ADDENDUM B

# Palm Beach International Airport Airspace/Airfield Constraints Analyses

*Draft Report*

# Palm Beach International Airport System Study - Phase I PBI Airspace/Airfield Constraints Analyses

Prepared for

**Palm Beach County Department of Airports**

November 2005

CH2MHILL

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# Acronyms and Abbreviations

| | |
|---|---|
| ADG | Airplane Design Group |
| AGL | Above Ground Level |
| AIP | Airport Improvement Program |
| ALP | Airport Layout Plan |
| ANOMS | Airport Noise and Operations Monitoring System |
| ARMT | Airport Resource Management Tool |
| ARP | Airport Reference Point |
| ASDA | Accelerate Stop Distance Available |
| ASV | Annual Service Volume |
| ATA | Arrival Transition Area |
| ATC | Air Traffic Control |
| ATCSCC | Air Traffic Control System Command Center |
| ATCT | Air Traffic Control Tower |
| CERAP | Combined Center and Radar Approach Control |
| DME | Distance Measuring Equipment |
| DOA | Palm Beach County Department of Airports |
| DTA | Departure Transition Area |
| EDCT | Expect Departure Clearance Times |
| ESP | Enroute Spacing Programs |
| ETMS | Enhanced Traffic Management System |
| FAA | Federal Aviation Administration |
| FBO | Fixed-Base Operator |
| FL | Flight Level |
| FLL | Fort Lauderdale-Hollywood International Airport |
| FLT | Focus Leadership Team |
| FXE | Fort Lauderdale Executive Airport |
| GA | General Aviation |
| GDP | Ground Delay Program |
| GS | Glide Slope |
| GPS | Global Positioning System |
| HIRL | High-Intensity Runway Light |
| IAF | Initial Approach Fix |
| IAP | Instrument Approach Procedure |
| ICAO | International Civil Aviation Organization |
| IFR | Instrument Flight Rules |
| ILS | Instrument Landing System |
| LAHSO | Land and Hold Short Operation |
| LDA | Landing Distance Available |
| LNA | Palm Beach County Park Airport |
| LOC | Localizer |
| LOM | Locator Outer Marker |

# Acronyms and Abbreviations, Continued

| | |
|---|---|
| MALSR | Medium-Intensity Approach Lighting System with Runway Alignment Indicator Lights |
| MAP | Missed Approach Point |
| MIA | Miami International Airport |
| MIRL | Medium-Intensity Runway Light |
| MIT | Miles-In-Trail |
| MM | Middle Marker |
| MOA | Military Operations Area |
| MSL | Mean Sea Level |
| MTO | Manager for Tactical Operations |
| NAR | National Airspace Redesign |
| NAS | National Airspace System |
| NATCA | National Air Traffic Controllers Association |
| NBAA | National Business Aviation Association |
| NDB | Non-Directional Beacon |
| NM | Nautical Miles |
| NOAA | National Oceanic and Atmospheric Administration |
| OAG | Official Airline Guide |
| OEP | Operational Evolution Plan |
| OM | Outer Marker |
| OPF | Opa-Locka Airport |
| OPSNET | Operational Network Database |
| PBI | Palm Beach International Airport |
| PHK | Palm Beach County Glades Airport |
| PMAD | Peak Month Average Day |
| PAPI | Precision Approach Path Indicator |
| RAPCON | Radar Approach Control |
| REIL | Runway End Identifier Light |
| ROFA | Runway Object Free Area |
| RPZ | Runway Protection Zone |
| RSA | Runway Safety Area |
| RVR | Runway Visual Range |
| SID | Standard Instrument Departure |
| SOP | Standard Operating Procedure |
| STAR | Standard Terminal Arrival Route |
| SUA | Military Special Use Airspace |
| TACAN | Tactical Air Navigation |
| TMB | Kendall-Tamiami Executive Airport |
| TODA | Takeoff Distance Available |
| TORA | Takeoff Run Available |
| TRACON | Terminal Radar Approach Control |
| VASI | Visual Approach Slope Indicator |
| VFR | Visual Flight Rules |
| VMC | Visual Meteorological Conditions |

| | |
|---|---|
| VOR | Very High Frequency Omni Range |
| VORTAC | VOR TACAN |
| ZMA | Miami Air Route Traffic Control Center |

# 1. Introduction

The Palm Beach County Department of Airports (DOA) has initiated a collaborative effort through a Systemwide Airport Master Plan to identify key issues for increasing capacity and efficiency at Palm Beach International Airport (PBI or the Airport) and optimizing the use of DOA's three General Aviation (GA) airports: North Palm Beach County GA Airport (F45), Palm Beach County Park Airport (LNA), and Palm Beach County Glades Airport (PHK). As part of the planning effort, this report presents an assessment of the ability of the current and future Federal Aviation Administration (FAA) National Airspace System (NAS) to accommodate the increased capacity that would result from proposed improvements at PBI and the GA airports. These improvements were identified through airfield analyses of PBI and F45. This Phase I Airport System Study report presents analyses of PBI airspace and airfield constraints. It includes a runway length assessment that validates the need for and utility of upgrading and extending Runway 9R-27L, as well as proposed refinements to the Airport Layout Plan (ALP) concept and preliminary airfield capacity results of those refinement alternatives. The airfield analysis for F45 is presented in a separate, stand-alone report that can be referenced for comparison.

Section 2 of this report presents detailed information on PBI airspace constraint considerations. Current FAA airspace and procedures provide two basic routes into and out of Florida airports located south of Tampa on the west and Daytona on the east; among these designated South Florida Airports are PBI, Miami International, Fort Lauderdale-Hollywood International, Fort Lauderdale Executive, Regional Southwest International at Fort Meyers, and Boca Raton. Arrivals to these airports normally enter Florida on the east or west side of the state. Departures are initially routed east and north over the Atlantic Ocean, or north through the middle of the state before proceeding on course. Competition for the use of these routes during peak traffic periods results in FAA-initiated traffic management measures, particularly in the form of Miles-In-Trail (MIT) restrictions (increased separation between arrivals and departures) and ground delay programs at the departure airport. Continued increases in traffic at most South Florida Airports make it important to study the FAA airspace and procedural relationship between PBI and the other South Florida Airports. To that end, this report initially focuses on assessing the existing regional terminal and enroute airspace structure, existing terminal area and traffic management procedures, special-use airspace, restricted areas, and any other operating practices associated with the airspace serving the region. Based on this inventory, the PBI airfield and airspace constraints are examined. As the FAA operational network database (OPSNET) delay data will show, there is a direct correlation between delays at PBI and constraints on the airfield and airspace. A subsection of this Airspace Constraints Analysis outlines actions that the FAA has taken and is planning to reduce delays and improve the overall efficiency of the South Florida airspace.

Section 3 of this report focuses on airfield constraints at PBI, presenting the runway length analysis for Runway 9R-27L (parallel to the main runway), refinement alternatives to the ALP concept, and preliminary airfield capacity of these alternatives. Refinement alternatives to the ALP concept focus primarily on improving Runway 9R-27L in order to assess the potential gain in airfield capacity over the short-term planning time frame. A preliminary assessment of the current airfield capacity and those of the refined alternative ALP concepts are based on current and projected demand patterns at PBI and conducted in accordance with the FAA's methodology as outlined in FAA AC 150/5060-5, *Airport Capacity and Delay*. The analyses presented in this report were conducted at a macro level of detail, recognizing that Phase II of the System Study will include precise modeling of PBI's airfield capacity.

# 2. Airspace Constraints Analysis

A number of factors affect aircraft operations at PBI, including the airfield layout, high percentage of general and business aviation operations, fleet mix, and current FAA terminal and enroute airspace design. To assist in establishing priorities in the master planning process, an analysis will be completed of the interaction of ongoing FAA National Airspace Redesign (NAR) initiatives in the terminal and enroute airspace that serves the county and the airport improvements being considered by the DOA. This study will identify current system constraints, the primary cause of the constraints, and the current and future actions planned to help reduce or eliminate the impact on PBI in the following areas:

- **Airfield Capacity constraints related to**
  - Current airfield layout
  - FAA terminal and enroute procedures and airspace design
  - Air carrier, corporate, and GA flight planning practices

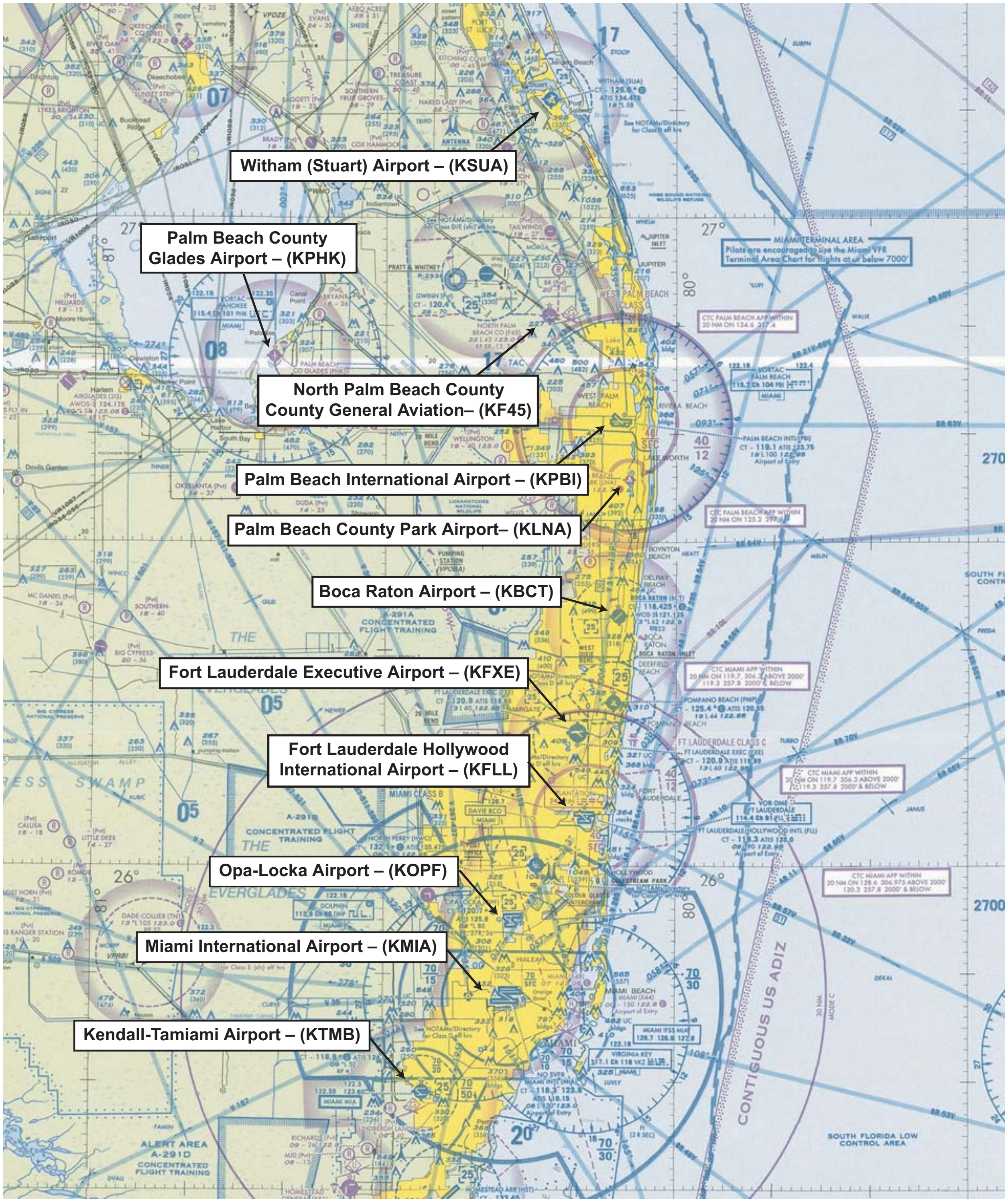
- **Airspace Capacity constraints related to**
  - PBI terminal airspace
  - Miami Air Route Traffic Control Center (ZMA) enroute airspace
  - FAA NAS
  - Air carrier, corporate, and GA flight planning practices.

The DOA, FAA, GA, and business and air carrier users (Users) as well as the Fixed Base Operators (FBOs) all play an integral part in contributing to a Master Plan that clearly states the actions necessary to ensure that any capital investment by the various stakeholders will achieve the desired benefits.

## 2.1 Existing Air Traffic Control Airspace and Procedures

This section describes the FAA control facilities and their general responsibilities and functions, along with airspace allocations and published procedures used for the safe and efficient movement of aircraft to and from PBI.

Three FAA facilities provide Air Traffic Control (ATC) services to aircraft arriving and departing PBI, F45, LNA, SUA, BCT, and PHK. For the purposes of this discussion, traffic from the Palm Beach area will be referred to as "PBI" traffic. Similarly, traffic from the Miami-area airports such as Miami International (MIA), Opa-Locka (OPF), and Kendall-Tamiami Executive (TMB) will refer to as "MIA" traffic. Traffic from the Fort Lauderdale-area airports such as Fort Lauderdale-Hollywood International (FLL) and Fort Lauderdale Executive (FXE) will be referenced as "FLL" traffic. These airports are shown in Exhibit 2-1. Airfields discussed will be referred using each airport's four-letter International Civil Aviation Organization (ICAO) identifier to alleviate confusion, as airport identifiers, navigational aid identifiers, and aviation acronyms sometimes may be the same.




Source: National Oceanic and Atmospherc Administration, Miami Sectional Chart.
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-1

north

## South Florida Airports

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### 2.1.1 Miami Air Route Traffic Control Center

Located in Miami, Florida, the Miami Air Route Traffic Control Center (ZMA) provides ATC services to aircraft operating on Instrument Flight Rules (IFR) flight plans within controlled airspace, principally during the enroute phase of flight, when aircraft are operating between departure and destination terminal areas. ZMA delegates to the PBI Terminal Radar Approach Control (TRACON) authority and responsibility for the control of aircraft within the PBI terminal area. The terminal area is described in complete detail in the next section. IFR governs the procedures for conducting instrument flight. When equipment capabilities and controller workload permit, certain additional advisory services may be provided to aircraft operating in accordance with Visual Flight Rules (VFR), which govern the procedures for conducting flight under visual conditions.

Miami Center provides separation between and expedites the movement of IFR traffic within its delegated airspace of almost 500,000 square miles. Exhibit 2-2 depicts the lateral limits of Miami Center. ZMA airspace borders with Jacksonville Air Route Traffic Control Center to the north; New York Air Route Traffic Control Center (Oceanic) to the northeast; San Juan CERAP (combined Center and Radar Approach Control, RAPCON) to the southeast; and Houston Air Route Traffic Control Center to the west. Miami Center also interfaces with three foreign centers along the southern boundary: Santo Domingo, Port-au-Prince, and Havana. ZMA was ranked seventh busiest among all the centers in 2004 with a total of 2.43 million operations. As Table 2-1 indicates, Miami Center operations grew more than 11 percent from 2003 to 2004. This was the third largest increase for all FAA centers. Table 2-2 shows the annual aircraft operations for airports in Florida in CY2003 and CY2004. The overall trend shows continued increases in traffic at most of the South Florida Airports.

TABLE 2-1
Total Air Traffic Handled by the Centers

| Rank (in 2004) | Centers | 2003 | 2004 | % growth (2003-2004) |
|---|---|---|---|---|
| 1 | ZTL | 2,958,905 | 3,137,890 | 6.0% |
| 2 | ZOB | 2,974,999 | 3,101,978 | 4.3% |
| 3 | ZNY | 2,804,662 | 3,048,009 | 8.7% |
| 4 | ZAU | 2,852,161 | 2,997,628 | 5.1% |
| 5 | ZDC | 2,595,036 | 2,934,618 | 13.1% |
| 6 | ZID | 2,712,992 | 2,881,358 | 6.2% |
| 7 | ZMA | 2,182,498 | 2,437,605 | 11.7% |
| 8 | ZJX | 2,274,389 | 2,415,342 | 6.2% |
| 9 | ZME | 2,227,935 | 2,296,974 | 3.1% |
| 10 | ZFW | 2,130,759 | 2,213,304 | 3.9% |
| 11 | ZLA | 2,020,612 | 2,187,604 | 8.3% |
| 12 | ZMP | 2,041,234 | 2,180,004 | 6.8% |
| 13 | ZHU | 2,004,771 | 2,107,237 | 5.1% |
| 14 | ZKC | 2,052,519 | 2,056,260 | 0.2% |
| 15 | ZBW | 1,780,341 | 1,882,898 | 5.8% |

TABLE 2-1
Total Air Traffic Handled by the Centers

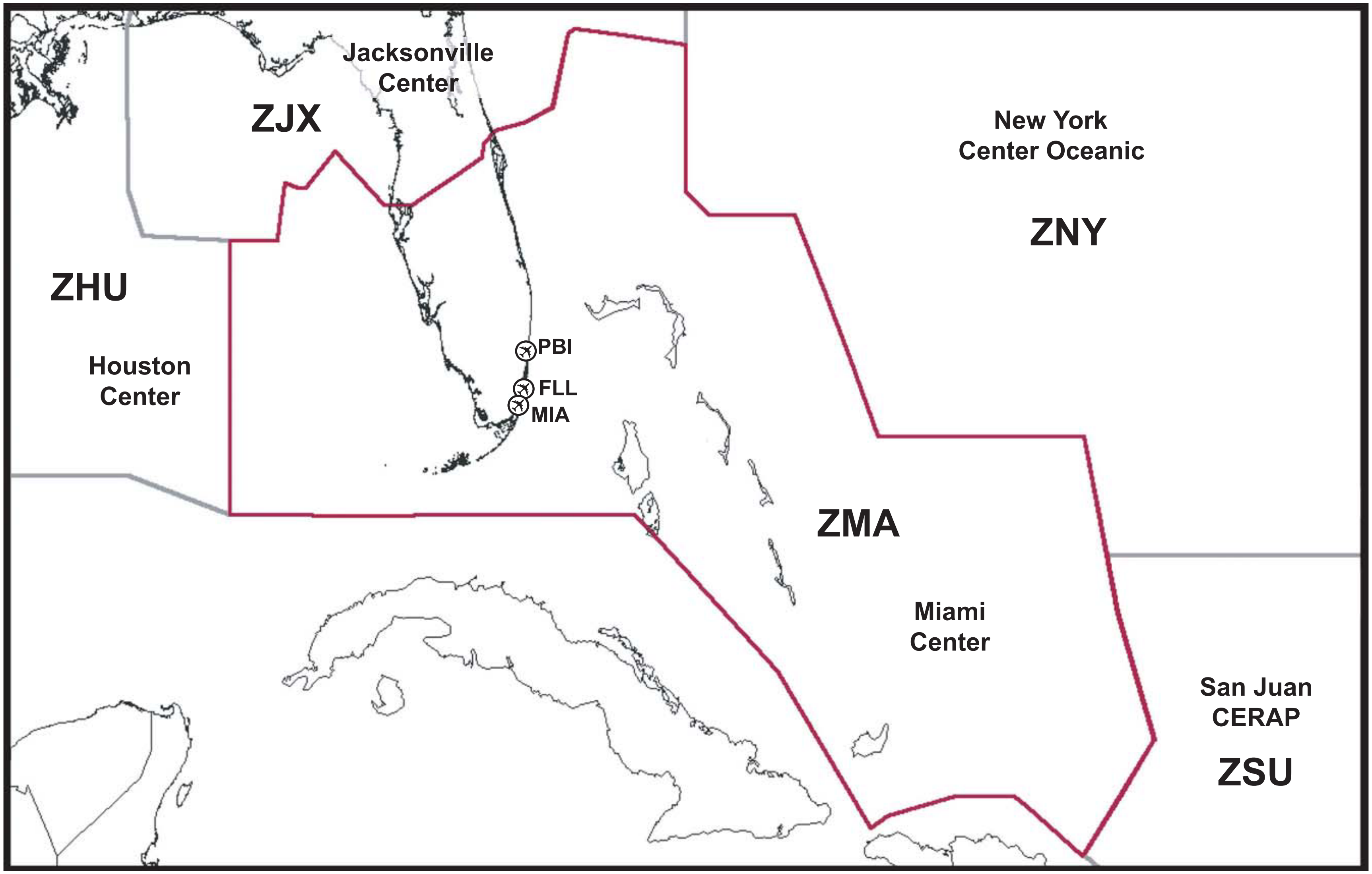
| Rank (in 2004) | Centers | 2003 | 2004 | % growth (2003-2004) |
|---|---|---|---|---|
| 16 | ZDV | 1,683,765 | 1,836,456 | 9.1% |
| 17 | ZAB | 1,700,948 | 1,764,555 | 3.7% |
| 18 | ZOA | 1,600,522 | 1,687,809 | 5.5% |
| 19 | ZLC | 1,460,557 | 1,522,142 | 4.2% |
| 20 | ZSE | 1,271,711 | 1,308,635 | 2.9% |
| 21 | ZAN | 571,549 | 613,240 | 7.3% |
| 22 | ZUA | 119,524 | 153,097 | 28.1% |

Source: FAA OPSNET Data for CY2003 and CY2004.
Prepared by: Ricondo & Associates, Inc.

TABLE 2-2
Florida Airports Annual Operations CY2003 and CY2004

| Airport | 2003 | 2004 | % change |
|---|---|---|---|
| APF | 114,708 | 137,604 | 20.0 |
| BCT | 89,890 | 88,066 | -2.0 |
| F45 | 18,136 | 19,355 | 6.7 |
| FLL | 287,870 | 315,336 | 9.5 |
| FXE | 226,699 | 212,246 | -6.4 |
| LNA | 149,483 | 152,518 | 2.0 |
| MCO | 301,322 | 326,470 | 8.3 |
| MIA | 411,489 | 395,801 | -3.8 |
| PBI | 197,976 | 199,108 | 0.6 |
| PHK | 14,721 | 15,040 | 2.2 |
| PIE | 212,205 | 208,818 | -1.6 |
| RSW | 76,614 | 85,807 | 12.0 |
| SRQ | 136,860 | 138,228 | 1.0 |
| SUA | 115,046 | 110,748 | -3.7 |
| TPA | 233,892 | 245,275 | 4.9 |
| Total | 2,586,911 | 2,650,420 | 2.5 |

Source: FAA ATADS data, 2004 operations for PHK and LNA are FAA's forecast numbers.
Prepared by: Ricondo & Associates, Inc.




Source: FDi - Flight Explorer AVWeb Edition 4.02
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-2

north

- Miami Center Lateral Limits
- Airports

## Miami Air Route Traffic Control Center Lateral Limits

ZMA airspace is divided into sectors that are defined both laterally and vertically. High-altitude sectors control airspace at and above 24,000 feet (FL240) Mean Sea Level (MSL) and are shown in Exhibit 2-3. The low-altitude sectors control airspace from the surface up to but not including FL240 and are depicted in Exhibit 2-4. The vertical and lateral limits of a sector are dictated by traffic volume and flow (direction) of arrival, departure, and over-flight aircraft in their respective areas of responsibility. Most ZMA traffic is in transition to or from the PBI, MIA, and FLL areas and over-flights to the Caribbean, Bahamas, and South America. As a result, the low- and high-altitude sectors are designed to accommodate a predominately north-south flow. The width of the Florida Peninsula and the large amount of Military Special Use Airspace (SUA), including Warning Areas offshore, also influence the design and function of the sectors and airspace. These SUA and Warning areas are depicted in Exhibit 2-5.

## Arrival Procedures

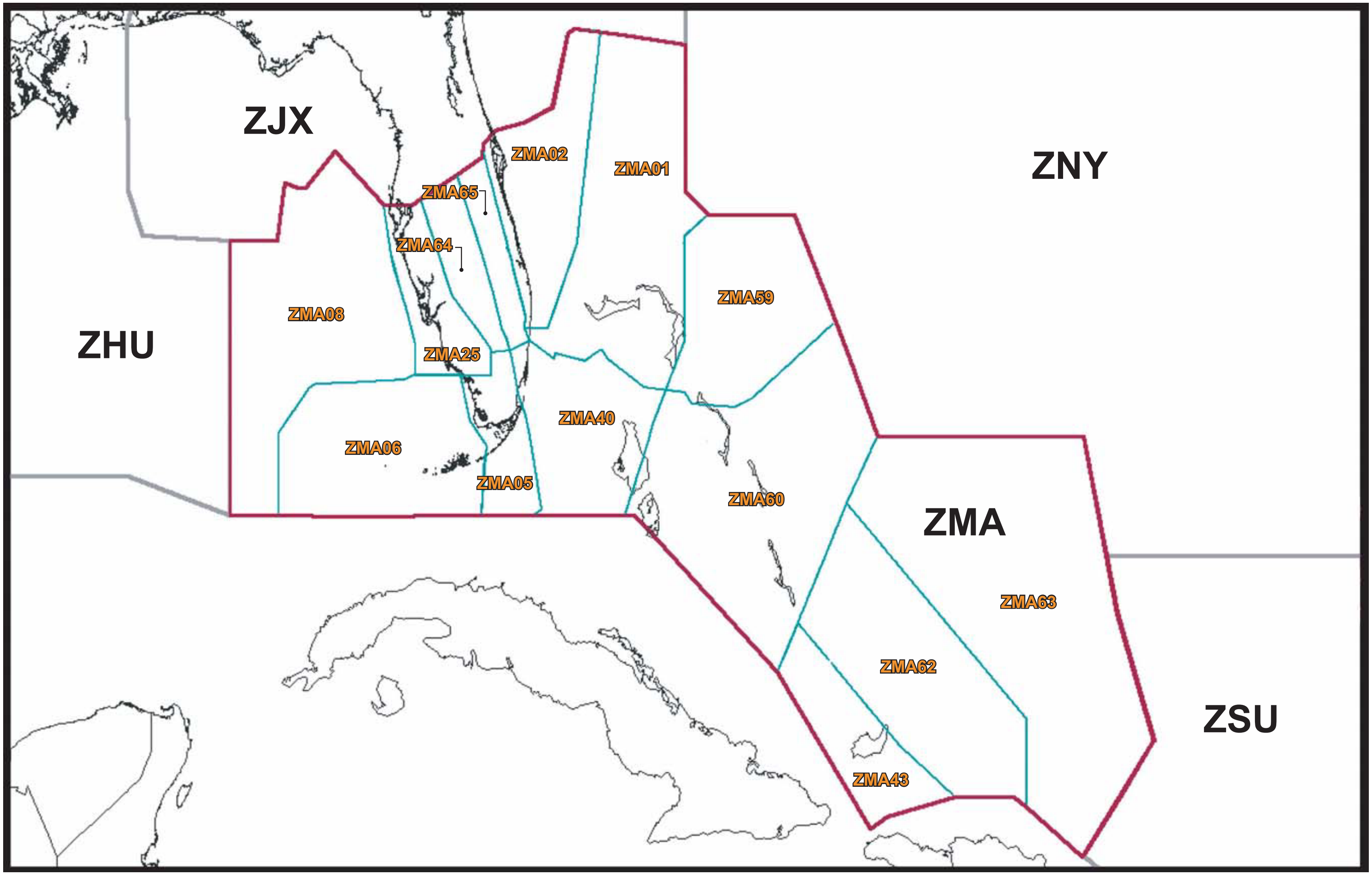
The ZMA sequences arrivals from the continental United States to the South Florida Airports through three high-altitude sectors: Sector 02, Sector 64, and Sector 25. During the descent from cruising altitude to the low-altitude sectors that serve the individual airports, FAA separation standards require five miles lateral separation or 1,000 feet vertical separation. This results in arrival aircraft to all South Florida Airports remaining in-trail throughout the descent regardless of final destination.

Exhibit 2-6 depicts ZMA High Sector 02. This sector sequences arrivals to PBI on the SURFN Standard Terminal Arrival Route (STAR). High Sector 02 also sequences arrivals destined to FLL and MIA. The primary arrival route for traffic originating along the eastern seaboard of the United States and eastern Canada passes through this sector. Traffic from these areas travels in-trail south along Atlantic Route (AR1) to HOBEE intersection. At HOBEE intersection, PMP, FLL, and FXE traffic joins the MRLIN STAR. After HOBBE intersection, MIA and PBI traffic will continue in-trail to TARPO intersection, where MIA traffic joins HEATT STAR. After TARPO intersection, PBI traffic transitions to ZMA Low Sector 20. This sector delivers PBI arrivals to the PBI TRACON at the SWOMP Arrival Transition Area (ATA).

High Sector 64 sequences arrivals to PBI that have been assigned to the LLAKE STAR; this is depicted in Exhibit 2-7. Traffic originating from the remaining areas of the United States and Canada is served along this route. Prior to LLAKE intersection, PBI traffic transitions to ZMA Low Sector 45, which delivers PBI arrivals to the PBI TRACON at the ULLMN ATA.

High Sector 25 sequences arrivals to FLL and MIA as illustrated in Exhibit 2-7. Traffic originating from the remaining areas of the United States and Canada is served along this routing in this sector. Traffic from these areas travels in-trail via Jet Airways J41, J43, and J75. Leaving Flight Level (FL) 240 control is assumed to occur by Low Sector 24. Traffic destined for MIA and FLL joins the FORTL STAR at the Lee County (RSW) VORTAC, while MIA joins Cypress STAR at the Cypress VORTAC.

High-altitude traffic from the Bahamas and eastern Caribbean are sequenced by High Sector 40 for aircraft arriving at PBI, FLL, and MIA, as depicted in Exhibit 2-8. Traffic generally enters ZMA airspace at URSUS intersection with MIA traffic, then joins the FOWEE STAR, while FLL, FXE, and PMP traffic joins the DEKAL STAR after URSUS intersection. PBI traffic is vectored toward the WALIK or MARLN intersection as appropriate. Traffic destined for PBI is then descended, and control is transferred to ZMA Low Sector 21 and the traffic delivered to the PBI TRACON at the WALIK and MRLIN ATAs.



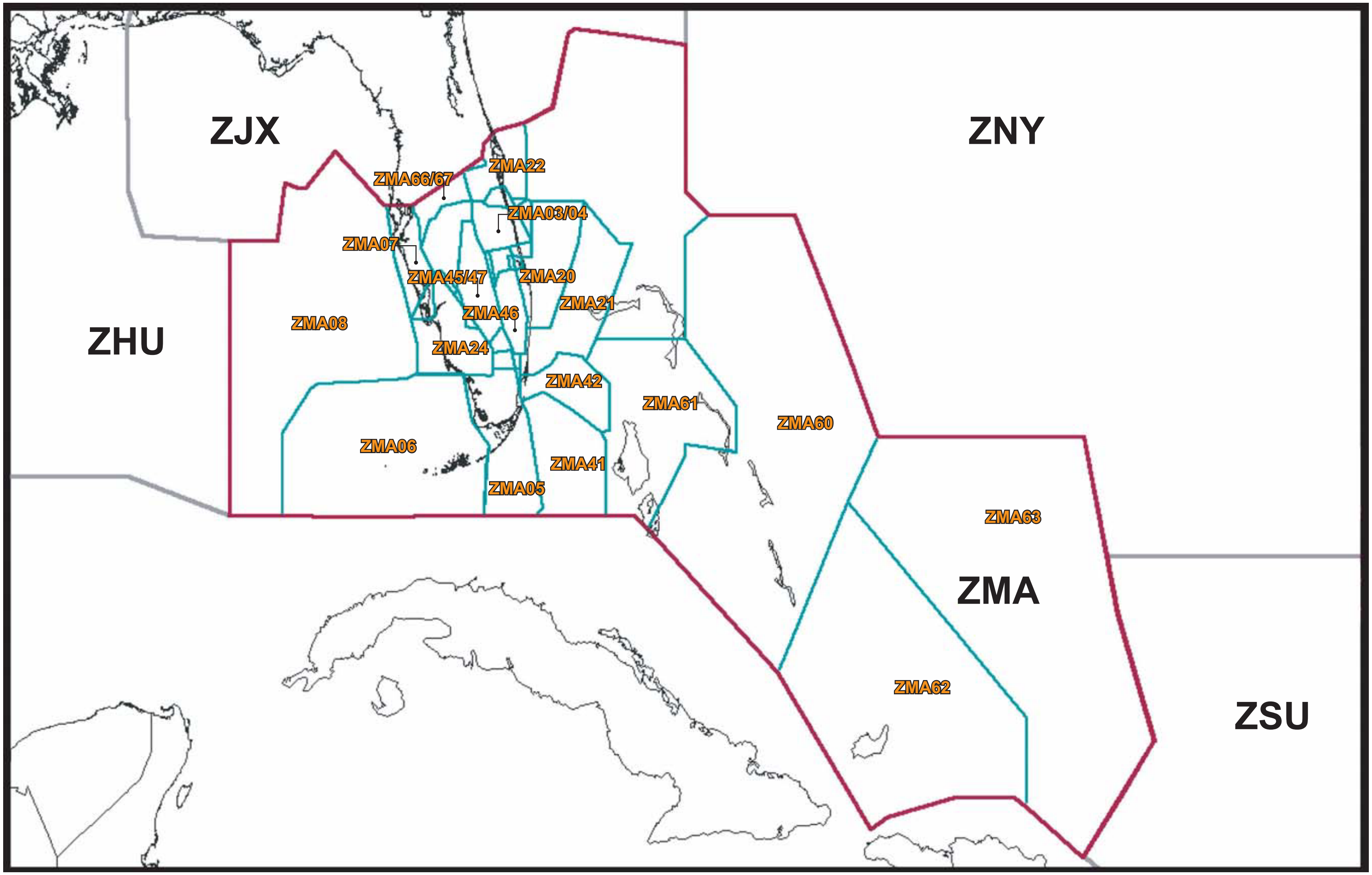

Source: FDi - Flight Explorer AVWeb Edition 4.02
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-3


- Miami Center Lateral Limits
- Sectors

## Miami Center
## High Altitude Sectors

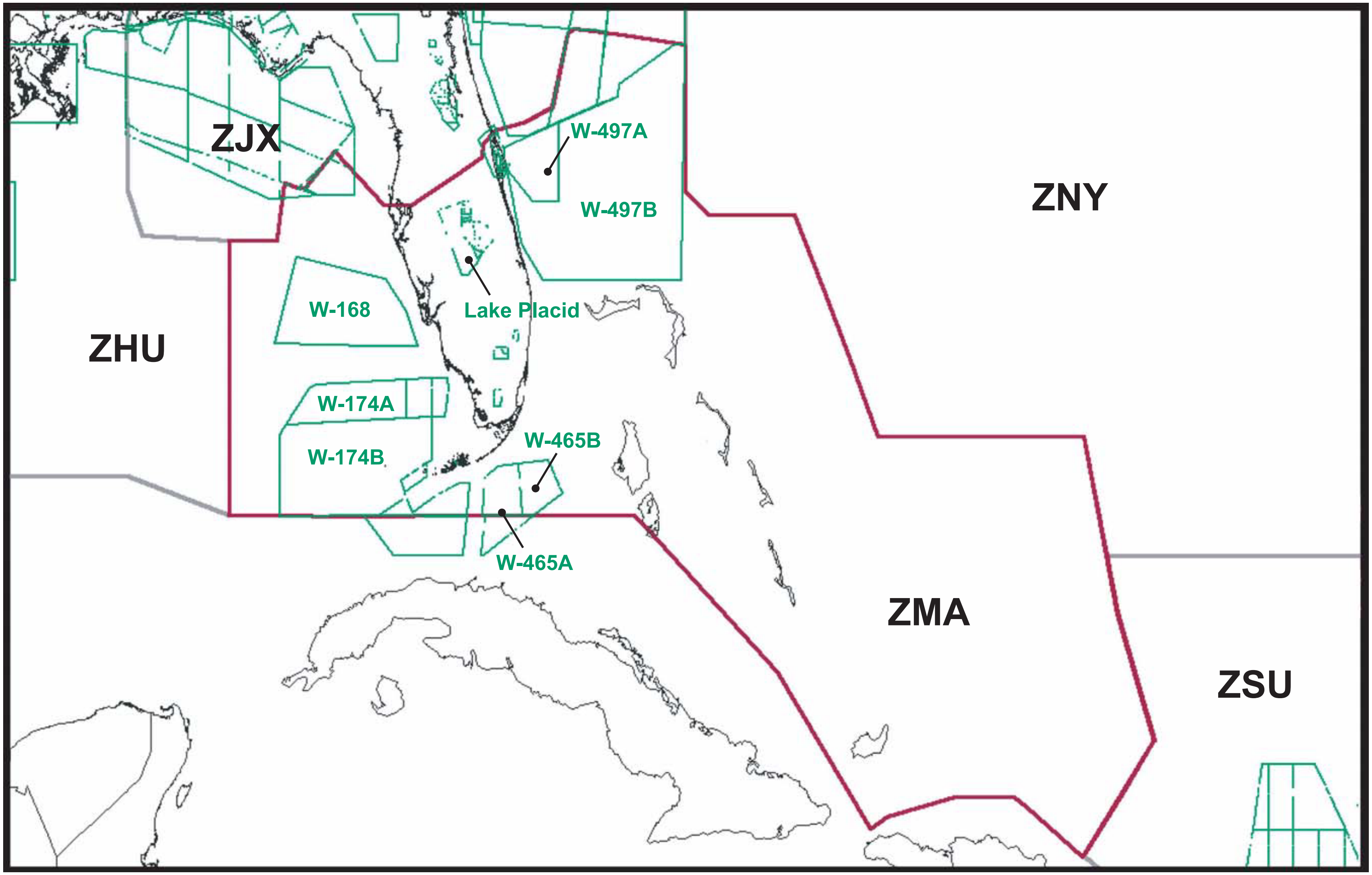
October 2005




Source: FDi - Flight Explorer AVWeb Edition 4.02
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-4

**Miami Centers Low Altitude Sectors**




Source: FDi - Flight Explorer AVWeb Edition 4.02
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-5

north

- Miami Center Lateral Limits
- Special Use Airspace

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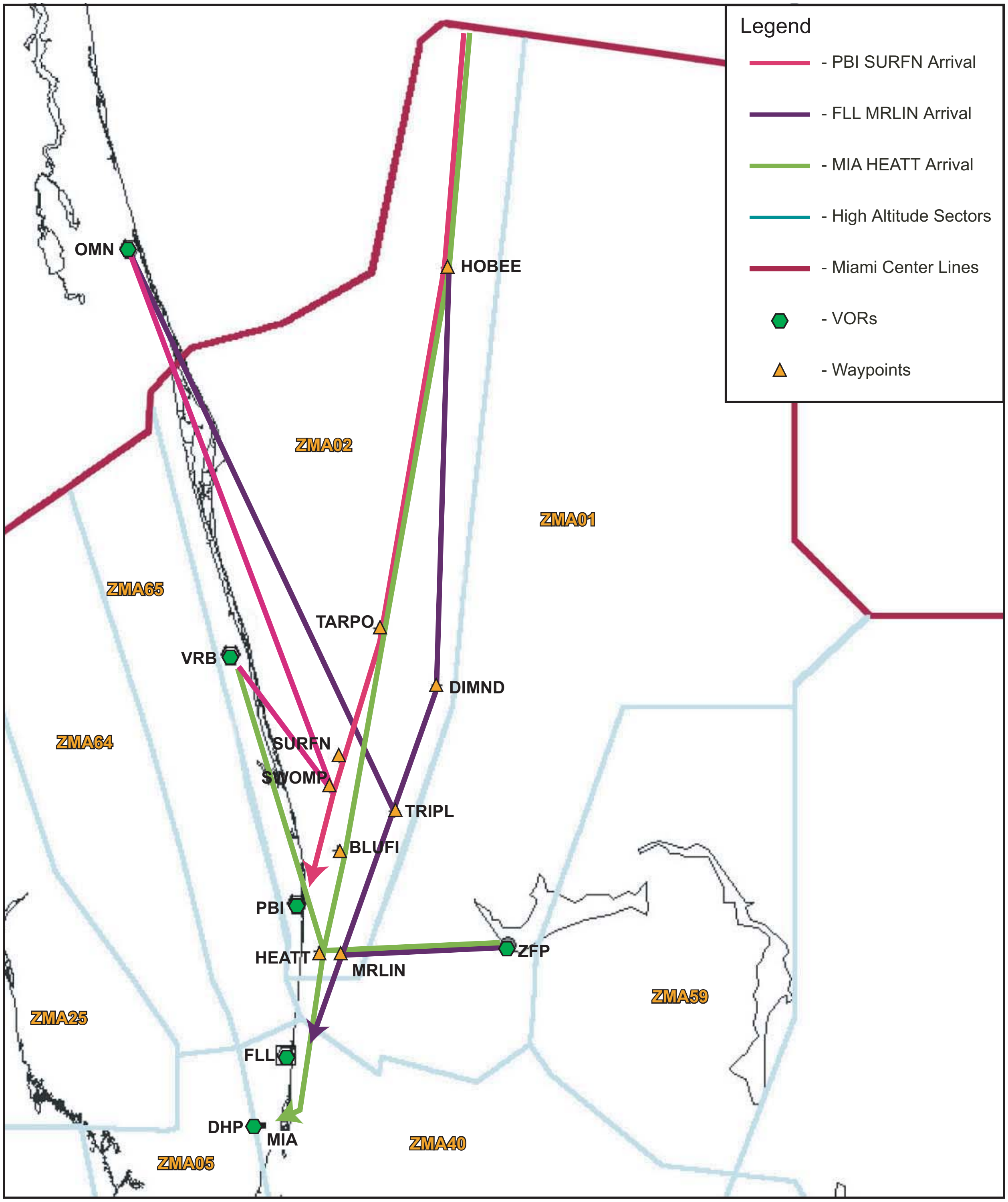
**Florida Special Use Airspace**

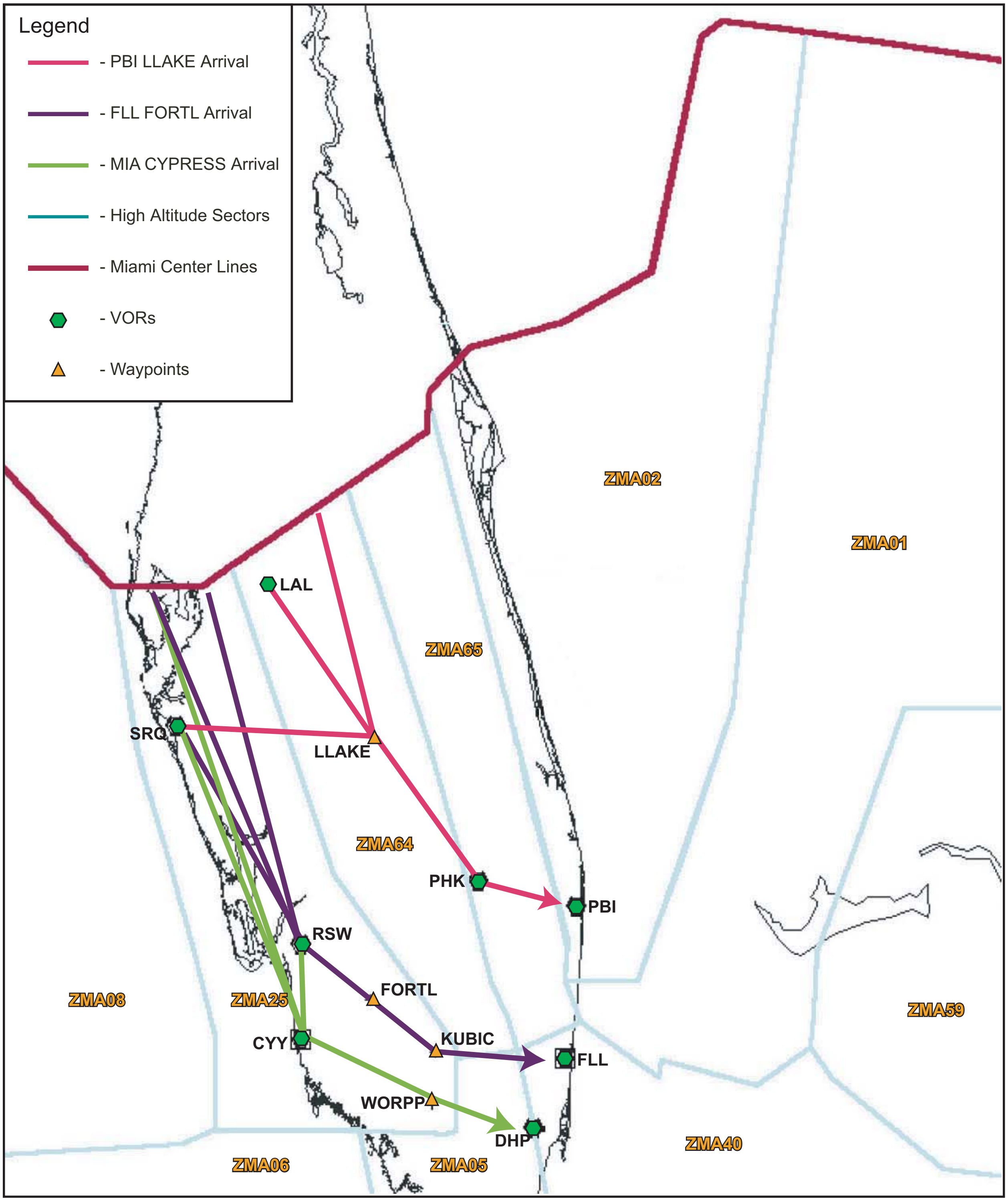



Source: FDi - Flight Explorer AVWeb Edition 4.02
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-6

north

## ZMA High Sector 02 Arrival Routes

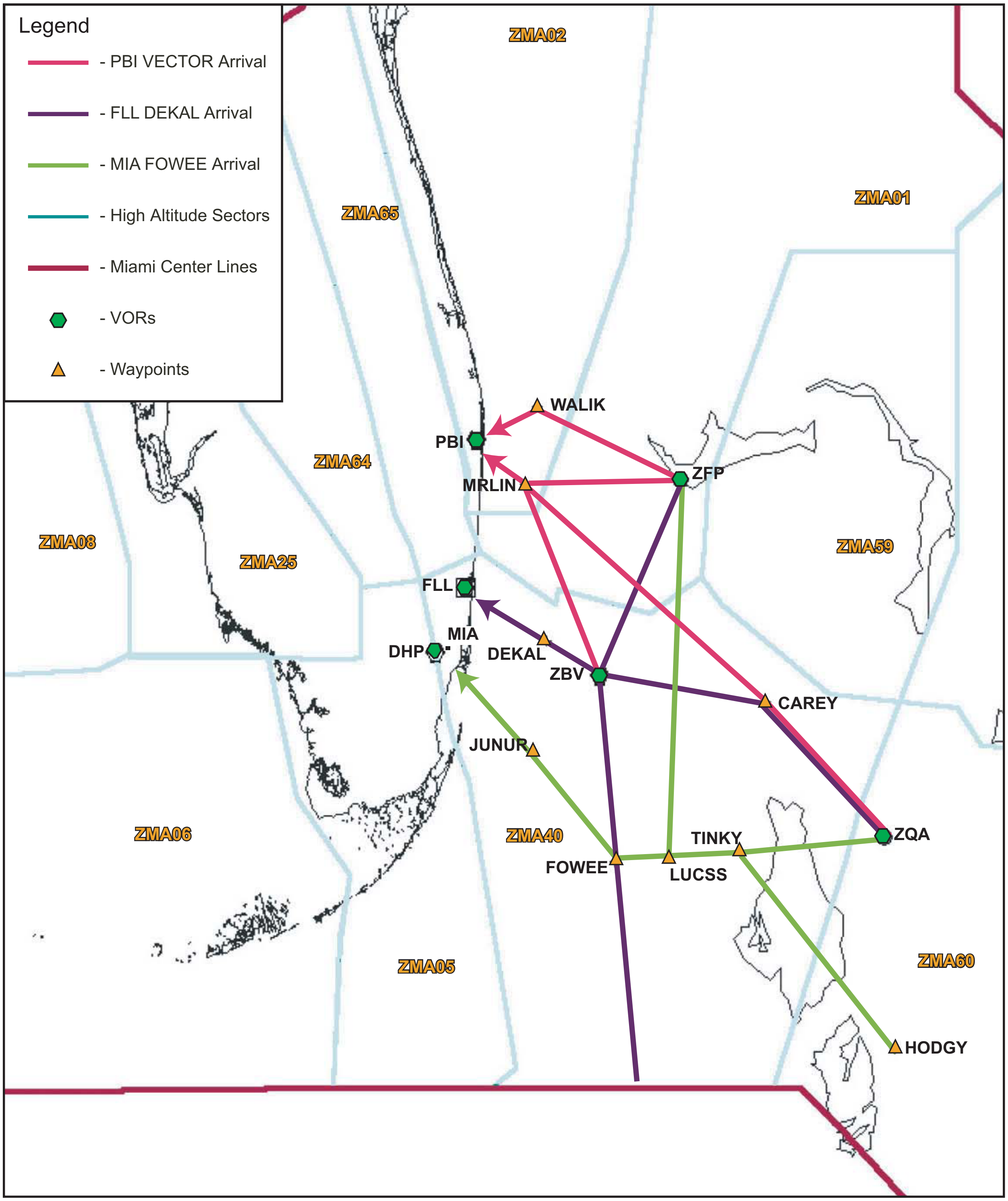



Source: FDi - Flight Explorer AVWeb Edition 4.02
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-7

north

## ZMA High Sectors 25 and 64 Arrival Routes




Source: FDi - Flight Explorer AVWeb Edition 4.02
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-8

north

## ZMA High Sector 40 Arrival Routes

### Departure Procedures

The ZMA sequences departures to the continental United States from the South Florida Airports through three high-altitude sectors: Sector 01, Sector 64, and Sector 65. During the climb from the low-altitude sectors to cruising altitude, FAA separation standards require five miles lateral separation or 1,000 feet vertical separation. This results in departure aircraft from all South Florida Airports remaining in-trail throughout this climb, regardless of destination.

ZMA High Sector 01, shown in Exhibit 2-9, sequences departures from the South Florida Airports destined to the northeastern United States and eastern Canada using aircraft and procedures that allow extended over-water routes. Aircraft from FLL and MIA are vectored toward PERMT intersection located on AR7. Aircraft from PBI use the BLUFI Departure Transition Area (DTA). Traffic exiting the BLUFI DTA does so established on the PBI VORTAC 057° radial. The PBI VORTAC 057° radial intercepts AR7 at PERMT intersection.

Traffic enroute to the northeastern United States and eastern Canada that cannot use extended over-water routes are routed through ZMA High Sector 65 as shown in Exhibit 2-9. ZMA vectors departure traffic from MIA and FLL to J53 and J81. Aircraft from PBI will transition to ZMA airspace using the TBIRD DTA.

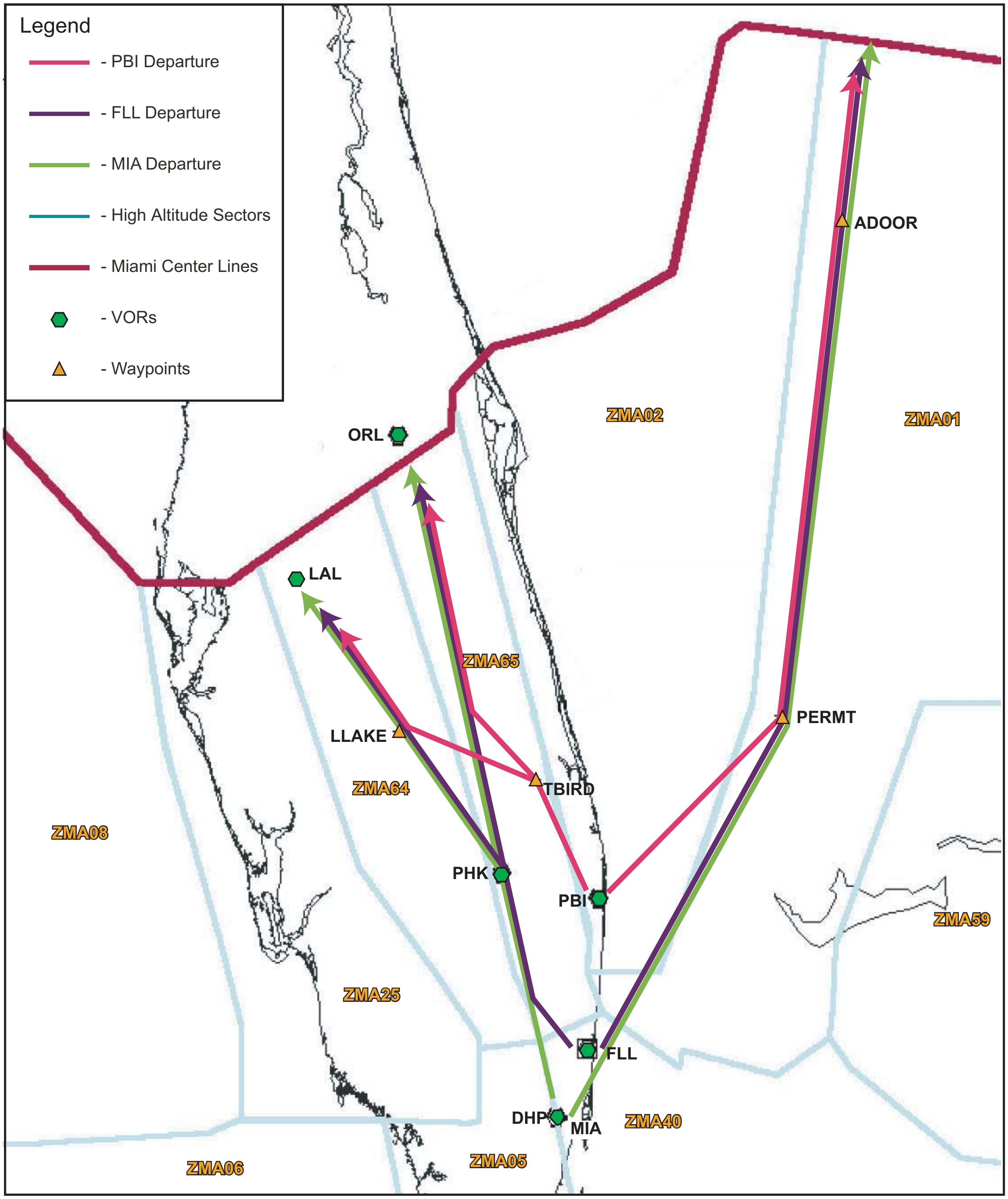
ZMA High Sector 64, shown in Exhibit 2-9, serves traffic departing to the rest of the continental United States and Canada. ZMA vectors departure traffic from MIA and FLL to LAL VORTAC. Aircraft from PBI will transition to ZMA airspace via the TBIRD DTA.

## 2.1.2 Palm Beach Terminal Radar Approach Control

The PBI TRACON is located at the Airport. The PBI TRACON provides radar service to aircraft arriving and departing the Airport and six additional civil airports in the terminal area, as shown in Exhibit 2-10. The lateral and vertical limits of the TRACON approach control airspace are depicted in Exhibit 2-11. "Radar service" is a term that encompasses one or more of the following services:

- Radar Monitoring, in which the radar flight follow aircraft to observe and note deviations from its authorized flight path, airway, or route when the aircraft's pilot is performing primary navigation;
- Radar Navigational Guidance, vectoring aircraft to provide course guidance;
- Radar Separation, spacing aircraft in accordance with the established minimum separations.

PBI TRACON receives arrival aircraft handed over by ZMA. The arrival and departure airspace delegated to the PBI TRACON by ZMA is depicted in Exhibit 2-12. ZMA and PBI TRACON transition arrivals and departures via the appropriate ATAs and DTAs on routing or vector headings that ensure aircraft transition within the confines of the appropriate ATA or DTA. Radar separation at the appropriate ATA/DTA must not be less than five nautical miles (NM) and must be constant or increasing.

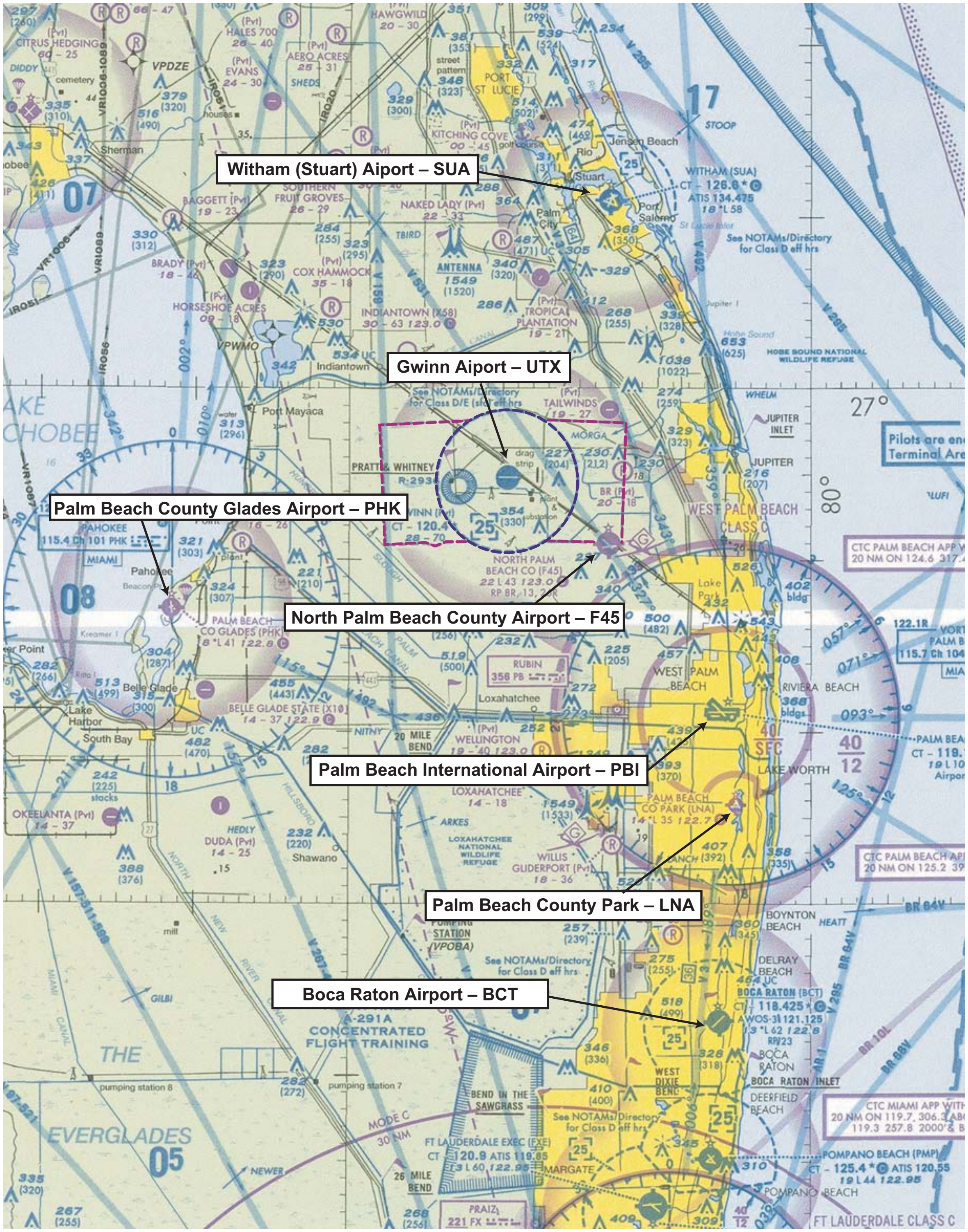



Source: FDi - Flight Explorer AVWeb Edition 4.02
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-9

north

## ZMA High Sector 01, 64, and 65 Departure Routes




Source: National Oceanic and Atmospherc Administration, Miami Sectional Chart.
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-10

north

# Airports in PBIA Approach Control Airspace

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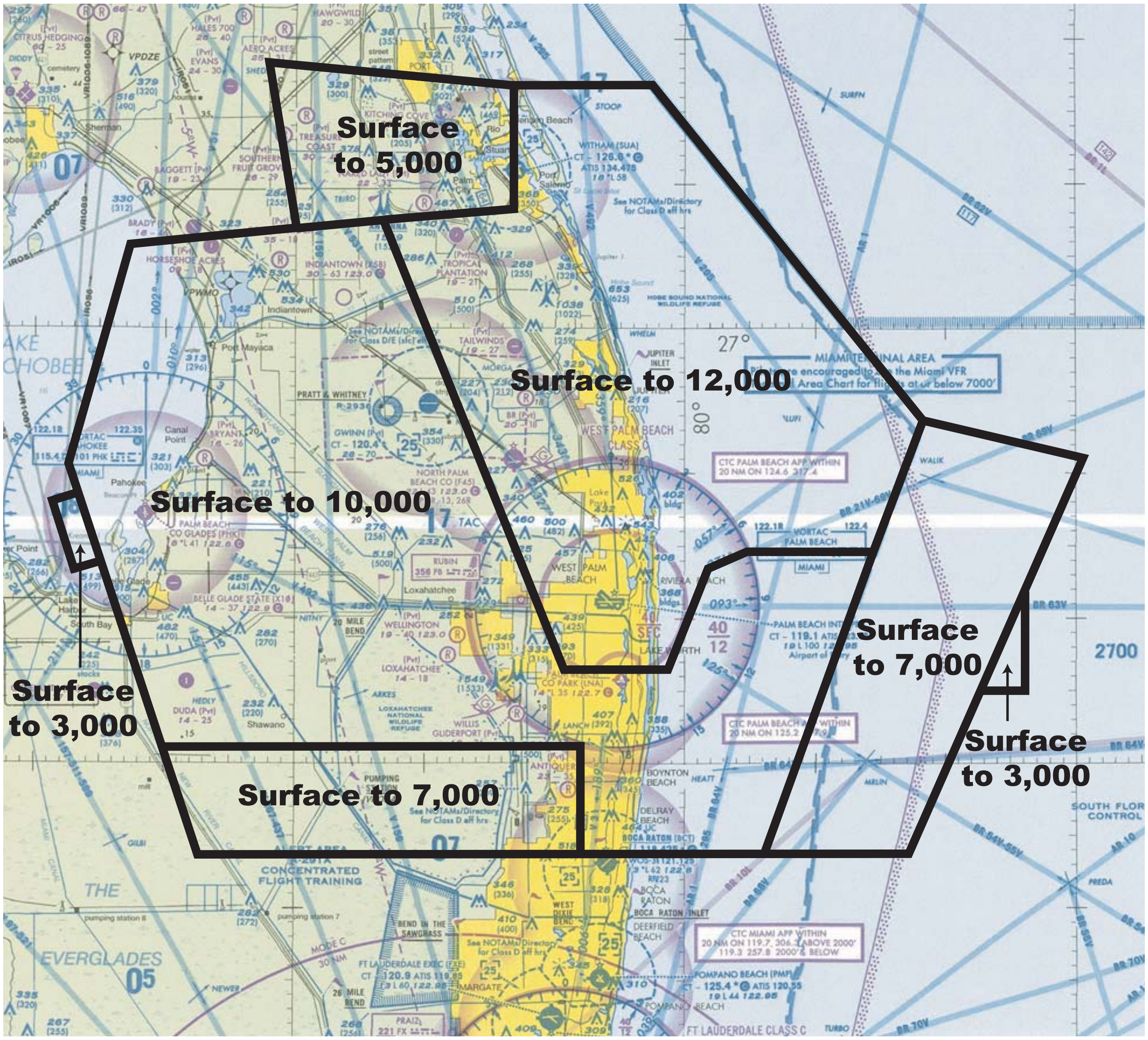



Source: Miami ARTC Center and Palm Beach ATC Tower Letter of Agreement.
Basemap - National Oceanic and Atmospherc Administration, Miami Sectional Chart.
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-11

north

## PBI TRACON Airspace

z:\PBI\Graphics\Airspace Exhibit 1.ai

As illustrated in Exhibit 2-12, the primary turbojet ATAs are SWOMP, ULLMN, WALIK, DOUGS, and MRLIN. The SWOMP ATA corresponds to the SURFN STAR. Turbojet aircraft cross SWOMP at 8,000 feet MSL, while prop and turboprop traffic cross at 6,000 feet MSL. During west flow operations, arrivals from SWOMP are vectored to a right downwind to Runway 27R. In east flow operations, arrivals from SWOMP are given vectors to join the left downwind to Runway 9L.

The ULLMN ATA corresponds to the LLAKE STAR. Turbojet aircraft cross ULLMN at 10,000 feet MSL, while prop and turboprop traffic cross at 5,000 feet or 7,000 feet MSL. During west flow operations, traffic from ULLMN is vectored to a right downwind to Runway 27R. In east flow, traffic may be vectored straight in to Runway 9L.

The WALIK and MRLIN ATAs serve traffic from the Bahamas and eastern Caribbean. Turbojet traffic crosses WALIK at 6,000 feet MSL and MRLIN at 5,000 feet MSL. Prop and turboprop traffic cross WALIK at 4,000 feet MSL or 6,000 feet MSL and MRLIN at 4,000 feet MSL. During west flow operations, arrivals from MRLIN and WALIK may be vectored straight in to Runway 27R. Arrival aircraft in the east flow are vectored to a right downwind for Runway 9L.

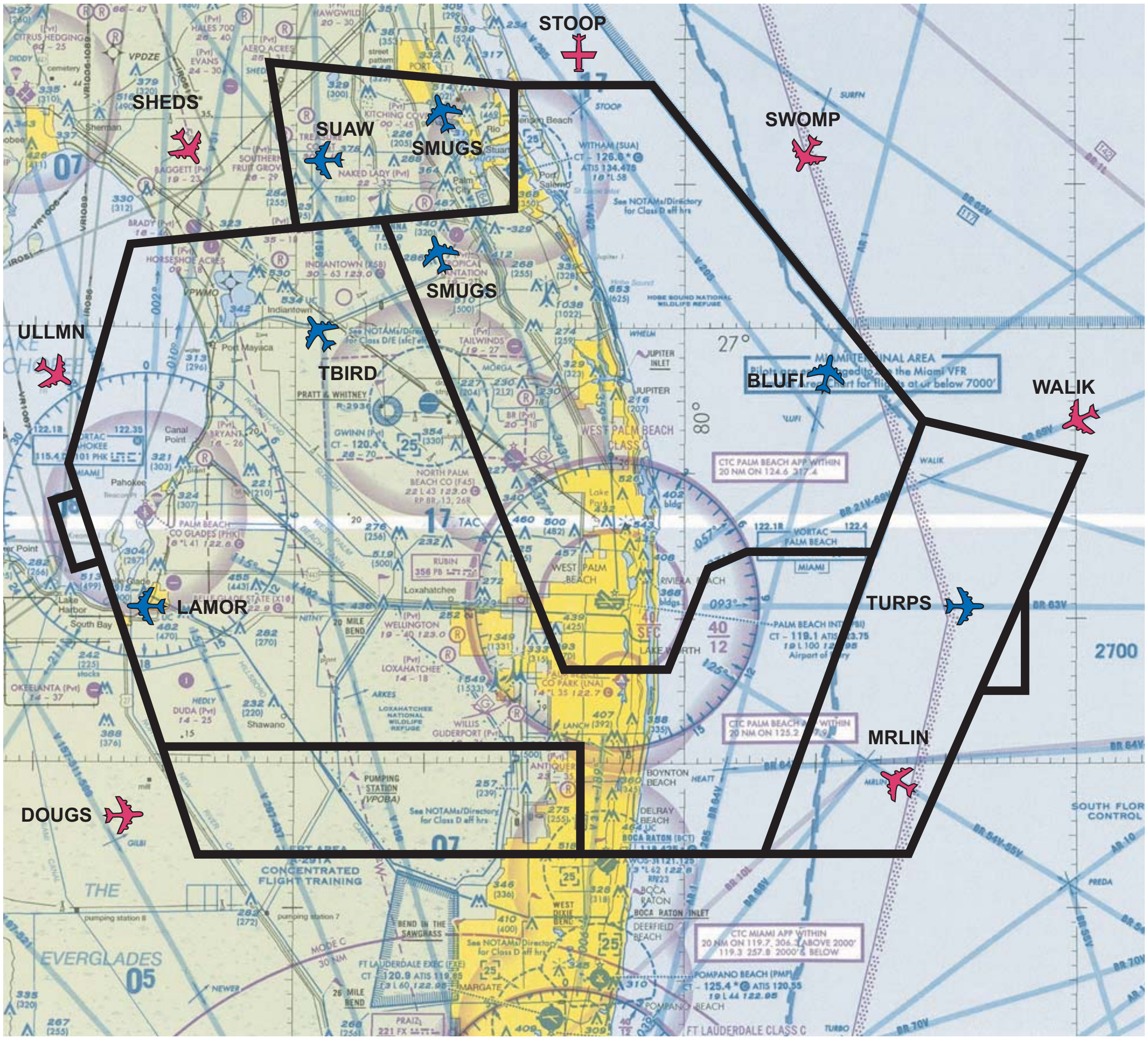
The DOUGS ATA serves traffic from the Florida Keys. Turbojet traffic crosses DOUGS at 7,000 feet MSL, and turboprop and prop traffic at 5,000 feet MSL or 7,000 feet MSL. During west flow operations, arrivals from DOUGS are vectored to a right downwind for Runway 27R. In the east flow, arrivals may be vectored straight in to Runway 9L.

The STOOP ATA serves turboprop and prop aircraft exclusively. This ATA is also depicted in Exhibit 2-12. Traffic crosses STOOP at 5,000 feet MSL or 6,000 feet MSL. During west flow operations, arrivals from STOOP are vectored to a left downwind for Runway 27R. In the east flow configuration, STOOP traffic is vectored to a left downwind for Runway 9L.

Aircraft depart the PBI Air Traffic Control Tower (ATCT) airspace via the DTAs shown in Exhibit 2-12. Aircraft departing the TBIRD DTA requesting an altitude at or below 9,000 feet MSL do so via V531. When PBI is operating to the east, traffic departing the TBIRD DTA with a final requested altitude at or above 11,000 feet MSL exit the DTA on a heading of 290°. When PBI is operating to the west, traffic departing the TBIRD DTA with a final requested altitude at or above 11,000 feet. MSL exit the DTA on a heading of 320°. Traffic exiting the BLUFI DTA does so as established on the PBI VORTAC 057° radial.

Aircraft with a destination of the Bahamas or eastern Caribbean use the TURPS DTA on 090° heading or via BR63V, depending upon the destination. The LAMOR DTA serves aircraft destined to western Florida that exits on a heading of 270°. Traffic exiting SMUGS DTA is delivered on V3, direct VRB, or direct FPR if landing at FPR.

Routings for aircraft over-flying the PBI ATCT airspace are depicted in Exhibit 2-12. Over-flights landing in the Miami Terminal Area from the north are routed on or east of V437 direct to the PHK VORTAC, then via V437 to BRIKL intersection. Turboprop aircraft landing in the Miami Terminal Area from the north are routed via STOOP intersection and V295. Caribbean over-flights landing in the Miami Terminal Area are routed via the MRLIN ATA and BR68V.




Legend

- – Jet/Prop Arrival Transition Area
- – Jet/Prop Departure Transition Area
- – Prop Only Arrival Transition Area

Source: Miami ARTC Center and Palm Beach ATC Tower Letter of Agreement.
Basemap - National Oceanic and Atmospherc Administration, Miami Sectional Chart.
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-12

north

## PBI Arrival & Departure Airspace

z:\PBI\Graphics\Airspace Exhibit 2.ai

Aircraft with a destination of the Bahamas or eastern Caribbean use the TURPS DTA on 090° heading or via BR63V, depending upon the destination. The LAMOR DTA serves aircraft destined to western Florida that exits on a heading of 270°. Traffic exiting SMUGS DTA is delivered on V3, direct VRB, or direct FPR if landing at FPR.

Routings for aircraft over-flying the PBI ATCT airspace are depicted in Exhibit 2-12. Over-flights landing in the Miami Terminal Area from the north are routed on or east of V437 direct to the PHK VORTAC, then via V437 to BRIKL intersection. Turboprop aircraft landing in the Miami Terminal Area from the north are routed via STOOP intersection and V295. Caribbean over-flights landing in the Miami Terminal Area are routed via the MRLIN ATA and BR68V.

### 2.1.3 Palm Beach International Airport Air Traffic Control

The PBI ATCT is located on the airfield and provides ATC services to aircraft operating on and within close proximity of the Airport. PBI ATCT authorizes aircraft to land or takeoff at the Airport or to transition through its delegated airspace. PBI ATCT is delegated that airspace within a 5 NM radius of the airport surface to 1,000 feet MSL, excluding that airspace east of the shoreline. PBI ATCT-delegated airspace is in effect only when the Class C airspace is VFR. In IFR conditions the airspace reverts to the TRACON.

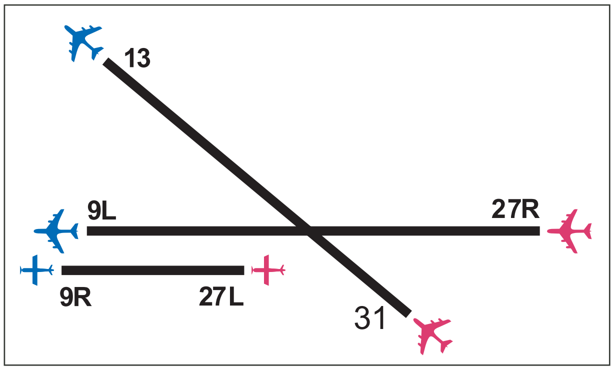
Exhibit 2-13 depicts the runway configuration use during east and west flow scenarios. When the airfield is landing to the east in VFR conditions, turbojet and turboprop aircraft typically use Runway 9L, while piston aircraft arriving from the north use Runway 9R or 13. Single-engine and light twin-piston aircraft arriving from the south use Runway 9R. Runway 9L is the primary arrival runway during periods of IFR weather. When the airfield operates to the west, turbojet aircraft use Runway 27R for landing, while some commuter aircraft arriving from the south use Runway 31. Single-engine and light piston twin-engine aircraft arriving from the north use Runway 27L or Runway 27R and Runway 27L when arriving from the south. Runway 27R is the primary arrival runway during IFR conditions.

Runway 9L is the primary turbojet departure runway when the airfield is operating to the east. Piston single-engine and light piston twin-engine aircraft depart on Runway 9R, while southbound and Bahamas-bound turboprop commuter aircraft use Runway 13. When the airfield is landing to the west, turbojet and turboprops depart from Runway 27R, and the small pistons depart from Runway 27L.

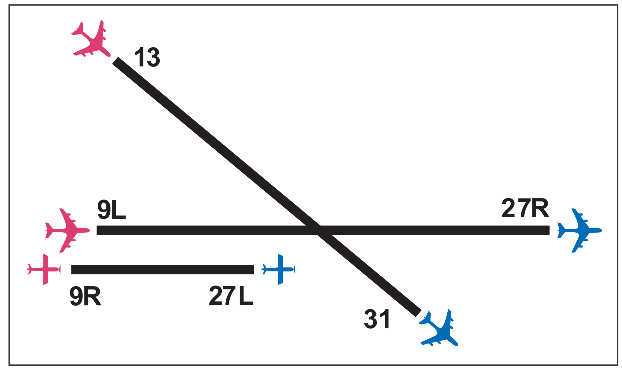
The airfield is operated to the east approximately 65 to 70 percent of the time. The west configuration is used approximately 30 to 35 percent of the time and is preferred for nighttime noise abatement operations.

Land and Hold Short Operations (LAHSO) are not utilized at PBI due to the heavy GA and air carrier mix. The National LAHSO order effectively prohibits LAHSO between GA and air carrier aircraft. While LAHSO may be used if both aircraft are GA, the mix of aircraft at PBI makes consistent use of LAHSO impractical.

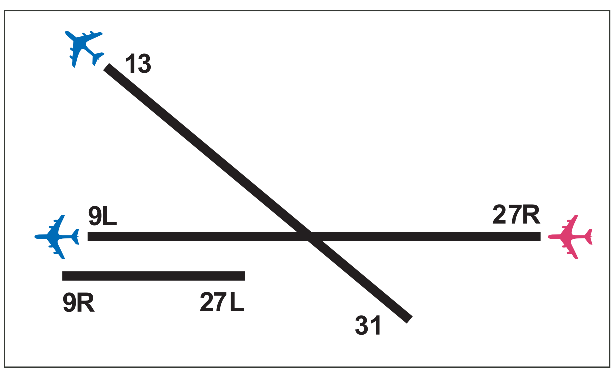
### VFR West Flow Operations



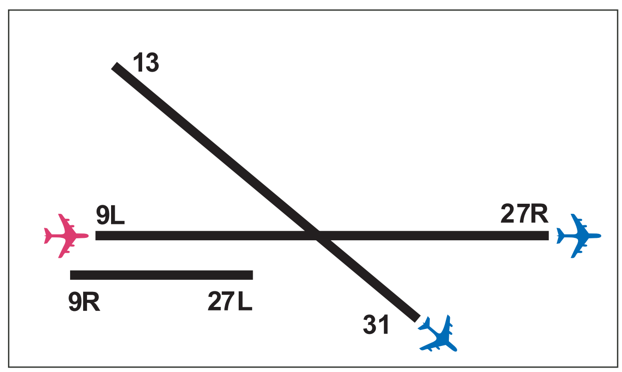

### VFR East Flow Operations



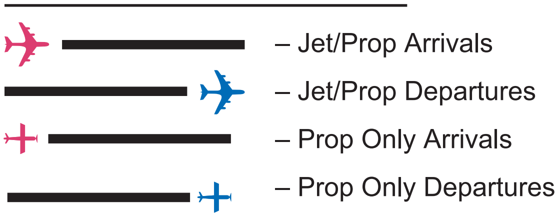

### IFR West Flow Operations




### IFR East Flow Operations




Legend




Source: Strategic Master Plan Study, 2000.
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-13

## East & West Flow Runway Operations

z:\PBI\Graphics\Airspace Exhibit 8.ai

Exhibit 2-14 depicts the airfield circulation patterns when the airfield is operating to the east. Aircraft parked at Concourse A or the west side of Concourse B use Taxiway B for departures on Runway 13 and Taxiways A and C when departing Runway 9L. Traffic from Concourse C and the east side of Concourse B use Taxiways C and B when departing Runway 13 or Taxiway C when taking off on Runway 9L. Aircraft from the southeast side of the airfield are usually routed to Runway 9L via Taxiways E, F, and L. GA aircraft parked west of Runway 13 typically use Taxiways F, L or R, S, L to runway 9L. GA aircraft parked west of Runway 13 use Taxiway R to depart on Runway 9R. The main passenger terminal can be accessed via Taxiways C and B. Taxiways R, F, G, or F provide access to the GA area. Aircraft arriving on Runway 9L use Taxiway K, E or J, E or Runway 13, and E to the southeast side. Landing traffic on 9L mostly uses Taxiways D, E, F, R or J, E, F, R or H, F, and R to parking west of Runway 13-31.

Taxiway flows when the airfield is operating to the west are illustrated in Exhibit 2-15. Runway 27R can be accessed for departure from the main terminal via Taxiways B and/or C. Taxiway E will be used by GA traffic parked at the airfield's southeast corner and departing Runway 27R. Aircraft parked in this same location and using Runway 31 do so via Taxiway E. GA aircraft parked west of Runway 31 and using Runway 31 for departure use Taxiway F. Aircraft requiring Runway 27R can use Taxiways F, E, and the connector east of E, or Taxiways G/H and C depending on traffic conditions. Aircraft using Runway 27L for departure use Taxiway F.

When the Airport is operating to the west, the main passenger terminal can be accessed via Taxiways A, B, and/or C. The GA area located in the southeast corner can be accessed via Taxiways D, K, F, G, and/or E. Taxiway R provides access to the GA area west of Runway 31.

## 2.2 Airfield and Airspace Constraints

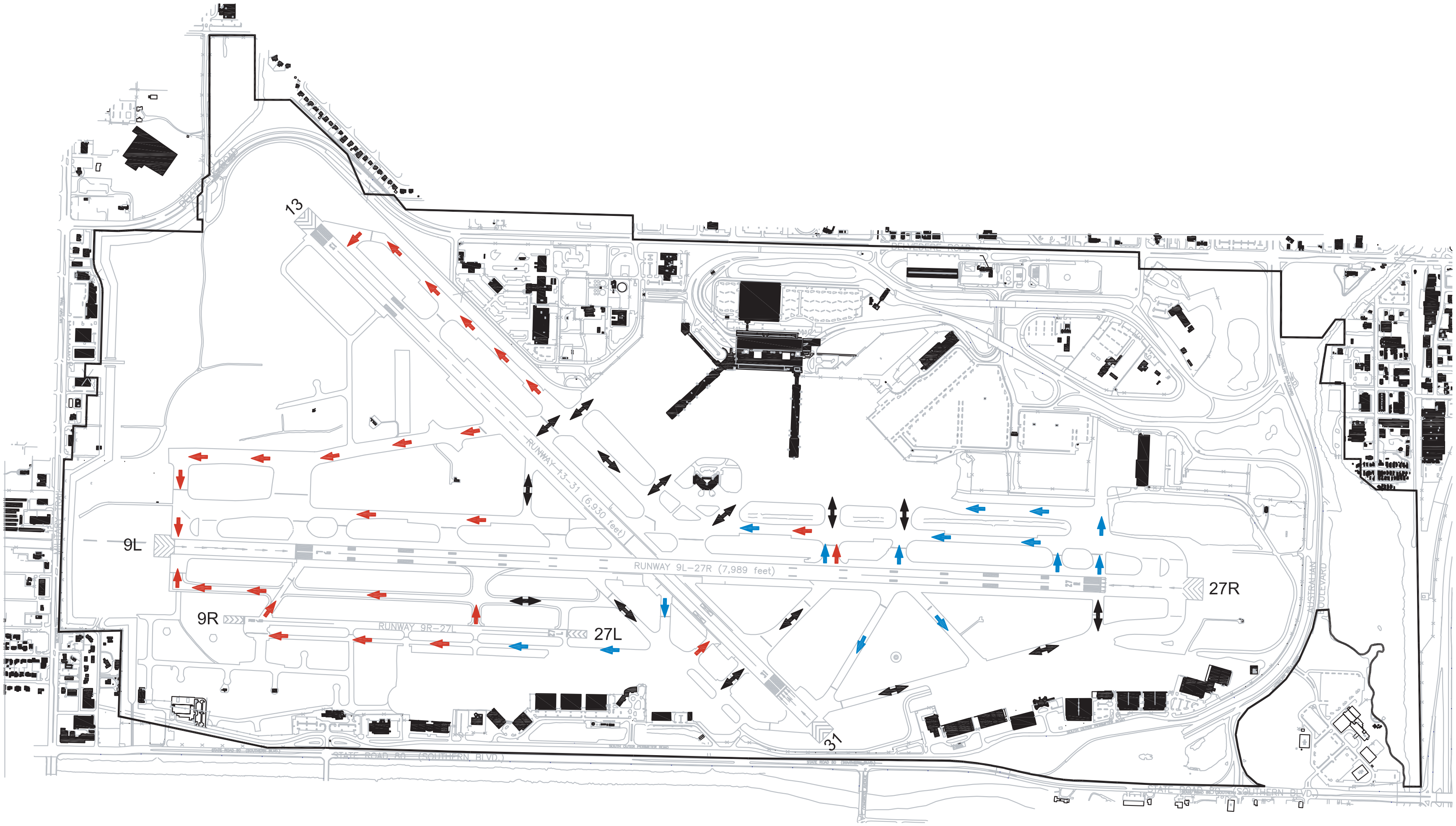
A review of FAA OPSNET delay data, presented in Table 2-3 and Table 2-4, shows a direct correlation between delays at PBI and the airfield and airspace constraints. Delay data were grouped from November to April each year based on the increased traffic demand during the winter season. From November 2002 to April 2004, the major cause of delays at PBI during the winter season was terminal (PBI) and enroute (ZMA) volume. From November 2003 to April 2004, terminal and enroute volume accounted for 54.3 percent of the delays at PBI.

Terminal delays (37.1 percent) were generated on the ground at PBI when:

1. Departure demand exceeded departure capacity; the primarily single-runway operation for arrival and departure aircraft at PBI allows a departure rate of approximately 36 aircraft an hour.
2. Mile-in-trail (MIT) restrictions were placed on departure aircraft by ZMA to control volume on routes shared with MIA, FLL, and other South Florida Airports.

Enroute delays (17.2 percent) were generated when:

1. Arrival demand exceeded the Airport's hourly arrival capacity; the primarily single-runway operation for arrival and departure aircraft at PBI allows an arrival rate of approximately 36 aircraft an hour
2. MIT restrictions are placed on arrival aircraft by ZMA to control volume on arrival routes shared with MIA, FLL, and other South Florida airports.

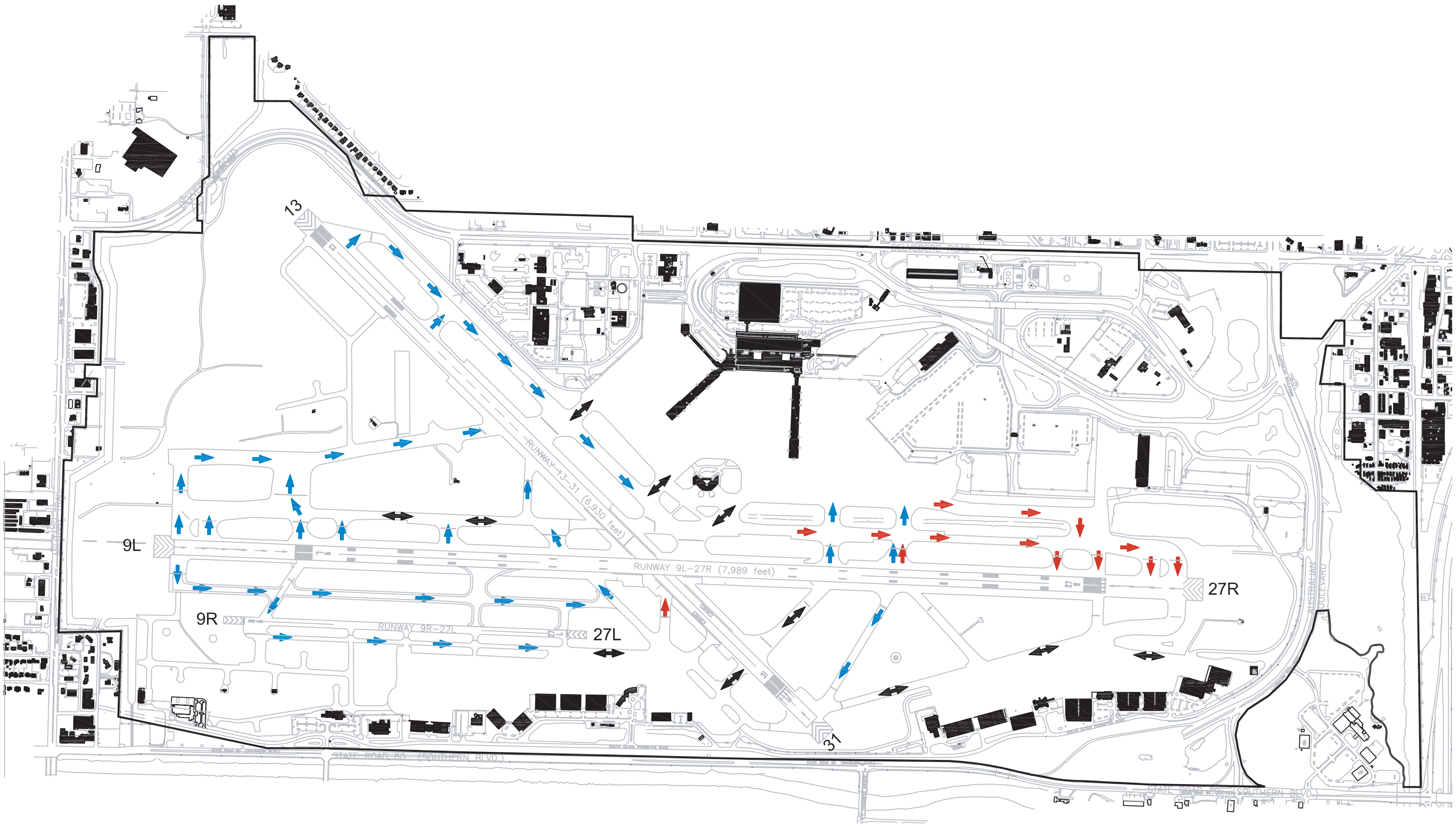



Source : Airport Management Records
Prepared By : Ricondo & Associates, Inc.

Exhibit 2-14

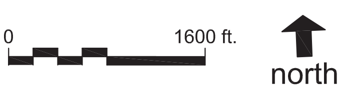

# Taxiway Routes East Flow

PBIA/SWMP Study - Phase I\Task I-2...\Taxi Route East Flow.dwg




Source: Airport Management Records
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-15




PBIA/SWMP Study - Phase I\Task I-2 \Taxi Route West Flow dwg

Legend.
- Arrivals
- Departures
- Bidirectional

# Taxiway Routes West Flow

TABLE 2-3
Palm Beach International Airport - Delay by Cause

| Month-Year | Total Ops | Total Delays | Delays by Cause | | | | | | Avg Time (Min) | Percent Ops Delayed |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Weather | Term Volume | ENRT Volume | Equip | Runway | Other | | |
| Nov-02 | 15,695 | 22 | 22 | 0 | 0 | 0 | 0 | 0 | 59.1 | 0.14 |
| Dec-02 | 17,524 | 285 | 64 | 0 | 58 | 0 | 0 | 163 | 49.4 | 1.63 |
| Jan-03 | 19,281 | 335 | 0 | 290 | 30 | 15 | 0 | 0 | 74.4 | 1.74 |
| Feb-03 | 19,700 | 226 | 15 | 0 | 136 | 8 | 0 | 67 | 39.1 | 1.15 |
| Mar-03 | 21,734 | 616 | 462 | 2 | 152 | 0 | 0 | 0 | 54.3 | 2.83 |
| Apr-03 | 18,941 | 124 | 23 | 11 | 71 | 17 | 0 | 2 | 31.8 | 0.65 |
| **Seasonal Total** | **112,875** | **1,608** | **586** | **303** | **447** | **40** | **0** | **232** | **53.8** | **1.42** |
| Nov-03 | 16,175 | 229 | 21 | 208 | 0 | 0 | 0 | 0 | 54.8 | 1.4 |
| Dec-03 | 17,786 | 149 | 29 | 66 | 19 | 29 | 0 | 6 | 39.2 | 0.8 |
| Jan-04 | 19,711 | 669 | 63 | 311 | 88 | 9 | 0 | 198 | 46.6 | 3.4 |
| Feb-04 | 20,389 | 772 | 107 | 167 | 52 | 0 | 0 | 446 | 46.9 | 3.8 |
| Mar-04 | 22,050 | 248 | 11 | 112 | 100 | 4 | 0 | 21 | 30.4 | 1.1 |
| Apr-04 | 19,620 | 264 | 39 | 0 | 141 | 53 | 1 | 30 | 54.8 | 1.35 |
| **Seasonal Total** | **115,731** | **2,331** | **270** | **864** | **400** | **95** | **1** | **701** | **46.2** | **2.0** |
| Nov-04 | 16,665 | 211 | 20 | 190 | 0 | 0 | 0 | 1 | 34.5 | 1.3 |
| Dec-04 | 17,855 | 80 | 0 | 73 | 0 | 0 | 0 | 7 | 47.7 | 0.5 |
| Jan-05 | 19,947 | 274 | 17 | 254 | 3 | 0 | 0 | 0 | 40.3 | 1.4 |
| Feb-05 | 19,814 | 171 | 2 | 48 | 0 | 0 | 115 | 6 | 34.1 | 0.9 |
| Mar-05 | 22,743 | 349 | 150 | 118 | 0 | 0 | 80 | 1 | 39.5 | 1.5 |
| Apr-05 | 19,407 | 356 | 126 | 34 | 0 | 0 | 193 | 3 | 41.6 | 1.8 |
| **Seasonal Total** | **116,431** | **1,441** | **315** | **717** | **3** | **0** | **388** | **18** | **39.2** | **1.2** |

Source: FAA OPSNET Data. Prepared by: Ricondo & Associates, Inc

TABLE 2-4
Palm Beach International Airport - Percent of Delay by Cause

| Month-Year | Weather | Term Volume | Enroute Volume | Equip | Runway | Other |
|---|---|---|---|---|---|---|
| Nov-02 | 100.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dec-02 | 22.5 | 0.0 | 20.4 | 0.0 | 0.0 | 57.2 |
| Jan-03 | 0.0 | 86.6 | 9.0 | 4.5 | 0.0 | 0.0 |
| Feb-03 | 6.6 | 0.0 | 60.2 | 3.5 | 0.0 | 29.6 |
| Mar-03 | 75.0 | 0.3 | 24.7 | 0.0 | 0.0 | 0.0 |
| Apr-03 | 18.5 | 8.9 | 57.3 | 13.7 | 0.0 | 1.6 |
| **Seasonal Total** | 36.4% | 18.8 | 27.8 | 2.5 | 0.0 | 14.4 |
| Nov-03 | 9.2 | 90.8 | 0.0 | 0.0 | 0.0 | 0.0 |
| Dec-03 | 19.5 | 44.3 | 12.8 | 19.5 | 0.0 | 4.0 |
| Jan-04 | 9.4 | 46.5 | 13.2 | 1.3 | 0.0 | 29.6 |
| Feb-04 | 13.9 | 21.6 | 6.7 | 0.0 | 0.0 | 57.8 |
| Mar-04 | 4.4 | 45.2 | 40.3 | 1.6 | 0.0 | 8.5 |
| Apr-04 | 14.8 | 0.0 | 53.4 | 20.1 | 0.4 | 11.4 |
| **Seasonal Total** | 11.6% | 37.1 | 17.2 | 4.1 | 0.0 | 30.1 |
| Nov-04 | 9.5 | 90.0 | 0.0 | 0.0 | 0.0 | 0.5 |
| Dec-04 | 0.0 | 91.3 | 0.0 | 0.0 | 0.0 | 8.8 |
| Jan-05 | 6.2 | 92.7 | 1.1 | 0.0 | 0.0 | 0.0 |
| Feb-05 | 1.2 | 28.1 | 0.0 | 0.0 | 67.3 | 3.5 |
| Mar-05 | 43.0 | 33.8 | 0.0 | 0.0 | 22.9 | 0.3 |
| Apr-05 | 35.4 | 9.6 | 0.0 | 0.0 | 54.2 | 0.8 |
| **Seasonal Total** | 21.9 | 49.8 | 0.2 | 0.0 | 26.9 | 1.2 |

Source: FAA OPSNET Data.
Prepared by: Ricondo & Associates, Inc

It is important to note that FAA delay data for November 2004 to April 2005 show that while terminal volume accounted for more than 49.8 percent of delays for the airport, the number of aircraft delayed was reduced by 147, with the average delay time reduced by 13.2 minutes. Enroute (ZMA) volume delays were reduced to less than 1 percent. This is indicative of the positive steps taken by the FAA in November 2004 in response to the constraints on arrival and departure capacity and efficiency at the South Florida Airports. However, not all terminal constraints can be addressed by FAA actions alone.

The following subsections present the current constraints on the airfield and airspace associated with PBI. Analyses will focus on specific issues associated with each element of the airfield and airspace operation as well as the systemic impact that each factor has on the overall efficiency of the Airport and the FAA NAS that provides the service.

### 2.2.1 Airfield

Runway 9L-27R is the primary runway for large turbojet aircraft. Runway 9L (East Operation) is the preferred daytime (10:00 a.m. to 10:00 p.m.) operational configuration as stated in PBI Order 7110.65J, Standard Operating Procedures, Appendix 11, Runway Use Program. Runway 27R (West Operation) is used during nighttime hours (10:00 p.m. to 10:00 a.m.) and when wind conditions require its use during daytime hours. Runway 13-31 is 6,931 feet in length. Runway 13 is used for some southbound departures on an East Operation, and Runway 31 is used for some northbound corporate turbojet departures on a West Operation. Runway 13-31 is used for arrivals only when weather and wind conditions are such that aircraft cannot accept Runway 9L-27R for arrival and departure. Runway 9R-27L is 3,213 feet in length and 75 feet wide and has no published approach procedures for either runway end. This runway is used for single-engine and light twin-engine piston aircraft arrivals and departures in Visual Meteorological Conditions (VMC), 1,000 feet above ground level (AGL) cloud ceiling, and three statute miles (SM) visibility.

The PBI Standard Instrument Departure (SID) stipulates the use of a standard departure heading for all turbojet aircraft off each of the runways at PBI. This precludes PBI ATCT from using the more efficient separation standard of 6,000 feet separation with initial course divergence (15° or more) between successive departures and requires the use of the more stringent 3 NM in-trail separation. In addition, Runway 9L-27R does not have high-speed taxiway exits; this increases the runway occupancy time for arriving aircraft, thereby delaying the release of departure aircraft. The impact of these constraints is greatest during periods of heavy arrival/departure demand. Increased separation may be required for arrival aircraft to accommodate departures. Typically, arrivals to a mixed-use runway are spaced 3 to 4 MIT but may be increased to 5 MIT, affecting the overall efficiency of the airfield operation.

Periods of high arrival and departure demand at PBI typically coincide with periods of high demand at the other South Florida Airports within ZMA's airspace. ZMA, working with the FAA Air Traffic Control System Command Center (ATCSCC) in Herndon, Virginia, will employ several traffic management tools to regulate the amount of departure traffic released from these airports into the enroute airspace environment. These include MIT, Expect Departure Clearance Times (EDCT), and Enroute Spacing Programs (ESP). As a result of these initiatives, PBI ATCT may have departure queues at the runway awaiting a release based on time and/or MIT following a preceding departure. Because the airfield has limited holding areas (one hold pad located at the departure end of Runway 9L), as depicted in Exhibit 2-14, departure aircraft that are not restricted are at times unable to taxi past the queue to the runway for takeoff. This scenario is exacerbated by the fact that air carrier, corporate, and GA aircraft often file for IFR departure times within a very narrow time frame during seasonal peak times, such as Sundays from 3:00 p.m. to 5:00 p.m. The Airport has experienced periods when 90 aircraft have filed for IFR departure within a one-hour time frame, far exceeding the PBI hourly turbojet departure capacity of approximately 36 aircraft on the primary runway. To effectively control the airfield environment, PBI ATCT (the Tower) will institute Gate Hold Procedures as outlined in Palm Beach Tower Order 7110.65J, Standard Operating Procedure (SOP). Aircraft will call the Tower for IFR clearance and a requested taxi time. The Tower then issues engine start times to the aircraft in 15-minute blocks. The objective of the procedure is to have no more that 10 aircraft at the runway for departure at any time. Pilots have the option to absorb their delays where they choose. If the pilot advises that the aircraft cannot hold at either the gate or the ramp, it will be relocated on the airfield movement area.

This increases the workload and complexity for PBI ATCT and adds to the congestion on the airfield, further reducing the overall efficiency of the airfield operation. The expected growth of traffic at PBI will continue to challenge the existing airfield infrastructure to accommodate the efficient movement of aircraft in a consistent and predictable manner. Additional hold pads or taxiways to hold or queue aircraft should be given careful consideration in the planning process.

### 2.2.2 Airspace

The airspace that is dedicated to the arrival and departure operations at PBI is designated as terminal airspace controlled by the PBI TRACON and enroute airspace controlled by ZMA. It is important to note this dedicated airspace is also used to control and separate arrival and departure aircraft to other airports contained within each FAA facilities area of responsibility. This interaction is critical to the safe and efficient movement of air traffic in the South Florida area.

#### Terminal Airspace

Significant changes have occurred in the demographics and travel patterns in the South Florida area. Population movement to the north has resulted in increased use and therefore increased aircraft operations at FLL, FXE, and PBI. This trend was accelerated by the events of September 11, 2001, which resulted in an increase in GA and corporate flying due to security constraints at major air carrier airports such as MIA. In addition, MIA's pricing structure as a major hub airport also contributes to the increased reliance on FLL and PBI for domestic air carrier service and corporate activity. According to the FAA Air Traffic Activity Data System (ATADS), in March 2005 PBI recorded 6,680 air carrier operations and 4,794 air taxi operations, both of which exceeded any previous monthly traffic totals for those categories. The total TRACON instrument traffic count of 39,959 in March was the highest monthly total since January 2001. This overall growth in traffic is expected to continue for all of the airports within the PBI terminal airspace. The terminal air traffic airspace operation at PBI is effective and efficient in meeting the current demand at PBI. However, the factors identified above will influence future operations at PBI and the satellite airports and must be considered in the master planning process.

#### Departures

As described in the existing airspace operations procedures, a number of DTAs are defined for the movement of PBI and satellite departure aircraft from terminal to enroute airspace. However, most PBI turbojet departure operations destined for airports in the United States are routed over two DTAs: BLUFI to the northeast and TBIRD to the northwest, as shown in Exhibit 2-12. Turbojet departures from satellite airports within the TRACON airspace are also sequenced over these two DTAs. The TRACON must provide ZMA three miles increasing to 5 MIT separation between successive departures over each DTA. There are two routes (east and west) that may be used to transition to enroute airspace over TBIRD and one route over BLUFI. The TRACON also provides IFR and VFR services to turboprop and prop aircraft over-flights at altitudes from 4,000 to 12,000 feet MSL within the TRACON airspace. This current airspace structure concentrates a large volume of PBI operations to the north and northwest of the airfield. Departure traffic must be separated from arrival and over-flight traffic as they are transitioned to the enroute airspace environment. Since most arrival traffic enters the PBI terminal airspace from the northeast and northwest, this airspace has the potential of becoming increasingly complex if no action is taken to redesign existing procedures. As traffic increases at the airports within the PBI terminal airspace, the existing routes will become more congested, thus increasing the probability of delays to air traffic operations at PBI.

### Arrivals

As described in the current PBI airspace operations procedures, a number of ATAs are defined for the movement of aircraft from terminal to enroute airspace. However, most PBI and satellite airport turbojet arrival operations are routed over two ATAs: SWOMP to the northeast and ULLMN to the northwest, as shown in Exhibit 2-12. Arrival aircraft are transitioned from the enroute environment at 7,000 or 8,000 feet MSL over SWOMP and 10,000 feet MSL over ULLMN. MIA TRACON feeds arrival aircraft to PBI from the south for all airports within the PBI airspace. PBI approach control also provides IFR and VFR service to turboprop over-flights at 12,000, 10,000, and 6,000 feet MSL transitioning to airports south of PBI, as well as over-flights transitioning north at 5,000 and 7,000 feet. This airspace to the north and northwest of PBI will continue to become more complex as traffic increases at PBI and the satellite airports, particularly F45 and Witham Field at Stuart. PBI TRACON personnel stated that pilot requests for practice Instrument Landing System (ILS) approaches at F45 are denied at times due to F45's proximity to PBI and airspace complexity northwest of the airfield. The efficiency of the current arrival airspace and procedures at PBI TRACON will continue to be challenged by the traffic growth at the South Florida Airports.

### Enroute Airspace

ZMA airspace design is influenced by a number of factors, particularly the following

- The geography of the Florida Peninsula which results in a significant number of airports located in a fairly narrow land mass in South Florida;
- Offshore Warning Areas, Military SUA, and Restricted Areas, as shown in Exhibit 2-5, that limit the amount of airspace available for arrival, departure, and over-flight routes in the South Florida airspace;
- The predominant north-south flow of traffic to and from cities in the United States and Canada.

As a result, ZMA has two primary high-altitude arrival sectors (64 and 02) and three primary high-altitude departure sectors (64, 65, and 01) that control traffic into and out of Palm Beach County airports as well as MIA, FLL, FXE, RSW, and other South Florida Airports as shown in Exhibit 2-3. These enroute sectors were designed when traffic volume at airports such as PBI was relatively low and the major arrival and departure flows served the air carrier traffic at MIA and FLL. The continued increase in traffic at all of the South Florida Airports has resulted in periods when traffic management initiatives such as MIT (extended space between successive arrivals and departures), Ground Delay Programs (GDPs), and alternate routings (Snowbird Routes) have been employed by ZMA and the ATCSCC to ensure the effective and efficient movement of air traffic in the enroute environment.

### Departures

Departing turbojet traffic from PBI and the satellite airports is influenced by a number of factors generated by the enroute airspace structure:

- Turbojet aircraft departing over the BLUFI DTA are transitioned through Sector 01. Aircraft departing over the TBIRD DTA are transitioned through Sectors 64 and 65. PBI departures are sequenced with traffic departing MIA, FLL, FXE, and Regional Southwest International (RSW).
- Departure traffic is transitioned by ZMA to assigned enroute altitudes a minimum of 5 to 7 MIT. Because ZMA is sequencing traffic from a number of airports into a single enroute sector, the competition for use of these primary departure routes often

exceeds the established ZMA sector traffic volume parameters. Traffic management initiatives, such as increased MIT between successive departures, may be used during heavy departure demand periods to manage volume.

- Adjacent Centers, such as at Jacksonville, may also place MIT restrictions on ZMA aircraft that will transition into their airspace to allow their own departure traffic to transition into the enroute airspace structure.
- Restrictions may be placed on departures to specific cities such as New York and Chicago due to high traffic volume to those airports or because of weather further complicating the staging of aircraft on the airfield at PBI.
- Activation of Military SUA may restrict or eliminate the use of a departure route, resulting in traffic management restrictions being placed on aircraft at the point of departure.

From November through March, departure demand at the South Florida Airports often must be controlled through the use of Ground Delay Programs, Enroute Spacing Programs, MIT, and other traffic management initiatives. This results in extended departure queues at PBI and causes aircraft staging problems for PBI ATCT. Arrival aircraft spacing may be expanded to allow for the movement of departures, further aggravating overall delays at the airport.

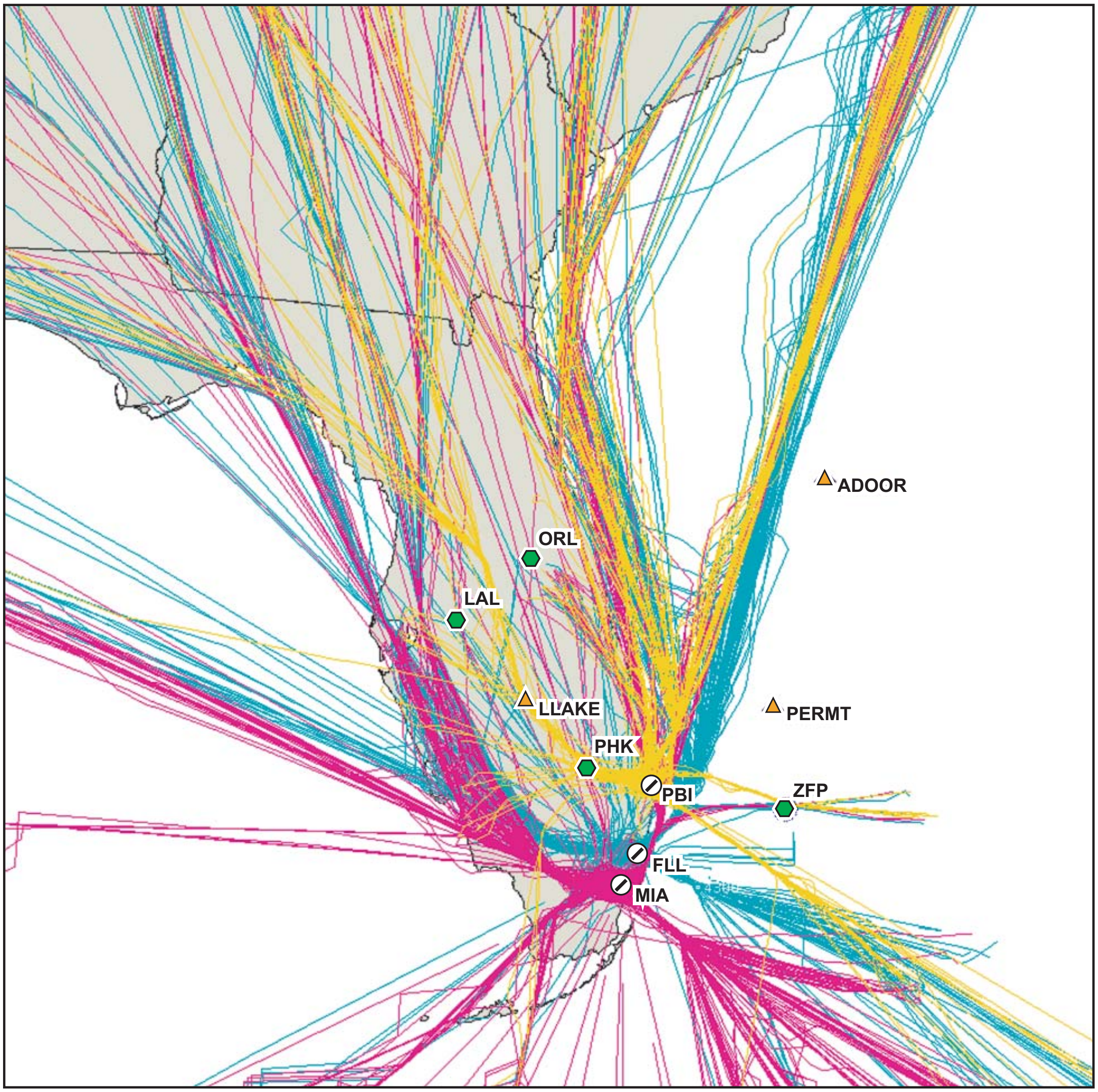
### Arrivals

Most turbojet arrivals to PBI transition from the enroute airspace environment on the LLAKE (northwest) and the SURFN (northeast) STAR. Several factors in the enroute airspace environment affect PBI arrival traffic, notably the following:

- While in the high-altitude airspace structure, Sector 02 sequences PBI arrivals from the northeast with arrivals to MIA, FLL, FXE, and other South Florida Airports. The volume of arrival traffic generated for these airports causes Sector 02 to become extremely busy and complex. Controllers use speed control and vectors (headings) to maintain proper in-trail spacing for arrivals, increasing the time and distance flown to their respective destinations.
- Sector 64 sequences PBI arrivals from the northwest. The Lake Placid Military Operations Area (MOA), as shown in Exhibit 2-5, is located northwest of PBI within Sector 64. When the MOA is active, arrivals from the northwest must maintain FL230 until clear of the MOA. As a result, these arrivals are at a higher altitude than normal, and additional spacing may be required to allow for their transition to the terminal environment.

Though extremely busy, the current arrival flows to PBI are efficient. However, traffic management initiatives used to control enroute sector volume during periods of heavy arrival demand at all of the South Florida airports result in delays to arrival traffic at PBI.

The separation of arrival and departure routes to key Florida airports including PBI is a key to increasing the enroute airspace capacity that serves these airports. Exhibit 2-16 and Exhibit 2-17 clearly illustrate the volume of arrival and departure traffic, which currently share the same enroute airspace structure. These radar tracks were produced with Enhanced Traffic Management System (ETMS) data from March 15, 2005. Providing individual STAR and SID procedures would reduce operational complexity and controller workload, thereby increasing throughput in the enroute environment.




Legend

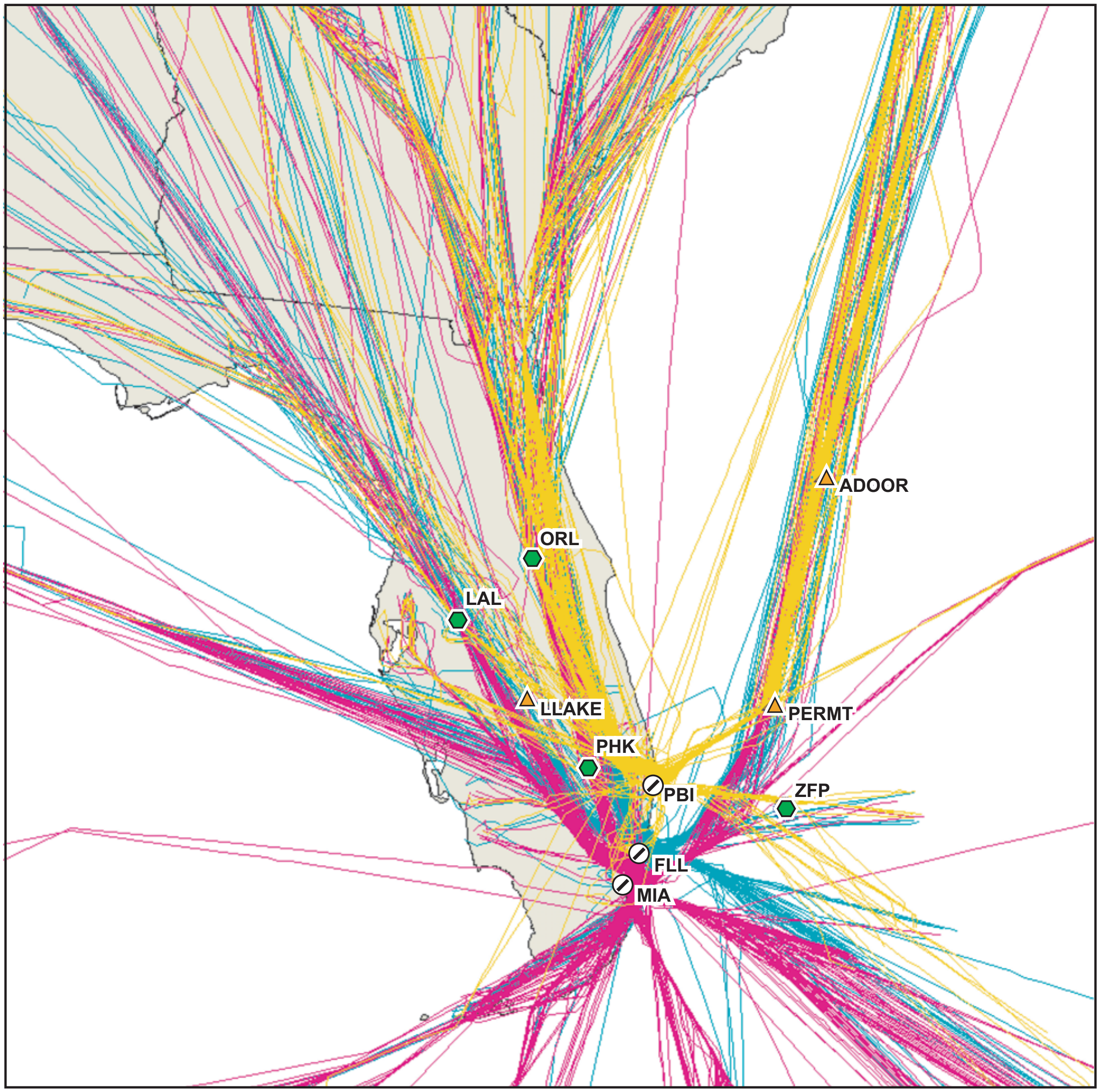
- PBI Arrival
- FLL Arrival
- MIA Arrival
- NAVAIDs
- Waypoints
- Airports

Source: SDAT Data March 15, 2005; FAA.
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-16

north

**Arrival Airspace Interaction**
**Arrivals to PBI, FLL & MIA on March 15, 2005**




Legend

- PBI Departure
- FLL Departure
- MIA Departure
- NAVAIDs
- Waypoints
- Airports

Source: SDAT Data March 15, 2005; FAA.
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-17

north

**Departure Airspace Interaction**
**Departures from PBI, FLL & MIA on March 15, 2005**

## 2.3 FAA Facility Initiatives and National Airspace Redesign

The DOA initiated discussions with the FAA at the local, regional, and national levels concerning current and future airfield and airspace operational and procedural changes that may affect air traffic operations at PBI and its satellite airports. The goal of this effort was to gain as much information as possible in the master planning process and to ensure stakeholder support for the final product.

Discussions took place with the following FAA personnel:

- PBI ATCT/TRACON, MIA ATCT/TRACON, and ZMA. Individuals interviewed included facility managers, facility supervisors, traffic management specialists, and National Air Traffic Controllers Association (NATCA) union representatives. These individuals were responsible for operations and/or procedures and were involved in the ongoing NAR efforts at their respective facilities;
- The NAR management lead in the Eastern Region Office;
- The Manager for Tactical Operations (MTO) for the Southern Tier FAA Centers and Tower/TRACONS. The MTO has been assigned the overall responsibility for the South Florida Airspace Redesign and Traffic Management initiatives to resolve enroute and terminal airspace constraints affecting the efficient flow of traffic into and out of South Florida, including at PBI.

The following subsections outline the actions that the FAA has taken and is planning to reduce delays and improve the overall efficiency of the South Florida airspace. First is a discussion of those actions with regard to the airfield and then with regard to the airspace.

### 2.3.1 Airfield

#### Airport Resource Management Tool (ARMT)

While center volume delays were significantly reduced in the past two years, terminal delays are still high at PBI, as shown in Tables 2-3 and 2-4. Discussions with FAA Traffic Management personnel indicate that PBI ATCT identified most of these as “multi-taxi” delays. This term is used when the number of IFR aircraft requesting similar departure times or taxiing for takeoff exceeds the airport hourly departure rate of approximately 36 aircraft. Since the departure rate can be influenced by traffic management restrictions and heavy arrival demand, the resulting delay can build quickly. In extreme cases, PBI will initiate Gate Hold Procedures as described earlier in this document. To help address this issue, the FAA has installed ARMT in the PBI ATCT. This electronic database stores the flight plan information for current and proposed arrival and departure aircraft at PBI. This allows ZMA to view the departure queue at PBI electronically and make real-time traffic management decisions on departure aircraft that may be released more expeditiously based on factors such as its route of flight and filed altitude. In addition, PBI ATCT can view anticipated arrival traffic and arrival spacing, allowing for better runway utilization and departure planning.

#### Airfield Improvements

The PBI ATCT was asked to provide recommendations for airfield improvements that would increase capacity and efficiency at PBI. The following were provided for DOA consideration:

1. Extend Runway 9R-27L to the maximum allowable length and upgrade it for turbojet operations. Currently in the VFR conditions, the Airport capacity is about 62 operations per hour. However, the extension in the future would provide it with the dual operations capability, which will increase the capacity to approximately 100 operations per hour in the VFR conditions. Departure delays would be reduced significantly through the use of a dedicated departure runway. The increase in departure capacity will also reduce delays induced by the extended queuing of aircraft at the runway.
2. Reduce runway occupancy times (east and west flows). Provide high-speed or radius turnoffs at H and D on both sides of Runway 9L; Runway27R at F; and Runway 9L on the north side between D and C-5; extend F northwest to A. These changes would allow the use of minimum FAA separation of 3 NM on the final approach course to the arrival runway. In addition, if runway occupancy time can be documented as 50 seconds or less, arrival separation can be reduced to 2.5 miles on final approach within 10 NM of the airport, which would further reduce delays.
3. Provide larger run-up pads for staging aircraft at all runway ends and South of Runway 27L: This would reduce departure delays as well as the complexity and workload for the controllers. Aircraft could be staged based on the restrictions in place. This would allow the PBI ATCT to efficiently sequence departures that are affected by a restricted route of flight or weather at their destination airports, allowing aircraft that are not restricted to access the runway.
4. Additional non-movement staging areas for the GA ramps. FBOs often prefer to stage aircraft with "gate holds" on the airport movement areas to make room for arriving corporate and GA aircraft. This increases PBI ATCT workload and congestion on the field.
5. Satellite airport: The TRACON requested that the DOA/FAA consider installing an ILS at PHK to encourage GA to use that airport for practice approaches. This could help reduce traffic and demand for VFR ATC services at airports close to PBI. PBI TRACON at times has refused requests for practice approaches at F45 due to workload.

### Airport Capacity

In 2003, the National Business Aviation Association (NBAA) initiated a plan with the FAA and the air carrier community to address the growing problems associated with ever-increasing traffic volume to the South Florida Airports during the fall and winter months. The resultant General Aviation Airport Program (GAAP) was initiated at PBI and FLL on November 23, 2004. This program was designed to account for and control GA “non-scheduled” IFR aircraft that often cause an airport to experience hourly arrival demands that exceeds the airport’s capacity. This automated program continuously compares the available capacity at PBI against the number of IFR flight plans in the system. Any excess capacity is identified and assigned to “non-scheduled” operations on a first come, first served basis. Once PBI demand exceeds capacity, subsequent arrival aircraft are given delayed departure times at their destination airports, moving them to later arrival hours. This, in effect, spreads out operations at the Airport and avoids unpredictable spikes in demand on the system. An article published by the NBAA in December 2004 cited an industry study showing that up to 40 percent of unused capacity, or about 1.5 million minutes of annual delay, was recoverable using GAAP. The FBOs and the PBI ATCT reported that the program was very successful in reducing the number of departure delays as well as the lengths of the delays. PBI ATCT indicated that delays were reduced from more than an hour to less than 30 minutes during heavy demand periods.

### 2.3.2 Airspace

#### Snowbird Routes

The FAA ATCSCC has initiated Snowbird Routes during the past three fall and winter seasons to balance arrival and departure flows into and out of South Florida. These routes are contained in the FAA Playbook and are published on the ATCSCC website. Eight separate routes provide alternatives for aircraft arriving or departing Florida, as follows:

- A700 and A761 routes over the Atlantic Ocean to and from Florida cities to the New York Metropolitan Area and Mid-Atlantic cities including the Washington Basin. Aircraft must be equipped and certified for over-water operations to utilize these routes.
- Florida to NE 1, 2, and 3 inland routes to the New York and Mid-Atlantic Metropolitan areas.
- Snowbird Routes 5, 6, and 7, a combination of inland routes to the east-coast and west-coast airports in Florida to airports and to Washington and New York Metropolitan areas and some New England cities.

The FAA ATCSCC uses these routes in several different scenarios:

- A route will be assigned to all aircraft to avoid severe weather that is impacting a region within the system.
- A route will be assigned to specific aircraft to balance the east and west arrival and/or departure flow into or out of Florida or the northeastern United States.
- Aircraft may file over-water routes if capable and thus avoid congested inland routes.

The FAA and NBAA agree that this initiative, used in conjunction with the GAAP program, reduced enroute airspace congestion, arrival delays, and departure delays at PBI and FLL by allowing a more balanced flow of traffic into and out of South Florida. This is validated by the FAA OPSNET Delay information for PBI. As shown in Table 2-4, Center volume delays (enroute congestion) have been reduced from 17.2 percent of total delays in 2003-2004 to less than 1 percent of total in 2004-2005. While Terminal volume delays accounted for 62.9 percent of all delays in the same time period, the number and average time of the delay was reduced by 181 aircraft and 8.2 minutes, respectively.

#### National Airspace Redesign

The NAR effort has been accelerated to address issues in both the terminal and enroute airspace system serving South Florida. The MTO for the Southern Tier air traffic facilities has been given the responsibility for presenting a comprehensive plan to increase capacity and efficiency at the South Florida Airports including PBI. The NAR Focus Leadership Teams (FLTs) from PBI, FLL, MIA, and ZMA have been meeting regularly over the past several months to finalize plans for a major redesign of the enroute airspace from ZMA north to Washington Center. Their analysis will include the associated terminal airspace at facilities where volume and system constraints are causing increased complexity and workload for air traffic controllers and increasing delays for Users.

On June 2, 2005, the plan was presented to the FAA Administrator and her staff. The Administrator placed South Central Florida on the list of eight major metropolitan areas to be given priority in taking the necessary actions to increase or improve aviation capacity. The following objective is stated in the recently published FAA Draft Flight Plan 2006-2010:

> Objective 2. Increase or improve aviation capacity in the eight major metropolitan areas and corridors that most affect total system delay. For FY 2006, those areas are: New York, Philadelphia, South Central Florida, Chicago, Washington/Baltimore, Atlanta, Los Angeles Basin, and San Francisco Bay Area.

To meet this objective, the Draft Flight Plan outlines the following two proposed strategies with accompanying initiatives.

### Strategy 1

Identify airport improvements that are most likely to reduce the major causes of system delay.

### Initiatives

- Monitor and maintain scheduled progress for Environmental Impact Statements (EIS) at Washington Dulles, the new South Suburban (Chicago area), Fort Lauderdale, and Philadelphia Airports located within the congested metro area (ARP).
- Support master plans for airfield improvements at Operational Evolution Plan (OEP) airports located within the congested metro areas.
- Conduct regional studies in the New York, New England, and Los Angeles Metropolitan Areas.
- Direct Airport Improvement Program (AIP) funding to reduce capacity constraints of secondary and reliever airports located within those metropolitan areas.
- Work with the aviation community to establish the most feasible policies to enhance capacity and manage congestion.
- Update which metropolitan areas are projected to have the greatest impact on the total system for delays over the period of the Flight Plan.

### Strategy 2

Redesign the airspace and traffic flows.

### Initiatives

- Redesign the airspace of eight major metropolitan areas: New York, Philadelphia, South Central Florida, Chicago, Washington/Baltimore, Atlanta, Los Angeles Basin, and San Francisco.
- Expand use of time-based metering at air traffic control centers.

On June 29, 2005, at the Fort Lauderdale-Hollywood International Airport, the FAA provided a briefing on the planned initiatives for South Florida Airports and airspace. This briefing highlighted the core issues that influence the movement of air traffic into and out of the South Florida Airports, particularly from November through April. The FAA acknowledged that the current airspace design does not provide sufficient capacity to effectively handle the traffic demands generated by the South Florida Airports during peak arrival and departure periods, regardless of the individual airports' capacity. The FAA made a commitment to accelerate the redesign of the airspace but at the same time asked that the airports collaborate with the FAA to ensure full utilization of existing airport capacity, meanwhile accelerating its own plans for increased airport capacity in the future. The following FAA actions will directly influence the air traffic airfield and airspace operations at PBI:

### Enroute Airspace

- Open five new sectors, four in ZMA, to reduce air traffic complexity and controller workload, allowing increased throughput and efficiency for arrival and departure aircraft. As shown in Exhibit 2-18, three of these sectors overlay the enroute arrival and departure corridors for PBI on the east side of the state.
- Create seven new over-water AR Routes as options for arrival and departure aircraft, as shown in Exhibit 2-19.
- Publish five new STARs for PBI. As shown in Exhibit 2-20, this will segregate arrival traffic into MIA, FLL, BCT, and PBI. Complexity and workload for controllers at ZMA and PBI will be reduced, producing a corresponding increase in efficiency and throughput.

### Terminal Airspace

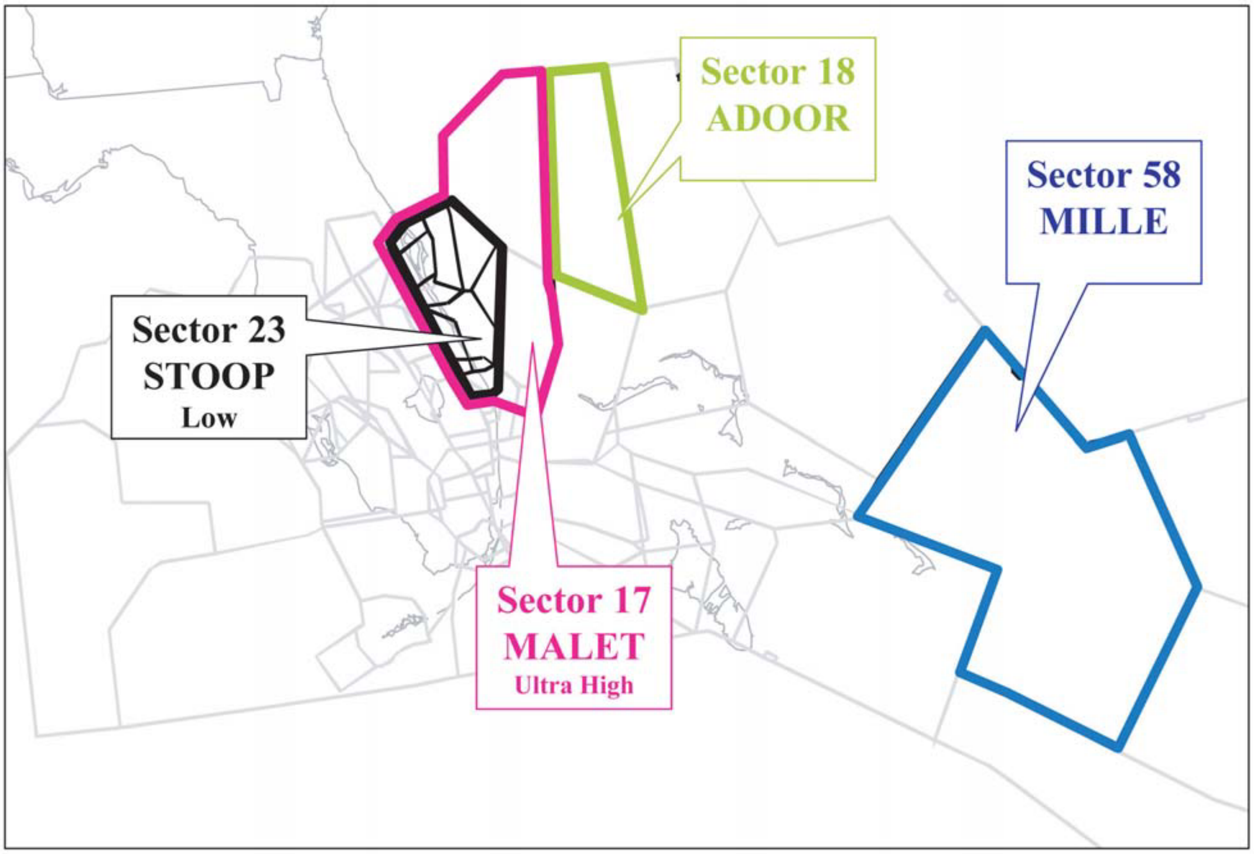
PBI TRACON has:

- Completed an internal airspace redesign to accommodate the new STAR arrivals. This will reduce the amount of radar vectors (headings) required to sequence aircraft to the arrival runway. This reduction in workload and complexity will increase the efficiency of the airspace.
- Completed an internal redesign of departure and satellite airport airspace to balance controller workload and increase operational efficiency.
- Designed three over-flight routes to accept aircraft from ZMA transitioning in MIA TRACON airspace. This will further reduce workload and complexity in the ZMA airspace.

The FAA will continue to expand the use of the GAAP program, Snowbird Routes, and timely traffic management initiatives to improve overall system safety and efficiency in the South Florida and PBI airspace.

## 2.4 Conclusions

PBI is constrained by both the current airfield layout and an FAA enroute airspace design that requires multiple airports to share common arrival and departure routes. In fact, these two constraints work in concert at PBI. When enroute volume and airspace constraints at ZMA trigger traffic management restrictions on PBI departures, the inability of PBI ATCT to efficiently stage aircraft based on route of flight, restricted departure fix, or destination airport causes departure delays to increase. Because PBI is primarily a single-runway operation, PBI ATCT may increase spacing between arrivals to accommodate departing aircraft to avoid further impact on the overall efficiency of the terminal and enroute operation.

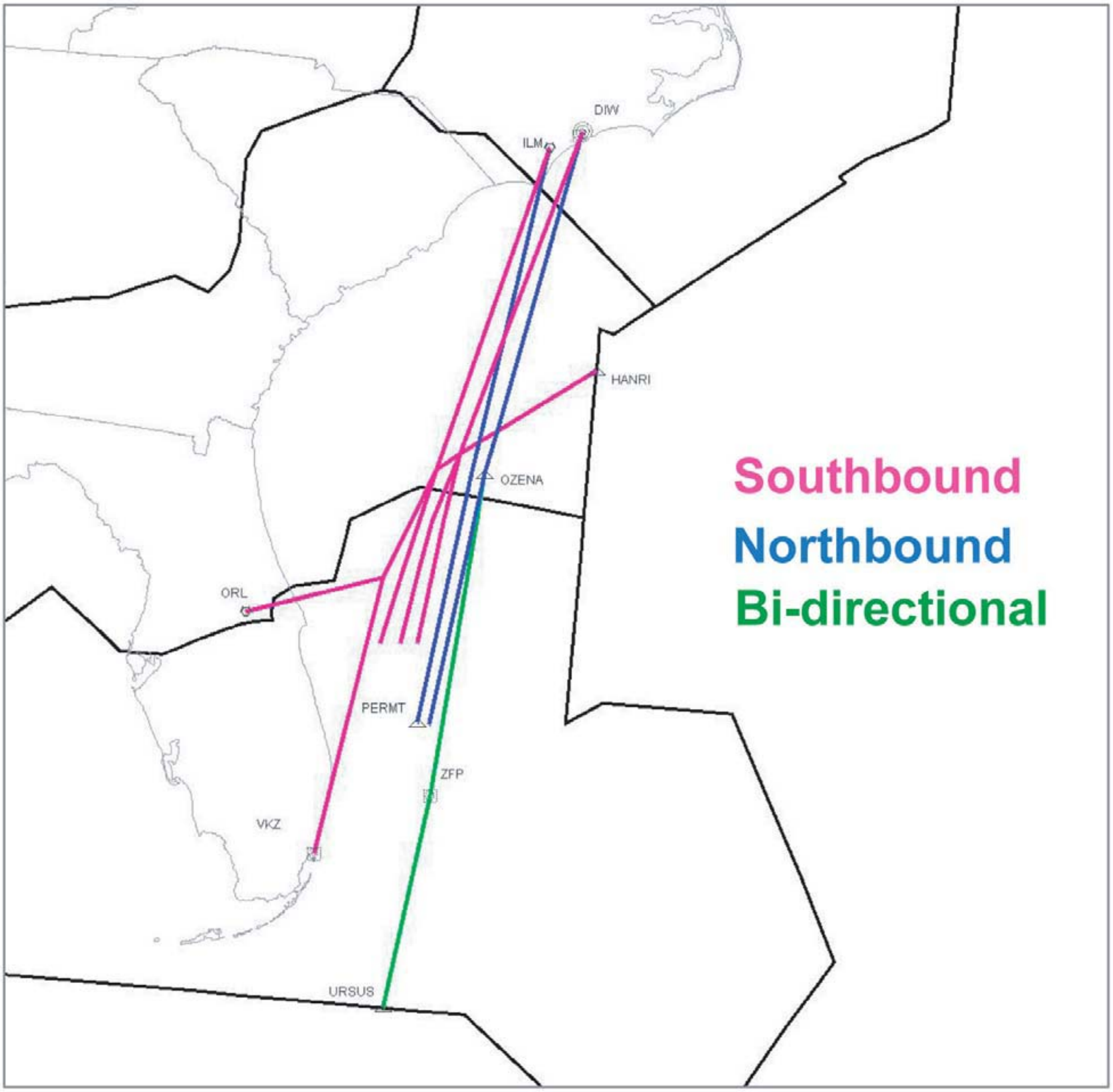



Source: FAA, Air Traffic Organization, June 05.
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-18

north

## Proposed New Sectors for ZMA

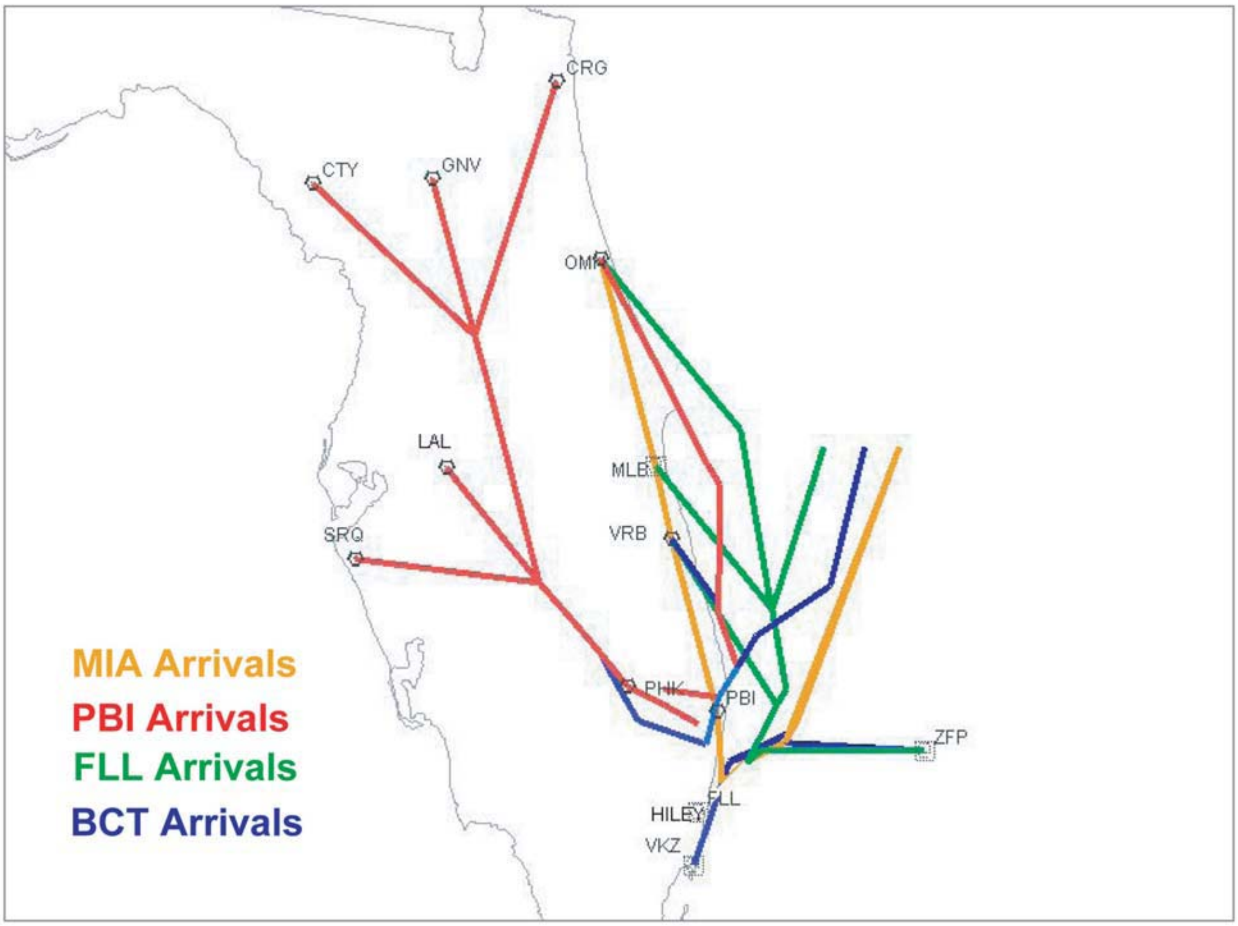



Source: FAA, Air Traffic Organization, June 05.
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-19

north

## Proposed Overwater Arrival Routes to South Florida Airports




Source: FAA, Air Traffic Organization, June 05.
Prepared by: Ricondo & Associates, Inc.

Exhibit 2-20


**Proposed RNAV STARs to South Florida Airports**

The DOA and the FAA have initiated concurrent activities to address these two critical issues. These initiatives need to continue to completion in order to reduce the current constraints at PBI. However, if either initiative is not completed, the overall benefits derived from the other initiative will be diminished. The increased efficiency of the airspace requires a complementing increase in capacity at the Airport in order for the system and the Users at PBI to truly benefit.

The FAA has initiated an aggressive redesign effort of the enroute and terminal airspace and the procedures that currently serve the South Florida Airports. This comprehensive effort will address capacity and efficiency at PBI, FLL, and MIA as well as others. The FAA's goal is to design airspace and procedures that will meet the increasing growth in traffic at all the South Florida Airports and, in particular, meet the high demand on the system during the fall and winter months. This effort has been incorporated into the FAA Flight Plan 2006-2010 by placing it on a fast-track schedule for completion.

The timelines for these two efforts should be compatible and therefore assist the master-planning and decision-making processes. Continued coordination with the FAA during the NAR process will help identify system benefits that may be enhanced by near-term airport improvements as well as future airport planning.

# 3. Airfield Analyses

This section of the report presents various airfield analyses undertaken for PBI as part of the Systemwide Master Plan Study and a succinct inventory of the airfield facilities. The analyses entail a runway length analysis for Runway 9R/27L, refinement alternatives to the 2001 ALP concept, and a preliminary assessment of airfield capacity for these alternatives. The runway length analysis was conducted using the aircraft performance manuals published by various corporate, GA, and air carrier manufacturers. Refinement alternatives to the ALP concept focus primarily on enhancements to Runway 9R/27L to provide incremental airfield capacity benefits for PBI. The preliminary assessment of current airfield capacity and refinement alternatives to the ALP concept was conducted in accordance with the FAA's methodology as outlined in FAA AC 150/5060-5, *Airport Capacity and Delay.* It should be noted that these preliminary analyses were conducted at a macro level of detail, recognizing that Phase II of the System Study or future environmental studies will include simulation modeling using SIMMOD to more precisely measure PBI's airfield capacity.

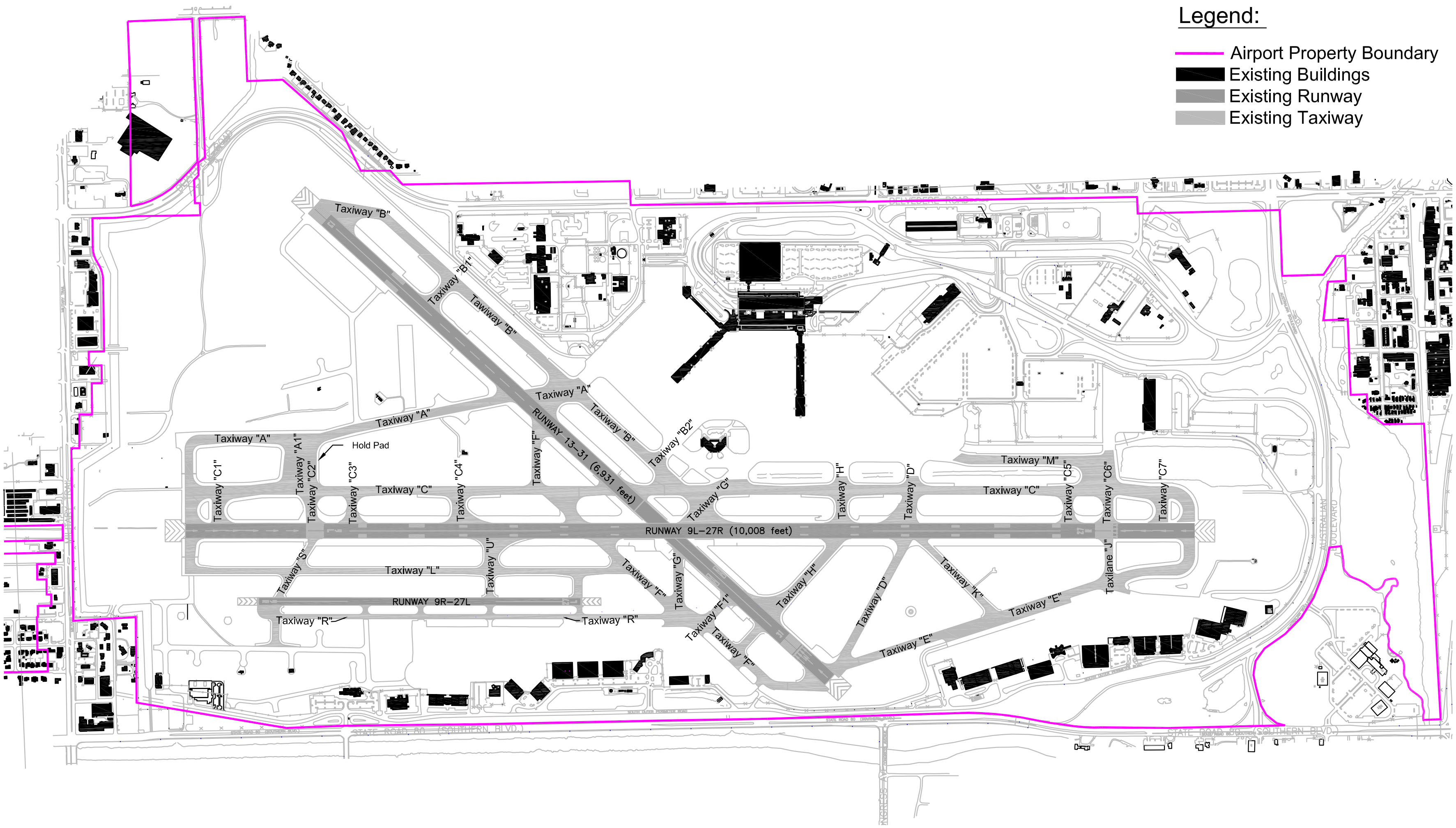
## 3.1 Inventory of Current Airfield Facilities

The inventory presented in this subsection pertains to the current PBI airfield facilities as identified in planning studies, DOA records, and/or the Airport Facilities Directory. The facilities include the runways, taxiways, and hold pads; aircraft apron and ramp areas; and lighting markings, signage, and navigational aids. The inventory serves as the basis for evaluating current facilities and subsequently determining future facility needs.

### 3.1.1 Runways, Taxiways, and Hold Pads

The Airport has three runways, two of which are 150 feet wide and capable of handling the current commercial aviation traffic. The third runway, which is parallel to the primary air carrier runway and separated by 700 feet, is 75 feet wide and is used primarily for GA activity. The current airfield layout is illustrated in Exhibit 3-1. The physical characteristics of each runway are summarized in Table 3-1.

The weight-bearing capacity of a runway refers to the strength of the pavement and the weight the pavement can support. The weights presented are not maximum allowable weights or operating limitations. These weights are based on estimates of the capability of the pavement to support an average level of activity. The runway weight-bearing capacity is expressed in terms of the various types of aircraft landing gear and the number of wheels distributing the weight on the pavement surface. The categories of landing gear considered for PBI are: Single-Wheel (S), Double-Wheel (D), and Double Tandem (DT).




Source : PBIA Existing Basemap, LPA 2005.
Prepared By : Ricondo & Associates, Inc.

Exhibit 3-1

**Existing Airfield**

Drawing: P:\PBIA\System Wide Airport Master Planning Study - Phase I\Task I-7 Airfield and Airspace\PBI\Documentation\CAD Exhibits\Exhibit 3-1_Existing Airfield.dwg_Layout: 8.5 x 11 L_Oct 31, 2005, 5:31pm

TABLE 3-1
Runway Characteristics Summary

| Description | Runways | | |
| --- | --- | --- | --- |
| | 9L/27R | 9R/27L | 13/31 |
| Length (feet) | 10,008 | 3,213 | 6,931 |
| Width (feet) | 150 | 75 | 150 |
| Shoulder Width (feet) | 75 | - | 75 |
| Blast Pad Length (feet) | 200 | 200 | 200 |
| Weight Bearing Capacity (pounds) | | | |
| Single Wheel (S) | 85,000 | 25,000 | 100,000 |
| Double Wheel (D) | 200,000 | N/A | 180,000 |
| Double Tandem (DT) | 400,000 | N/A | 325,000 |
| Composition | Asphalt | Asphalt | Asphalt |
| Runway Grade | 0.11% up east | 0.11% up east | 0.02% down southeast |
| Runway Markings | Precision Instrument | Basic | Non-Precision Instrument |

Source: Airport Facility Directory; Airnav.com.
Prepared by: Ricondo & Associates, Inc.

## Runway 9L-27R

Runway 9L-27R is the primary runway at PBI. It is 10,008 feet long and 150 feet wide. Blast pads extend from each end of the runway to protect the ground from erosion caused by aircraft departures. The runway pavement surface is grooved asphalt. Runway 9L-27R has displaced thresholds; the Runway 9L threshold is displaced 1,200 feet, and the Runway 27R threshold is displaced 811 feet. Taxiway C is a full-length parallel taxiway to Runway 9L-27R on the north side of the runway. This taxiway provides access to and from both ends of the runway. Access to the end of Runway 9L from the Terminal is provided via Taxiway A. On the south side, access to the end of Runway 9L is facilitated by the new Taxiway L, which is 50 feet wide and serves Airplane Design Group (ADG) III aircraft and smaller. Taxiway M parallels Taxiway C on the north side from the western edge of the Terminal-area apron to Taxiway C6, which connects Taxiway C and Taxiway M to Runway 27R. Access to Runway 27R from the south side is provided via Taxiway E or Taxiway J.

## Runway 9R-27L

Parallel Runway 9R-27L is 3,213 feet long and 75 wide and constructed of asphalt. Access to this runway is provided by two parallel taxiways, L and R. Taxiway S connects Runway 9R-27L to Runway 9L-27R.

### Runway 13-31

Runway 13-31 is a crosswind runway used primarily when winds do not favor the use of the primary runway. It is constructed of grooved asphalt and is 6,931 feet long and 150 feet wide. The Runway 31 threshold is displaced 428 feet to provide clearance over Southern Boulevard (also known as State Road 80) and trees in the approach. Access to this runway is provided via partially parallel Taxiway B to the west (Runway 13 end) and via partially parallel Taxiway F to the east (Runway 31 end). Taxiways H, D, and E provide access to the east end of Runway 13-31. Taxiways B, H, and D are the primary taxiways for aircraft taxiing from the passenger Terminal to Runway 13-31, while Taxiways F and E serve primarily GA aircraft traveling to or from the southwest or southeast areas of the Airport.

### Taxiway System

Most of the taxiways serving the three runways at PBI are 75 feet wide. The exceptions are Taxiways R, S, and K and the newly constructed Taxiway L. Taxiways K, S, and L are 50 feet wide, and Taxiway R is 40 feet wide. Exhibit 3-1 also shows the current taxiway system.

### Hold Pads

There is one hold pad on the airfield. As shown in Exhibit 3-1, the hold pad is located at the intersection of Taxiways C and A north of Runway 9L. It is 500 feet long and 250 feet wide, including a 75-foot-wide taxiway along the eastern edge. The hold pad is constructed of asphalt.

## 3.1.2 Aircraft Apron and Ramp Areas

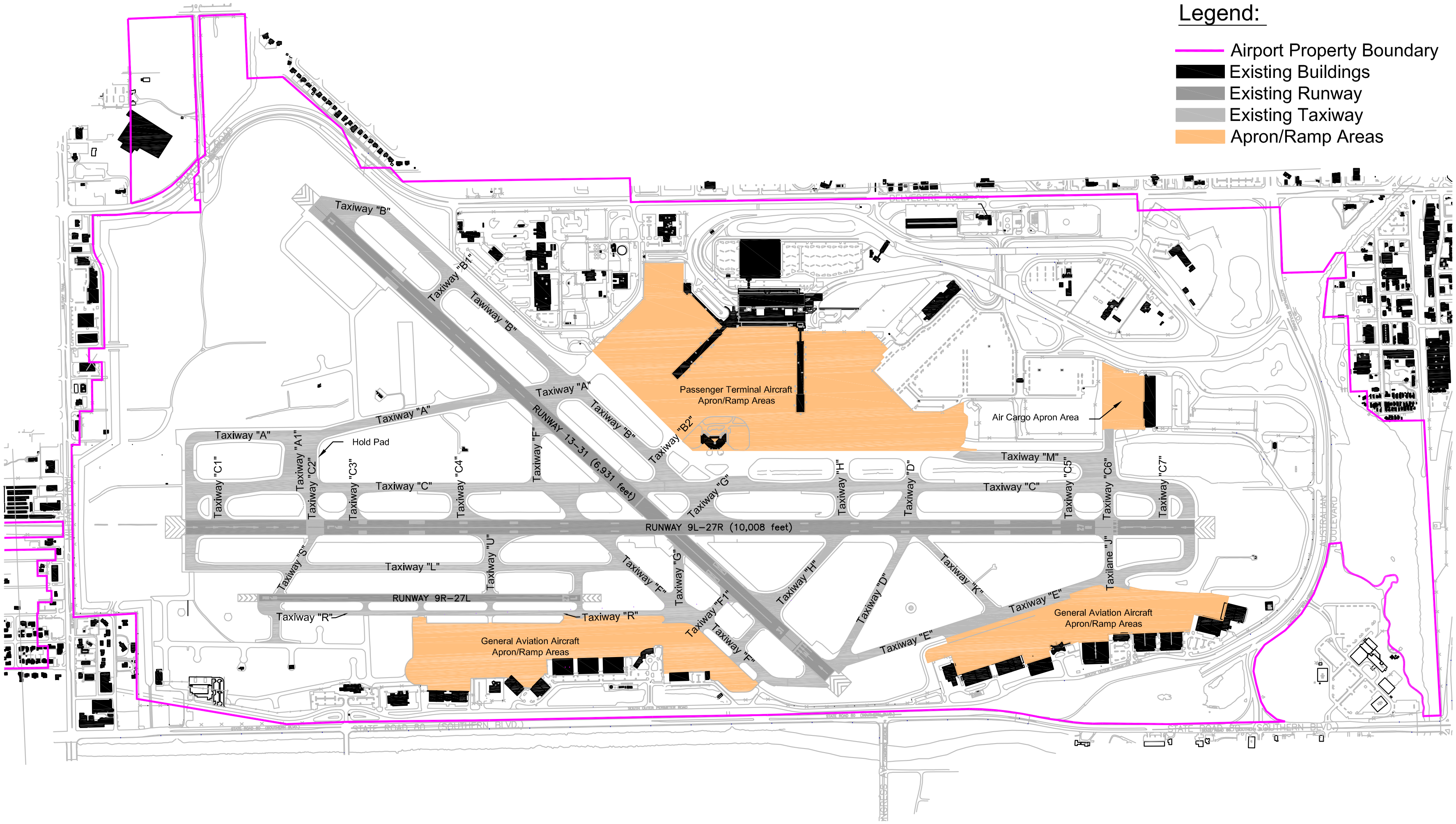
For the purpose of this inventory, four categories of ramps and apron areas are identified and depicted in Exhibit 3-2:

- The passenger terminal apron on the north side of the airfield
- The air cargo apron east of the Park and Ride facilities and north of Runway 27R
- The general aviation aprons south of the airfield and operated by the FBOs

The passenger terminal apron and ramp area encompasses approximately 395,693 square yards and is designed to allow safe maneuvering of air carrier aircraft around the gates of Concourses A, B, and C. It supports all of the air carrier and regional carrier parking requirements as well as ground service equipment storage, service roads, aircraft pushback areas, and taxi lanes.

East of the passenger terminal apron area and north of Taxiway M is the air cargo apron. This area has approximately 26,302 square yards of apron available for cargo and equipment marshaling, aircraft parking, and cargo make-up.

The two GA apron areas on the south side of the airfield serves three major FBOs at PBI: Signature Flight Support, Galaxy Aviation, and Jet Aviation. The apron east of Runway 13-31 is used by Signature Flight Support and Jet Aviation. It is approximately 127,613 square yards, excluding a 75-foot-wide taxiway along the northern edge. The apron area west of Runway 13-31 is primarily controlled by Galaxy Aviation and Signature Flight Support and comprises a total area of approximately 179,721 square yards.




Source : PBIA Existing Basemap, LPA 2005.
Prepared By : Ricondo & Associates, Inc.

Exhibit 3-2

0 1600 ft
north

# Aircraft Apron/Ramp Areas

Drawing: P:\PBIA\System Wide Airport Master Planning Study - Phase I\Task I-7 Airfield and Airspace\PBI\Documentation\CAD Exhibits\Exhibit 3-2_Aircraft apron-ramp areas.dwg_Layout: 8.5 x 11 L_Oct 31, 2005, 5:34pm

### 3.1.3 Lighting, Marking, Signage, and Navigational Aids

The Airport is identified at night by a green and white rotating beacon on the roof of the Terminal. All the taxiway and apron edges at PBI are equipped with Medium-Intensity Taxiway Lights (MITL). Lighted windsocks are provided at each runway end except on Runway 27L.

The primary runway, 9L-27R, has High-Intensity Runway Lights (HIRL). Runway 9R-27L and Runway 13-31 are equipped with MIRL. Runway 9L is also equipped with a Medium-Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR), and is marked in accordance with the standards for a precision-instrument approach runway. Runway 27R is equipped with Runway End Identifier Lights (REIL) and marked in accordance with the standards for a precision-instrument approach runway. Runway 13-31 is marked according to the standards for a non-precision-instrument runway, and Runway 9R-27L has basic runway markings.

Table 3-2 summarizes the various NAVAIDS serving the Airport and its operating lighting systems. The Airport has 10 published Instrument Approach Procedures (IAPs). Two of the IAPs are based on Instrument Landing Systems (ILSs) installed for Runway 9R and Runway 27L. These precision IAPs provide vertical and horizontal guidance to the runway; they consist of a localizer antenna (horizontal guidance signal) and a glide slope antenna (vertical guidance signal). The Runway 9L ILS approach also has two fan markers used to identify the Initial Approach Fix (IAF) and the Missed Approach Point (MAP). These fan markers are referred to as the Outer Marker (OM) and the Middle Marker (MM). Co-located with the OM associated with the Runway 9L ILS is a Non-Directional Beacon (NDB) called RUBIN. The combination of NDB and OM is also referred to as Locator Outer Marker (LOM). Runway 9L used to have a published NDP approach, but the FAA is phasing out NDB approaches ( as more accurate technologies, such as RNAV GPS, are emerging. The Runway 27 approach does not have markers that identify the IAF or MAP. The IAF and MAP for this approach can be identified by radar or by Distance Measuring Equipment (DME). In addition, a Runway Visual Range (RVR) is provided in the touchdown area for Runway 9L. The RVR provides visibility measurements in the touchdown location.

TABLE 3-2
NAVAIDS and Lighting Systems

| | **Runways** | | | | | |
|---|---|---|---|---|---|---|
| | **9L** | **27R** | **9R** | **27L** | **13** | **31** |
| System Instrumentation: | | | | | | |
| Precision | ILS | ILS | | | | |
| Non-Precision | RNAV (GPS)/VOR | RNAV (GPS)/VOR | RNAV (GPS)/VOR | RNAV (GPS)/VOR | RNAV (GPS)/VOR | RNAV (GPS)/VOR |
| Glide Slope (GS) | ✓ | ✓ | | | | |
| Localizer (LOC) | ✓ | ✓ | | | | |
| Outer Marker (OM) | ✓ | | | | | |
| Middle Marker (MM) | ✓ | | | | | |
| Runway Visual Range (RVR) | ✓ | | | | | |

TABLE 3-2
NAVAIDS and Lighting Systems

| | Runways | | | | | |
|---|---|---|---|---|---|---|
| | 9L | 27R | 9R | 27L | 13 | 31 |
| Lowest Approach Minimums: | | | | | | |
| Ceiling/Visibility | 200'/2400 RVR | 200'/ 3/4 SM | | | 300' / 1 SM | 440'/ 1 SM |
| Approach Lighting System | | | | | | |
| MALSR | ✓ | | | | | |
| PAPI | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ |
| Runway Lighting | | | | | | |
| HIRL | ✓ | ✓ | | | | |
| MIRL | | | ✓ | ✓ | ✓ | ✓ |
| REIL | | ✓ | | | ✓ | ✓ |

Sources: Airport Facility Directory; NOAA Approach Plates published on Airnav.com as of October 18, 2005.
Prepared by: Ricondo & Associates, Inc.

Note: Lowest approach minimums are lowest available on each runway. Runway 9L: Ceiling (feet)/RVR (feet); All other runways: Ceiling (feet)/Visibility (Statute Mile).

ILS Instrument Landing System
GPS Global Positioning System
HIRL High-Intensity Runway Lights
MALSR Medium-Intensity Approach Light System with Runway Alignment Indicator Lights
MIRL Medium-Intensity Runway Lights
PAPI Precision Approach Path Indicator
REIL Runway End Identifier Lights
RNAV Area Navigation
VOR Very High Omni Range

A Very High Frequency Omni Range (VOR) with Tactical Air Navigation (TACAN) facility is also located at PBI. The TACAN function is an ultra-high-frequency guidance system used by the military, which provides civilian users with DME. Referred to as the VORTAC, the VOR is used to define the Low-Altitude (VICTOR) Airways and the High-Altitude (JET) routes that traverse the Florida coastline. There are published IAPs for Runways 9L, 13, 27R, and 31 based on course guidance from this VORTAC facility. These approaches are referred to as non-precision approaches, since the VOR only provides horizontal course guidance. Unlike the ILS, which provides a horizontal course signal along the runway centerline, the VOR approach course signal may not be directly aligned with the runway centerline. The VOR approach course may differ as much as 30 degrees from the runway centerline.

## 3.2 Runway Length Analyses

Prior to refining the ALP concept for PBI, it was necessary to determine the optimum length for Runway 9R-27L. The runway length analysis was conducted using the GA business jet aircraft and commercial aircraft fleets currently operating at the Airport. The purpose of this analysis serves to validate the operational benefits associated with extending Runway 9R-27L as shown in the existing Airport Layout Plan and recommended in the 2001 Master Plan Update for PBI. The methodologies used to determine aircraft runway length requirements, considering typical passenger and fuel payload assumptions, are described in the following subsections. GA jet requirements are discussed first, then air carrier aircraft requirements.

### 3.2.1 General Aviation Jet Aircraft Takeoff Runway Length Requirements

Based on FAA Advisory Circular (AC) 150/5325-4A, *Runway Length Requirements for Airport Design*, the recommended length is determined by considering the airplanes that are forecast to use the runway on a regular basis. A regular basis is considered to be at least 250 departures per year. As such, the ANOMS data obtained for the week of March 14-20, 2005, which represents an average week in the peak month, was annualized and used as a basis for determining a representative GA fleet at PBI. Additional fleet information was obtained from the FBOs at the Airport and compared against the ANOMS data.

Table 3-3 summarizes the estimated annual operations of GA aircraft that would conduct at least 250 departures annually. It should be noted that the Challenger and the Learjet 35A were substituted by the Falcon 900 and the Learjet 45, respectively, for purposes of conducting the aircraft performance analyses, due to the unavailability of aircraft manuals at the time this analysis was undertaken.

TABLE 3-3
Estimated Annual Operations at PBI

| Aircraft Type | Total Weekly Operations [1] | Estimated Annual Operations [2] |
|---|---|---|
| Gulfstream IV | 88 | 4,576 |
| Falcon 900 (Substitute for the Challenger) | 69 | 3,588 |
| Learjet 60 | 35 | 1,820 |
| Hawker 800XP | 33 | 1,716 |
| Gulfstream II | 32 | 1,664 |
| Learjet 45 (Substitute for Learjet 35A) | 27 | 1,404 |
| Beechjet 400A | 26 | 1,352 |
| Falcon 2000 | 24 | 1,248 |
| Cessna Citation 750 (X) | 22 | 1,144 |
| Falcon 50 | 20 | 1,040 |
| Learjet 31A | 9 | 468 |
| Beechjet 400 | 9 | 468 |

Sources: DOA ANOMS data.
Prepared by: Ricondo & Associates, Inc.

Notes:
[1] Based on the ANOMS data from March 14-20, 2005.
[2] Estimated based on annualizing the weekly ANOMS data.

## Aircraft Takeoff Weight Considerations

The aircraft performance manuals provide the maximum certified takeoff weight for each aircraft type. However, aircraft typically do not take off at maximum takeoff weight. Therefore, the takeoff and landing weights were adjusted to consider typical passenger seating configurations of the aircraft. This was accomplished by establishing the number of crew members and passengers associated with the typical seating configurations identified by the aircraft manufacturers. An average weight of 200 pounds per passenger and crew member was assumed for establishing the aircraft's payload, not including usable fuel. This 200-pound metric also takes into account the weight of baggage and other equipment needs on the aircraft.

Table 3-4 summarizes the typical crew and passenger seating configuration, as well as the resulting "typical" payload assumptions associated with each of the aircraft types considered for this assessment.

TABLE 3-4
Typical Payload Calculations

| | Typical Seating Configuration | | Maximum Payload Determination | | | |
|---|---|---|---|---|---|---|
| **Aircraft Type** | **Crew** | **Passengers** | **Typical Payload (Pounds)** [1] | **Basic Empty Weight** [2] | **Max. Zero Fuel Weight** [3] | **Maximum Payload (Pounds)** [4] |
| Gulfstream II | 2 | 12 | 2,800 | 32,944 | 42,000 | 9,056 |
| Falcon 900 (Substitute for Challenger) | 2 | 12 | 2,800 | 22,537 | 28,220 | 5,683 |
| Falcon 2000 | 2 | 8 | 2,000 | 21,200 | 28,660 | 7,460 |
| Hawker 800XP | 2 | 8 | 2,000 | 15,723 | 18,450 | 2,727 |
| Cessna Citation 750 (X) | 2 | 8 | 2,000 | 21,700 | 24,400 | 2,700 |
| Learjet 60 | 2 | 8 | 2,000 | 14,640 | 17,000 | 2,360 |
| Falcon 50 | 2 | 9 | 2,200 | 19,100 | 25,570 | 6,470 |
| Gulfstream IV | 2 | 14 | 3,200 | 42,250 | 46,500 | 4,250 |
| Learjet 45 (Substitute for 35A) | 2 | 8 | 2,000 | 11,700 | 16,000 | 4,300 |
| Beechjet 400 | 2 | 7 | 1,800 | 9,715 | 12,470 | 2,755 |
| Beechjet 400A | 2 | 7 | 1,800 | 10,255 | 13,000 | 2,745 |
| Learjet 31A | 2 | 8 | 2,000 | 10,253 | 13,500 | 3,247 |

Sources: Aircraft Flight Manuals; Airliners.net; Omnijet.com/database; Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc., August 2005.

[1] Assumes 200 pounds per passenger/crew for considerations of baggage, catering, and other aircraft equipment.
[2] Basic Empty Weight is the aircraft empty weight plus oil and unusable fuel.
[3] Max Zero Fuel Weight can be defined as the aircraft empty weight plus the maximum allowable payload (passengers, cargo and crew).
[4] Maximum payload does not include fuel storage capacity. It reflects the Maximum Zero Fuel Weight minus the aircraft Basic Empty Weight.

## Aircraft Field Length

Because aircraft typically do not take off at their maximum certified takeoff weight and their range varies by aircraft type, this evaluation compares the field length requirements for each aircraft type for various stage lengths at a typical payload versus the runway length required at maximum takeoff weight. This comparison assumes an outside air temperature of 90° Fahrenheit, mean sea level, calm wind conditions, maximum departure flaps setting, anti-ice and bleed air systems off, zero gradient dry runway, and no obstructions.

Based on the typical crew requirements and passenger seating configurations presented in Table 3-2, the aircraft field length was calculated for the following stage lengths:

- A short-range stage length (500 NM)
- A mid-range stage length (1,000 NM)
- A long-range stage length (2,000 NM)
- A very long-range stage length (2,700 NM)
- The takeoff at maximum takeoff weight

Exhibit 3-3 illustrates these ranges. The takeoff weight for short range assumes a reduction in takeoff weight to account for the reduction in fuel payload required for a short-range stage length of 500 NM. It is assumed that the estimated takeoff weight for short range is the typical landing weight plus the fuel required to travel 500 NM at cruising speed. The typical landing weight includes the aircraft Basic Empty Weight (BEW), the typical payload previously discussed, and the minimum fuel reserve requirements. The latter is based on the FAA's prescribed 45-minute reserves for IFR plus a half-hour reserve to an alternate airport. The fuel required for the 500 NM is based on the average fuel burn rate and the aircraft cruise speed. The average fuel burn rate is then estimated by dividing the aircraft maximum fuel capacity by the maximum economy cruise range. This methodology was used to determine the runway length requirements for the remaining stage lengths considered.

Exhibits 3-4, 3-5, 3-6, and 3-7 illustrate the aircraft field length requirements under dry conditions for each stage length.

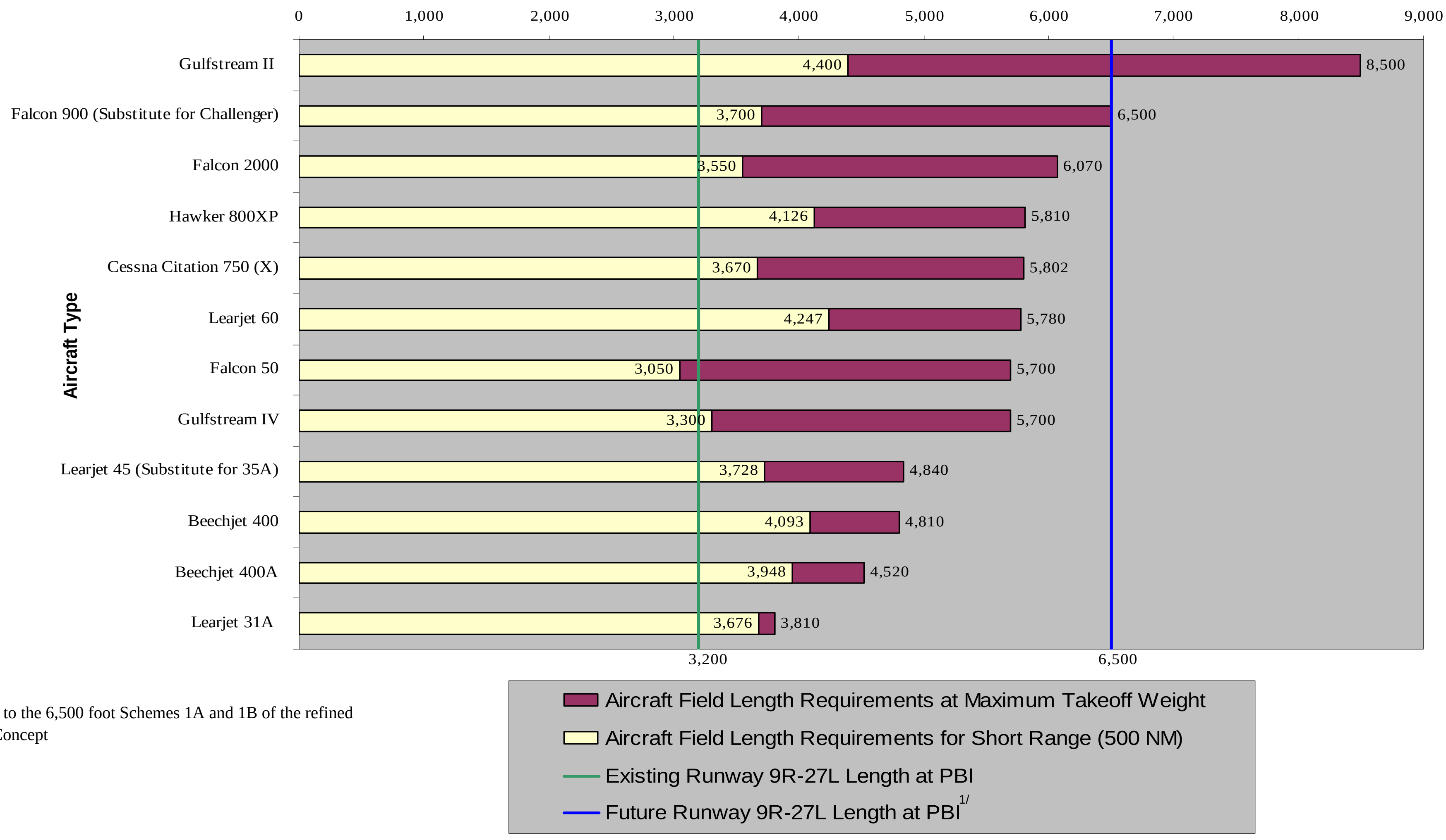
Appendix A provides more detailed summary tables on the calculation of the field length requirements considering the typical passenger and fuel payload assumption for each stage length.

## Results

The analysis demonstrated that for short or mid range (500 or 1,000 NM), most of the selected GA/business jet aircraft are able to take off within 5,500 feet of runway length with the typical payload assumed. For long range (more than 1,000 NM), the midsize jets can also take off within 5,500 feet of runway length with the typical payload assumed. However, in some cases, aircraft such as the Gulfstream II or the Cessna Citation X would need to have their payloads adjusted to make 5,500 feet runway length.


Exhibit 3-3

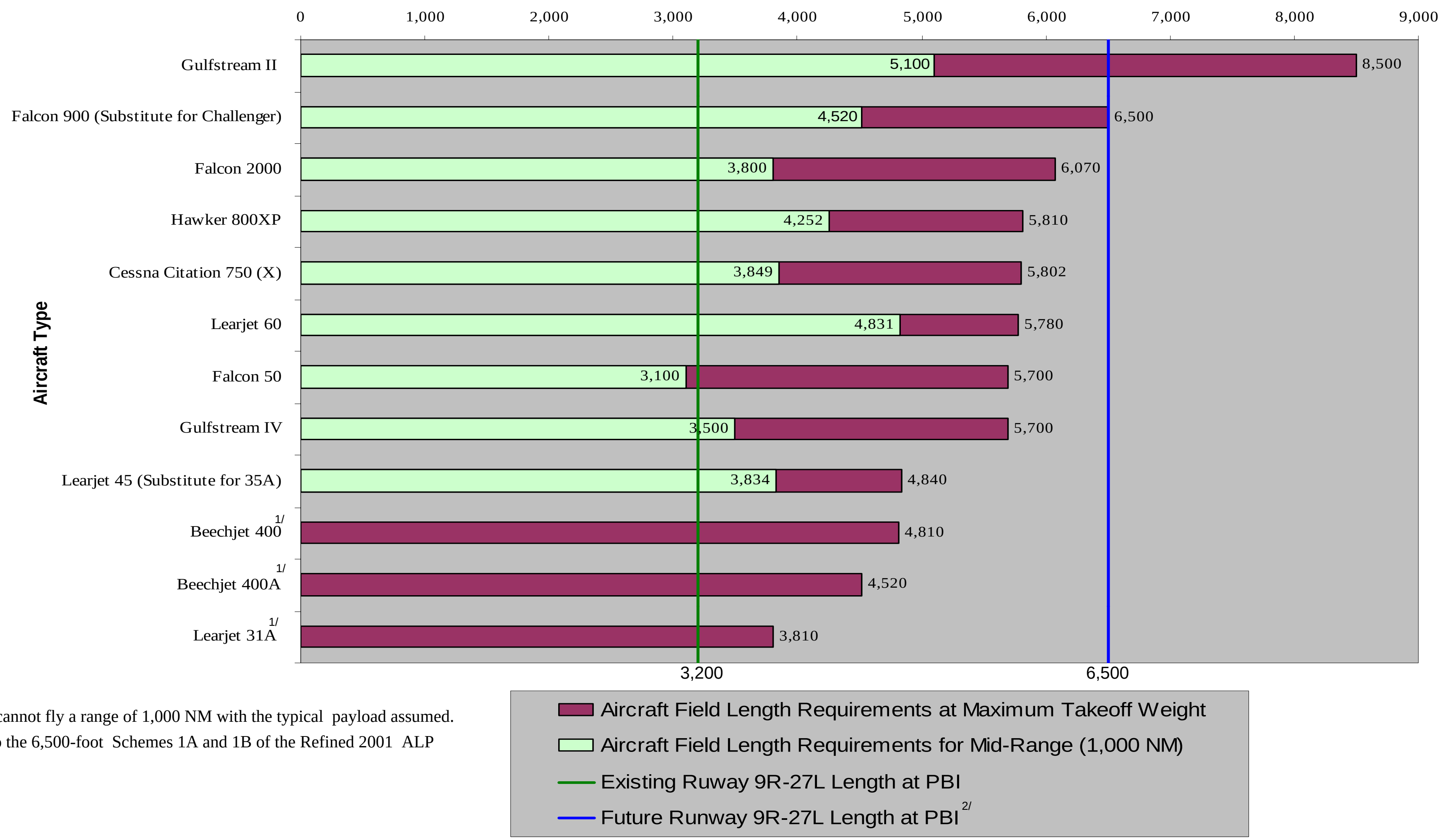
**Stage Lengths from PBI**




Note:
1/ Corresponds to the 6,500 foot Schemes 1A and 1B of the refined 2001 ALP Concept

Exhibit 3-4

**Aircraft Field Length Requirements for Short Range (500 NM)**



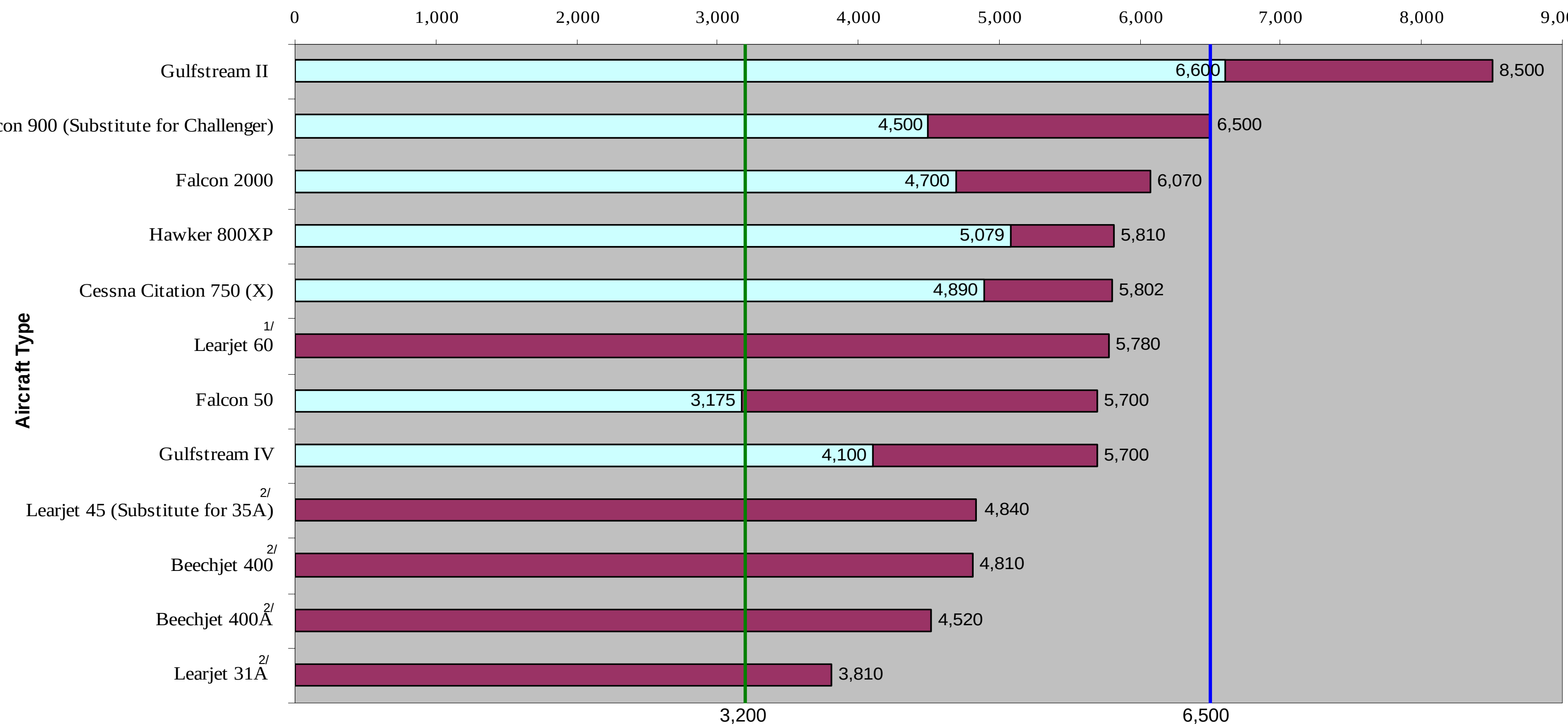

Notes:

1/ These aircraft cannot fly a range of 1,000 NM with the typical payload assumed.

2/ Corresponds to the 6,500-foot Schemes 1A and 1B of the Refined 2001 ALP Concept.

Exhibit 3-5

## Aircraft Field Length Requirements for Mid-Range (1,000 NM)




Notes:

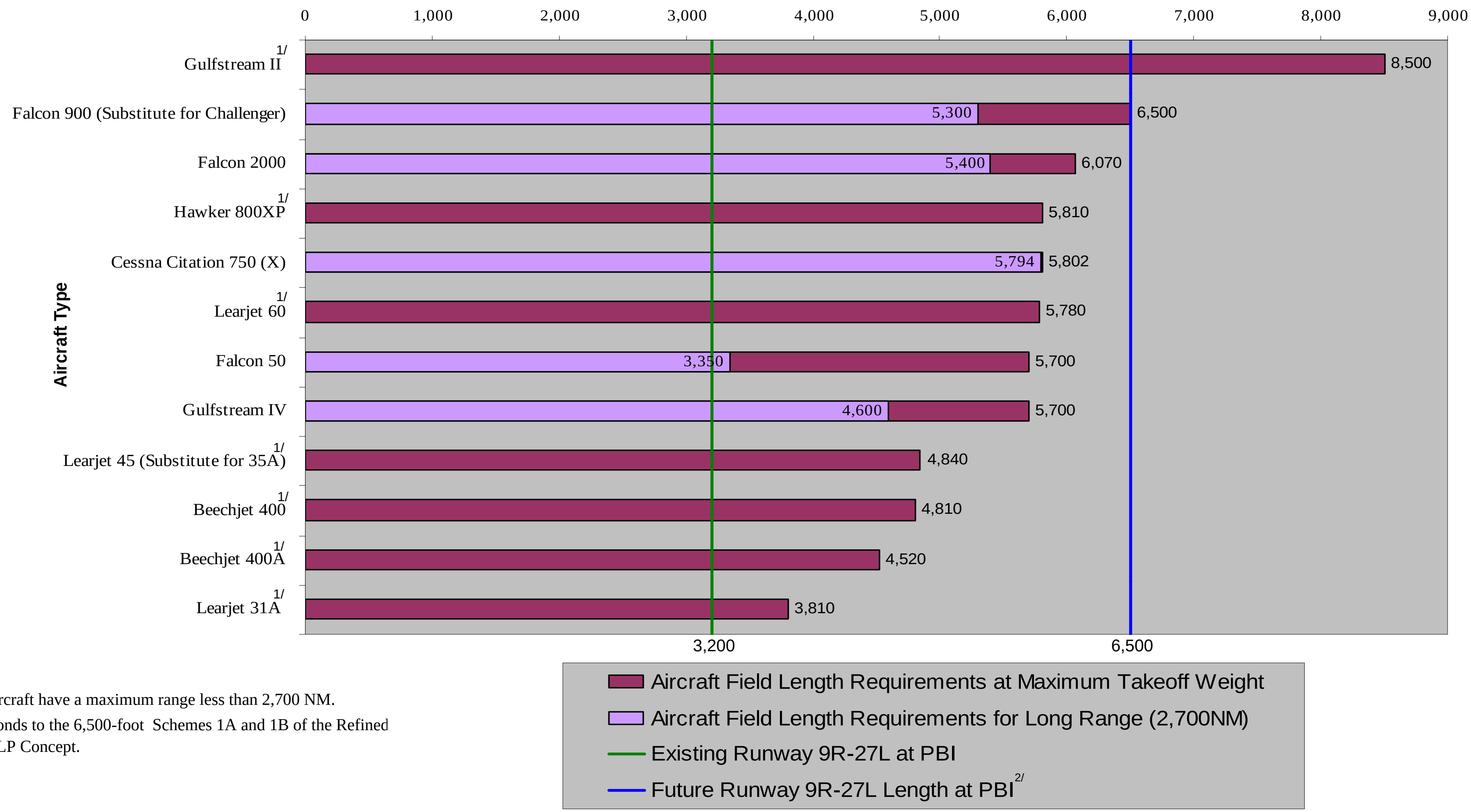
1/ The learjet 60 cannot fly 2,000 NM with the typical payload assumed

2/ These aircraft have a maximum range less than 2,000 NM

3/ Corresponds to the 6,500-foot Schemes 1A and 1B of the Refined 2001 ALP Concept

Exhibit 3-6

## Aircraft Field Length Requirements for Long Range (2,000 NM)




Notes:

1/ These aircraft have a maximum range less than 2,700 NM.

2/ Corresponds to the 6,500-foot Schemes 1A and 1B of the Refined 2001 ALP Concept.

Exhibit 3-7

**Aircraft Field Length Requirements for very Long Range (2,700 NM)**

### 3.2.2 Air Carrier Aircraft Landing Runway Length Requirements

This subsection presents analyses for the potential use of the extended Runway 9R-27L as an air carrier landing runway. Landing runway requirements for the air carrier aircraft operating at PBI were determined for both dry and wet pavement conditions using the aircraft characteristics. The general environmental and operational assumptions are similar to those used for the GA runway length analysis and are as follows: outside air temperature of 90°F, mean sea level, calm wind conditions, maximum landing flaps setting, anti-ice and bleed air systems off, zero gradient dry runway, and no obstructions.

Exhibit 3-8 depicts the landing runway length requirements at maximum aircraft landing weight for both wet and dry pavement conditions. The landing field length is obtained by dividing the measured landing distance by 0.6 to account for the possibility of variations in approach speed, touchdown point, and other deviations from standard procedures as set forth in Federal Aviation Regulation (FAR) Part 121.195.

From the standpoint of an aircraft performance calculation, the analysis shows that most of the air carrier fleet at PBI can land on a 6,500 feet runway in both dry and wet pavement conditions at maximum landing weight.

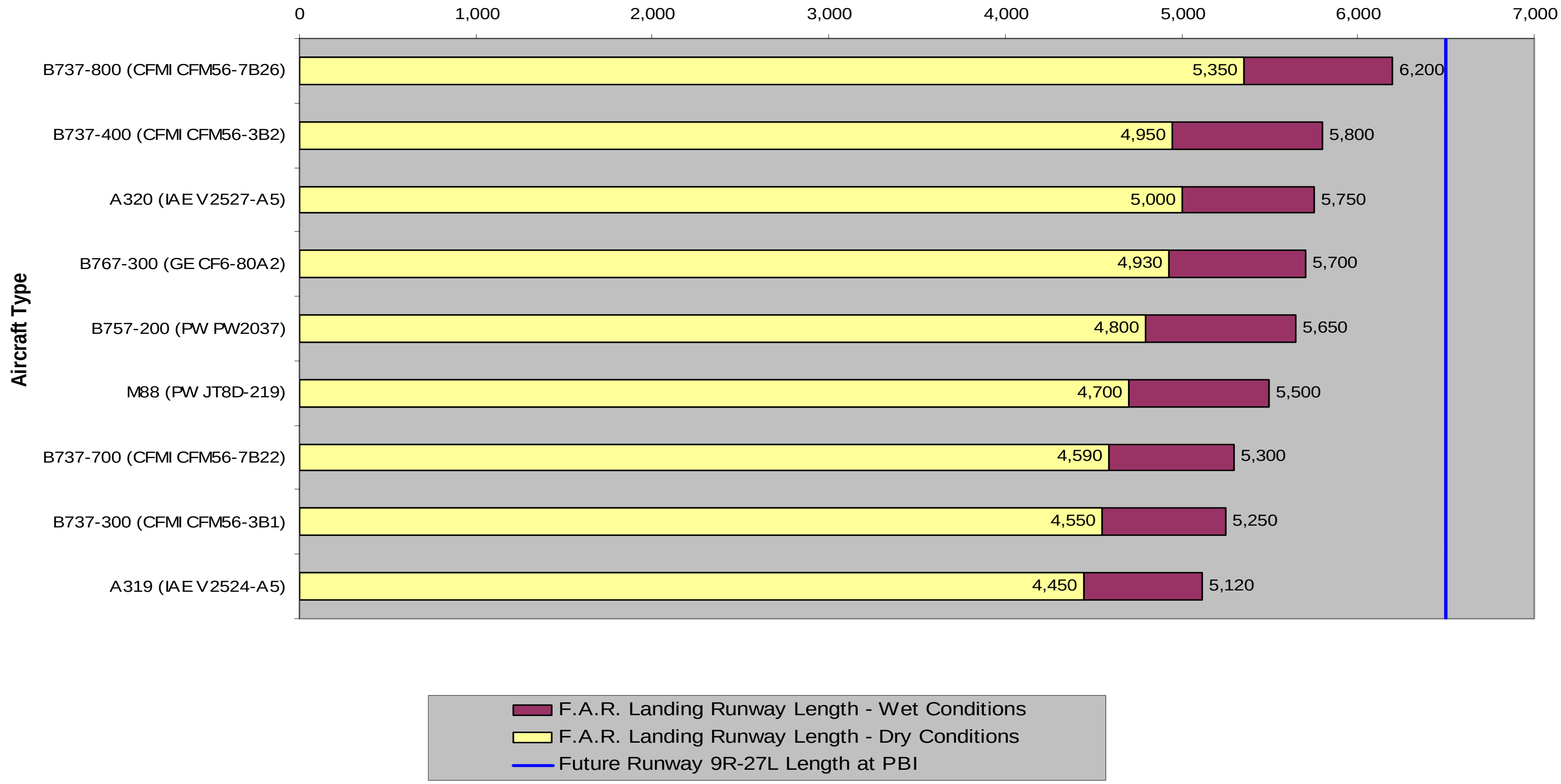
However, the air carriers' preference may be to use the longer runway, Runway 9L-27R. Therefore, additional coordination with the air carriers is required to validate the feasibility of having air carrier arrival operations served on a 6,500 feet runway, given the existence of an alternate longer runway at the Airport.

## 3.3 Refined 2001 ALP Concept Alternatives

Refinements to the 2001 ALP concept primarily addressed extending Runway 9R-27L to an optimum length for the short-term planning period. It was assumed that the runway extension would be operational in 2013, which coincides with the FAA 2004 OEP that identified which airports at the national level would need additional capacity given the anticipated future demand in air travel. This analysis does not include the long-term (2025) airfield concept for the Airport. This option will be addressed in Phase II of the Systemwide Master Planning Study.

Based on the runway length analyses presented in subsection 3.2, it was determined that a 6,500-foot runway length would be a feasible alternative that would satisfy the operational capabilities of the existing GA/business jet fleet at PBI. Although air carriers could theoretically land on a 6,500-foot runway length in both wet and dry pavement conditions, an 8,000-foot runway was also assessed in order to reflect a longer air carrier runway, as proposed in the existing ALP. The following refined 2001 ALP concept schemes were identified:

- **Scheme 1A** extends Runway 9R-27L to a total length of 6,500 feet;
- **Scheme 1B** is Scheme 1A with Runway 13-31 shortened;
- **Scheme 2** extends Runway 9R-27L to a total length of 8,000 feet, with Runway 13-31 shortened.




Note:

[1/] The FAR landing field length is obtained by dividing the measured landing distance by 0.6 in order to account for the possibility of variations in approach speed, touchdown point, and other deviations from standard procedures (FAR Part 121, paragraph 121.195).

Exhibit 3-8

## Landing Runway Length Requirements for Air Carrier Aircraft

The assumptions and impacts of each of the above schemes are described and discussed in the following subsections.

## 3.3.1 Assumptions

For this analysis it is assumed that future extended Runway 9R-27L is a non-precision runway with visibility minimums not lower than 1 SM. This assumption was necessary for the short-term planning time frame to minimize impacts to existing FBOs and off-Airport properties due to Runway Safety Area (RSA), Runway Object Free Area (ROFA), Runway Protection Zone (RPZ), and Part 77 surfaces requirements. It should be noted, however, that the ALP's precision runway alternative for Runway 9R-27L still remains a viable long-term option. Future Runway 9R-27L is also relocated 800 feet south of Runway 9L-27R to provide for an Airplane Design Group (ADG) IV/V separation design standard, and it is shifted west to correspond to that runway end.

### Runway Safety Areas

RSAs are provided to enhance operational safety for landing or departing aircraft. The RSA is an area surrounding a runway that must be cleared, grubbed, and free of objects except those needed within the RSA because of their functions, such as airfield signs, runway edge lights, precision approach path indicators (PAPIs), and visual approach slope indicators (VASIs). The RSA's purpose is to minimize damage to aircraft that undershoot, overrun, or veer off the runway. The size of the RSA for each runway depends on the aircraft approach category and the ADG of the aircraft types that it serves. For Schemes 1A, 1B, and 2, the RSA dimension standard is 500 feet wide with 1,000 feet in length beyond the end of Runway 9R-27L.

### Runway Object Free Areas

The ROFA is an area on the ground centered on the runway centerline. FAA Advisory Circular 150/5300-13, *Airport Design*, Change 9, states: "The ROFA clearing standard requires clearing the OFA of above ground objects protruding above the RSA edge elevation. Except where precluded by other clearing standards, it is acceptable to place objects that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes and to taxi and hold aircraft in the OFA. Objects non-essential for air navigation or aircraft ground maneuvering purposes are not to be placed in the OFA. This includes parked airplanes and agricultural operations" For Schemes 1A, 1B, and 2, the ROFA dimension standard is 800 feet wide with 1,000 feet in length beyond the end of Runway 9R-27L.

### Runway Protection Zone

The RPZ serves to enhance the protection of people and property on the ground. This is achieved through airport owner control over airport property. Such control includes clearing and maintaining RPZ areas of incompatible objects and activities. Control is typically exercised by acquiring sufficient property interest in the RPZ. Other than with a special application of declared distances, the RPZ begins 200 beyond the runway end of the area usable for takeoff or landings and is centered along the runway centerline. For Schemes 1A, 1B, and 2, the RPZ dimension standard will be for a non-precision runway with visibility minimums not lower than 1 SM, with a length of 1,700 feet and an inner and outer width of 500 feet and 1,010 feet, respectively.

### 3.3.2 Refined 2001 ALP Concept: Scheme 1A

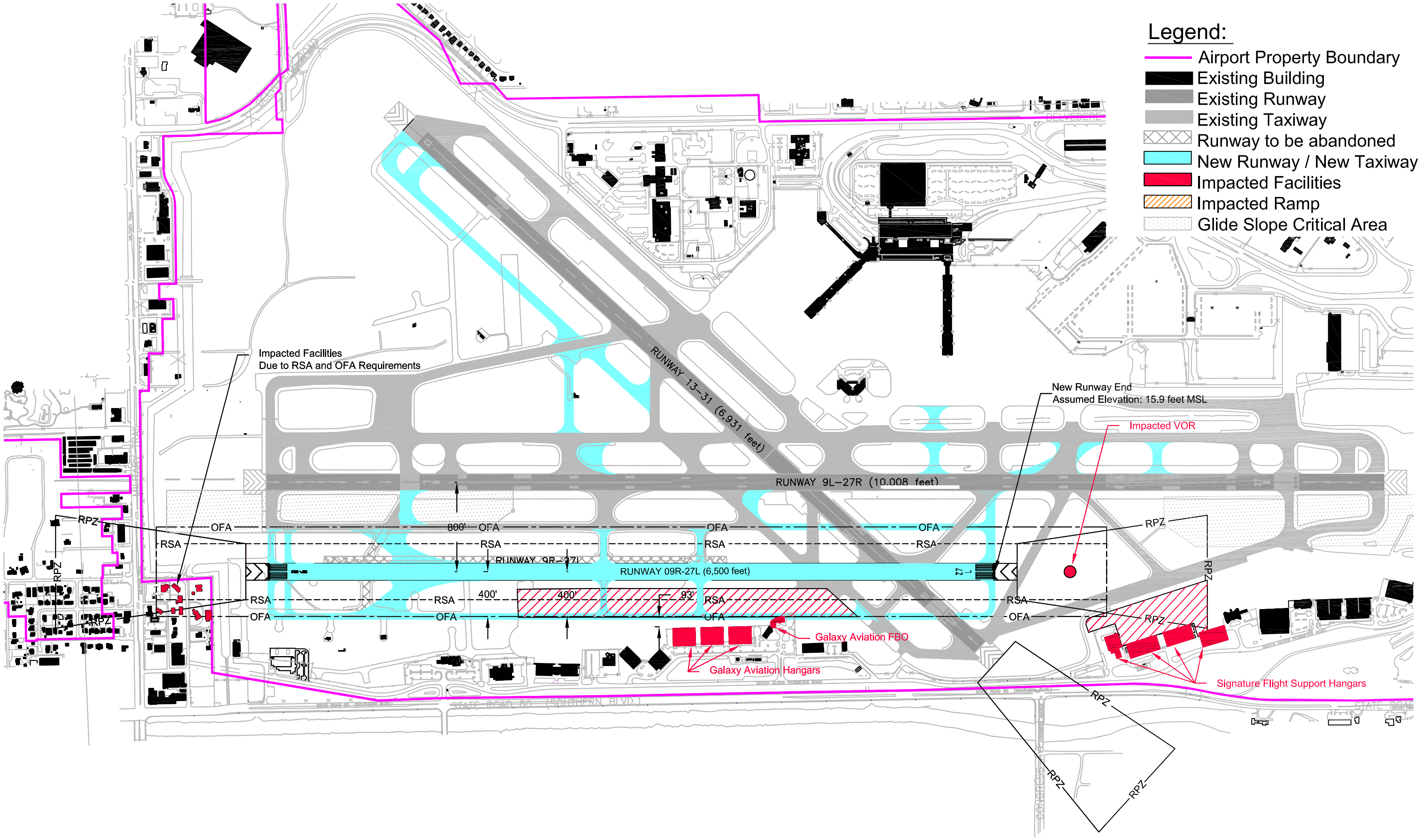
Exhibit 3-9 illustrates Scheme 1A. As shown, future Runway 9R-27L is relocated 800 feet from Runway 9L-27R centerline and shifted to the west so that Runway 9R-27L threshold corresponds with Runway 9L-27R end. The proposed relocated and extended Runway 9R-27L is 6,500 feet long and is served by two full-length parallel ADG III taxiways. The newly constructed ADG III 50-foot-wide Taxiway L is extended to the east, and a new full-length parallel taxiway is proposed south of Runway 9R-27L. Two acute-angled high-speed exit taxiways, also referred to as "high-speed exits," are provided for landing operations in west flow. When properly located, the purpose of these high-speed exits is to minimize aircraft occupancy times on the runway, thus enhancing airport capacity. These high-speed exits are not proposed for landing operations in east flow due to the complexity of the Runway 27L end intersection with Runway 31 end. Adding more pavement in that vicinity could result in operational confusion for pilots as they exit the runway. Therefore, it is assumed that existing Taxiway H would serve as a high-speed exit for landing operations in east flow. As shown in Exhibit 3-9, other taxiway improvements are proposed. These primarily include an extension of Taxiway F to the Runway 13 end, improved high-speed taxiway exits for Runway 9L-27R, and various 90-degree taxiway connectors north of the primary runway.

Shifting the Runway 9R pavement end to the east so that it matches the existing Runway 9L pavement end would affect facilities located off Airport property west of the relocated Runway 9R end. These impacts are due to RSA and ROFA requirements. On the east side, the existing VOR would be affected because of its location within the RSA and ROFA. Signature Flight Support's hangars would be affected due to RPZ requirements. As Exhibit 3-9 shows, the RPZ would condemn the apron area serving the Signature Flight Support's hangars, thus impacting the hangars as well. Similarly, a large section of the apron serving the west facilities of Signature Flight Support and Galaxy aviation hangars would be affected due to RSA and ROFA requirements. The RPZ would affect operational activities on Taxiways D, K, and E during landings on Runway 27L or departures on Runway 9R. In addition, some of Galaxy Aviation's hangars and FBO would be affected due to taxiway OFA requirements along the proposed taxiway south of future Runway 9R-27L.

### 3.3.3 Refined 2001 ALP Concept: Scheme 1B

Exhibit 3-10 illustrates Scheme 1B. As shown, this scheme is similar to Scheme 1A, with the conversion of Runway 13-31 from an air carrier runway to a GA runway. In Scheme 1B, Runway 13-31 was shortened to remove the intersection with both parallel runways. The Runway 13 end was extended to the northeast to obtain a maximum runway length of 4,163 feet. The RSA and OFA requirements were satisfied through the use of declared distances and new RSA criteria set forth in Change 8 of FAA AC 150/5300-13, *Airport Design*. This change allows an RSA length prior to the Runway 13 landing threshold of 600 feet. It should be noted, however, that the 1,000-foot RSA length is still required when operating in the opposite direction, that is, for departures on Runway 31.

The FAA defines declared distances as "the distances the airport operator declares unavailable and suitable for satisfying the airplane's takeoff run, takeoff distance, accelerate-stop distance, and landing distance requirements." Aircraft operators use these declared distances in conjunction with weather data and aircraft performance characteristics to determine payload and/or range limitations. The FAA defines four declared distances:




Source : PBIA Existing Basemap, LPA 2005.
Prepared By : Ricondo & Associates, Inc.

Exhibit 3-9

0 1400 ft.

north

# 2001 ALP Concept Refined Scheme 1A with 6,500 Feet Non-Precision Runway 9R-27L (Visibility Mimimums not Lower than 1 Mile)

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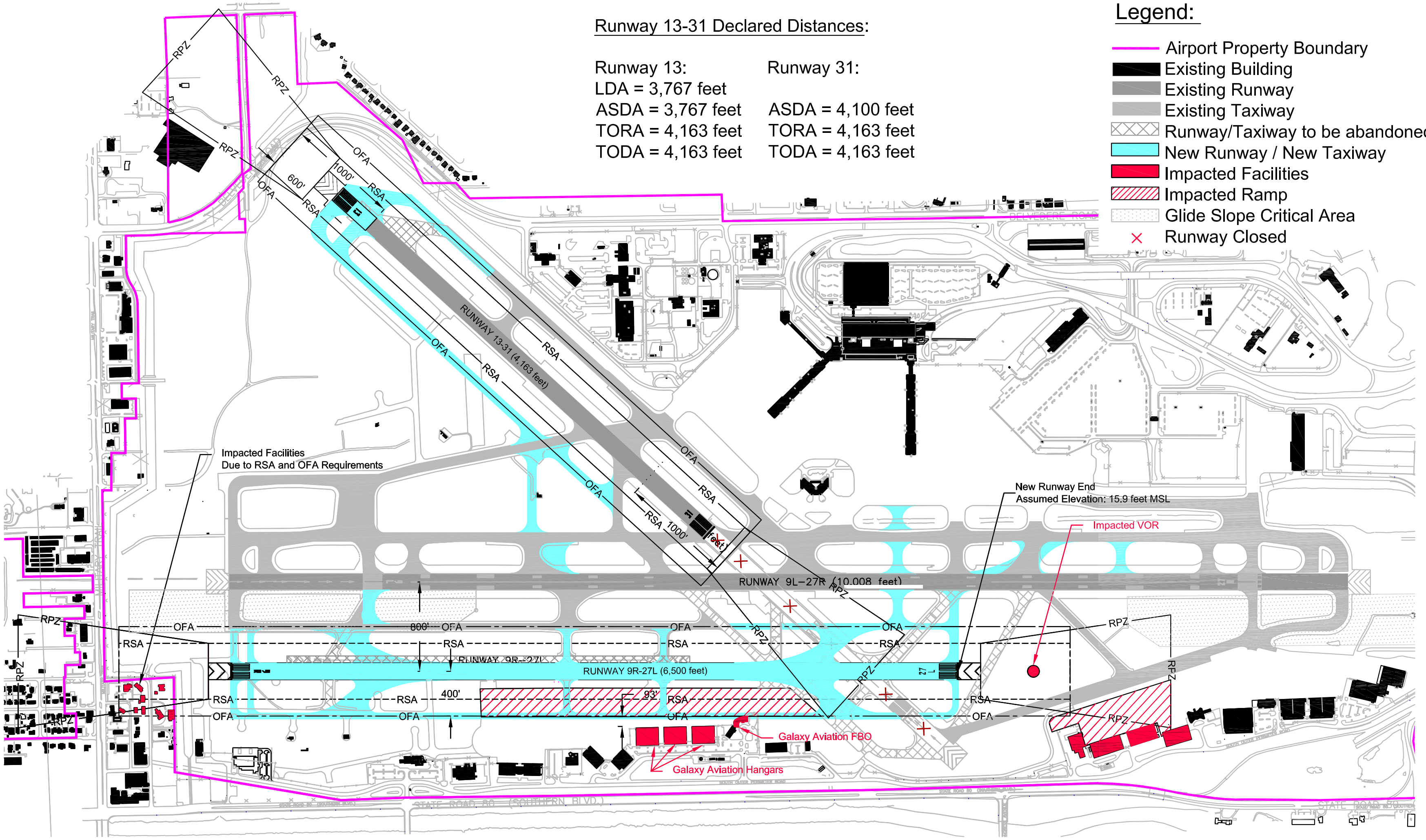



Source : PBIA Existing Basemap, LPA 2005.
Prepared By : Ricondo & Associates, Inc.

0 1400 ft.

north

Exhibit 3-10

## 2001 ALP Concept Refined Scheme 1B with 6,500 Feet Non-Precision Runway 9R-27L and 4,163 Feet Diagonal Runway 13/31

Drawing: P:\PBIA\System Wide Airport Master Planning Study - Phase I\Task I-7 Airfield and Airspace\PBI\Documentation\CAD Exhibits\Exhibit 3-10_Scheme 1B.dwg_Layout: 8.5 x 11 L_Oct 31, 2005, 5:44pm

**Takeoff Run Available (TORA)** is defined as the runway length declared available and suitable for satisfying takeoff run requirements. The TORA is measured from the start of takeoff to a point 200 feet from the beginning of the departure RPZ. Thus, if land use constraints prevent an airport operator from positioning the departure RPZ 200 feet from the departure end of the runway, the TORA will be shorter than the length of the runway.

**Takeoff Distance Available (TODA)** is defined as the TORA plus the length of any remaining runway or clearway beyond the far end of the TORA. Because the practical limit on clearway length is 1,000 feet, the TODA is typically no longer than the TORA plus 1,000 feet. The TODA cannot be shorter than the TORA.

**Accelerate Stop Distance Available (ASDA)** is defined as the runway plus stopway length declared available and suitable for the acceleration and deceleration of an aircraft aborting its takeoff. The ASDA is measured from the point at which the aircraft takeoff run begins to the point where the extended RSA or OFA begins, whichever is shorter. The ASDA must not be longer than the length of the runway plus the stopway, if one is provided. If full RSAs and OFAs cannot be provided beyond the ends of a runway, the ASDA could be shorter than the runway length.

**Landing Distance Available (LDA)** is defined as the runway length that is declared available and suitable for satisfying landing distance requirements. The LDA is measured from the arrival threshold of a runway, taking into account that full RSAs and OFAs must be provided behind the arrival threshold. The LDA extends to whichever of the following yields a shorter distance: (1) the point where the extended RSA or OFA begins at the rollout end of the runway or (2) the runway end. The LDA cannot be longer than the runway. However, if obstacles on the ground prevent the airport operator from providing extended RSAs or OFAs long enough to meet runway design criteria off either end of the runway, the LDA may be shorter than the runway.

The proposed declared distances for Runway 13-31 for Airfield Scheme 1B are summarized in Table 3-5. As shown, the TORA and TODA for both Runway 13 and Runway 31 are 4,163 feet. The ASDA and LDA for Runway 13 have a total length of 3,767 feet to account for the 1,000-foot RSA length required on the Runway 31 end. In west flow operations, the ASDA is 4,100 feet when departing on Runway 31. Landing operations, however, are typically not applicable in this type of airfield configuration, that is, landing operations crossing two active parallel runways.

TABLE 3-5
Proposed Runway 13-31 Declared Distances

| Description | Declared Distances (Feet) | |
|---|---|---|
| | Runway 13 | Runway 31 |
| Takeoff Run Available (TORA) | 4,163 | 4,163 |
| Takeoff Distance Available (TODA) | 4,163 | 4,163 |
| Accelerate Stop Distance Available (ASDA) | 3,767 | 4,100 |
| Landing Distance Available (LDA) | 3,767 | N/A |

Sources: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc

Overall, the conversion of Runway 13-31 to a GA runway provides better operational capability than the existing Runway 9R-27L at PBI. An additional benefit of this scheme is that it addresses the existing non-standard RSA on the Runway 31 end. The facility impacts associated with Scheme 1B are similar to those previously described for Scheme 1A.

### 3.3.4 Refined 2001 ALP Concept: Scheme 2

Exhibit 3-11 illustrates Scheme 2 of the refined 2001 ALP concept. As shown, Scheme 2 was derived from Scheme 1B. It reflects the shortening and conversion of Runway 13-31 to a GA runway but shows the upgrade of Runway 9R-27L to an 8,000-foot air carrier runway, as proposed in the existing ALP. Due to the length of Runway 9R-27L, two high-speed exits are proposed for both east and west landing operations. Existing Taxiway L is also widened to 75 feet to comply with ADG IV/V design criteria and lengthened to accommodate both Runways 9L-27R and 9R-27L. Under Scheme 2, it is also assumed that all FBOs would be relocated to the northwest parcels of the Airport. Therefore, no parallel taxiway is proposed south of Runway 9R-27L. Additional 90-degree taxiway connectors, however, are provided at multiple locations between the two parallel runways connecting to the new parallel taxiway. Similar to Schemes 1A and 1B, additional taxiway improvements are recommended north of the existing Runway 9L-27R. These include an extension of Taxiways F and B to Runway 13 end, improved high-speed taxiway exits for Runway 9L-27R, and various 90-degree taxiway connectors.

The declared distances discussed for Scheme 1B are similar for Scheme 2. Other impacts associated with Scheme 2 include those to facilities west of Runway 9R end, off Airport property, due to RSA and OFA requirements; relocation of all FBOs as discussed above; and relocation of the VOR. Under Scheme 2, the glide slope antennae for Runway 27R would need to be relocated slightly north of its current location to allow for the extension of Taxiway L.

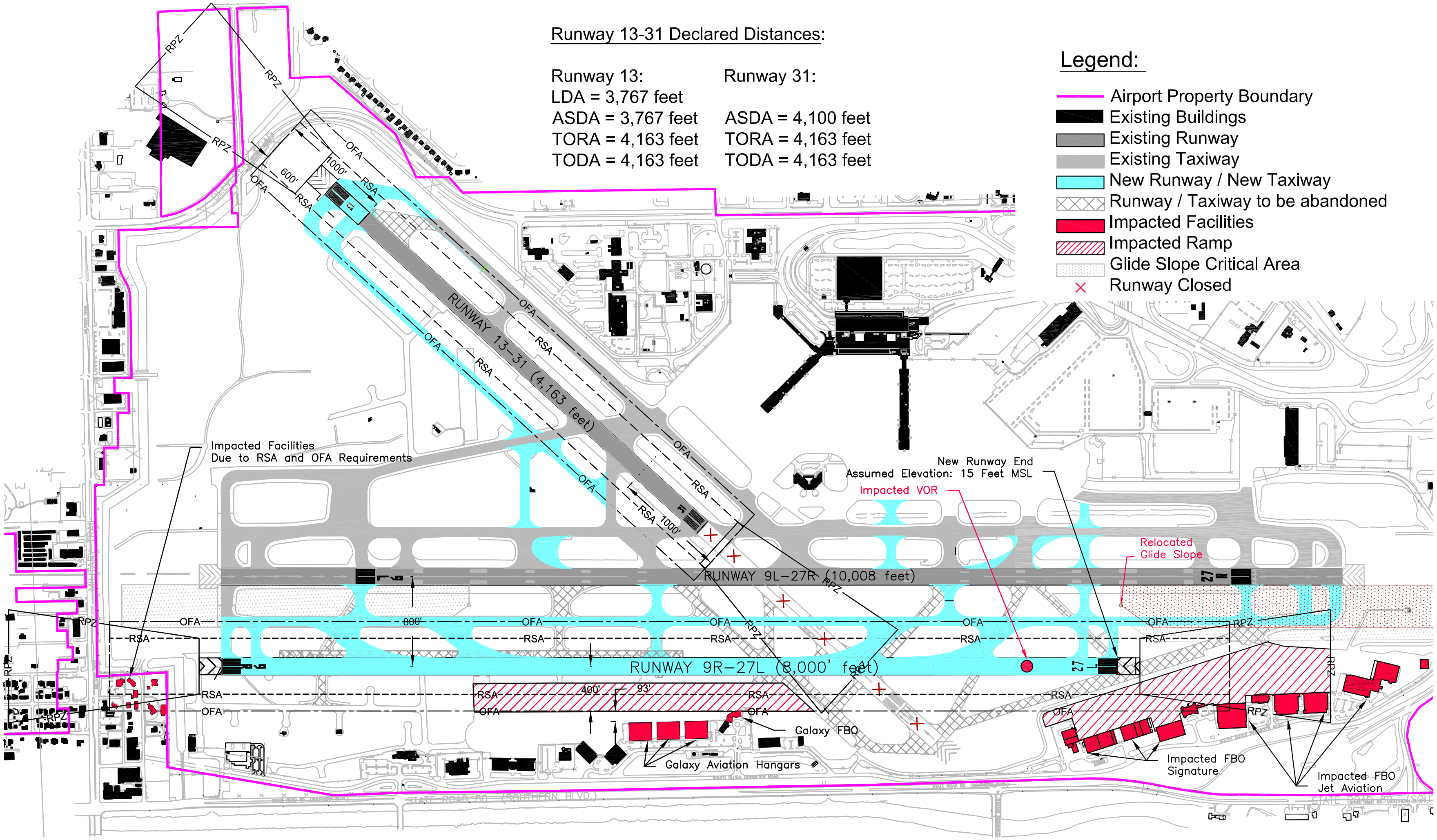
### 3.3.5 General Characteristics and Facility Impacts of the Schemes

Table 3-6 summarizes the general characteristics and facility impacts associated with all three refinement alternative schemes for the 2001 ALP concept.

## 3.4 Preliminary Airfield Demand/Capacity Analyses

This subsection presents a summary of the airfield capacity assessment associated with each airfield scheme as previously presented. Using the FAA's methodology for assessing airfield capacity as delineated in FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*, a preliminary assessment of the current airfield capacity and the various airfield schemes presented above was conducted given current and projected demand patterns at PBI. The analysis presented here does not include any delay calculations.

Airfield capacity is defined as the maximum number of aircraft operations that an airfield can accommodate during a specific period and under specific operating conditions. The capacity varies according to the airfield configuration (i.e., runway layout, number and location of runway exits), weather conditions, types of aircraft and operations performed, and ATC airspace handling procedures.




Source : PBIA Existing Basemap, LPA 2005.
Prepared By : Ricondo & Associates, Inc.

0 1400 ft.

north

Exhibit 3-11

## 2001 ALP Concept Refined Scheme 2 with 8,000 Feet Non-Precision Runway 9R/27L and 4,163 Feet Diagonal Runway

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TABLE 3-6
General Characteristics and Facility Impacts Summary of the Schemes

| | 2001 Refined ALP Concept | | |
|---|---|---|---|
| | Scheme 1A | Scheme 1B | Scheme 2 |
| Runway Lengths (in feet): | | | |
| 9L-27R | 10,008 | 10,008 | 10,008 |
| 9R-27L | 6,500 | 6,500 | 8,000 |
| 13-31 | 6,930 | 4,163 | 4,163 |
| Facility Impacts Summary: | | | |
| FBO ramp area | ✓ | ✓ | ✓ |
| Partial FBO facilities relocated[1/] | ✓ | ✓ | - |
| All FBO facilities relocated[1/] | - | - | ✓ |
| VOR relocation[2/] | ✓ | ✓ | ✓ |
| 27 Glide Slope Antennae relocation[3/] | - | - | ✓ |
| Facilities west of Runway 9R relocation[4/] | ✓ | ✓ | ✓ |

Sources: Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

- not applicable
✓ applicable

[1] Partial FBO or all FBO facilities relocations are required due to RSA, ROFA, and RPZ requirements.

[2] The VOR relocation is required due to RSA requirements in Schemes 1A and 1B and the Runway 9R-27L extension in Scheme 2.

[3] The glide slope antennae relocation is due to the extension of Taxiway L to Runway 27R end.

[4] These facilities would need to be relocated to satisfy RSA and/or ROFA requirements beyond Runway 9R end.

## 3.5 Preliminary Airfield Demand/Capacity Analyses

This subsection presents a summary of the airfield capacity assessment associated with each airfield scheme as previously presented. Using the FAA's methodology for assessing airfield capacity as delineated in FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*, a preliminary assessment of the current airfield capacity and the various airfield schemes presented above was conducted given current and projected demand patterns at PBI. The analysis presented here does not include any delay calculations.

Airfield capacity is defined as the maximum number of aircraft operations that an airfield can accommodate during a specific period and under specific operating conditions. The capacity varies according to the airfield configuration (i.e., runway layout, number and location of runway exits), weather conditions, types of aircraft and operations performed, and ATC airspace handling procedures.

### 3.4.1 Factors Affecting Airfield Capacity

The capacity of an airfield system, including the runways and associated taxiways, is not constant over time. As discussed above, a variety of factors can affect the airfield capacity at an airport. These factors, which are individually discussed in the subsequent subsections, include:

- Runway configuration
- Number and location of runway exits or exit taxiways
- Runway use restrictions
- Weather conditions such as number of times the Airport experiences low cloud ceilings and low visibility
- Aircraft fleet mix
- Runway use as dictated by wind conditions
- Touch-and-go operations.

#### Runway Configuration

The number of runways, their orientation, the location of runway intersections, and the lateral separation between parallel runways are primary factors affecting airfield capacity. The number of runway exits, their locations, and their types (90-degree exits, angled exits, high-speed exits, etc) also affect the airfield's capacity.

Aircraft operations on intersecting runways are typically considered dependent operations. Aircraft separations must be increased to allow adequate time for aircraft operations on the intersecting runway to occur safely. The amount of in-trail separation between aircraft depends on the type of operation (arrival or departure) and the distance between the runway intersection and the approach end of the runway. As the distance between the approach end of the runway and the intersection increases, the required amount of in-trail separation may also increase. This is due to the greater amount of time that an aircraft needs to travel beyond the runway intersection and thus allow for an operation on the intersecting runway to occur. As in-trail separations increases, airfield capacity decreases.

Airports with intersecting runways may improve airfield capacity through the use of LAHSO, which allows for an arrival and/or departure to occur on one runway independent of aircraft arrivals on an intersecting runway. These operations are only permitted on runways where sufficient landing distance exists. As mentioned in Section 2, the Airspace Constraint Analysis, however, LAHSO is not used at PBI due to the general aviation and air carrier mix. The National LAHSO order effectively prohibits LAHSO between GA and air carrier aircraft. While LAHSO may be used if both aircraft are GA, the mix of aircraft at PBI makes consistent use of LAHSO impractical.

When an airfield configuration includes parallel runways, the lateral spacing between the runways affects the airfield capacity. Parallel runways with a lateral spacing of 2,500 feet or more and serving large aircraft can operate as independent runways during VFR weather conditions. Independent runway operations allow aircraft to arrive or depart on the parallel runways simultaneously. If the lateral separation is less than 2,500 feet, as is the case at PBI, operations during VFR conditions become dependent, as do simultaneous arrivals and departures during VFR conditions if wake turbulence is a concern. These dependencies require an increase in the in-trail separations, thus reducing airfield capacity. The minimum lateral spacing between parallel runways during VFR conditions is 700 feet.

During IFR conditions in a radar-controlled environment, the minimum lateral spacing between parallel runways is 2,500 feet for dependent operations. At this separation, simultaneous departures may occur independently. Dependent staggered approaches to the parallel runway are typically conducted with a minimum of 1.5 miles separation diagonally between successive aircraft on the adjacent runways. Increasing the lateral separation of the runway to 4,300 feet or more would allow for simultaneous arrival and/or simultaneous departure operations on the parallel runways during IFR conditions, provided both runways have an instrument approach procedure. If the airport is equipped with a Precision Radar Monitor, simultaneous arrivals and/or simultaneous departures may occur during IFR conditions with a separation of 3,400 feet between parallel runways.

The time an aircraft occupies a runway is another factor affecting the airfield capacity. Runway occupancy time for arriving aircraft depends on the number, type, and location of runway exits as well as the aircraft performance. Typically, lighter aircraft require less runway distance for landing and thus less time occupying the runway. However, if a runway exit is not available once the aircraft has an opportunity to decelerate to a speed that allows for safely maneuvering off the runway, airfield capacity is compromised.

Runway occupancy times can be reduced with high-speed exit taxiways provided these exits are properly located. These high-speed exits are aligned at an acute angle relative to the runway centerline, typically between 30 and 45 degrees relative to the runway orientation. The purpose of such a configuration is to allow landing aircraft to exit the runway at a higher speed than when using standard 90-degree taxiway exits, thus reducing runway occupancy times and increasing airfield capacity.

### Weather Conditions

The airfield capacity can also vary significantly due to weather conditions at the Airport. Prevailing winds (direction and speed) dictate which runways can be used for aircraft arrivals or departures. Typically, aircraft take off and land into the wind and can withstand a limited amount of crosswind and tailwind. If the maximum crosswind or tailwind is exceeded, the aircraft may not operate on particular runways.

Other meteorological conditions affecting airfield capacity include cloud ceiling height and visibility. Low cloud ceiling heights and low- visibility conditions result in increased spacing between aircraft in the airspace surrounding the Airport. These conditions may also cause restrictions on which runways can be used and determine whether VFR or IFR operating procedures are followed. VFR governs the procedures used to conduct operations under VMC. IFR governs the procedures used to conduct flight operations under Instrument Meteorological Conditions (IMC). The criteria for determining these operating procedures are summarized in Table 3-7.

TABLE 3-7
Weather Operating Conditions for Airfield Capacity Analysis

| Classification | Weather Conditions | | |
|---|---|---|---|
| | Visibility | | Cloud Ceilings |
| VFR | At least 5 SM | and/or | At least 3,000 feet AGL |
| IFR | Less than 3 SM | and/or | Less than 1,000 feet AGL |

Source: FAA AC 150/5060-5, Airport Capacity and Delay.
Prepared by: Ricondo & Associates, Inc.

## Aircraft Fleet Mix

The aircraft fleet mix is an important factor in determining an airport's airfield capacity. As the diversity of approach speeds and aircraft weights increases, airfield capacity decreases. This is due to a safety issue referred to as "wake vortices" or "wake turbulence." This phenomenon creates air turbulence behind an airplane that results from its movement through the air. Heavier aircraft cause more severe wake vortices than smaller aircraft do. Although more prevalent during departure operations than arrivals, wake vortices are considered a significant safety hazard during any operation.

To alleviate the hazards of wake turbulences, aircraft are spaced according to the differences in their airspeeds and weights. Lighter aircraft are more susceptible to damage from wake vortices than heavy aircraft are. Therefore, light aircraft are typically required to wait up to three minutes before operating on a runway after heavy aircraft. This delay results in a loss in airfield capacity. The greater the size and weight differential of the aircraft fleet, the greater the separation required between successive aircraft operations.

The FAA's Airport Capacity and Delay Handbook uses a factor referred to as the "mix index" to account for aircraft composition of the fleet mix. The mix index is a factor represented as a percentage to quantify the share of large aircraft in the fleet mix. To establish the mix index, aircraft are assigned to one of five categories based on maximum certified takeoff weight of the aircraft. Based on the number of operations for each classification, a percentage is established to quantify the share of total aircraft operations. Table 3-8 summarizes the weight classifications of the five aircraft categories considered in the fleet mix.

TABLE 3-8
Aircraft Classifications for Establishing Aircraft Mix Index

| Aircraft Classification | Maximum Certified Takeoff Weight (pounds) | Representative Aircraft |
|---|---|---|
| Small | 12,500 or less | Piper PA-23, Cessna C-180 |
| | | Cessna C-207, and King Air |
| Small + | 12,501 to 41,000 | Lear 25, Cessna Citation, and Grumman G-1 |
| Large | 41,001 to 220,000 | Gulfstream IV, F-28, Dash 8, B737 and B727 |

TABLE 3-8
Aircraft Classifications for Establishing Aircraft Mix Index

| Aircraft Classification | Maximum Certified Takeoff Weight (pounds) | Representative Aircraft |
|---|---|---|
| B757 | 220,001- to 300,000 | B757 |
| Heavy | 300,001 or more | A-300, B-767, L1011, DC-10, New Large Aircraft |

Source: FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay.*
Prepared by: Ricondo & Associates, Inc.

### Touch-and-Go Operations

"Touch-and-go" operations are defined as operations by a single aircraft that lands and departs without stopping or exiting the runway. Pilots conducting touch-and-go operations are usually performing training exercises and thus stay in the airport traffic pattern. Theoretically, airport capacity in terms of the number of operations handled increases with the ratio of touch-and-go operations to total operations. This is because aircraft in the traffic pattern are continually making approaches and departures without incurring significant runway occupancy time. A touch-and-go operation is counted as two operations, one arrival and one departure. Repeat touch-and-go operations, however, reduce the availability of the runway for other operations.

## 3.5.2 Preliminary Airfield Capacity Results

For these analyses, the airfield capacity at PBI was updated from the 2001 Master Plan Update to reflect current operating conditions at the Airport; for instance, LAHSO is currently not used at PBI. Scheme 1A, Scheme 1B, and Scheme 2 assumed operating in 2013. The airfield capacity in the refinement alternatives is presented in terms of both peak hourly capacity and Annual Service Volume (ASV). A comparison of estimated peak-hour airfield capacity and peak-hour demand is presented for existing conditions and the above schemes.

### Overview of Airfield Capacity Assessment

For the current and potential future runway use configurations, peak hourly capacities were established for four operating conditions: VFR East, VFR West, IFR East, and IFR West. Historical weather data obtained from the National Climatic Data Center from January 1, 1995, to December 31, 2004, were used to establish the availability of each runway use configuration during the above operating conditions.

An overview of the Peak Month Average Day (PMAD) peak-hour demand is presented for existing conditions and the 2013 forecast time frame, when the future schemes are assumed to be operating. Tuesday, March 15, 2005, was identified to represent the existing PMAD. The 2013 PMAD was derived from the existing PMAD based on the baseline forecast developed for PBI as part of the Systemwide Master Plan Study.

A weighted hourly capacity was then established based on the occurrence rate of each runway use configuration and weather condition and their respective hourly capacities. The weighted hourly capacity forms the basis for determining the airfield's ASV. The ASV represents an estimate of the annual number of aircraft operations the Airport can efficiently accommodate, taking hourly, daily, and monthly operational patterns into consideration. As defined in the FAA's *Airport Capacity and Delay* handbook, ASV "is a reasonable estimate of an airport's annual capacity."

The formula for calculating ASV is composed of three variables: $C_W$ (weighted hourly capacity), D (ratio of annual demand to average daily demand in the peak month), and H (ratio of average daily demand to average peak-hour demand during the peak month). These variables are multiplied ($C_W$*D*H) to obtain the ASV for the airport.

### Peak-Hour Airfield Capacity

The assumptions undertaken for determining peak-hour airfield capacity are presented below; these include the current and future mix indices and resulting peak-hour capacity results associated with the various runway use configurations. All peak-hour capacities are shown for both VFR and IFR weather conditions.

### Assumptions

The assumptions made for deriving the existing and future airfield capacity estimates are as follows.

- 50 percent arrivals
- No touch-and-go operations
- Schemes 1A, 1B, and 2 operational in 2013
- No LASHO due to the GA/air carrier mix
- Historical weather data occurrences of 60.6 percent in east VFR, 0.4 percent in east IFR, 38.3 percent in west VFR, and 0.7 percent in west IFR for all schemes
- Existing Airfield:
  - VFR Weather Conditions
    - Mixed use of Runways 9L-27R and 9R-27L for arrivals and departures
    - 4 NM in-trail separation at touchdown point
  - IFR Weather Conditions
    - Mixed use of Runways 9L-27R and 9R-27L for arrivals and departures
    - 5.5 NM in-trail separations at touchdown point

- Schemes 1A and 1B:
  - VFR Weather Conditions
    - Segregated departures on Runway 9L-27R and arrivals on Runway 9R-27L
    - 2.5 NM in-trail separations at touchdown point
    - 5 NM in-trail separations at touchdown point on Runway 13 for Scheme 1B only
  - IFR Weather Conditions
    - Mixed use of Runways 9L-27R and 9R-27L for arrivals and departures
    - 5.5 NM in-trail separations at touch down point

- Scheme 2:
  - VFR Weather Conditions
    - Segregated departures on Runway 9L-27R and arrivals on Runway 9R-27L
    - 2.5 NM in-trail separations at touchdown point on Runway 9R-27L
    - 5 NM in-trail separations at touchdown point on Runway 13 to facilitate runway crossings
  - IFR Weather Conditions
    - Segregated: departures on Runway 9R-27L and arrivals on Runway 9L-27R
    - 3 NM in-trail separations at touchdown point on Runway 9L-27R

Table 3-9 presents a summary of the VFR and IFR mix index determination for the existing (2004) and future (2013) conditions. As shown, aircraft operations are classified by type of operation (commercial, cargo, and GA) and by weight classification. Military operations were not considered in the mix index because they represent less than 1 percent of total operations. The future 2013 fleet mix for PBI reflects an increase in the proportion of air carrier activity by large aircraft. A decrease in small-aircraft activity is anticipated over the same time frame, reflecting greater utilization of nearby GA airports as described in the baseline forecast report for PBI. The increased share of heavy aircraft is relatively small and not expected to have a significant impact on the airfield's capacity. Overall, the VFR mix index increases from 91.3 percent in 2004 to 100.5 percent in 2013; the IFR mix index increases from 98.7 percent in 2004 to 106.0 percent in 2013. These relatively small increases are expected to have minimal effect on the hourly capacity of the airfield.

### Results

Exhibit 3-12 illustrates the existing airfield capacities for VFR and IFR weather occurrences in both east and west operating configurations. The estimated VFR peak-hour capacities for existing conditions are 64 operations when operating to the east and 76 operations when operating to the west. In both east and west flows, Runway 9L-27R is the primary runway, and Runway 9R-27L is limited to small GA aircraft. In west flow operations, Runway 31 provides an additional benefit for GA aircraft departures because of the short distance of the intersection from Runway 31 end to Runway 9L-27R. As aircraft expeditiously clear this intersection, another operation can occur on Runway 27R. This explains why peak-hour capacity in the west flow operating configuration yields more operations than in the east flow operating configuration. As Exhibit 3-12 shows, some departures can also occur on Runway 13 when operating to the east, but only during non-peak hours. This is due to the geometry associated with the Runway 13 and Runway 9L intersection. Typically, an aircraft departing on Runway 13 would be cleared for takeoff as the Runway 9L arrivals roll through the intersection of the two runways. As Runway 13 intersects Runway 9L at approximately midfield and considering the landing distance required by with the fleet mix, the vast majority of the landing aircraft are at a relatively slow speed intending to exit the runway at Taxiway G just east of the intersection of the two runways. As a result, it is not reasonable to expect a departure on Runway 13 and Runway 9L between arrivals. Therefore, departures on Runway 13 are assumed during non-peak hours only.

**Table 3-9**
**Existing and Future VFR and IFR Mix Index**

**VFR - Existing Aircraft Fleet Mix Compostion (Base Year 2004):**

| | Small [1] | | Small+ [2] | | Large [3] | | B757 | | Heavy [4] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity | Share (%) | Quantity | Share (%) | Quantity | Share (%) | Quantity | Share (%) | Quantity | Share (%) | Total | Mix Index [5] |
| Commercial | 0 | 0.0% | 7,879 | 9.2% | 49,528 | 70.5% | 10,366 | 84.8% | 4 | 100.0% | 67,778 | |
| Cargo | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1,864 | 15.2% | 0 | 0.0% | 1,864 | |
| General Aviation | 29,369 | 100.0% | 78,030 | 90.8% | 20,767 | 29.5% | 0 | 0.0% | 0 | 0.0% | 128,165 | |
| Total | 29,369 | 100.0% | 85,909 | 100.0% | 70,295 | 100.0% | 12,230 | 100.0% | 4 | 100.0% | 197,807 | |
| **Percent** | **14.8%** | | **43.4%** | | **35.5%** | | **6.2%** | | **0.0%** | | **100%** | **91.3%** |

**IFR - Existing Aircraft Fleet Mix Compostion (Base Year 2004)[6]:**

| | Small [1] | | Small+ [2] | | Large [3] | | B757 | | Heavy [4] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity | Share (%) | Quantity | Share (%) | Quantity | Share (%) | Quantity | Share (%) | Quantity | Share (%) | Total | Mix Index |
| Commercial | 0 | 0.0% | 7,879 | 9.2% | 49,528 | 70.5% | 10,366 | 84.8% | 4 | 100.0% | 67,778 | |
| Cargo | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 1,864 | 15.2% | 0 | 0.0% | 1,864 | |
| General Aviation | 14,684 | 100.0% | 78,030 | 90.8% | 20,767 | 29.5% | 0 | 0.0% | 0 | 0.0% | 113,481 | |
| Total | 14,684 | 100.0% | 85,909 | 100.0% | 70,295 | 100.0% | 12,230 | 100.0% | 4 | 100.0% | 183,123 | |
| **Percent** | **8.0%** | | **46.9%** | | **38.4%** | | **6.7%** | | **0.0%** | | **100%** | **98.7%** |

**VFR - Future Aircraft Fleet Mix Compostion (2013):**

| | Small [1] | | Small+ [2] | | Large [3] | | B757 | | Heavy [4] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity | Share (%) | Quantity | Share (%) | Quantity | Share (%) | Quantity | Share (%) | Quantity | Share (%) | Total | Mix Index [5] |
| Commercial | 0 | 0.0% | 3,160 | 3.9% | 64,322 | 69.2% | 14,894 | 87.5% | 2,785 | 100.0% | 85,160 | |
| Cargo | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 2,130 | 12.5% | 0 | 0.0% | 2,130 | |
| General Aviation | 21,545 | 100.0% | 78,052 | 96.1% | 28,568 | 30.8% | 0 | 0.0% | 0 | 0.0% | 128,165 | |
| Total | 21,545 | 100.0% | 81,213 | 100.0% | 92,890 | 100.0% | 17,024 | 100.0% | 2,785 | 100.0% | 215,455 | |
| **Percent** | **10.0%** | | **37.7%** | | **43.1%** | | **7.9%** | | **1.3%** | | **100%** | **100.5%** |

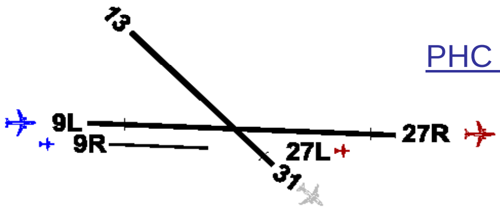
**IFR - Future Aircraft Fleet Mix Compostion (2013)[6]:**

| | Small [1] | | Small+ [2] | | Large [3] | | B757 | | Heavy [4] | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity | Share (%) | Quantity | Share (%) | Quantity | Share (%) | Quantity | Share (%) | Quantity | Share (%) | Total | Mix Index |
| Commercial | 0 | 0.0% | 3,160 | 3.9% | 64,322 | 75.6% | 14,894 | 87.5% | 2,785 | 100.0% | 85,160 | |
| Cargo | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 2,130 | 12.5% | 0 | 0.0% | 2,130 | |
| General Aviation | 10,772 | 100.0% | 78,052 | 96.1% | 20,763 | 24.4% | 0 | 0.0% | 0 | 0.0% | 109,588 | |
| Total | 10,772 | 100.0% | 81,213 | 100.0% | 85,085 | 100.0% | 17,024 | 100.0% | 2,785 | 100.0% | 196,878 | |
| **Percent** | **5.5%** | | **41.3%** | | **43.2%** | | **8.6%** | | **1.4%** | | **100%** | **106.0%** |

Notes:
[1] Small: Aircraft with 12,500 pounds or less maximum certificated takeoff weight.
[2] Small+: Aircraft with a maximum certificated takeoff weight of more than 12,500 pounds and less than or equal to 41,000 pounds.
[3] Large: Aircraft with a maximum certificated takeoff weight of more than 41,000 pounds and less than or equal to 300,000 pounds.
[4] Heavy: Aircraft with certificated maximum takeoff weight exceeding 300,000 pounds.
[5] Mix Index = [(The % of Small+ Aircraft) + (The % of Large Aircraft)] + [2*(the % of B757 Aircraft)] + [3*(the % of Heavy Aircraft)]
[6] Assumes a 50% reduction of small aircraft during IFR conditions.

Sources: Airport Landing Reports; Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

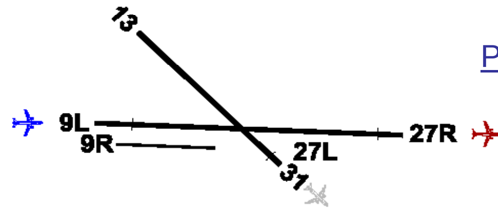
**East Configuration - VFR** **(60.6% Occurence)**




PHC = 64 Operations

- 30 Arrivals on Runway 9L
- 30 Departures on Runway 9L
- 2 Arrivals for Small Aircraft Only on Runway 9R
- 2 Departures for Small Aircraft Only on Runway 9R

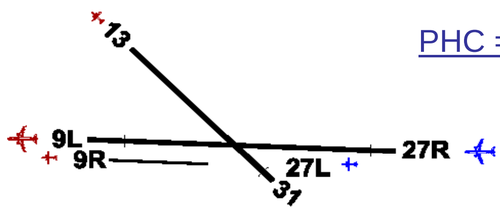
**East Configuration - IFR** **(0.4% Occurence)**




PHC = 44 Operations

- 22 Arrivals on Runway 9L
- 22 Departures on Runway 9L

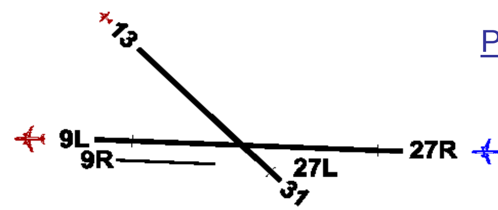
**West Configuration - VFR** **(38.3% Occurence)**




PHC = 76 Operations

- 30 Arrivals on Runway 27R
- 30 Departures on Runway 27R
- 12 Departures on Runway 31 (GA Aircraft Only)
- 4 Total Operations for Small Aircraft Only on Runway 27L

**West Configuration - IFR** **(0.7% Occurence)**




PHC = 54 Operations

- 22 Arrivals on Runway 27R
- 22 Departures on Runway 27R
- 10 Departures on Runway 31 (GA Aircraft Only)

**Legend:**

Arrivals Departures Potential Operations During Non-Peak Hours

Exhibit 3-12

**Peak-Hour Capacity Results: Existing Airfield**

During IFR conditions, the same operating patterns are assumed. The difference resides in the increased in-trail separation to allow for proper spacing between aircraft in such weather conditions. Thus, the IFR peak-hour capacities are 44 operations in east flow operating configuration and 54 operations in west flow operating configuration. The additional capacity when operating in west flow is attributed to GA aircraft departures on Runway 31.

Similarly, Exhibit 3-13 illustrates the peak-hour capacities for Scheme 1A. As shown, the VFR peak-hour capacities increase by approximately 44 percent and 21 percent when operating to the east and west, respectively, totaling 92 operations in both VFR operating configurations. Scheme 1A enhances airfield capacity by simply segregating arrival operations from departure operations. Assuming user acceptance for landings on a 6,500-foot non-precision runway, it is anticipated that the south runway, 9R-27L, would serve arrivals and the north runway, 9L-27R, would serve departures. Thus Runway 9R-27L can accommodate 42 arrivals, and Runway 9L-27R can accommodate at least 50 if departures can be fanned.

In Scheme 1A, the IFR peak-hour capacities are similar to those of the current airfield configuration. Due to the closely spaced runways and the types of approaches to Runway 9R-27L, the extension of the runway to 6,500 feet does not provide additional capacities in IFR weather conditions.

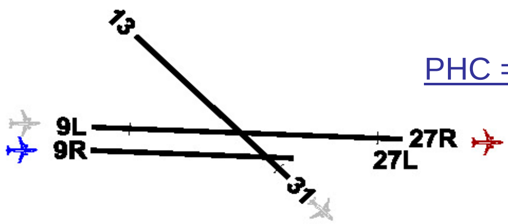
Exhibit 3-14 presents the peak-hour capacities for Scheme 1B. As shown, the VFR and IFR peak-hour capacities are similar to those of Scheme 1A, where arrivals and departures are segregated. The additional capacity gain is obtained from the converted general aviation Runway 13-31. In VFR conditions, this runway can be used for GA arrivals or departures when operating to the east and west, respectively. Assuming 5 NM of in-trail spacing for Runway 13 to facilitate runway crossings for aircraft landing on Runway 9R, 24 peak-hour arrivals are estimated. For departures on Runway 31, a conservative figure of 20 departures is assumed in order not to overstate the capacity of the airfield.

In IFR conditions, the only gain in airfield capacity occurs when operating to the west. Due to the decoupling of Runway 9L-27R and Runway 13-31, 10 additional GA departures are assumed for Runway 31 compared to Scheme 1A or the current airfield configuration. As a result, the total IFR peak-hour capacity for Scheme 1B is 64 operations when operating to the west. The IFR peak-hour capacity remains identical to that in Scheme 1A and the existing airfield configuration at 44 operations when operating to the east.

It should be emphasized that the gain in peak hour airfield capacities estimated for Scheme 1B only applies to GA operations. Due to the on-demand nature of the GA market, GA activities do not necessarily peak during the same periods as scheduled air carrier operations.

Schemes 1A and 1B greatly enhance the airfield capacities by segregating arrivals from departures. However, landing on the 6,500-foot Runway 9R-27L depends on acceptance by users, that is, airlines. Although the runway length analysis demonstrates that PBI's air carrier fleet is technically able to land on such a runway length, it may be the air carriers' preference to request the longer runway.

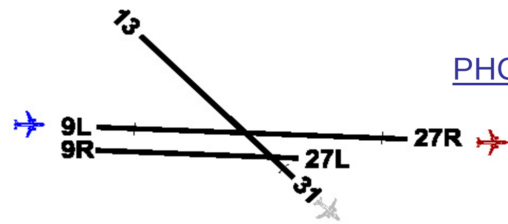
**East Configuration - VFR** **(60.6% Occurence)**




PHC = 92 Operations

- 50 Departures on Runway 9L
- 42 Arrivals on Runway 9R

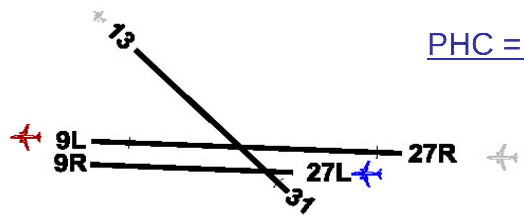
**East Configuration - IFR** **(0.4% Occurence)**




PHC = 44 Operations

- 22 Arrivals on Runway 9L
- 22 Departures on Runway 9L

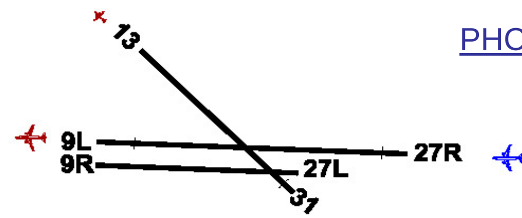
**West Configuration - VFR** **(38.3% Occurence)**




PHC = 92 Operations

- 50 Departures on Runway 27R
- 42 Arrivals on Runway 27L

**West Configuration - IFR** **(0.7 % Occurence)**




PHC = 54 Operations

- 22 Arrivals on Runway 27R
- 22 Departures on Runway 27R
- 10 Departures on Runway 31 (GA Aircraft Only)

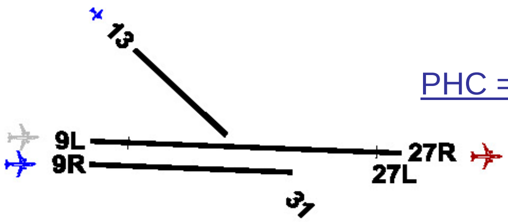
**Legend:**

Arrivals Departures Potential Operations During Non-Peak Hours

Exhibit 3-13

**Peak-Hour Capacity Results: Scheme 1A**

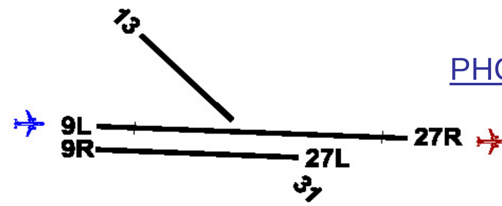
**East Configuration - VFR** **(60.6% Occurence)**




PHC = 116 Operations

- 50 Departures on Runway 9L
- 42 Arrivals on Runway 9R
- 24 Arrivals on Runway 13 (GA Aircraft Only)

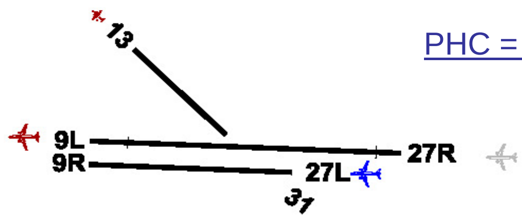
**East Configuration - IFR** **(0.4% Occurence)**




PHC = 44 Operations

- 22 Arrivals on Runway 9L
- 22 Departures on Runway 9L

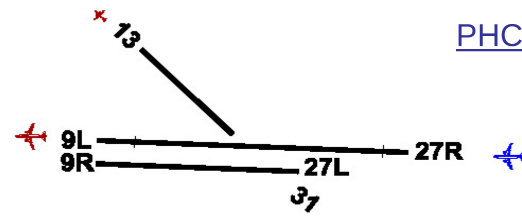
**West Configuration - VFR** **(38.3% Occurence)**




PHC = 112 Operations

- 50 Departures on Runway 27R
- 42 Arrivals on Runway 27L
- 20 Departures on Runway 31 (GA Aircraft Only)

**West Configuration - IFR** **(0.7 % Occurence)**




PHC = 64 Operations

- 22 Arrivals on Runway 27R
- 22 Departures on Runway 27R
- 20 Departures on Runway 31 (GA Aircraft Only)

**Legend:**

Arrivals — Departures — Potential Operations During Non-Peak Hours

Exhibit 3-14

**Peak-Hour Capacity Results: Scheme 1B**

Exhibit 3-15 illustrates the peak hour capacities for Scheme 2. As presented, the VFR peak hour capacities, when operating in both east and west flow configurations, are similar to those obtained in Scheme 1B, with 116 and 112 operations, respectively. The arrival operations are segregated from the departure operations, and GA gains additional capacity from Runway 13-31.

During IFR conditions, peak hour capacities are greatly enhanced due to segregated arrival and departure operations. As Exhibit 3-15 shows, IFR peak-hour capacities increased by approximately 64 percent and 70 percent from the existing airfield configuration when operating in east and west flow configurations, totaling 72 and 92 operations, respectively. When operating to the east, arrivals are conducted on the precision approach Runway 9L, while Runway 9R serves departure operations. When operating to the west, arrivals are conducted on the precision approach Runway 27R, while Runway 27L serves aircraft departures. GA aircraft gain additional departures from Runway 31 in west flow operating configuration.

### Existing and Forecast (2013) Demand Overview

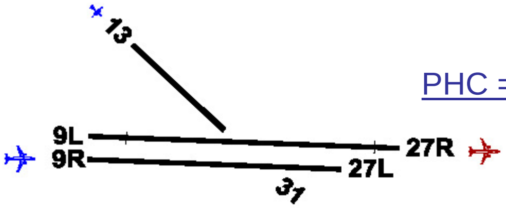
In order to compare the peak-hour capacities previously presented to existing and future (2013) peak-hour demand, daily demand rolling peak graphs were developed showing scheduled air carrier aircraft operations, including all-cargo aircraft operations, and GA aircraft operations. The baseline forecast developed for PBI was used to obtain the 2013 activity at the Airport, and the existing March 15, 2005, daily patterns were assumed to also represent the 2013 PMAD daily distribution of activity.

Exhibit 3-16 illustrates the daily rolling peaks for the existing PMAD (March 15, 2005), showing total GA and scheduled air carrier operations. Military operations were not accounted for in the rolling peak graphs because they represent less than 1 percent of total operations. Scheduled air carrier operations were obtained from the Official Airline Guide (OAG) and verified with air carriers currently operating at the Airport. GA aircraft operations information was obtained from the DOA's ANOMS database. The rolling peak graph clearly shows that scheduled air carrier aircraft operations and GA aircraft operations do not have the same peaking patterns. Air carrier aircraft operations peak at approximately 25 operations at 12:30 p.m., and GA aircraft operations peak at approximately 31 operations about 3:00 p.m. Combined scheduled air carrier and GA aircraft operations yield a maximum of approximately 49 operations at about 1:29 p.m. and 2:19 p.m.

For comparison, a daily rolling peak graph was also developed for March 20, 2005, to assess the typical high GA activities on Sundays at PBI. These daily patterns are presented in Exhibit 3-17. As expected, the late-afternoon GA aircraft operations represent approximately 82 percent of the 55 peak-hour operations occurring between 3:50 p.m. and 4:49 p.m. This typically high activity on a Sunday afternoon corresponds primarily to GA aircraft departing PBI ending a weekend or business trip in the Palm Beach area.

Exhibit 3-18 illustrates the daily rolling peaks for the 2013 time-frame horizon under which the future schemes are assumed operational. As previously stated, the future demand shown is based on the baseline forecast developed for PBI, and the March 15, 2005, PMAD daily peaking patterns are assumed unchanged. Accordingly, the total peak-hour demand of total air carrier and GA aircraft operations consists of approximately 55 operations.

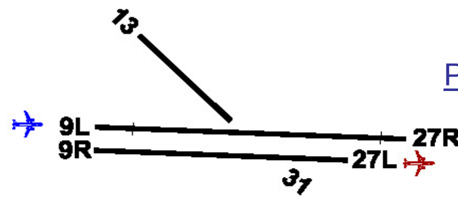
**East Configuration - VFR** **(60.6% Occurence)**




PHC = 116 Operations

- 50 Departures on Runway 9L
- 42 Arrivals on Runway 9R
- 24 Arrivals on Runway 13 (GA Aircraft Only)

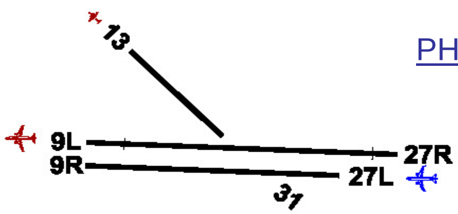
**East Configuration - IFR** **(0.4% Occurence)**




PHC = 72 Operations

- 36 Departures on Runway 9R
- 36 Arrivals on Runway 9L

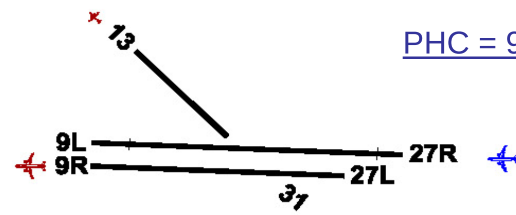
**West Configuration - VFR** **(38.3% Occurence)**




PHC = 112 Operations

- 50 Departures on Runway 27R
- 42 Arrivals on Runway 27L
- 20 Departures on Runway 31 (GA Aircraft Only)

**West Configuration - IFR** **(0.7 % Occurence)**




PHC = 92 Operations

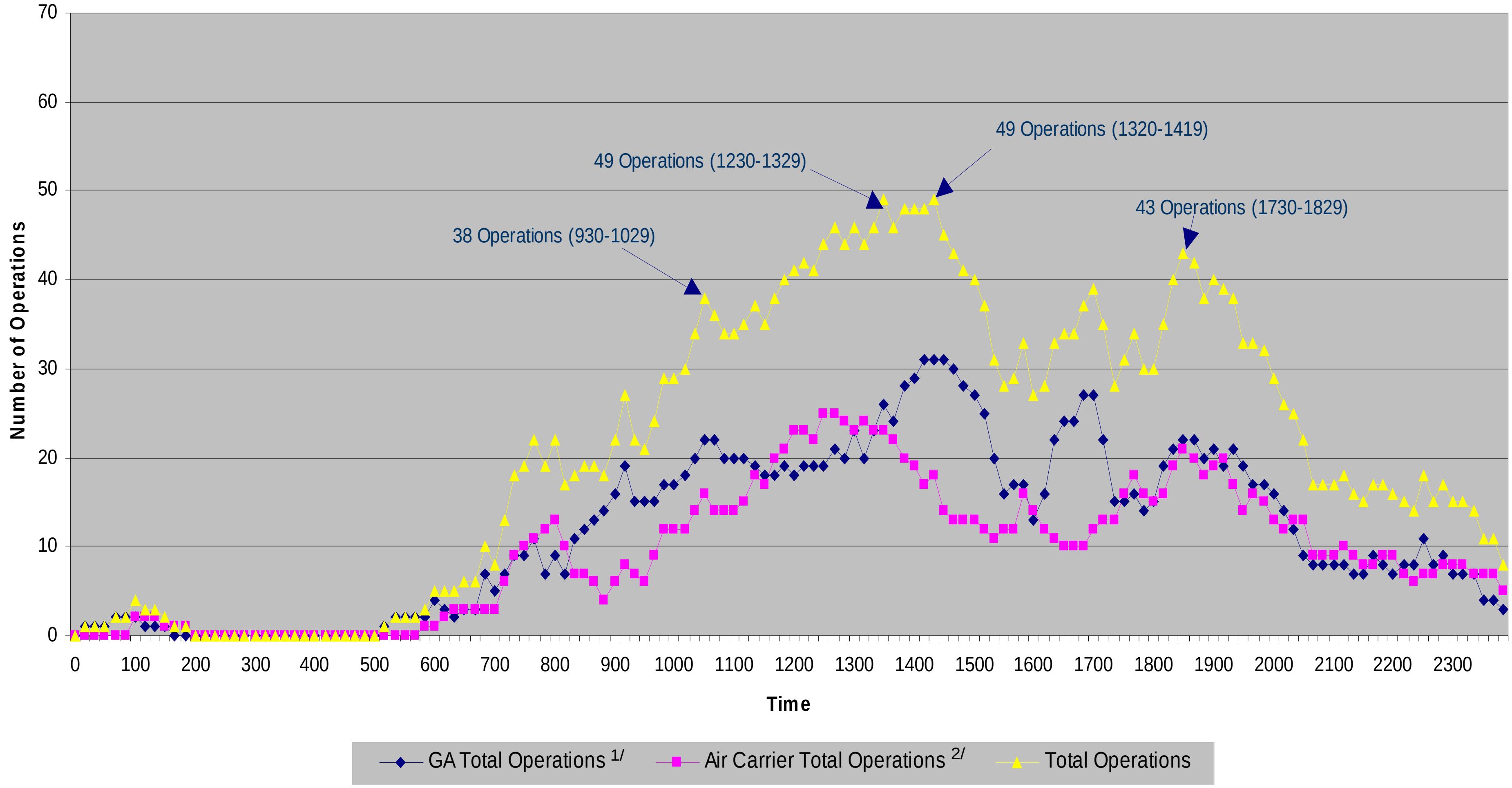
- 36 Departures Runway 27L
- 36 Arrivals on Runway 27R
- 20 Departures on Runway 31 (GA Aircraft Only)

**Legend:**

Arrivals Departures Potential Operations During Non-Peak Hours

Exhibit 3-15

**Peak-Hour Capacity Results: Scheme 2**



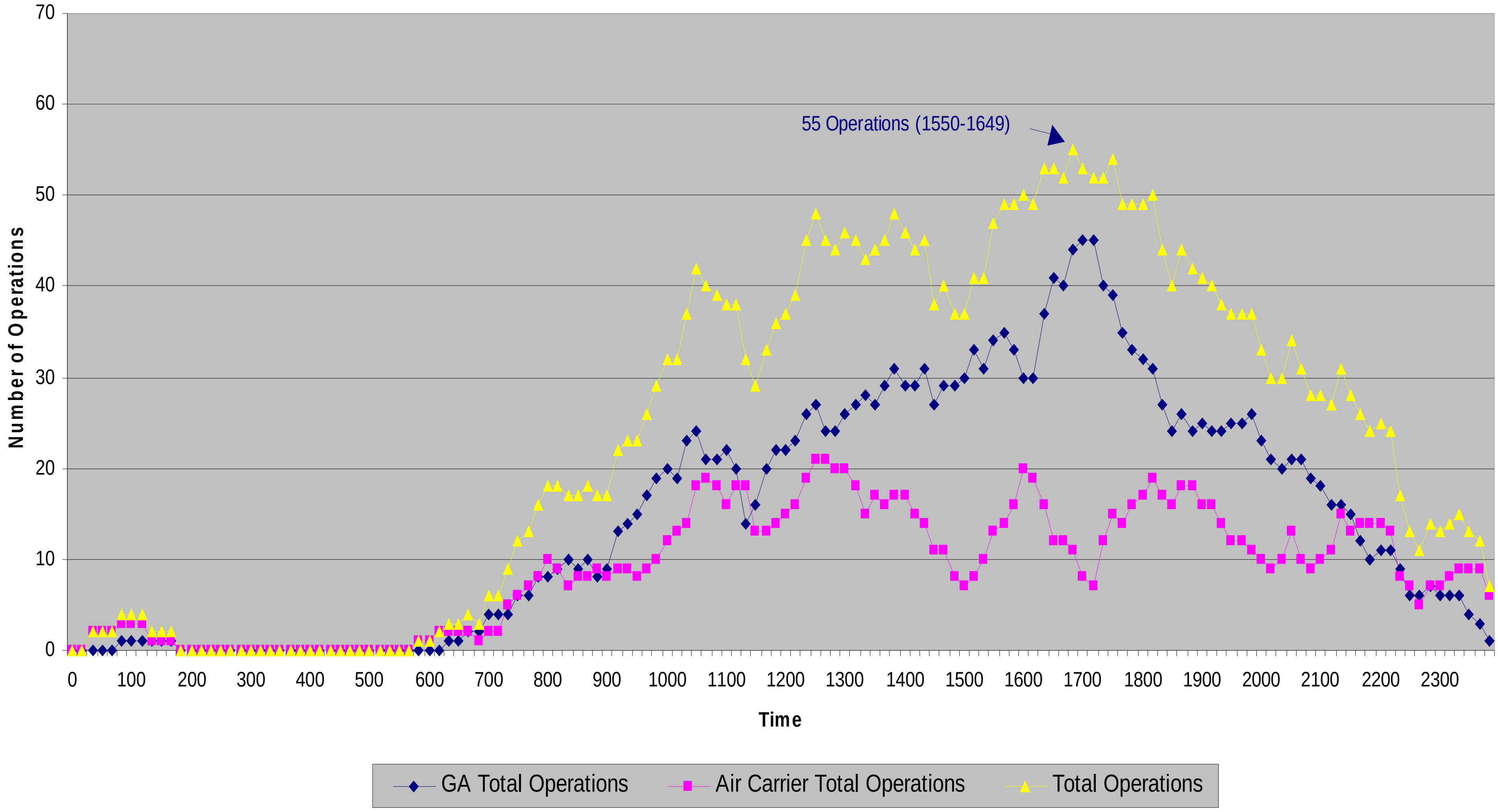

Notes:

[1/] Source: ANOMS Data for March 15, 2005.

[2/] Source: Official Airline Guide (OAG) schedule for March 15, 2005.

Exhibit 3-16

## Existing PMAD Rolling Peaks (March 15, 2005)

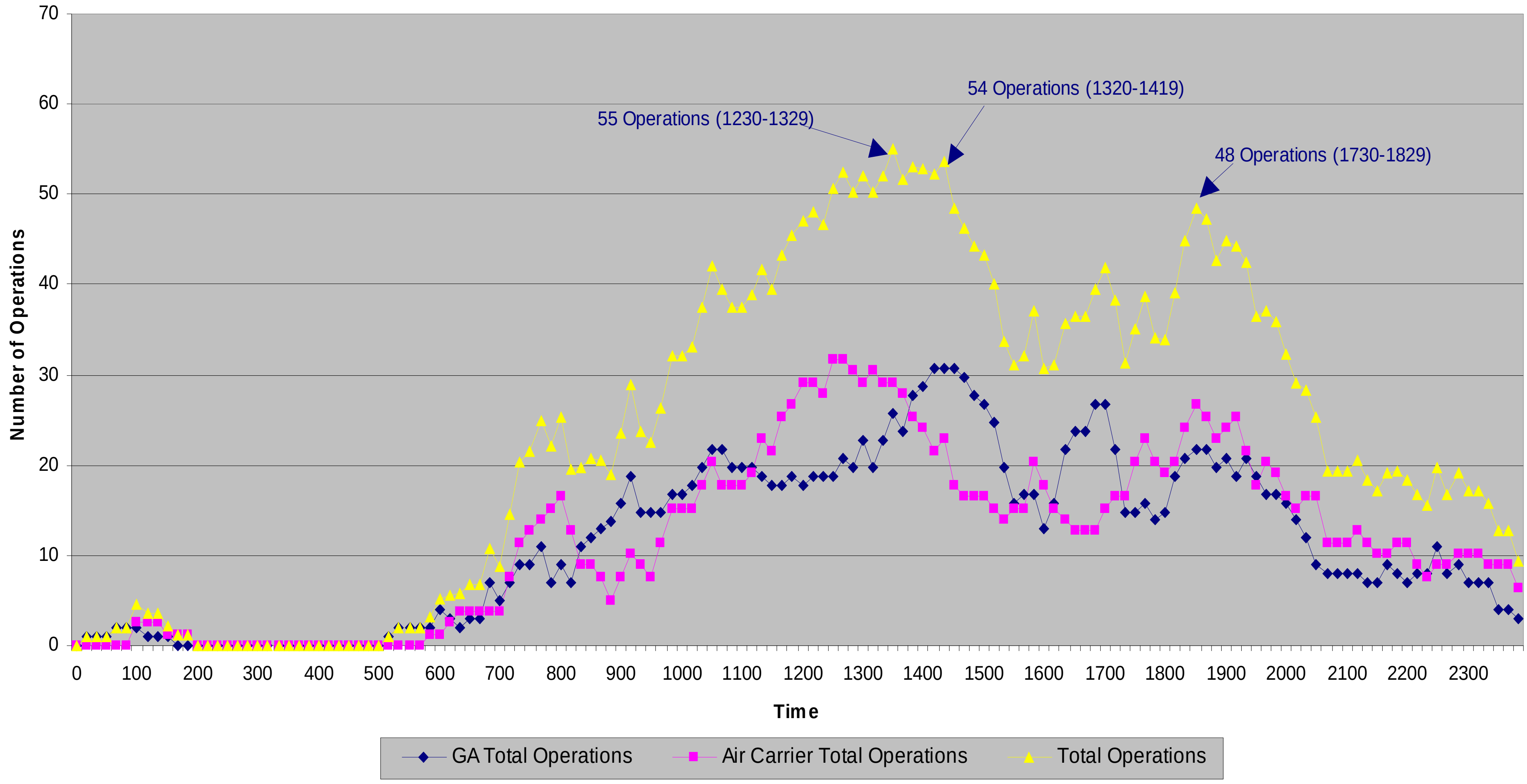



Note:

[1/] Source: ANOMS Data for March 20, 2005.

Exhibit 3-17

**March 20, 2005 (Sunday) Rolling Peaks[1/]**




Notes:

[1/] Source: ANOMS Data for March 15, 2005.

[2/] Source: Official Airline Guide (OAG) schedule for March 15, 2005.

[3/] Base on draf baseline forecast. The March 15, 2005 PMAD patterns are assumed unchanged in 2013. Also assumes that future airfield Schemes 1A, 1B, and 2 are operational by 2013.

Exhibit 3-18

**2013 PMAD Rolling Peaks[3/]**

### 3.5.3 Demand/Capacity Comparison

Exhibits 3-19 through 3-22 graphically illustrate the peak-hour airfield capacities compared to the PMAD peak-hour demand discussed above. As illustrated, each of the peak-hour capacities is shown on a vertical bar for each operating airfield configuration (east and west flows) and each weather condition (VFR and IFR). For comparison, the airfield capacities associated with GA aircraft operations are shown as a white-hatched pattern where applicable. The weighted peak-hour capacity, which forms the basis for determining the airfield's ASV, is shown and includes the capacities associated with the GA aircraft operations.

As Exhibit 3-19 shows, the VFR hourly capacities are slightly above the peak-hour demand of 49 operations, not including airfield capacities associated with GA aircraft operations. The PMAD future peak-hour demand of 55 operations is shown as a no-action alternative. During IFR conditions, however, the existing peak-hour demand exceeds the available peak hourly airfield capacities. This could create potential operational delays should the peak-hour demand occur in such weather conditions. The weighted peak-hour capacity for the existing airfield configuration at PBI is estimated at 64 operations.

Exhibit 3-20 shows that Scheme 1A provides ample VFR peak-hour capacity compared to the 2013 peak-hour demand, providing users' acceptance of a 6,500-foot runway length for landing operations. In IFR weather conditions, the potential operational delays are equivalent to the existing airfield operating conditions. The weighted peak-hour capacity for Scheme 1A is 82 operations. Exhibit 3-21 indicates the significant airfield capacity gain associated with the GA aircraft operations performed on the shortened Runway 13-31 proposed in Scheme 1B.

Thus, the weighted peak-hour capacity for Scheme 1B is increased to an estimated total of 100 operations.

Under Scheme 2, depicted in Exhibit 3-22, the peak-hour capacities associated with all four operating conditions exceeds the 2013 peak-hour demand of 55 operations, resulting in a weighted peak hourly capacity of 106 operations.

#### Annual Service Volume

The weighted peak-hour airfield capacity estimates for the Airport form the basis for establishing the ASV of the current and future airfield configurations. The ASV values are then compared to the existing and projected annual aircraft operational demand levels for the short-term planning period (2013). When annual demand exceeds the ASV of the airfield, delays would increase at an exponential rate. In order to minimize delays, however, the FAA recommends that planning for additional airfield capacity should commence when the airfield's annual demand levels exceed 60 percent of the ASV. Identifying the demand level in which this would occur requires that the annual demand estimates be quantified and expressed as a share (percent) of the ASV. Table 3-10 presents this comparison between the existing airfield conditions and the proposed future schemes. The table also shows the 2013 no-action alternative and summarizes the weighted peak-hour airfield capacity estimates for each airfield configuration.

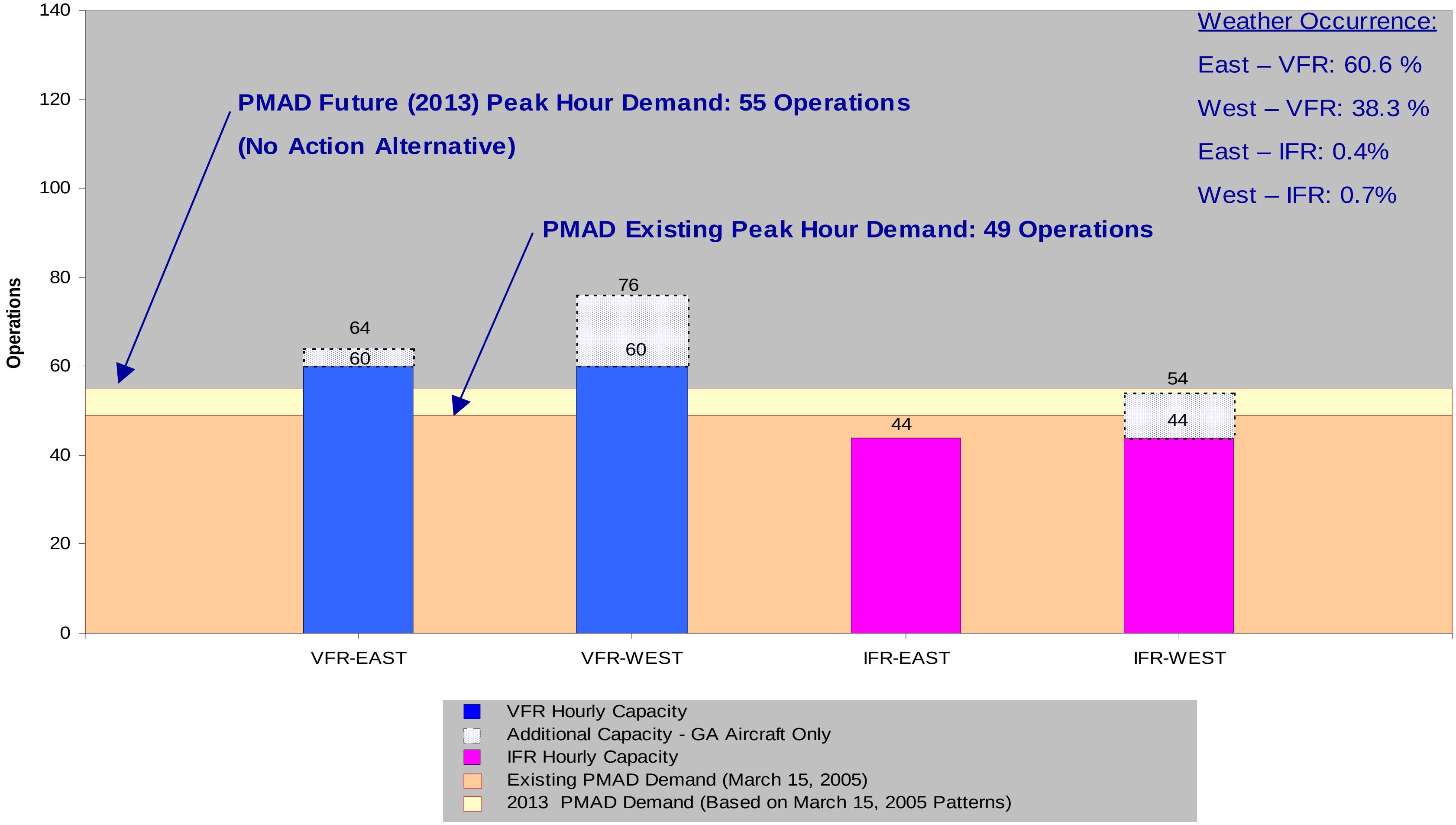



Exhibit 3-19

**Demand/Capacity Comparison: Existing Conditions**

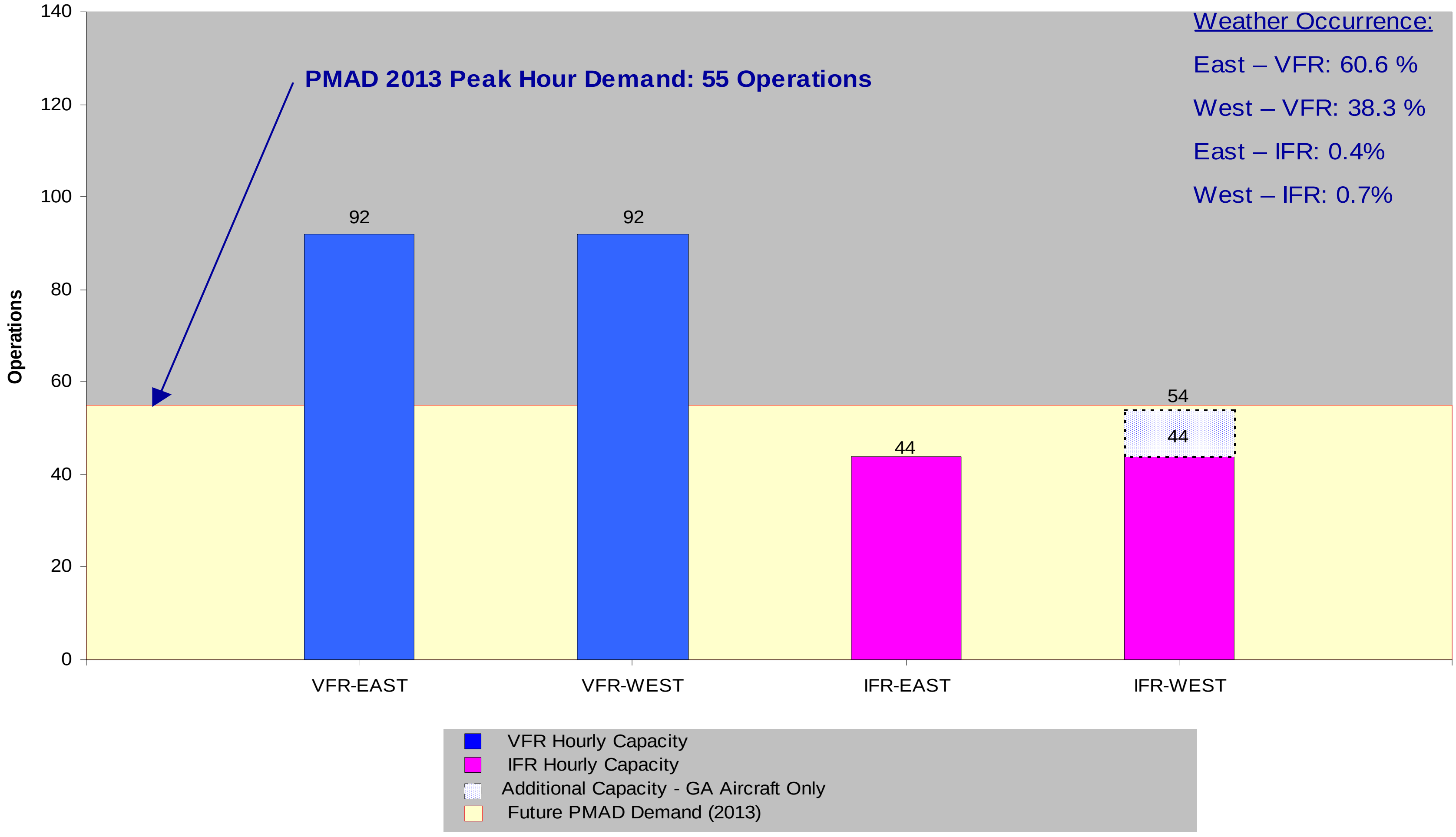



Exhibit 3-20

**Demand/Capacity Comparison: Scheme 1A**

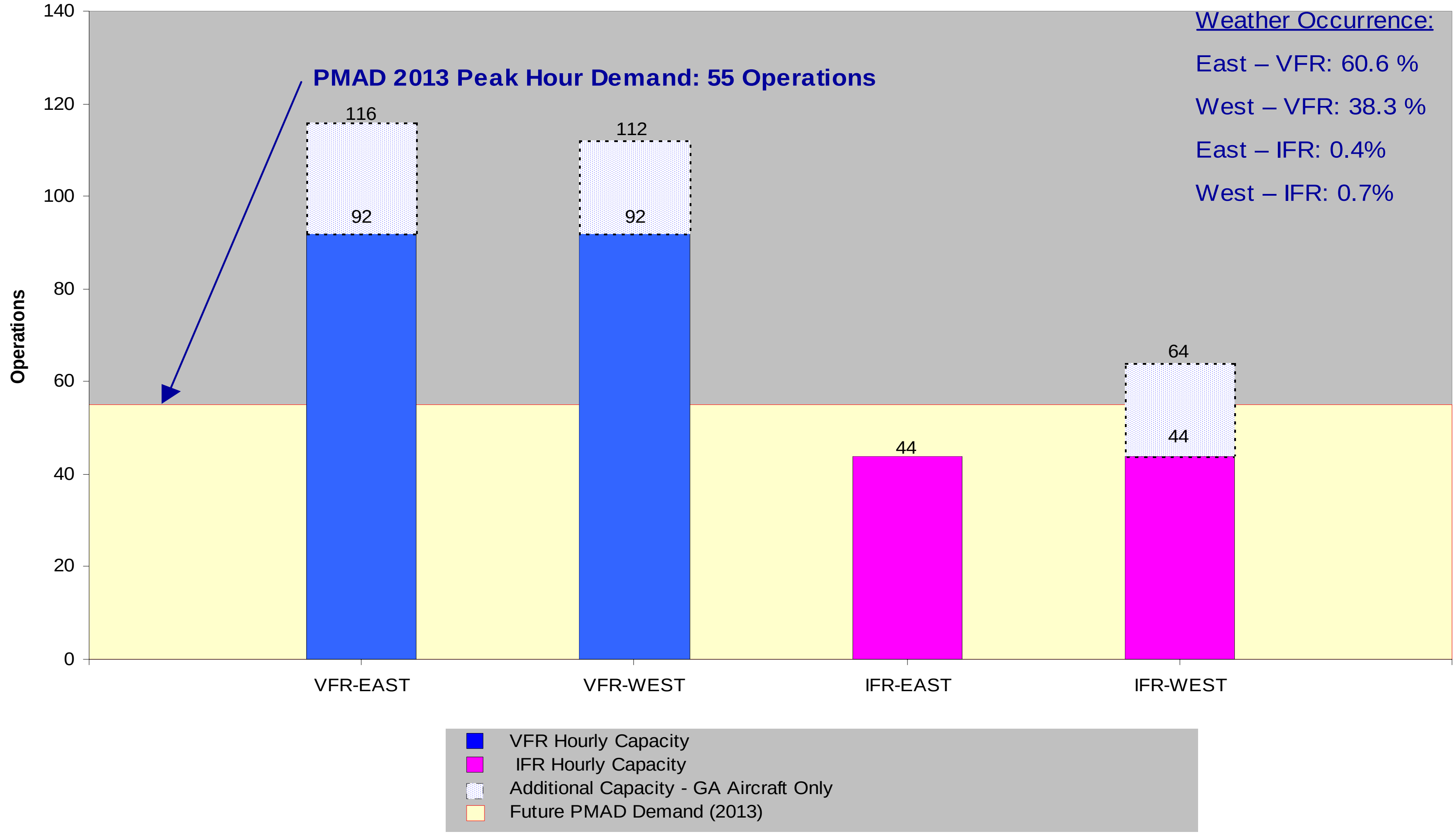



Exhibit 3-21

**Demand/Capacity Comparison: Scheme 1B**

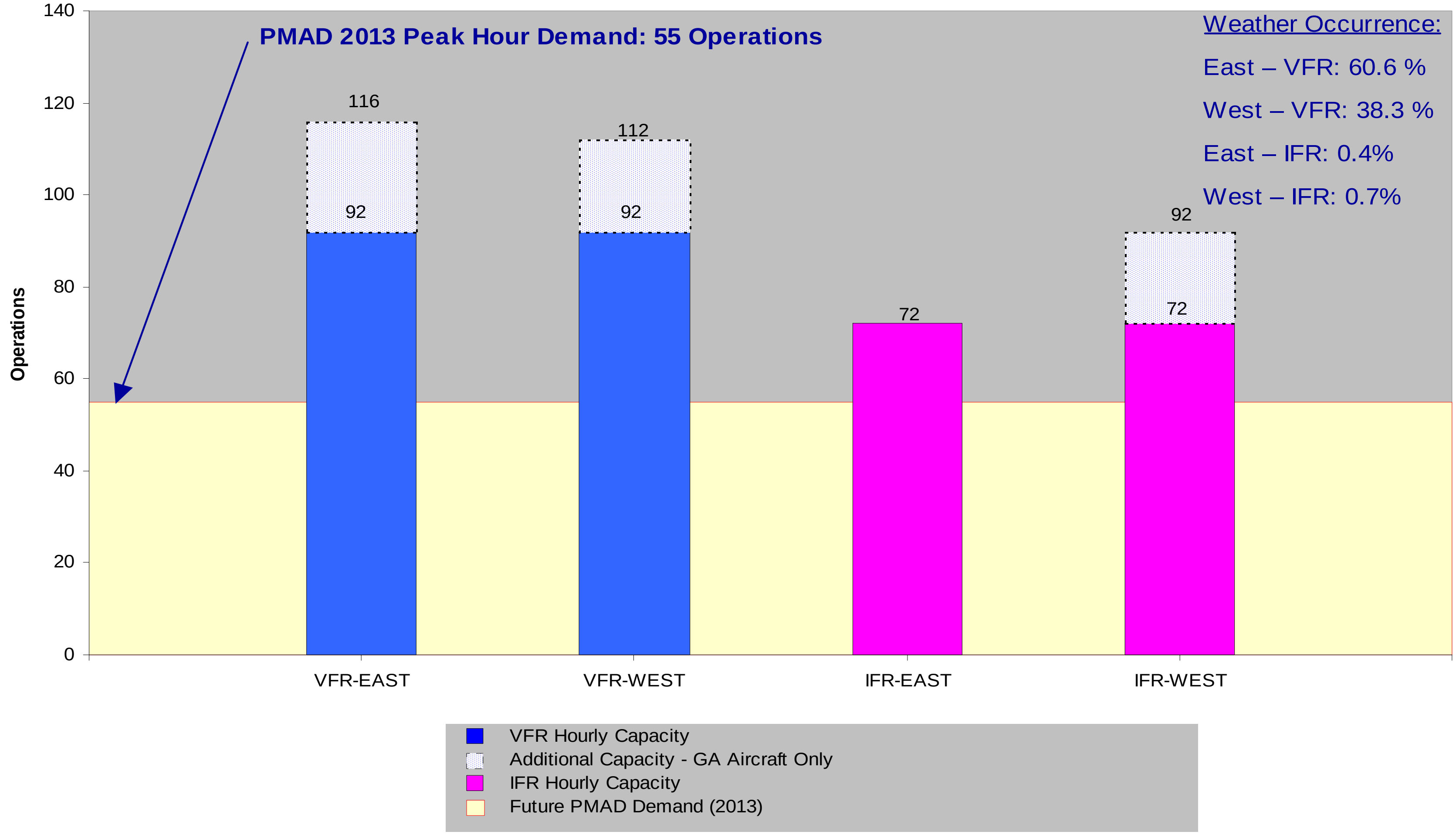



Exhibit 3-22

**Demand/Capacity Comparison: Scheme 2**

TABLE 3-10
Comparison of Annual Demand with Annual Service Volumes

| | | | 2001 ALP Concept Refined Schemes | | |
|---|---|---|---|---|---|
| | **Existing Conditions (2005 Est.)** | **2013 No Action Alternative** | **2013 Scheme 1A** | **2013 Scheme 1B** | **2013 Scheme 2** |
| Weighted Average Hourly Capacity | 64 | 64 | 82 | 100 | 106 |
| Hourly Capacity Percent Increase from Existing Conditions | - | - | 27.9% | 57.2% | 66.4% |
| Annual Operations (Demand)[1] | 201,964 | 221,814 | 221,814 | 221,814 | 221,814 |
| Annual Service Volume (ASV) | 263,444 | 263,444 | 329,588 | 405,311 | 428,854 |
| ASV Percent Increase from Existing Conditions | - | - | 25.1% | 53.9% | 62.8% |
| **Annual Demand (Percent of ASV)[2]** | **76.7%** | **84.2%** | **67.3%** | **54.7%** | **51.7%** |

Sources: FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*; Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

[1] Annual operations for 2005 and 2013 were derived from the baseline forecast prepared for PBI as part of the Airport System Study.

[2] The FAA-recommended threshold for commencing the planning for additional runway capacity is when annual demand reaches 60 percent of the airfield ASV.

As shown, the ASV at PBI in 2005 was estimated at 263,444 annual operations, and the estimated 2005 annual demand is anticipated to reach 201,964 annual operations. As a result, the 2005 annual demand represents 76.7 percent of the ASV. This percentage indicates that the planning of additional facilities should be under way. Should the airfield remain as is in 2013, the estimated annual demand would be even greater, representing 84.2 percent of the ASV. Scheme 1A also shows a share of annual demand greater than the 60 percent, while Scheme 1B annual demand is 54.7 percent of the ASV. Under Scheme 2, the 2013 estimated annual demand represents 51.7 percent of the ASV.

For comparison purposes, Exhibits 3-23 and 3-24 depict the airports and metro areas identified by the FAA 2004 OEP that will need additional capacity in 2013 and 2020. As shown, PBI is among the airports needing capacity provided no airfield improvements are under way.

## Sensitivity Analysis

As previously shown, the refinement alternative schemes for the 2001 ALP concept provide the Airport with significant airfield capacity gains. As a sensitivity analysis, the ASV for the Airport was calculated assuming the Scheme 2 airfield configuration and the baseline forecast projections for aircraft operations in the 2020 and 2025 time frames. Scheme 2 was selected for the sensitivity analysis because it provided the highest ASV for PBI in 2013. Table 3-11 presents the summarized results of this sensitivity analysis and shows the airfield ASV for the two time frames should no improvements occur at the Airport.

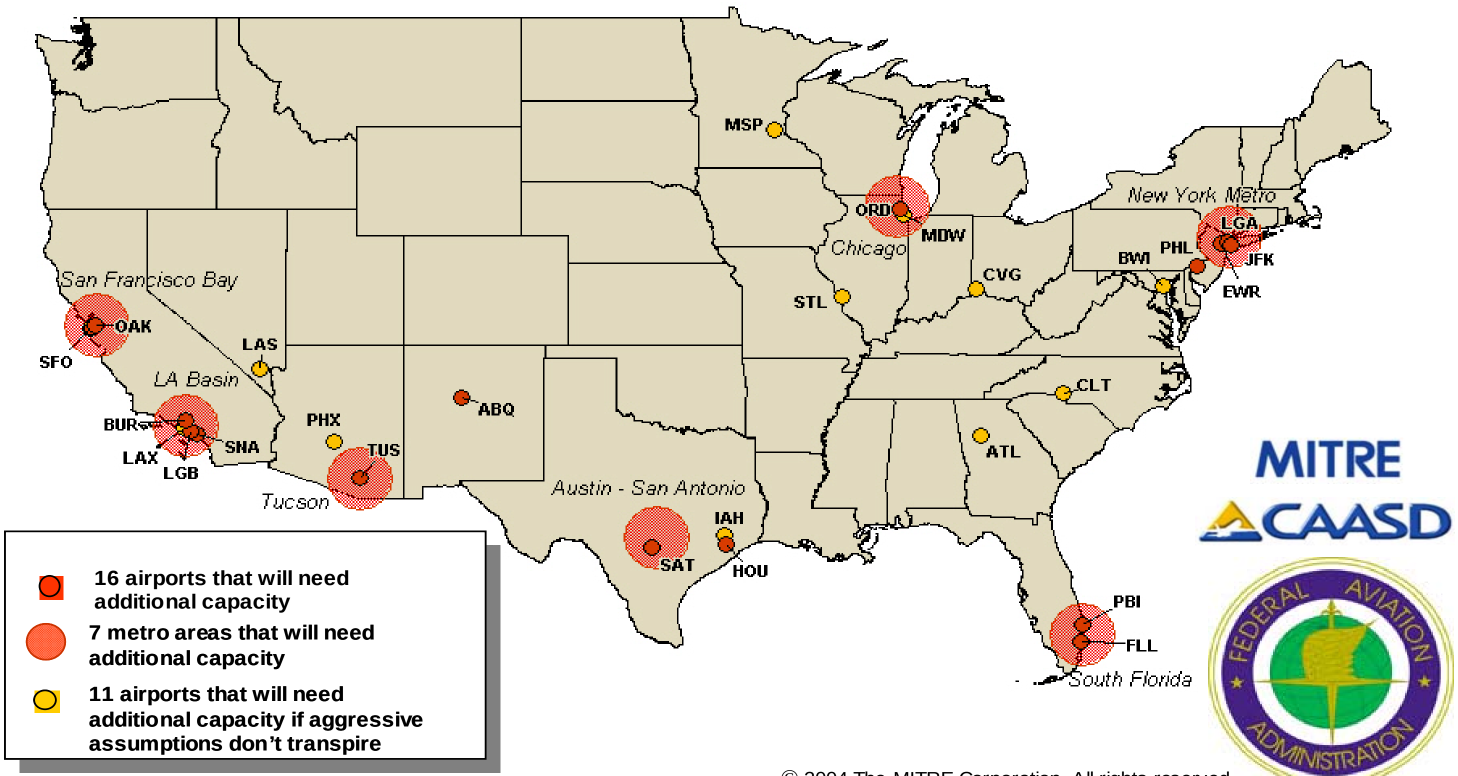



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Exhibit 3-23

**FAA 2004 Operational Evolution Plan (OEP): Airports Needing Additional Capacity in 2013 (Without Improvements)**

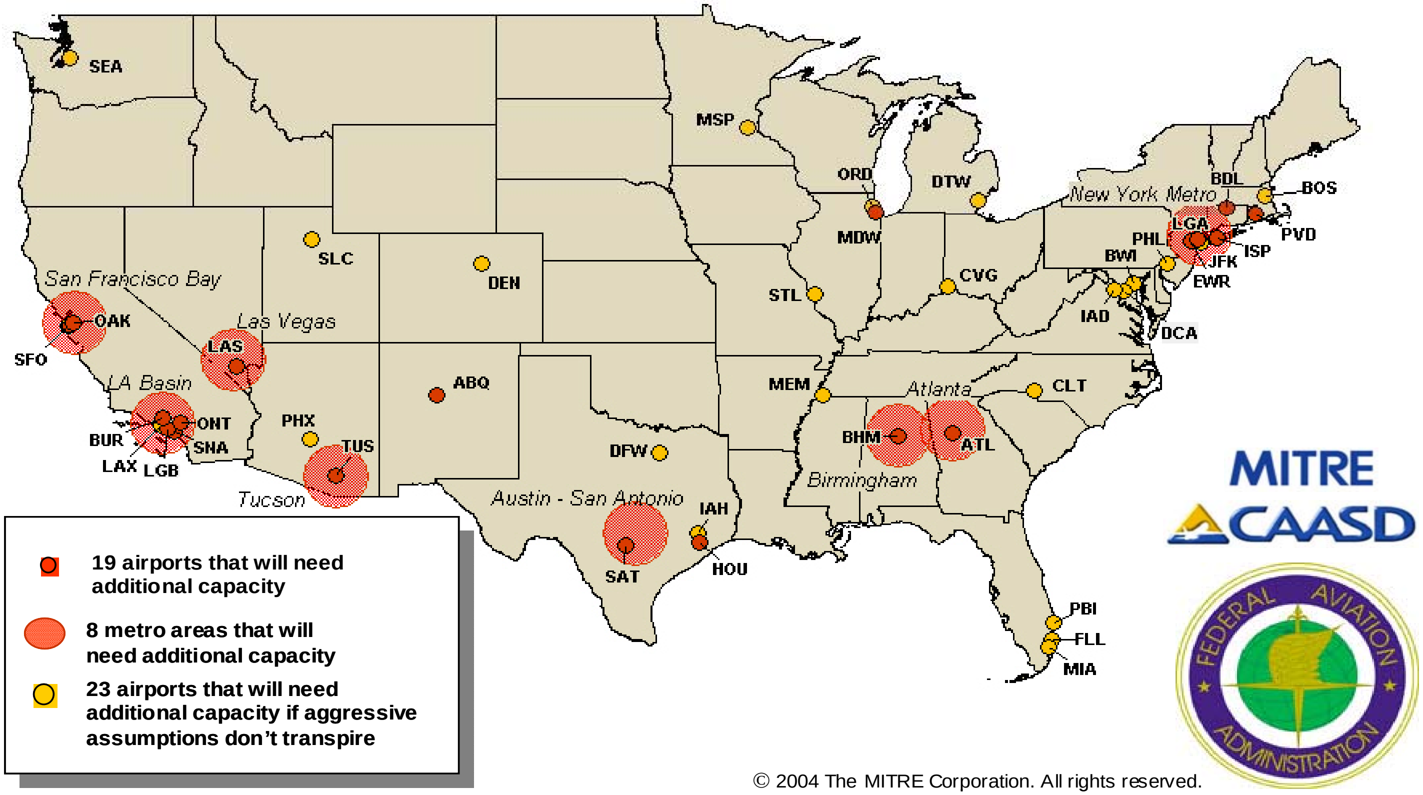


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Exhibit 3-24

**FAA 2004 Operational Evolution Plan (OEP): Airports Needing Additional Capacity in 2020 (Without Improvements)**

TABLE 3-11
Sensitivity Analysis: 2020 and 2025 ASVs with Scheme 2

| | | 2013 | | 2020[1] | | 2025[1] | |
|---|---|---|---|---|---|---|---|
| | **Existing Conditions (2005 Est.)** | **No Action Alternative** | **Scheme 2** | **No Action Alternative** | **Scheme 2** | **No Action Alternative** | **Scheme 2** |
| Weighted Average Hourly Capacity | 64 | 64 | 106 | 64 | 106 | 64 | 106 |
| Annual Operations (Demand) | 201,964 | 221,814 | 221,814 | 245,954 | 245,954 | 267,644 | 267,644 |
| Annual Service Volume (ASV) | 263,444 | 263,444 | 428,854 | 221,039 | 367,742 | 221,039 | 367,742 |
| **Annual Demand (Percent of ASV)** [2] | **76.7%** | **84.2%** | **51.7%** | **111.3%** | **66.9%** | **121.1%** | **72.8%** |

Sources: FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*; Ricondo & Associates, Inc.
Prepared by: Ricondo & Associates, Inc.

[1] Annual operations for 2020 and 2025 were derived from the baseline forecast prepared for PBI as part of the Airport System Study.

[2] The FAA recommended threshold for commencing the planning for additional runway capacity is when annual demand reaches 60 percent of the airfield ASV.

As shown, should the existing airfield at PBI remain as is in 2020 and 2025, the annual demand would far exceed the ASV of the airfield, representing 111.3 percent and 121.1 percent of the ASV, respectively. The Scheme 2 configuration, however, demonstrates that it could provide airfield capacity through the 2025 time frame. Per the FAA recommended threshold, additional facilities planning should commence in the early 2020.

## 3.6 Recommendations

The ASV calculations clearly demonstrate that Scheme 2 provides the greatest airfield capacity benefits. Compared to the other two schemes, Scheme 2 has the advantage of Runway 9R-27L being a true air carrier runway with a total length of 8,000 feet. In addition, Scheme 2 provides sufficient airfield capacity through the 2025 time frame. Therefore, Scheme 2 is the recommended airfield configuration.