AVIATION FACILITY REQUIREMENTS

To properly plan for the future of Hector International Airport, it is necessary to translate forecast aviation demand into the specific types and quantities of facilities that can adequately serve this identified demand. This chapter uses the results of the forecasts conducted in Chapter Two, as well as established planning criteria, to determine the airfield (i.e., runways, taxiways, navigational aids, marking and lighting), and landside (i.e., hangars, terminal building, cargo buildings, aircraft parking apron) 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 these may be needed to accommodate forecast demands. Having established these facility requirements, alternatives for providing these facilities will be evaluated in Chapter Four to determine the most cost-effective and efficient means for implementation.

Recognizing that the need to develop facilities is determined by demand, rather than a point in time, the requirements for new facilities have been expressed for the short, intermediate, and long term planning horizons, which roughly correlate to five-year, ten-year, and twenty-year time frames. Future facility needs will be related to these activity levels rather than a specific year. **Table 3A** summarizes the activity levels that define the planning horizons used in the remainder of this master plan.

TABLE 3A Planning Horizon Activity Levels	Current Levels	Short Term Planning Horizon	Intermediate Term Planning Horizon	Long Term Planning Horizon
Passenger Enplanements	225,000	260,000	300,000	370,000
Air Cargo Landed Weight (tons)	55,000	95,000	134,000	210,000
Based Aircraft	163	202	235	302
Annual Operations	91,000	118,000	137,000	177,000

AIRFIELD REQUIREMENTS

Airfield requirements include the need for those facilities related to the arrival and departure of aircraft. These facilities are comprised of the following items:

- Runways (including safety areas)
- Taxiways
- Navigational Aids
- Airfield Marking and Lighting

The following airfield facilities are outlined to describe the scope of facilities that would be necessary to accommodate the airport's role throughout the planning period.

AIRFIELD DESIGN STANDARDS

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 are currently using, or are expected to use the airport. Planning for future aircraft use is of particular importance since design standards are used to plan separation distances between facilities. These standards must be determined now since the relocation of these facilities will likely be extremely expensive at a later date.

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 code, the 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 aircraft 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 ADG's 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.

In order to determine facility requirements, an ARC should first be determined, then appropriate airport design criteria can be applied. This begins with a review of the type of aircraft using and expected to use Hector International Airport. **Exhibit 3A** summarizes representative aircraft by ARC.

Hector International Airport currently accommodates a wide variety of civilian aircraft use. Aircraft using the airport include small single and multi-engine aircraft (which fall within approach categories A and B and airplane design group I) and business turboprop, and jet aircraft (which fall within approach categories B, C, and D and airplane design group II). The airport is also used by transport jet aircraft for transporting passengers and cargo. These aircraft fall primarily within approach category C and airplane design groups III and IV. The NDANG uses the F-16 (an ADG D-I aircraft).

The future civilian fleet mix is expected to include a greater number of aircraft operations by transport aircraft, within similar design categories. Future air cargo activities could initially include 727, 757, or A310 aircraft, and potentially include DC-10/MD-11 aircraft, which fall within ARC D-IV or 747 freighters, which fall within ARC D-V. The airport is also expected to serve a growing number of business jet operations, which commonly have approach speeds in Categories C and D.

Large transport aircraft are the critical aircraft for defining airfield design standards. The previous master plan included a recommendation to plan airfield elements to ARC D-V standards. ARC D-V accommodates the approach speed requirements of business and military jets and the wingspan requirements of large transport aircraft.

The design of taxiway and apron areas should consider the wingspan requirements of the most demanding aircraft to operate within that specific functional area on the airport. The terminal area should consider ADG IV requirements to accommodate the full range of transport jet aircraft. General aviation areas should consider ADG III requirements to accommodate the full range of business jet and large turboprop aircraft. Future air cargo facilities should follow ADG V design standards.

RUNWAYS

The adequacy of the existing runway system at Hector International Airport has been analyzed from a number of perspectives, including airfield capacity, runway orientation, runway length, and pavement strength. From this information, requirements for runway improvements have been determined for the airport.

AIRFIELD CAPACITY

An airport's airfield capacity is expressed in terms of its annual service volume. Annual service volume is a reasonable estimate of the maximum level of aircraft operations that can be accommodated in a year. Annual service volume accounts for annual differences in runway use, aircraft mix, and weather conditions. The airport's annual service volume was examined utilizing FAA Advisory Circular (AC) *150/5060-5, Airport Capacity and Delay*.

Factors Affecting Annual Service Volume

Exhibit 3B graphically presents the various factors included in the calculation of an airport's annual service volume. These include: the airfield characteristics, meteorological conditions, aircraft mix, and demand characteristics (aircraft operations). These factors are described below.

Airfield Characteristics

The layout of the runways and taxiways directly affects an airfield's capacity. This not only includes the location and orientation of the runways, but the percent of time that a particular runway or combination of runways is in use and the length, width, weight bearing capacity, and instrument approach capability of each runway at the airport. The length, width, weight bearing capacity, and instrument approaches available to a runway determine which type of aircraft may operate on the runway and if operations can occur during poor weather conditions.

- **Runway Configuration**

The existing runway configuration consists of the primary north-south runway, and two intersecting runways, with the intersecting runways limited to small aircraft. A precision instrument approach is available to

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A-I

Beech Baron 55
Beech Bonanza
Cessna 150
Cessna 172
Piper Archer
Piper Seneca

C-I, D-I

Lear 25, 35, **55**
Israeli Westwind
HS 125

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

C-II, D-II

Gulfstream II, III, IV
Canadair 600
Canadair Regional Jet
Lockheed JetStar
Super King Air 350

B-II
less than 12,500 lbs.

Super King Air 200
Cessna 441
DHC Twin Otter

C-III, D-III

B 727-200
B 737-200
B 737-300, 400, 500
DC-9
Fokker 70, 100
MD-80
A320

B-I, II
over 12,500 lbs.

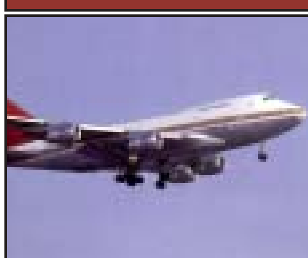
Super King Air 300
Beech 1900
Jetstream 31
Falcon 10, 20, 50
Falcon 200, 900
Citation II, III, IV, V
Saab 340
Embraer 120

C-IV, D-IV

B-757
B-767
DC-8-70
DC-10
MD-11
L1011

A-III, B-III

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



D-V

B-747 Series
B-777

Note: Aircraft pictured is identified in bold type.

HECTOR INTERNATIONAL AIRPORT

Exhibit 3A
AIRPORT REFERENCE CODES

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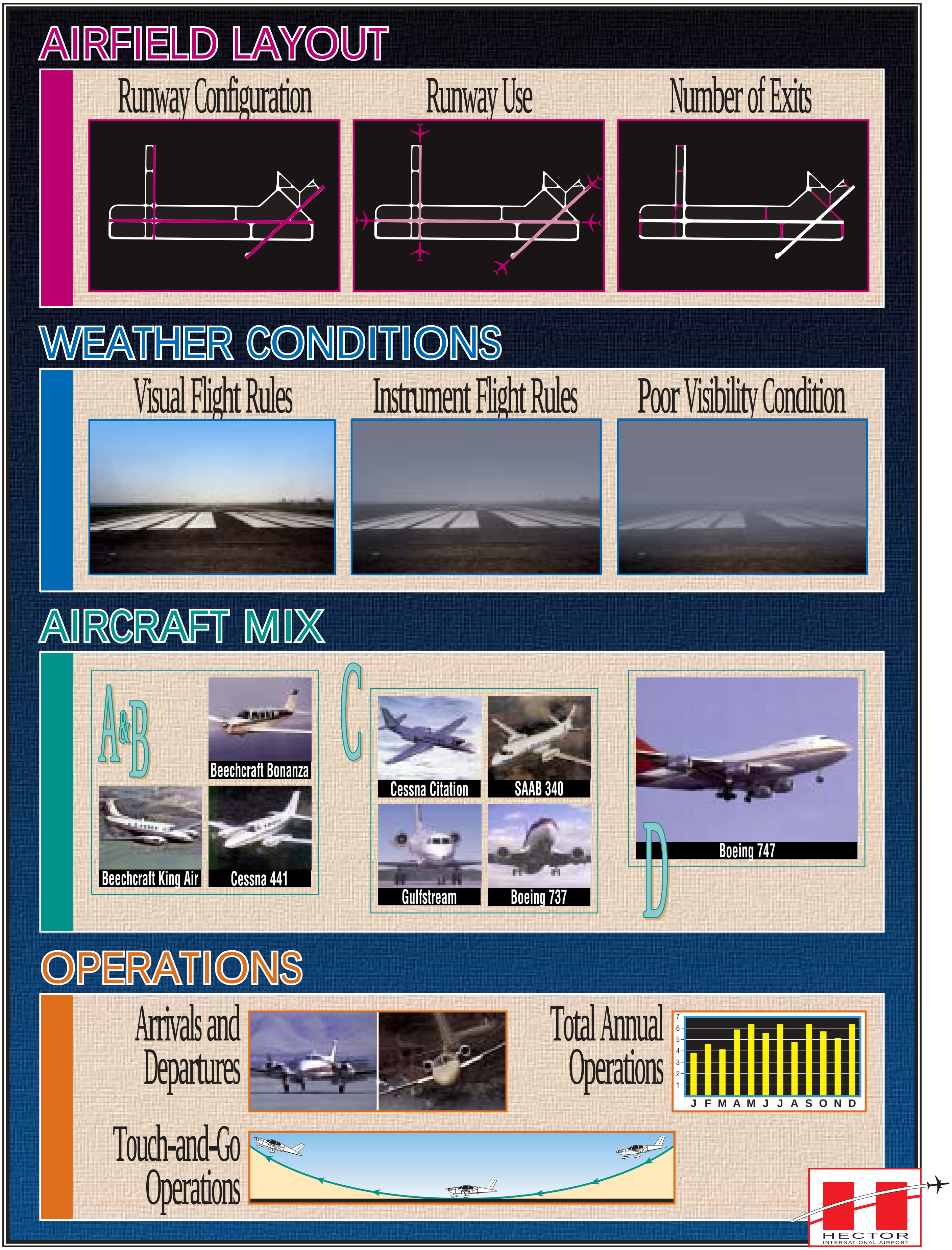

Exhibit 3B
FACTORS INFLUENCING
ANNUAL SERVICE VOLUME

Runway 17 and 35. A GPS non-precision approach has been approved for Runway 8. Airfield capacity is reduced during low visibility (instrument) conditions.

- **Runway Use**

Runway use is normally dictated by wind conditions. The direction of take-offs and landings is generally determined by the speed and direction of wind. It is generally safest for aircraft to take off and land into the wind, avoiding a crosswind (wind that is blowing perpendicular to the travel of the aircraft) or tailwind components during these operations. Prevailing winds favor use of Runways 17 and 35 (50 percent of the time with northerly/southerly flow split evenly), while Runways 8-26 and 13-31 are each used approximately 25 percent of the time.

- **Exit Taxiways**

Exit taxiways have a significant impact on airfield capacity since the number and location of exits directly determines the occupancy time of an aircraft on the runway. The airfield capacity analysis gives credit to exits located within a prescribed range from a runway's threshold. This range is based upon the mix index of the aircraft that use the runway. The exits must be at least 750 feet apart to count as separate exits. Under this criteria, north or south flow has either one or two available exits (providing optimum capacity) within the prescribed range.

Meteorological Conditions

Weather conditions can have a significant affect on airfield capacity. Airport capacity is usually highest in clear weather, when flight visibility is at its best. Airfield capacity is diminished as weather conditions deteriorate and cloud ceilings and visibility are reduced. As weather conditions deteriorate, the spacing of aircraft must increase to provide allowable margins of safety. The increased distance between aircraft reduces the number of aircraft which can operate at the airport during any given period. This consequently reduces overall airfield capacity.

There are three categories of meteorological conditions, each defined by the reported cloud ceiling and flight visibility. Visual Flight Rule (VFR) conditions exist whenever the cloud ceiling is greater than 1,000 feet above ground level, and visibility is greater than three statute miles. VFR flight conditions permit pilots to approach, land, or take off by visual reference.

Instrument Flight Rule (IFR) conditions exist when the reported ceiling is less than 1,000 feet above ground level and/or visibility is less than three statute miles. Under IFR conditions pilots must rely on instruments for navigation and guidance to the runway. Safe separation between aircraft must be assured solely by following air traffic control rules and procedures. As mentioned, this leads to increased distances between aircraft which diminishes airfield capacity.

Poor Visibility Conditions (PVC) exist when the cloud ceiling and/or visibility is less than cloud ceiling and visibility minimums prescribed by the instrument approach procedures for the airport. Essentially, the airport is closed to arrivals during PVC conditions.

According to local weather data, VFR conditions exist 88 percent of the time, IFR conditions occur 11 percent of the time, and PVC conditions occur the remaining one percent of the time.

Aircraft Mix

Aircraft mix refers to the speed, size, and flight characteristics of aircraft operating at the airport. As the mix of aircraft operating at an airport increases to include larger aircraft, airfield capacity begins to diminish. This is due to larger separation distances that must be maintained between aircraft of different speeds and sizes.

Aircraft mix for the capacity analysis is defined in terms of four aircraft classes. Classes A and B consist of single and multi-engine aircraft weighing less than 12,500 pounds. Aircraft within these classifications are primarily associated with general aviation operations. Class C consists of multi-engine aircraft weighing between 12,500 and 300,000 pounds. This is broad classification that includes business jets, turboprops, military aircraft, and commercial airline aircraft. Class D includes all aircraft over 300,000 pounds and includes wide-bodied and jumbo jets. **Exhibit 3B** depicts representative aircraft in each aircraft class.

For the capacity analysis, the percentage of Classes C and D aircraft operating at the airport is critical in determining the annual service volume as these classes include the larger and faster aircraft in the operational mix. The existing and projected operational fleet mix for the airport is summarized in **Table 3B**. Consistent with projections prepared in the previous chapter, the operational fleet mix at the airport is expected to remain relatively unchanged in its percentage of Classes C and D through the planning period.

TABLE 3B
Aircraft Operational Mix

	A & B	C	D
Existing (1999)	72.4%	26.9%	0.8%
Short Term	71.2%	27.9%	0.9%
Intermediate Term	72.3%	26.8%	0.8%
Long Term	73.4%	25.9%	0.7%

Demand Characteristics

Operations, not only the total number of annual operations, but the manner in which they are conducted, have an important effect on airfield capacity. Peak operational periods, touch-and-go operations, and the percent of arrivals impact the number of annual operations that can be conducted at the airport.

- **Peak Period Operations**

For the airfield capacity analysis, average daily operations and average peak hour operations during the peak month is calculated. These operational levels were calculated previously in Chapter Two for existing and forecast levels of operations. Typical operational activity is important in the calculation of an airport's annual service level as "peak demand" levels occur sporadically. The peak periods used in the capacity analysis are representative of normal operational activity and can be exceeded at various times through the year.

- **Touch-and-Go Operations**

A touch-and-go operation involves an aircraft making a landing and an immediate take-off without coming to a full stop or exiting the runway. These operations are normally associated with training operations and are included in local operations data recorded by the air traffic control tower. For the capacity analysis, touch-and-go operations were assumed to account for 50 percent of operations during a typical peak hour.

Touch-and-go activity is counted as two operations since there is an arrival and a departure involved. A high percentage of touch-and-go traffic normally results in a higher operational capacity because one landing and one takeoff occurs within a shorter time than individual operations.

- **Percent Arrivals**

The percentage of arrivals as they relate to the total operations in the design hour is important in determining airfield capacity. Under most circumstances, the lower the percentage of arrivals, the higher the hourly capacity. However, except in unique circumstances, the aircraft arrival-departure split is typically 50-50. Traffic information indicated no major deviation from this pattern, and arrivals were estimated to account for 50 percent of design period operations.

CALCULATION OF ANNUAL SERVICE VOLUME

The preceding information was used in conjunction with the airfield capacity methodology developed by the FAA to determine airfield capacity for Hector International Airport.

Hourly Runway Capacity

The first step in determining annual service volume involves the computation of the hourly capacity of each runway in use configuration. The percentage use of each runway, the amount of touch-and-go training activity, and the number and locations of runway exits become important factors in determining the hourly capacity of each runway configuration.

If the mix of aircraft operating at the airport changes to include a greater utilization of Class C and D aircraft, the hourly capacity of the runway system is reduced. This is because larger aircraft potentially require longer utilization of the runway for takeoffs and landings, and because the greater approach speeds of the aircraft require increased separation. There was no significant variation in this analysis, and the weighted hourly capacity remains constant.

Annual Service Volume

Once the hourly capacity is known, the annual service volume can be determined. Annual service volume is calculated by the following equation:

Annual Service Volume = C x D x H
C = weighted hourly capacity D = ratio of annual demand to average daily demand during the peak month H = ratio of average daily demand to average peak hour demand during the peak month

Annual service volume has been calculated for two situations. First, ASV has been calculated assuming the existing runway configuration can be used by all of the aircraft using (and expected to use) the airport. The previous master plan included a recommendation to add a parallel runway for small aircraft. A second calculation was prepared to examine airfield capacity in this situation.

Following this formula, the current annual service volume for Hector International Airport has been estimated at 152,000 operations.

Following the same formula above, a calculation of annual service volume was prepared to compare airfield capacity with a parallel runway (as recommended in the previous master plan). As shown in **Table 3C**, the annual service volume with a parallel runway increases to 226,000. It has been assumed that the parallel runway would be limited to small aircraft operations and would be available 45 percent of the time under VFR conditions. Intersecting Runways 8-26 and 13-31 would continue to be available.

Conclusion

Exhibit 3C compares annual service volume to existing and forecast operational levels for each runway configuration. The 1999 total of 91,372 operations represented 60.1% of the annual service volume. By the end of the planning period, total annual operations are projected to represent 115.7% of annual service volume, creating additional delays to aircraft.

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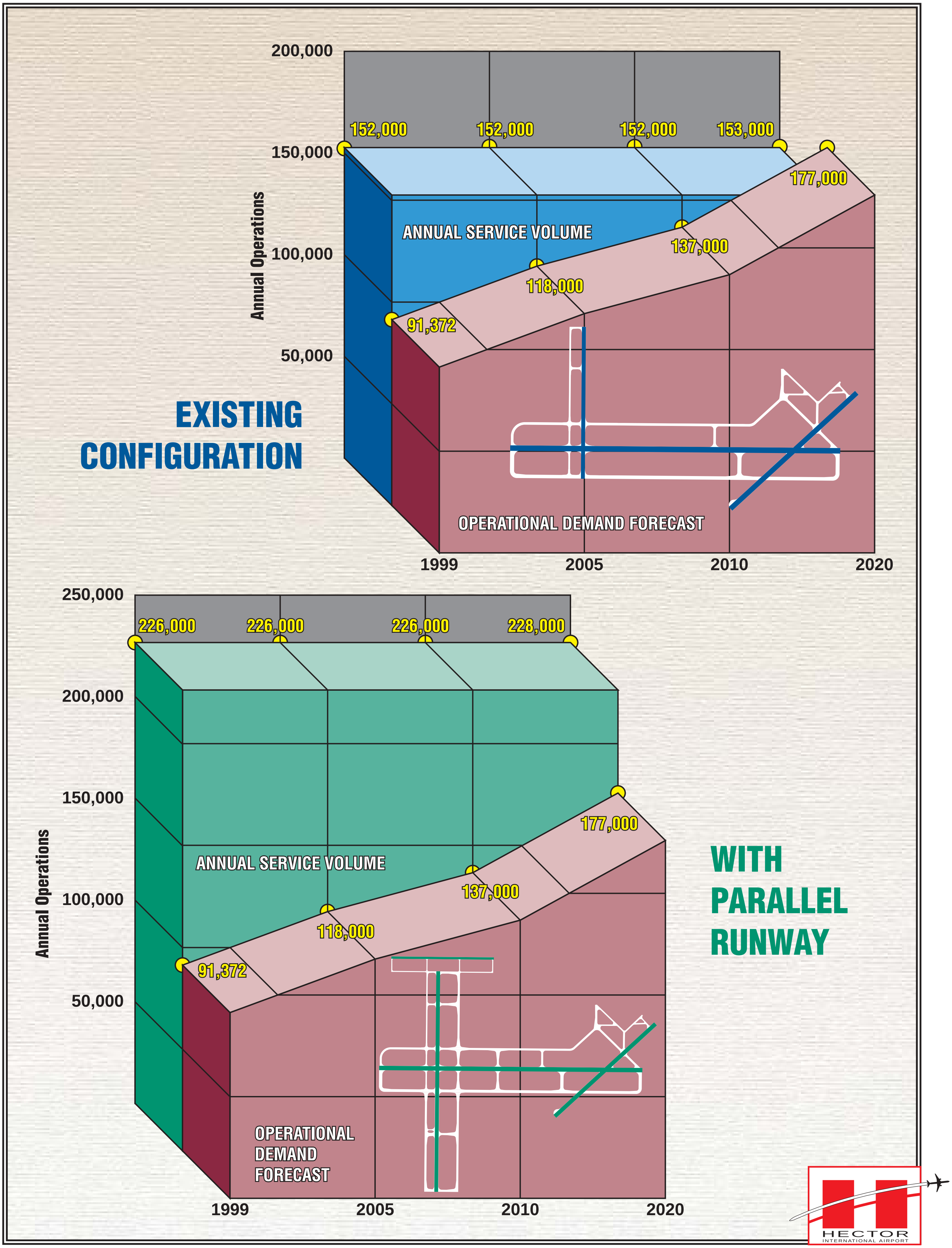


Exhibit 3C
DEMAND VS. CAPACITY SCENARIOS

TABLE 3C
Annual Service Volume Comparison

	Annual Operations	Weighted Hourly Capacity	Annual Service Volume	Percent Capacity
EXISTING CONFIGURATION				
Existing (1999)	91,372	80	152,000	60.1%
Short Term (2005)	118,000	80	152,000	77.6%
Intermediate Term (2010)	137,000	80	152,000	90.1%
Long Term (2020)	177,000	80	153,000	115.7%
WITH PARALLEL RUNWAY				
Existing (1999)	91,372	119	226,000	40.4%
Short Term (2005)	118,000	119	226,000	52.2%
Intermediate Term (2010)	137,000	119	226,000	60.6%
Long Term (2020)	177,000	119	228,000	77.6%

FAA Order 5090.3B, *Field Formulation of the National Plan of Integrated Airport Systems* (*NPIAS*), indicates that improvements for airfield capacity purposes should be considered when operations reach 60 percent of the annual service volume. Addition of a parallel runway for small aircraft will increase capacity and reduce future aircraft delays.

Runway Orientation

The airport is presently served by intersecting runways. For the operational safety and efficiency of an airport, it is desirable for the principal runway of an airport's runway system to be oriented as close as possible to the direction of the prevailing wind. This reduces the impact of wind components perpendicular to the direction of travel of an aircraft that is landing or taking off (defined as a crosswind).

FAA design standards recommend additional runway configurations when the primary runway configuration provides less than 95 percent wind coverage at specific crosswind components. The 95 percent wind coverage is computed on the basis of crosswinds not exceeding 10.5 knots for small aircraft weighing less than 12,500 pounds and from 13 to 20 knots for aircraft weighing over 12,500 pounds.

According to wind data summarized over the past ten years (1990-1999) at Hector International Airport, the existing primary runway (17-35) configuration provides less than 95 percent wind coverage in 10.5 and 13 knot crosswind conditions. **Table 3D** summarizes the wind coverage for Runway 17-35 and in combination with Runways 8-26 and 13-31. According to the control tower, Runway 17-35 is used approximately 50 percent of the time, while Runways 8-26 and 13-31 are each used approximately 25 percent of the time.

TABLE 3D
Wind Coverage Summary

	10.5 knots	13 knots	16 knots	20 knots
Runway 17-35	86.75%	94.08%	98.61%	99.98%
Combined Runways	98.86%	99.26%	100.00%	100.00%

Source: National Oceanic and Atmospheric Administration (NOAA), Hector International Airport, Fargo, North Dakota, Observation Period: 1990-1999.

Runway Length

The determination of runway length requirements for an airport are based on five primary factors: airport elevation; mean maximum temperature of the hottest month; runway gradient (difference in elevation of each runway end); critical aircraft type expected to use the airport, and stage length of the longest nonstop trip destinations.

Aircraft performance declines as each of these factors increase. Summertime temperatures and stage lengths of large transport aircraft are the primary factors in determining runway length requirements.

For calculating runway length requirements, airport elevation is 900 feet above mean sea level (MSL) and the mean maximum temperature of the hottest month is 82.7 degrees Fahrenheit. Runway end elevations vary by no more than three feet across the airfield, making the impact of runway gradients insignificant.

To determine runway length requirements for the airport, take-off runway lengths of typical transport aircraft used for air cargo and passenger services have been calculated. Since passenger aircraft are operating on shorter stage lengths and are expected to continue similar stage lengths in the future, the critical runway length evaluations will be based on forecast cargo aircraft. In calculating the runway requirements for these aircraft, near maximum loading (payload and fuel) has been assumed.

Stage lengths for most domestic (and some international) air cargo aircraft are not expected to exceed 2,000 nautical miles, while long-range international traffic is not expected to exceed 6,000 nautical miles. As shown in **Table 3E**, runway length requirements vary by aircraft type and range from 7,600 feet to 9,500 feet. The design temperatures used varied by manufacturer, but the closest to 82.7° was used. The existing length of Runway 17-35 (9,546 feet) will satisfy long-term runway length requirements.

The previous master plan determined that the optimum length for Runway 8-26 would be 8,000 feet, if used as a secondary runway by air carrier and air cargo users. This is substantiated by current length requirements.

The FAA runway length design model was applied to determine the appropriate length for a parallel runway limited to use by aircraft less than 12,500 pounds. Based upon local altitude and temperature, the recommended length ranges from 3,260 to 3,870 feet (depending on the percentage of fleet to be accommodated).

TABLE 3E
Runway Length Requirements - Cargo Aircraft

Aircraft	Temp.° F	Range (nm)	Required Length (feet)
McDonnell-Douglas DC-10-10F	94	2,500	9,000
McDonnell-Douglas MD-11F	86	6,000	8,800
Boeing 767-300 ER	86	5,800	7,600
Boeing 747-200	80	6,000	9,200
Boeing 747-400F	90	6,000	9,500

Sources: FAA Advisory Circular 5325-4A, Runway Length Requirements for Airport Design.
Aircraft Characteristics for Airport Planning (Boeing, McDonnell-Douglas).

Runway Width

Presently, Runway 17-35 is 150 feet wide. This width is adequate for aircraft through ADG V. Runway 8-26 is 100 feet wide and Runway 13-31 is 150 wide. While the width of Runway 8-26 matches current standards based upon its use, Runway 13-31 exceeds the standard (of 100 feet). A parallel runway to serve small aircraft should be 75 feet wide.

Runway Pavement Strength

The most important feature of airfield pavement is its ability to withstand repeated use by aircraft of significant weight. At the airport, this includes a wide range of civilian aircraft. The current strength ratings for Runways 17-35, 8-26, and 13-31 have been summarized in **Table 3F**. It is expected that the critical aircraft in the short term planning period will include the B727, A310/A300, and B767. However, it is possible that future air cargo may be transported on 747, DC-10, or MD-11 aircraft. These represent the largest aircraft expected to operate at the airport through the planning period. Adequacy of pavement sections will need to consider the frequency of landings. Therefore, Runway 17-35 is expected to adequately serve the loading requirements of critical aircraft.

TAXIWAYS

Taxiways are constructed primarily to facilitate aircraft movements to and from the runway system. Some taxiways are necessary simply to provide access between the aprons and runways, whereas other taxiways become necessary as activity increases at an airport to provide safe and efficient use of the airfield. Presently, a combination of connecting taxiways and parallel taxiways provide access between the aprons and runways.

The current Airport Layout Plan includes several taxiway improvements to improve airfield access and provide more direct and efficient access to the runways and landside areas. The current Airport Layout Plan also depicts the development of connecting taxiways to a parallel runway to serve general aviation traffic.

TABLE 3F
Pavement Strength Ratings (pounds)

	Runway 17-35	Runway 8-26	Runway 13-31
Single Wheel Loading (SW)	100,000	60,000	26,000
Dual Wheel Loading (DW)	200,000	75,000	35,000
Dual-Tandem Wheel Loading (DTW)	400,000	—	—

Source: Airport Master Records.

Taxiway width is determined by the ADG of the most demanding aircraft to use the taxiway. As mentioned previously, the most demanding aircraft to use the airfield fall within ADG V. According to FAA design standards, the minimum taxiway width for ADG V is 75 feet. Taxiways serving ADG III require a minimum width of 50 feet.

NAVIGATIONAL AIDS AND INSTRUMENT APPROACH PROCEDURES

A number of electronic navigational aids are in place to assist pilots in locating the airport and landing. The Fargo VORTAC, Runways 17 and 35 Instrument Landing Systems, and GPS navigational aids assist pilots during poor weather conditions when following instrument approach procedures established by the FAA.

The advent of Global Positioning System (GPS) technology will ultimately provide the airport with the capability of establishing instrument approaches at minimal cost since there is not a requirement for the installation and maintenance of costly ground-based transmission equipment at the airport. As mentioned previously in Chapter One, the FAA is proceeding with a program to transition from existing ground-based navigational aids to a satellite-based navigation system utilizing GPS technology. Currently, GPS is certified for enroute guidance and for use with instrument approach procedures. The initial GPS approaches being developed by the FAA provide only course guidance information. Within the next few years, it is expected that GPS approaches will also be certified for use in providing descent information for an instrument approach. A non-precision GPS approach has been approved for Runway 8.

GPS approaches fit into three categories, each based upon the desired visibility minimum of the approach.

The three categories of GPS approaches are: precision, non-precision with vertical guidance, and non-precision. To be eligible for a GPS approach, the airport must meet specific standards as outlined in FAA AC 150/5300-13, *Airport Design*, Appendix 16, Change 6. The new standards were published on September 30, 2000 (attached as an Appendix to this Master Plan).

However, based upon the circular, only Runways 17 and 35 fully meet the requirements for an approach with less than 3/4 mile minimums since the other runways are not equipped with an approach lighting system. As the new standards are finalized, they will be applied to the future airfield requirements.

According to regional weather observations, visual weather conditions (visibility greater than three miles and cloud ceiling greater than 1,000 feet above the ground) occur 88 percent of the time. Therefore, it may not be necessary to provide instrument approach capability to one-half mile minimums at each runway end. However, with additional air cargo operations being anticipated in the future, the airport should consider providing for lower visibility approaches on Runway 17 or 35 by adding touchdown zone and centerline lighting. (the number of annual instrument approaches help substantiate this need).

LIGHTING AND MARKING

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

Runway markings are designed according to the type of instrument approach available on the runway. FAA AC 150/5340-1H, *Standards for Airport Markings*, provides the guidance necessary to design an airport's markings. Runway 17-35 has precision runway markings, while Runway 8-26 has basic markings. Runway 13-31 has non-precision instrument markings.

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

Airport lighting systems provide critical guidance to pilots during nighttime and low visibility operations. Runway 17-35 is equipped with high intensity runway lighting (HIRL), while Runways 8-26 and 13-31 are equipped with medium intensity runway lighting (MIRL). Runway 8-26 edge lighting will need to be upgraded to high intensity if the approach is ultimately upgraded to precision capability.

Effective ground movement of aircraft at night is enhanced by the availability of taxiway lighting. Presently, medium intensity taxiway edge lighting is available on all taxiways.

The airport is equipped with a rotating beacon to assist pilots in locating the airport at night.

In most instances, the landing phase of any flight must be conducted in visual conditions. To provide pilots with visual guidance information during landings to the runway, visual glideslope indicators (VGSIs) are commonly provided at airports. Presently, VGSIs are available to Runways 17 and 35 in the form of a visual approach slope indicator (VASI-4), while Runways 8 and 26 have a four-light precision approach path indicator (PAPI-4). A VASI-4 is also available on Runway 13. Facility planning should provide for the eventual replacement of the VASI systems with PAPIs.

Approach lighting systems provide the basic means to transition from instrument flight to visual flight for landing. A medium intensity approach lighting system with runway alignment lighting (MALSR) is required for one-half mile visibility minimum instrument landing system and global positioning system instrument approach procedures. To lower the visibility minimums (below 200 feet), the MALSR system on Runway 17 or SSALR on 35 will need to be upgraded to an ALSF-2 system, which adds additional lights and higher intensity lighting.

CONCLUSIONS

A summary of the airfield facility requirements is presented on **Exhibit 3D**. Planning should continue to reflect a parallel runway for light aircraft. The existing runway lengths, widths, and strengths are sufficient to serve the expected mix of aircraft through the planning period. GPS precision approach capability will become available within the next year. The VASIs on the airfield should eventually be replaced with PAPIs. The approach lighting systems will need to be upgraded to an ALSF-2 system to realize lower minimums.

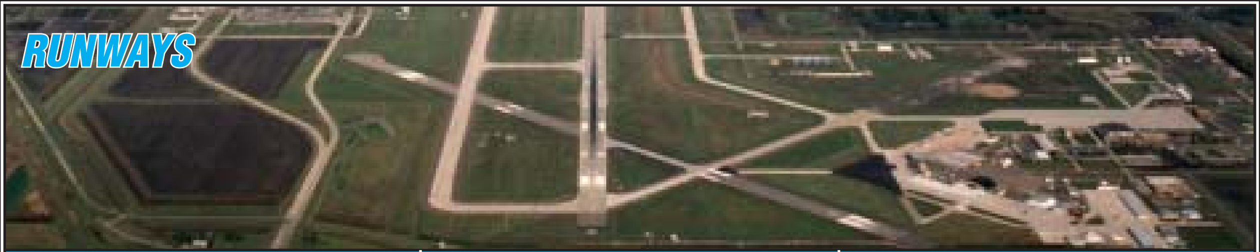
LANDSIDE REQUIREMENTS

Landside facilities are those necessary for handling of aircraft, passengers, and freight while on the ground. These facilities provide the essential interface between the air and ground transportation modes. The capacities of the various components of each area were examined in relation to projected demand to identify future landside facility needs.

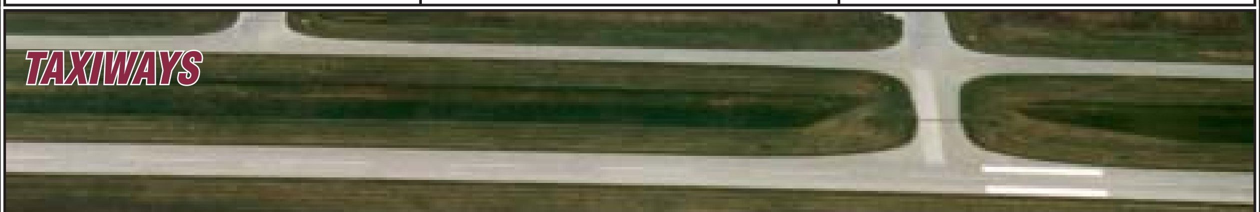
TERMINAL AREA REQUIREMENTS

Components of the terminal area complex include the terminal apron, vehicle parking area, and the various functional elements within the terminal building. This section identifies the terminal area facilities required to meet the airport's needs through the planning period.

The requirements for the various terminal complex functional areas were determined with the guidance of FAA Advisory Circular 150/5360-13, 99MP14-3D-12/18/00



EXISTING	SHORT TERM NEED (5 years +/-)	LONG TERM NEED (15 years +/-)
Runway 17-35 9,546' x 150' 100,000 SW • 200,000 DW • 400,000 DT	**Runway 17-35** Reconstruct and shift 400' to the north	**Runway 17-35** Same
Runway 8-26 4,387' x 100' 60,000 SW • 75,000 DW	**Runway 8-26** Lengthen to 6,300'	**Runway 8-26** Lengthen to 8,000'
Runway 13-31 4,199' x 150' 26,000 SW • 35,000 DW	**Runway 13-31** Same	**Runway 13-31** Same Add parallel runway (4,400' x 75')



EXISTING	SHORT TERM NEED (5 years)	LONG TERM NEED (15 years +/-)
Parallel taxiway systems on Runways 17-35 and 8-26	Extend parallel with Runway 8-26	Complete parallel taxiway system and add exits.

EXISTING	SHORT TERM NEED (5 years +/-)	LONG TERM NEED (15 years +/-)
Rotating Beacon PAPI-4 (8, 26) VASI-4 (17, 35, 13) HIRL (17-35) MIRL (8-26, 13-31) MITL (all taxiways) CAT 1 ILS (17, 35) GPS (8) MALSR (17) SSALR (35)	Transition VASI to PAPI system as per FAA recommendations Lower visibility minimums to Runway 17 or 35 (adding touchdown zone lights and centerline lights.) Add ALSF-2 Transition to GPS approaches as equipment becomes operational (may extend into long-term period)	Maintain obstruction free approaches Add MALSR to Runway 8-26

ILS - Instrument Landing System
GPS - Global Positioning System
PAPI - Precision Approach Path Indicator
VASI - Visual Approach Slope Indicator
HIRL - High Intensity Runway Lights
MIRL - Medium Intensity Runway Lights
MITL - Medium Intensity Taxiway Lights
MALSR - Medium Intensity Approach Lighting System with Runway Alignment Indicator Lighting
ALSF-2 - Approach Lighting System; with Sequenced Flashing Lights
SW - Single Wheel
DW - Dual Wheel
DT - Dual Tandem

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Exhibit 3D
AIRFIELD REQUIREMENTS

Planning and Design Guidelines for Airport Terminal Facilities. The consultant's database for space requirements was also considered.

Facility requirements were developed for the planning period based upon the forecast enplanement levels. It should be noted that actual need for construction of facilities will be based upon enplanement levels rather than a forecast year.

Exhibit 3E summarizes passenger terminal building functional area requirements for forecast enplanement levels. The various functional areas of the terminal building are summarized as follows:

- **Ticketing** - includes estimates of the space necessary for the queuing of passengers at ticket counters, the linear footage of ticket counters, and the space necessary to accommodate baggage make-up and airline ticket offices.

- **Departure Facilities** - includes estimates of the space necessary for departure holdrooms and the number of aircraft gate positions. Holdroom space and gate positions in excess of the requirements presented on the exhibit are frequently necessary to accommodate individual airline demands.

- **Baggage Claim** - includes estimates of the linear footage of baggage claim needed and space for passengers to claim baggage.

- **Rental Cars** - includes estimates of space necessary for the queuing of passengers at rental car counters, the space necessary for rental car offices, and the linear footage for rental car counters. Surveys have been distributed to each rental car company to more accurately determine their future needs. Survey results will be included in the alternatives analysis.

- **Concessions** - includes estimates of the space necessary to provide adequate concession services such as restaurant and retail facilities.

- **Security Screening** - include estimates of the amount of space required to accommodate passenger screening devices, the queuing of passengers, and security offices.

- **Public Waiting Lobby** - includes estimates of the amount of space to accommodate arriving and departing passengers.

- **Terminal Area Automobile Parking** spaces required for long-term and short-term public parking, employee parking, and rental car parking.

- **Terminal Curb Frontage** - includes an estimate of the linear footage of curb required to accommodate the queuing of enplaning and deplaning passenger vehicles.

The terminal building area calculations include factors for circulation and mechanical systems. While these estimates provide reasonable planning guidelines, specific airline requirements should be incorporated in the actual design of terminal building functional areas.

AIR CARGO REQUIREMENTS

The two primary cargo-related facilities requiring analysis include the cargo apron and building space for sorting and transfer. Presently, there are several buildings dedicated to air cargo on the airport. The air cargo area on the north side of the airfield is expected to handle a significant portion of future demand, although buildings in the southeast area have been included in the existing building space calculation since they provide temporary air cargo space. Surveys were distributed to each cargo company operating on the airfield to assist with future planning.

An industry planning standard of 200 pounds of enplaned cargo per square foot was used to determine building space requirements and a planning standard of 3.5 square feet of apron per square foot of building was used to estimate future apron requirements. Vehicles are typically loaded at cargo buildings using truck docks or drive-in garages. The demand for docks and garages will vary with each company. However, each cargo building should be planned with the capability to process trucks. Once survey information has been received, the requirements will be adjusted. **Exhibit 3F** summarizes air cargo apron and building requirements through the planning period.

GENERAL AVIATION REQUIREMENTS

This section will evaluate the space requirements for general aviation hangars and apron. Currently aircraft storage and maintenance is being met through the use of T-hangars, executive hangars, and conventional hangars which can accommodate multiple aircraft simultaneously. Presently, general aviation facilities are located in the southeast hangar area, and on the north end of the airfield.

Utilization of hangar space varies as a function of local climate, security, and owner preferences. The trend in general aviation aircraft, whether single or multi-engine, is in more sophisticated (and consequently more expensive) aircraft. Therefore, most hangar owners prefer hangar space to outside tiedowns. For this analysis, it has been assumed that 100 percent will be hangared.

Future hangar requirements for the airport are summarized on **Exhibit 3F**. A planning standard of 1,200 square feet per based aircraft stored in T-hangars has been used to determine future T-hangar requirements. A planning standard of 2,500 square feet for remaining aircraft stored in executive or conventional hangars has been used to determine future hangar requirements. Conventional hangar area was increased by 15 percent to account for future aircraft maintenance needs.

A parking apron should be provided for transient aircraft. Transient positions were calculated at 25 percent of the

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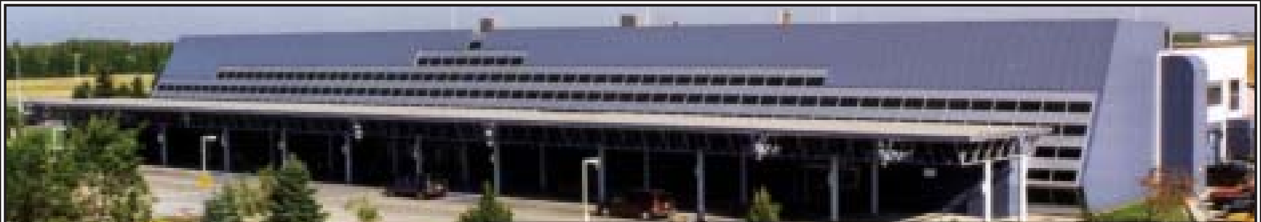

	ENPLANEMENTS			
	EXISTING	250,000	300,000	400,000
TICKETING				
Counter Length (l.f.)	130	80	90	125
Counter Area (s.f.)	1,300	800	900	1,250
Ticket Lobby (s.f.)	3,300	2,010	2,300	3,130
Airline Operations/Bag Make-up (s.f.)	9,700	4,800	6,060	6,800
DEPARTURE FACILITIES				
Aircraft Gates	4	5	5	6
Holdroom Area (s.f.)	6,400	3,960	4,530	6,160
BAGGAGE CLAIM				
Claim Display (l.f.)	170	180	210	280
Baggage Claim Lobby (s.f.)	4,000	4,860	5,560	7,560
TERMINAL SERVICES				
Rental Car				
Counter Length (l.f.)	65	75	82	100
Office Area (s.f.)	650	1,500	1,630	2,000
Lobby (s.f.)	650	450	490	600
Food/Beverage (s.f.)	4,400	6,600	7,560	10,300
Retail (s.f.)	900	830	950	1,290
Restrooms (s.f.)	1,200	1,220	1,400	1,900
PUBLIC LOBBY				
Greeting/Farewell Area/Security Queuing (s.f.)	3,300	6,130	7,010	9,530
SECURITY SCREENING				
Security Stations	1	1	2	2
Security Equipment Area (s.f.)	150	170	340	340
Security Offices (s.f.)	80	100	200	200
SUBTOTAL PROGRAMMED AREA*	**57,000**	**50,000**	**57,300**	**77,900**
General Circulation, Mechanical/ Electrical, Maintenance & Storage (s.f.)	19,000	17,600	20,100	27,300
TOTAL TERMINAL AREA	**76,000**	**67,600**	**77,400**	**105,200**
AUTO PARKING				
Public				
Short Term	245	135	160	210
Long Term	739	810	930	1,260
Rental Car	150	180	210	280
Employee	92	125	150	200
TERMINAL CURB				
Enplane Curb (l.f.)	150	160	185	250
Deplane Curb (l.f.)	150	190	220	290

*** Also includes administrative area and conference room.**

Source: Coffman Associates analysis.

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Exhibit 3E
PASSENGER TERMINAL
BUILDING REQUIREMENTS

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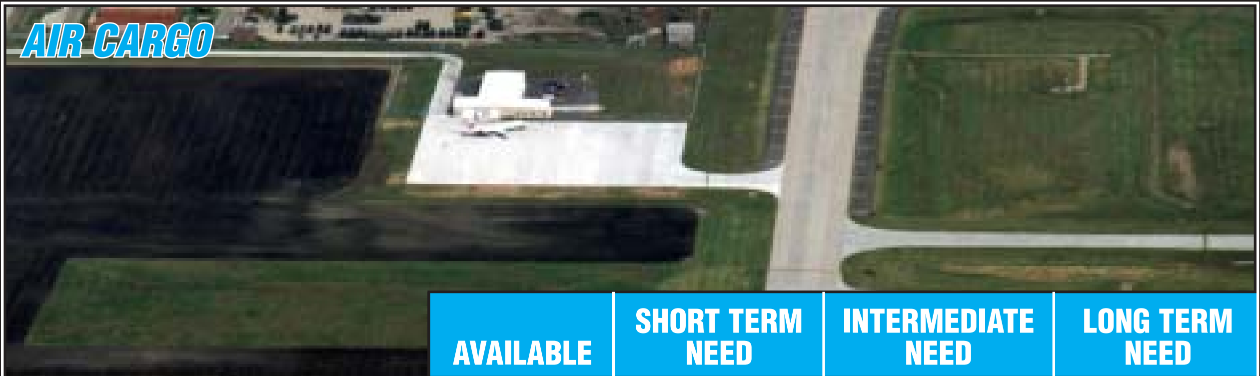
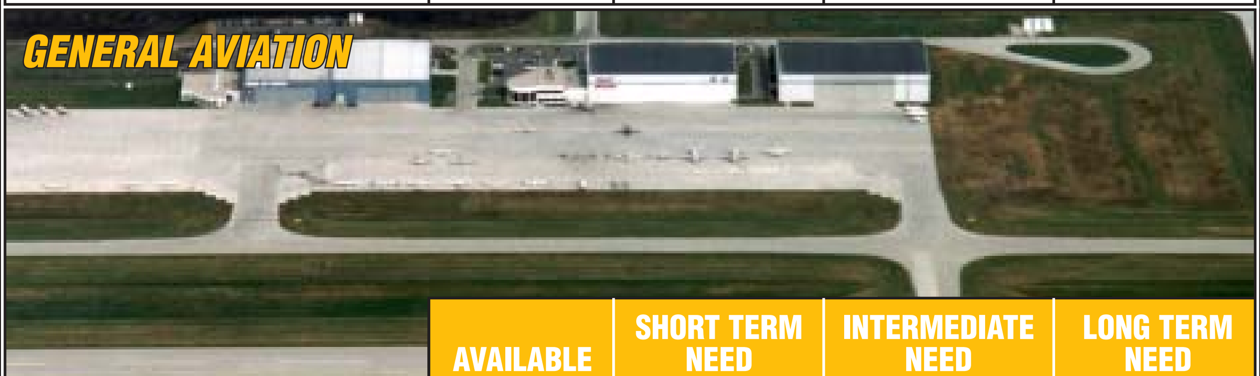


	AVAILABLE	SHORT TERM NEED	INTERMEDIATE NEED	LONG TERM NEED
Building Space (s.f.)	30,000+	61,400	86,000	136,000
Apron Area (s.y.)	18,000+	23,900	33,400	52,900



	AVAILABLE	SHORT TERM NEED	INTERMEDIATE NEED	LONG TERM NEED
Aircraft Storage Hangars				
T-hangar Positions	45	76	88	111
Conventional Hangar Positions	Approx. 75 *	106	146	171
T-hangar Area (s.f.)	57,000	91,600	105,800	133,600
Conventional Hangar Area (s.f.)**	234,000	263,900	318,250	432,350
Total Hangar Area (s.f.)	291,000	355,500	424,050	565,950
* *Hangars may contain multiple aircraft* ** *Reflects maintenance areas*				
Apron Area				
Transient Apron Positions	Approx. 56	49	57	75
Single Engine/Multi-Engine	-	44	51	68
Transient Business Jet	-	5	6	8
Total Transient Apron Area (s.y.)	43,000	42,900	50,400	66,400
General Aviation Terminal Facilities				
Building Space (s.f.)	10,000 +*	10,000	12,400	18,000
* *Includes private conventional hangars*				
General Aviation Vehicle Parking				
Parking Spaces	Approx. 400	500	530	630
Parking Area (s.f.)	130,000	200,000	212,000	252,000

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Exhibit 3F
AIR CARGO AND GENERAL AVIATION REQUIREMENTS

forecast busy day operations (as forecast in the previous chapter). Ten percent of the itinerant positions are allocated to business jets. Total apron area requirements were determined by applying a planning criterion of 800 square yards per transient single or twin-engine aircraft parking position and 1,600 square yards per transient jet position. The results of this analysis are presented on **Exhibit 3F**.

General aviation terminal building space is required for waiting passengers, pilot's lounge and flight planning, concessions, management, storage, and various other needs. This space is not provided in a single, separate terminal building, but is offered by fixed base operators (FBOs).

The methodology used in estimating general aviation terminal facility area was based on the number of airport users expected to utilize general aviation facilities during a typical design hour (estimated at 2.5 per flight, and 90 square feet per passenger). **Exhibit 3F** outlines these requirements.

Public vehicle parking is located adjacent to each existing FBO building, and private conventional hangars. It will be required adjacent to new hangar development. Vehicle parking requirements for future facilities have been determined utilizing planning standards of 1.8 spaces per design hour passenger, two parking spaces per 1,500 square feet of new hangar area, and 400 square feet for each parking position. **Exhibit 3F** outlines vehicle parking requirements for the general aviation facilities.

SUPPORT REQUIREMENTS

Various facilities that do not logically fall within classifications of airfield, terminal building, air cargo or general aviation areas have also been identified. These other areas provide certain functions related to the overall operation and safety of the airport and include: airport rescue and firefighting, fuel storage, and maintenance/snow removal storage.

AIRPORT RESCUE AND FIREFIGHTING

Requirements for Airport Rescue and Firefighting (ARFF) services at an airport are established under Federal Aviation Regulations (FAR) Part 139. FAR Part 139 applies to the certification and operation of land airports serving air carriers having a seating capacity of more than 30 seats. Paragraph 139.315 of Subpart D of FAR Part 139 regulations establishes an ARFF index determination. This index rating is based on the number of departures conducted by passenger aircraft having at least 30 seats within a specific category (based on length of aircraft). The airport currently meets the requirements for ARFF Index C. Facilities should be sized to properly house the equipment that is required under Index C.

FUEL STORAGE

When fuel is delivered to the airport by truck, it cannot be used the day it is delivered to allow for contaminants to separate from the fuel. Therefore, a multiple tank system is generally used. The fuel farm located on the west side of the terminal area and each of the FBOs have multiple tanks at their disposal, for both Jet-A and AvGas. However, area should be reserved to allow for expansion of these fuel farms should their demands change through the planning period. While planning standards generally recommend a minimum two-week supply, the availability of a nearby wholesale supplier may generally allow for more limited reserves.

MAINTENANCE/SNOW REMOVAL EQUIPMENT STORAGE

Existing facilities on the west side of the terminal area will be considered for expansion to meet anticipated needs. Local climatic conditions demand adequate storage areas for these facilities.

SUMMARY

The intent of this chapter has been to outline the facilities required to meet potential aviation demands projected for the airport through the planning horizon. The next step is to develop a direction for development to best meet these projected needs. The remainder of the master plan will be devoted to outlining this direction, its schedule, and costs.