedicated air cargo building space (40,300 square feet) to determine existing utilization rates for comparison to other facility utilization in the U.S. Surveys of the top 50 cargo airports in the U.S. have determined that the current utilization rate is approximately 1.75 square feet per ton. The range of adequacy for an airport on average is between 1.00 and 2.50 square feet per ton. KOA's current utilization rate of 1.25 falls in the low range of the spectrum. Portions of the buildings are currently in other uses, so the true ratio is actually even lower. Since the ratio tends to be lower at the busier airports, the available space at KOA appears to be undersized.

The cargo operators have adapted with some transfer occurring outside either directly on the ramp or in the GSE areas. This has allowed the cargo operators to handle more air cargo with smaller buildings. It still suggests a need for additional building space both now and in the future.

The Hawaii Department of Agriculture (HDOA) has been mandated by Hawaii State law [Act 236 (08) (Senate Bill 2850) to provide joint-use inspection facilities at all Hawaii ports-of-entry. KOA has become a key port-of-entry for cargo so space needs to be planned for this type of facility.

The joint use facility should be located to minimize the impact on air cargo operations as well as to reduce the movement of cargo from one agency to the other for various inspections and compliance documentation. All cargo should be inspected at the joint inspection facility before it is released to the importer or before leaving the airline's possession. The joint agencies expected to participate include HDOA, USDA, CBP, U.S. Food and Drug Administration, and the U.S. Fish and Wildlife Service.

The inspection facilities should provide an area to prevent potential pest release as well as treatment capacity to seize and/or destroy cargo and/or contraband. A joint facility centralizes plant quarantine expertise and agen-

cies for information sharing and rapid response and mobilization in an emergency. Large scale treatment facilities such as an irradiation facility should also be planned.

The facility should house offices of the various inspection agencies as well as inspection bays, inspection counters and treatment areas. The inspection of outbound cargo should be centralized for efficient clearance and documentation for the exporters.

Contamination and spoilage has become an issue at ports in Hawaii, the mainland, and internationally. Cargo marshalling with refrigeration and weather protections should also be included to alleviate food safety and quality concerns. Based upon information provided by HDOA and USDA representatives to the planning advisory committee, the space requirements for the joint inspection facility are estimated at 20,000 square feet.

In providing future cargo building requirements, it is important to consider the goals of individual operators. Some operators may want to limit space for cargo sorting activities for cost savings, while others may need more square-footage to accommodate their specific sorting methods. Taking this need into consideration, as well as accounting for agriculture inspection and marshalling needs future requirements have been based upon a utilization factor of 1.90. Cargo building requirements have been summarized on **Table 3EE**.

TABLE 3EE
Air Cargo Requirements
Kona International Airport at Keahole

		Planning Horizons			
	Available	Base Year (2006)	Short Term	Inter. Term	Long Term
Annual Cargo Tons		32,390	39,000	45,000	62,000
Annual Operations		4,372	4,700	5,100	6,100
Cargo Apron Area (s.y.)	19,300	21,500	29,600	37,700	51,100
GSE Storage (s.f.)	51,100	68,000	82,000	94,000	130,000
Building Space (s.f.)	40,310	62,000	74,000	86,000	118,000
Truck Docks (ea.)	12	18	22	26	35
Truck Staging/Vehicle Parking (ac.)	2.4	4.2	5.1	5.9	8.1

Truck dock requirements are based upon a planning factor of 0.3 trucks per 1,000 square feet of building space. In addition to truck docks, area must be provided adjacent to the building for staging activities and employee parking. An area approximately three times the building area is provided for these activities. These requirements are also outlined in the table.

Cargo Apron Requirements

Apron space requirements vary with the size of the aircraft and the manner in which aircraft are handled on the

ground. The space requirements of aircraft commonly used for air cargo operations at the airport were reviewed to examine future ramp requirements. United Parcel Service (UPS) serves KOA with Boeing 747 and Boeing 767 aircraft. Aloha Air Cargo operates several daily Boeing 737 cargo flights. Commuter aircraft operating on a regular basis include the Beech 1900, Beech 99, and Shorts 330 and 360 aircraft.

The cargo forecast anticipates additional operations by the wide-body aircraft. The cargo ramp requirements outlined on **Table 3EE** take into account the operational mix changes expected over the planning horizons.

Space is also needed within the secure area for ground service equipment (GSE). This includes cargo pallets, tugs, and other equipment necessary to service and process freight from aircraft. Space requirements equivalent to the building space plus ten percent were estimated and included on the table.

GENERAL AVIATION FACILITIES

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

- Hangars
- Aircraft Parking Apron
- Commuter Terminal Services

HANGARS

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

Demand for hangars varies with the number of aircraft based at the airport. Another important factor is the type of based aircraft. Smaller single engine aircraft usually prefer T-hangars, while larger business jets will prefer conventional hangars. The tropical climate and rental costs will also be factors in the choice for based aircraft owners at KOA. Input from the Hawaii County General Aviation Council indicated a strong unserved demand for hangars at KOA.

In fact, based upon the information provided, if adequate hangar facilities were currently available, it is estimated that the current based aircraft would immediately increase from 61 to 79.

Another factor to be considered with regards to hangar development is ex-

ecutives with second homes on the island. Some own or have access to corporate aircraft and visit the island for periods of time. While these aircraft may not be considered based aircraft, it can be desirable to some to hangar the aircraft out of the elements during the frequent visits. Additional hangar capabilities should be considered to meet the needs of these types of corporate aviation users.

The airport currently has two T-hangar storage facilities, providing 18 storage units. T-hangar space available at the airport totals approximately 23,100 square feet for aircraft storage. Analysis of future hangar requirements, as depicted on **Table 3FF**, indicates that an additional 54 hangar storage spaces could be filled immediately today if available. In the long term, the T-hangar demand could increase nearly five times from the spaces currently available.

TABLE 3FF
General Aviation Hangar Requirements
Kona International Airport at Keahole

		Planning Horizons			
	Available	Base Year (2006)	Short Term	Inter. Term	Long Term
Based Aircraft					
Single Engine Piston		50	65	74	99
Multi-Engine Piston		6	7	7	7
Turboprop		6	9	11	14
Jet		2	4	7	14
Helicopter		13	16	19	26
Other		2	1	0	0
Total Based Aircraft		79	102	118	160
Hangar Positions					
T-Hangars	18	47	59	66	86
Conventional Box Hangars	0	25	34	44	64
Total Hangar Positions	18	72	93	110	150
Hangar Space Requirements					
T-Hangars (s.f.)	23,100	59,900	75,200	84,200	109,700
Conventional Hangar Space (s.f.)	--	53,100	82,400	115,900	189,400
Service Hangar Space (s.f.)	--	17,000	23,600	30,000	44,900
Total Hangar Space	23,100	130,000	181,200	230,100	344,000

KOA does not currently have any conventional hangars for general aviation aircraft storage. These hangars are used primarily to store corporate aircraft and helicopters, although some fixed-wing piston aircraft may be stored in multi-aircraft hangars. Conventional hangar space will need to be planned to accommodate a growing number of corporate jets forecast to base at KOA. As was discussed above, there is also potential demand for conventional hangar storage for non-based corporate aircraft.

KOA is also lacking hangar facilities for aircraft maintenance and other services. Requirements for the main-

tenance and fixed base operator (FBO) hangar area were estimated at 15 percent of the total hangar storage requirements. It should be noted that FBO hangars are often cross-utilized for storage and aircraft maintenance. They are also sometimes used to store transient aircraft overnight.

Table 3FF compares the available hangar space to the future hangar requirements. It is evident from the table that the airport is extremely deficient in both storage and service hangars. This demand can be expected to grow over the planning horizons.

AIRCRAFT PARKING APRON

A parking apron should be provided for at least the number of locally based aircraft that are not stored in hangars, as well as transient aircraft. The airport currently has approximately 64,500 square yards of general aviation apron parking on the south side of the airport. The breakdown of spaces by type is presented in **Table 3GG**.

TABLE 3GG
General Aviation Parking Apron Requirements
Kona International Airport and Keahole

		Planning Horizons			
	Available	Base Year (2006)	Short Term	Inter. Term	Long Term
Aircraft Parking Positions					
Based Aircraft Tie-downs	36	8	10	11	15
Charter/Tour Operator Ramp	15	14	18	21	28
Helicopter Parking	3	8	10	12	16
Transient GA Parking	7	35	45	53	70
Corporate Jet Parking	15	28	40	50	69
Total Parking Positions	76	93	123	147	198
Total Apron Area (s.y.)	64,500	92,700	126,800	154,900	211,000

For planning purposes, the ramp requirements were divided into five types. Based aircraft tie-downs are located immediately east of the T-hangars. These are used for parking non-hangared based aircraft. Apron requirements were based upon 350 square yards per aircraft.

Air taxi (charter and commuter) or tour operator parking positions were considered as the drive-through positions located in front of the commuter terminal. The parking positions required were based upon accommodating 25 percent of the design day operations. Apron requirements were estimated at 600 square yards per aircraft.

The helicopter positions are located at the south end of the commuter terminal ramp. Requirements were based upon accommodating the equivalent of 65 percent of the based helicopters.

Transient general aviation parking comprises the remainder of the ramp parking in front of the commuter ter-

minal and the air cargo buildings. The corporate jet ramp is the newer, large ramp located at the south end of the general aviation area. The spaces required were based upon accommodating the equivalent of three times the number of corporate jet flights during the design day. The holiday season of Christmas and New Year's is the busiest corporate aircraft period at the airport. At its peak during the 2006-07 holiday season, the airport had more than 65 corporate jets on the ground. To accommodate this peak period, allowances for overflow parking in addition to that outlined in **Table 3GG** will need to be considered. This unique situation will be further addressed in the alternatives analysis of the next chapter.

Another consideration for the general aviation apron area is an aircraft wash rack. The constant salt spray from the Airport's ocean-side location creates a demand for washing down all types of general aviation aircraft. A wash rack equipped to meet Environmental Protection Agency (EPA) would provide a designated location for washing aircraft.

GENERAL AVIATION TERMINAL SERVICES

General aviation terminal services at KOA are currently provided from several buildings in the general aviation area. The highest profile is the commuter terminal located adjacent to the ramp that is utilized by air taxi and air tour operators. Other buildings provide facilities related to terminal services, including passenger waiting, pilots' lounge and flight planning, concessions, management offices, storage, and various other needs.

The methodology used in estimating general aviation terminal facility needs was based upon the number of passengers expected to utilize general aviation facilities during the design hour, as well as FAA guidelines. Space requirements for terminal facilities were based on providing 120 square feet per design hour air taxi and general aviation itinerant passenger.

Table 3HH outlines the general space requirements for air taxi and general aviation terminal services at KOA through the long term planning horizon. In 2006, the terminal services space is currently at least 35 percent undersized. In addition, it is scattered through many different buildings, making the available space less efficient than the table suggests. In the long term, the space will need to nearly triple.

GENERAL AVIATION PARKING

Vehicle parking requirements for general aviation were also examined. Space determinations were based on an evaluation of the existing airport use, as well as industry standards. General aviation auto parking spaces were calculated at 50 percent of based aircraft, plus an industry standard of 1.8 spaces per design hour passenger.

Automobile parking requirements are summarized in **Table 3HH**. The general aviation parking around the

commuter terminal and the other GA facilities at the south end of the airport is sufficient for approximately 130 vehicles. This is inadequate during peak periods. During these periods, vehicles park along U`u Street and in other overflow areas. As shown on the table, at least 254 spaces are currently needed and over 500 spaces will be needed for the long term planning horizon.

TABLE 3HH
General Aviation Terminal Services
Kona International Airport at Keahole

		Planning Horizons			
	Available	Base Year (2006)	Short Term	Inter. Term	Long Term
Air Taxi Design Hour Passengers					
Design Hour Operations		11	14	17	22
Passengers per Operation		7.0	7.0	7.0	7.0
Design Hour Passengers		77	98	119	154
GA Design Hour Passengers					
Design Hour Itinerant Operations		15	19	22	29
Passengers per Operation		2.8	2.9	3.0	3.1
Design Hour Passengers		42	55	66	90
Total Design Hour Passengers		119	153	185	244
Terminal Services Area (s.f.)	10,600	14,300	18,400	22,200	29,300
General Aviation Parking Spaces	130	254	327	392	519

AIRPORT SUPPORT REQUIREMENTS

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

- Aircraft Rescue and Firefighting Equipment
- Airport Maintenance-Baseyard
- Aviation Fuel Facilities

AIRCRAFT RESCUE AND FIREFIGHTING EQUIPMENT

Requirements for aircraft rescue and firefighting (ARFF) services at an airport are established under 14 Code of Regulations (CFR) Part 139. 14 CFR Part 139 applies to the certification and operation of land airports served by any scheduled or unscheduled passenger operation of an air carrier using aircraft with more than 10 seats. Paragraph 139.315 establishes ARFF index ratings based on the length of the largest aircraft with an average of five or more daily departures. The following defines each index:

- Index A - aircraft less than 90 feet in length.
- Index B - aircraft less than 126 feet in length.
- Index C - aircraft less than 159 feet in length.
- Index D - aircraft less than 200 feet in length.
- Index E - aircraft at least 200 feet in length.

If there are not five daily departures by the largest aircraft, then the next lower index will apply.

The airport currently maintains at least an Index "D" ARFF facility. Index D is adequate for aircraft such as the Boeing 767-200, Airbus 300, and Dec-10. The Index D requirements include the following:

- One vehicle carrying at least 500 pounds of sodium-based dry chemical of halon 1211; or 450 pounds of potassium-based dry chemical and water with a commensurate quantity of aqueous film-forming foam (AFFF) to total 100 gallons for simultaneous dry chemical and AFFF application.

- Two vehicles carrying an amount of water and the commensurate quantity of AFFF so that the total quantity of water for foam production carried by all three vehicles is at least 4,000 gallons.

The airport's equipment includes one 3,000 gallon vehicle and two 1,500 gallon vehicles. There is also a reserve 1,500 gallon vehicle. In addition, there is a chief's vehicle, a captain's truck, and a quad agent rapid intervention vehicle (RIV).

The airport is currently serving scheduled passenger flights by Boeing 777-200 and Boeing 747 aircraft. Both of these aircraft are over 200 feet in length, qualifying the airport for Index "E." Index E requirements are the same as Index D with the exception that all three vehicles carry the water and AFFF so that the total quantity of foam production is 6,000 gallons. The current equipment can meet this requirement.

The current four-bay ARFF facility houses the three trucks plus the captain's truck. The chief's vehicle is parked in a lean-to shadeport with the reserve truck directly adjacent. While the facility meets the current need, consideration should be given to an updated ARFF facility with wider bays at some point in the future.

AIRPORT MAINTENANCE FACILITIES

The airport maintenance facilities are located south of the terminal loop road and east of U`u Street. The three-acre site includes a 15,000 square-foot maintenance building and a 7,800 square-foot shadeport for equipment storage.

Future expansion of these facilities will be a function of airfield development and airport management needs. This U`u Street location is outside of the secure airport operations area. To access the airfield, all vehicles must

cross a public street (U`u), and then enter the airside through a security gate. The alternatives analysis should consider airport maintenance facilities in a consolidated location with direct and secure access to the airfield.

AVIATION FUEL STORAGE

Aviation fuel at KOA is stored on the south side of the airport. There are currently 90,000 gallons of Jet A storage and 12,000 gallons of Avgas.

Fuel sales are handled through the commercial general aviation operators. One FBO is contracted by a consortium of the airlines to manage the fuel storage and fueling of their aircraft. While Avgas storage is currently adequate, Jet A is not. According to the FBO, Bradley Pacific Aviation, the Jet A usage at KOA in 2006 was 110,000 gallons daily. Thus, on-airport storage has been less than a single day's usage.

Besides the limited storage, fuel must be delivered to the airport from the harbor terminal in Hilo. This requires as many as 15 daily round trips by 8,000-gallon over-the-road tankers between Hilo and Kona. An interruption in delivery of more than a few hours will interrupt flights into and out of the airport. On-airport fuel storage needs to be increased to at least five days supply. Volumes are sufficient that a fuel terminal on the west side of the island should also be considered.

Storage requirements were based upon maintaining a five-day supply. **Table 3JJ** outlines the analysis for both airline and general aviation fuel storage.

TABLE 3JJ
Fuel Storage Requirements
Kona International Airport at Keahole

		Planning Horizons			
	Available	Base Year (2006)	Short Term	Inter. Term	Long Term
Jet A Requirements					
Daily Usage (gal.)		110,000	126,000	138,000	171,000
Five Day Storage (gal.)	90,000	550,000	630,000	690,000	855,000
Avgas Requirements					
Daily Usage (gal.)		1,200	1,900	2,200	2,900
Five Day Storage (gal.)	10,000	6,000	10,000	11,000	15,000

SUMMARY

The intent of this chapter has been to outline the facilities required to meet aviation demands projected for Kona International Airport at Keahole through the long term planning horizon. A summary of the airfield, airline terminal, and general aviation facility requirements are presented on **Exhibits 3F**, **3G**, and **3H**.

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

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	AVAILABLE	SHORT TERM	INTERMEDIATE TERM	LONG TERM
RUNWAYS	ARC D-V **Runway 17-35** 11,000' x 150' 200,000# DWL 850,000# DTL	ARC D-V **Runway 17-35** 11,000' x 150' 200,000# DWL 850,000# DTL **Military KATR** 4,250' x 90' 340,000# DTL **Helicopter TLOF** Heliport Training Pads	ARC D-V **Runway 17-35** Same **Parallel Runway** 4,200' x 75' 12,500# SWL **Military KATR** 4,250' x 90' 340,000# DTL **Helicopter TLOF** Same	ARC D-V **Runway 17-35** (Ultimate 12,000' x 150') 200,000# DWL 850,000# DTL **Parallel Runway** 7,000' x 150' (Ultimate 11,000' x 150') 200,000# DWL 850,000# DTL **Helicopter TLOF** Same
TAXIWAYS	**Runway 17-35** 75' wide Full Length Parallel Partial Dual Parallel Five Exits Holding Aprons	**Runway 17-35** 75' wide Full Length Parallel Partial Dual Parallel Seven Exits **Military KATR** 75' wide Two Exits	**Runway 17-35** 75' wide Full Length Parallel Partial Dual Parallel Seven Exits **Parallel Runway** 35' wide Three Exits Holding Aprons **Military KATR** 75' Wide Two Exits	**Runway 17-35** 75' wide Full Length Dual Parallel Nine Exits **Parallel Runway** 75' wide Full Length Parallel Seven Exits Holding Aprons
NAVIGATIONAL AIDS	ATCT, ASR, ASOS, RTR **Runway 17-35** RNAV, GPS ILS (17) DME (17) LOC BC 35	ATCT, ASR, ASOS ASOS, RTR **Runway 17-35** VOR, TACAN, RNAV, GPS ILS (17) DME (17) LOC BC 35 **Military KATR** None	ATCT, ASR, ASOS ASOS, RTR **Runway 17-35** VOR, TACAN, RNAV, GPS ILS, DME (17) LOC BC 35 **Parallel Runway** GPS **Helicopter TLOF** None **Military KATR** None	ATCT, ASR, ASOS, ASOS, RTR **Runway 17-35** CAT I GPS **Parallel Runway** GPS **Helicopter TLOF** GPS
LIGHTING AND MARKING	Airport Beacon, MITL Segmented Circle, Lighted Wind Cones **Runway 17-35** HIRL, PAPI-4 MALSR (17) Precision Marking	Airport Beacon, MITL Segmented Circle, Wind Cones **Runway 17-35** HIRL, PAPI-4 MALSR (17) Precision Marking **Military KATR** Visual Marking	Airport Beacon, MITL Segmented Circle, Wind Cones **Runway 17-35** HIRL, PAPI-4 MALSR (17) Precision Marking **Parallel Runway** Nonprecision Marking **Helicopter TLOF** Heliport Markings **Military KATR** Visual Marking	Airport Beacon, MITL Segmented Circle, Wind Cones **Runway 17-35** HIRL, PAPI-4 MALSR (17) Precision Marking **Parallel Runway** Nonprecision Marking **Helicopter TLOF** Heliport Markings

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	AVAILABLE SUPPLY	ANNUAL PASSENGER THRESHOLDS (MILLIONS)		
		3.47	3.82	4.72
AIRLINE COUNTER / OFFICE				
Agricultural Check Stations	3	3	3	5
Ag Station Queue Area (s.f.)	732	1,066	1,277	1,829
Counter Length (l.f.)	299	90	92	107
Ticket Queue/Lobby (s.f.)	10,062	7,332	7,812	9,387
Outbound Baggage (s.f.)	27,601	12,782	13,694	16,553
Airline Ticket Office (s.f.)	8,391	5,939	6,296	7,527
SECURITY PROCESSING / CONCOURSES				
Security Stations	4	5	5	7
Security Queue Area (s.f.)	2,375	2,641	2,906	3,612
Aircraft Gates	12	13	14	16
Holdroom Area (s.f.)	20,326	15,058	16,574	20,593
Airline Operations	904	842	1,046	1,151
International Arrivals Processing (s.f.)	18,130	14,280	15,192	19,532
BAGGAGE CLAIM				
Inbound Baggage (s.f.)	34,694	60,518	69,387	95,212
Bag Claim Devices	3	5	5	7
Bag Claim Display (l.f.)	544	894	988	1,231
Bag Claim Lobby (s.f.)	14,938	24,680	27,296	34,000
Bag Services Office (s.f.)	706	1,136	1,293	1,568
PUBLIC / SUPPORT SPACE				
Restrooms (s.f.)	3,777	10,940	12,072	15,019
Food & Beverage (s.f.)	5,034	9,424	10,324	12,716
Retail Concessions (s.f.)	3,179	5,074	5,560	6,847
CURB AND PARKING				
Terminal Curb (l.f.)	1,380	930	1,030	1,280
Commercial Median (l.f.)	850	550	610	760
Parking Spaces				
Public	1,138	1,215	1,337	1,652
Employee	758	521	573	708
Rental Car Facilities	14.0	13.9	15.3	18.9
GROSS TERMINAL AREA	323,740	351,500	377,300	447,200

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AIR CARGO FACILITIES

	AVAILABLE SUPPLY	DEMAND PLANNING HORIZONS			
		BASE YEAR	SHORT	INTERMEDIATE	LONG
Cargo Apron Area (s.y.)	19,300	21,500	29,600	37,700	51,100
GSE Storage (s.f.)	51,100	68,000	82,000	94,000	130,000
Building Space (s.f.)	40,310	62,000	74,000	86,000	118,000
Truck Docks (ea.)	12	18	22	26	35
Truck Staging/Vehicle Parking (ac.)	2.4	4.2	5.1	5.9	8.1

GA AIRCRAFT HANGARS

	AVAILABLE SUPPLY	DEMAND PLANNING HORIZONS			
		BASE YEAR	SHORT	INTERMEDIATE	LONG
T-Hangars					
Positions	18	47	59	66	86
Hangar Area (s.f.)	23,100	59,900	75,200	84,200	109,700
Conventional Hangars					
Storage Positions	0	25	34	44	64
Hangar Area (s.f.)	0	53,100	82,400	115,900	189,400

GA TERMINAL SERVICES

	AVAILABLE SUPPLY	DEMAND PLANNING HORIZONS			
		BASE YEAR	SHORT	INTERMEDIATE	LONG
Apron Parking					
Positions	76	93	123	147	198
Area (s.y.)	64,500	92,700	126,800	154,900	211,000
Maintenance Hangar (s.f.)	0	17,000	23,600	30,000	44,900
Services Building (s.f.)	10,600	14,300	18,400	22,200	29,300
Auto Parking (spaces)	130	254	327	392	519

AVIATION FUEL STORAGE

	AVAILABLE SUPPLY	DEMAND PLANNING HORIZONS			
		BASE YEAR	SHORT	INTERMEDIATE	LONG
Jet A (gal)	90,000	550,000	630,000	690,000	855,000
Avgas (gal)	10,000	6,000	10,000	11,000	15,000