4 Demand / Capacity Facility Requirements

4.1 Identify Assumptions, Planning and Design Standards

This chapter presents the future facility requirements meeting the high-growth forecast demand developed during the 20-year (2017 to 2037) planning period at Austin-Bergstrom International Airport, while providing airport users with the highest-possible quality of service. In addition to providing for growth in demand, the facilities must also accommodate the passengers and aircraft types forecasted to operate at ABIA. Factors such as aircraft size, demand type, and peak passenger and aircraft volumes are key drivers of facility needs. ABIA airfield requirements were determined based on industry standards accepted by the Federal Aviation Administration and local conditions. Terminal requirements were calculated using the Airport Cooperative Research Board – *Airport Passenger Terminal Planning and Design Volume 2: Spreadsheet Models*.

The facility requirements analysis is a foundation for defining development alternatives in the master planning process. The requirements identified in this chapter of the Master Plan are evaluated in subsequent chapters to determine reasonable and prudent alternatives to meet future needs. The results of the Demand/Capacity and Facility Requirements are presented in the following sections.

- Planning Levels
- Airfield and Airspace Requirements
- Terminal Facility Requirements
- Landside Development Needs
- Airport and Airline Support Facility Needs
- Regional Traffic and Roadway Development Needs
- New Technology Impacts on Landside Facility Requirements
- Strom Water and Drainage Needs
- Site Utilities Requirements

4.2 Planning Levels

Timing estimates of certain threshold events are the basis of planning decisions, and should correspond to level of aviation demand, referred to as “Planning Activity Levels (PALs).” The projected need for facility improvements is based on these PALs, rather than specific time periods. This Master Plan addresses four future PALs, which correspond to the planning years 2019, 2022, 2027, and 2037. Future planning levels have been identified for million annual passengers (MAP), annual tons of enplaned cargo (metric tons), and annual aircraft operations for both the High Growth Forecast and Baseline Growth Forecast as shown in **Table 4.2-1** and **Table 4.2-2**, respectively.

The facility requirements for the passenger terminal and some other airport facilities are based on PALs. Facility requirements for cargo facilities are based on annual enplaned tons of cargo, and the requirements for airfield (runways) facilities are tied to aircraft operations.

Table 4.2-1: Future Planning Levels - High Growth Forecast

ITEM	ACTUAL (2017)	PAL 1 (2019)	PAL 2 (2022)	PAL 3 (2027)	PAL 4 (2037)	AVG. ANNUAL GROWTH RATE [%]
Annual Passengers, MAP	14.0	16.0	18.0	22.0	31.0	4.5
Annual Enplaned Cargo, tons	88,000	100,700	113,000	513,500	1,549,000	15.2
Annual Aircraft Operations	199,600	214,700	230,600	287,200	426,600	3.9

Source: Aviation Forecast, High Growth scenario

Table 4.2-2: Future Planning Levels - Baseline Growth Forecast

ITEM	ACTUAL (2017)	PAL 1 (2019)	PAL 2 (2022)	PAL 3 (2027)	PAL 4 (2037)	AVG. ANNUAL GROWTH RATE [%]
Annual Passengers, MAP	14.0	16.0	17.0	20.0	27.0	3.8
Annual Enplaned Cargo, tons	88,000	100,700	113,000	129,800	161,000	3.4
Annual Aircraft Operations	199,600	213,300	225,400	247,800	296,500	2.1

Source: Aviation Forecast, Baseline Growth scenario

Planning assumptions and factors were used to define the basis for computing the demand/capacity relationships used to derive facility requirements from the derivative demand forecasts in Chapter 3, *Aviation Activity Forecast*. These factors are unique to the facility type being assessed and must reflect the airport's development objectives in consideration of internal and external stakeholder feedback.

Some factors are simple processing rate multipliers of activity, such as forecast peak hour flows of passengers or baggage. Other considerations are more complex and involve tradeoffs between airport land use, airport impacts, and operational capacity necessitating use of modelling techniques. The assumptions, planning and design standards used in determining the future requirements for each facility is provided in the various subsections throughout this chapter.

4.3 Airfield / Airside Development Needs

The airfield demand/capacity analysis examines the ability of ABIA's airfield system to accommodate existing activity levels, as well as determine the ability to meet projected demand levels. The primary objective is to meet existing and future demand levels without incurring excessive aircraft delay, resulting from an airfield-related deficiency. The demand/capacity analysis was conducted using both existing and forecasted aviation demand and compared to the capacity of the current airfield layout and operational procedures.

Many factors influence an airfield's ability to meet existing demand and projected demand over the course of a 20-year planning horizon, including predictions of annual operations by a specific fleet mix that was developed, vetted, and approved by the FAA. Various factors that impact capacity and the efficient airfield operation at ABIA include:

- Runway configuration
- Future fleet mix
- Percentage of arrivals
- Hourly percent of Visual Flight Rules (VFR)
- Hourly percent of Instrument Flight Rules (IFR)
- Environmental

These factors have been used for the airspace/airfield capacity calculations and are briefly described in their respective sections.

4.3.1 Airspace/Airport Capacity

As part of the ABIA 2040 Master Plan Study, a simulation modeling analysis was performed to evaluate the capacity of the existing airfield and airspace system against future aircraft operations demand. AirTOp, a state-of-the-art simulation software, was used to develop simulation models for this analysis. AirTOp is a simulation tool that is capable of conducting large scale, detailed, fast-time simulations of entire air traffic systems. AirTOp simulates aircraft movement in detail: a full individual airfield (including runways, taxiways and apron areas) and its associated terminal airspace; a regional system of airports and the associated airspace; or, a regional volume of airspace. It produces detailed statistics on each aircraft operation simulated. Outputs include, but are not limited to, the following:

- Aircraft enroute travel times
- Airport movements
- Operations on taxiways and runways
- Runway occupancy

- Airspace operation metrics such as:
    - usage of routes
    - sectors
    - fixes and coordination
    - throughput capacity per unit of time
    - delays by time of day and location on the airfield or in airspace, along with the reason for each delay
    - fuel consumption
    - potential conflicts

Simulation modeling assignments begin with model calibration and/or visual validation. Calibrated/validated simulation models are intended to generate a reasonable representation of design day operations. It should be noted that airspace/airfield simulation modeling does not produce an exact replica of all aspects of the real-world operating environment. To be effective, however, the model must reflect the logic applied by pilots and air traffic controllers to the greatest extent possible and produce representative performance metrics associated with the operating conditions at the airport.

This analysis used Landrum & Brown's spreadsheet-based Runway Queue Models (RQM) and FAA approved forecasts (Chapter 3, *Aviation Activity Forecast*) of aviation demand at ABIA. Queue models are an effective tool that can assist with planning and decision-making regarding existing runway rehabilitation and future runway development. These queue models were used to obtain a high-level estimate of the progression or evolution of average delays per operation in response to forecast growth in the aviation activity. A 10-minute threshold of acceptable delay, as recommended by the FAA, was used in this analysis.[1] When compared with the queue model outputs, these thresholds helped identify ideal times to schedule rehabilitation works on the existing runways, while minimizing disruptions to operations and potential trigger points for the development of an additional runway.

The following sections provide:

- An overview of the existing airport operating assumptions used in the simulation models
- The AirTOp model validation process and results
- Airfield capacity and delay projections based on the queue modeling analysis

[1] FAA Airport Benefit-Cost Analysis Guidance, December 15, 1999.

4.3.1.1 Airport Operating Assumptions

The capacity analysis at ABIA began with an understanding of design day airport operations. Assumptions about runway use, airspace, ground flows, and gate usage were required to develop and calibrate the simulation models used to determine the Airport's capacity. When confirmed that the simulation model reflected the design day operating conditions, the model was adjusted using various control parameters and demand levels to evaluate changes in operations.

The Airport's operating assumptions used to develop and calibrate the AirTOp model are as follows:

- Design day flight schedule
- Runway operating configurations
- Airspace structure
- Aircraft separations
- Taxiway flow patterns
- Airline gate allocation
- Aircraft speed assumptions

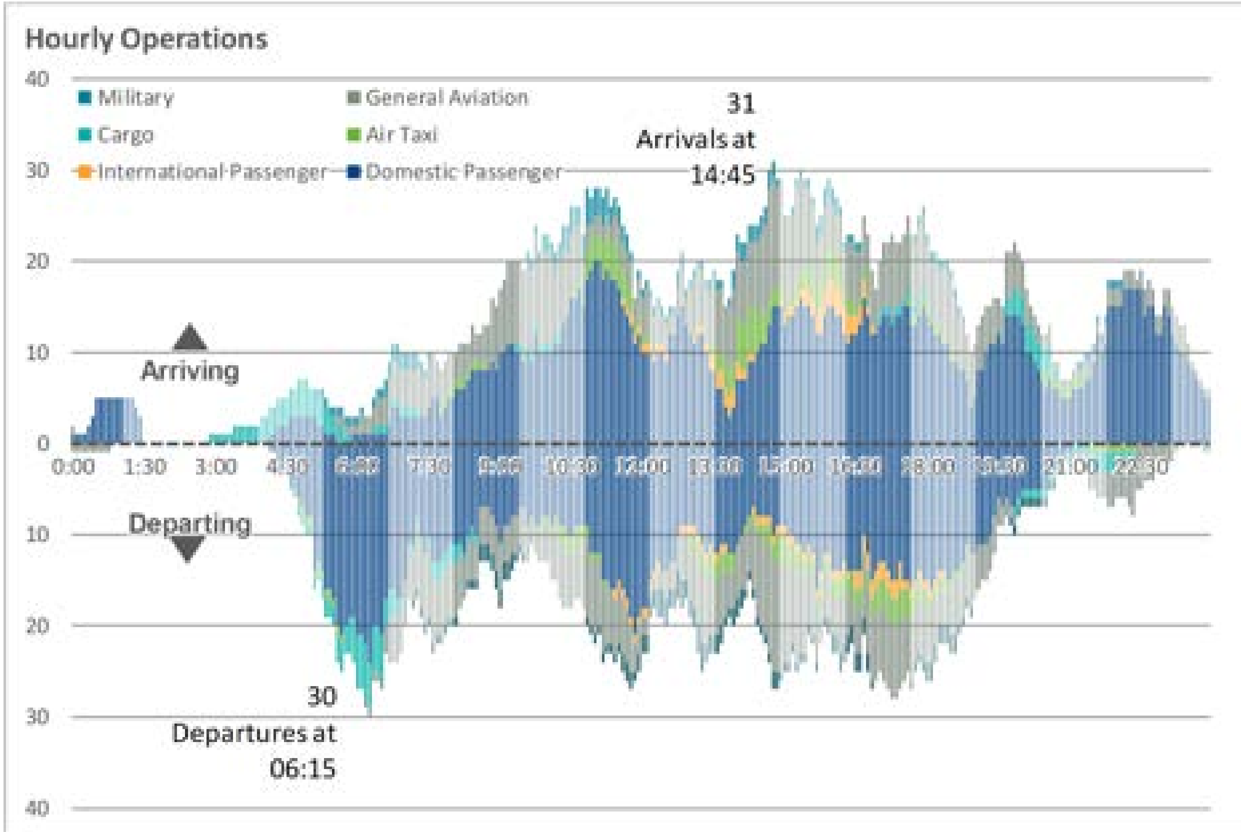
4.3.1.2 Design Day Flight Schedule

Construction of a new nine-gate East Terminal Expansion of the Barbara Jordan Terminal will be completed in March 2019; this condition was considered the basis for modeling the design day flight schedule. The expansion will increase the number of passenger gates, increase the number of remain overnight (RON) positions (also known as remote parking positions), and improve the ingress and egress of aircraft on the passenger terminal apron. As a consequence of the construction, current aircraft operations on and around the passenger terminal apron are not representative of standard operations in this area. Therefore, existing conditions at ABIA were not simulated. Instead, the models assumed all construction work related to the East Terminal Expansion is complete. A 2019 design day flight schedule was developed for use in this study. The following sections include the assumptions that were used in this study. These assumptions were reviewed and approved by ABIA Operations and FAA-ATCT staff.

The 2019 design day flight schedule used in the modeling analysis was generated from the recently approved ABIA aviation activity forecast. **Exhibit 4.3-1** presents the rolling hourly aircraft operations of the 2019 demand profile modeled in this study.

The 2019 design day consists of 329 arrivals and 324 departures (commercial, GA/FBO, military and cargo operations). At ABIA, the busiest departure peaks occur in the morning, from 06:15 to 07:15 hours. Up to 30 departures are scheduled during the morning departure peak. The arrival and overall peak for the airport occurs in the afternoon, from 15:15 pm to 16:15 hours with 31 arrivals and 26 departures.

Exhibit 4.3-1: ABIA 2019 Design Day Flight Schedule Rolling Hourly Profile



Source: ABIA Aviation Forecast 2019 Design Day Flight Schedule

4.3.1.3 Runway Operating Configurations

The FAA-ATCT operates the ABIA runway system in two primary combinations of arrival and departure configurations. The two runway operating configurations at ABIA are as follows:

South Flow: Arrivals and departures use Runways 17L and 17R. Both runways are operated in a mixed mode (arrivals and departures).

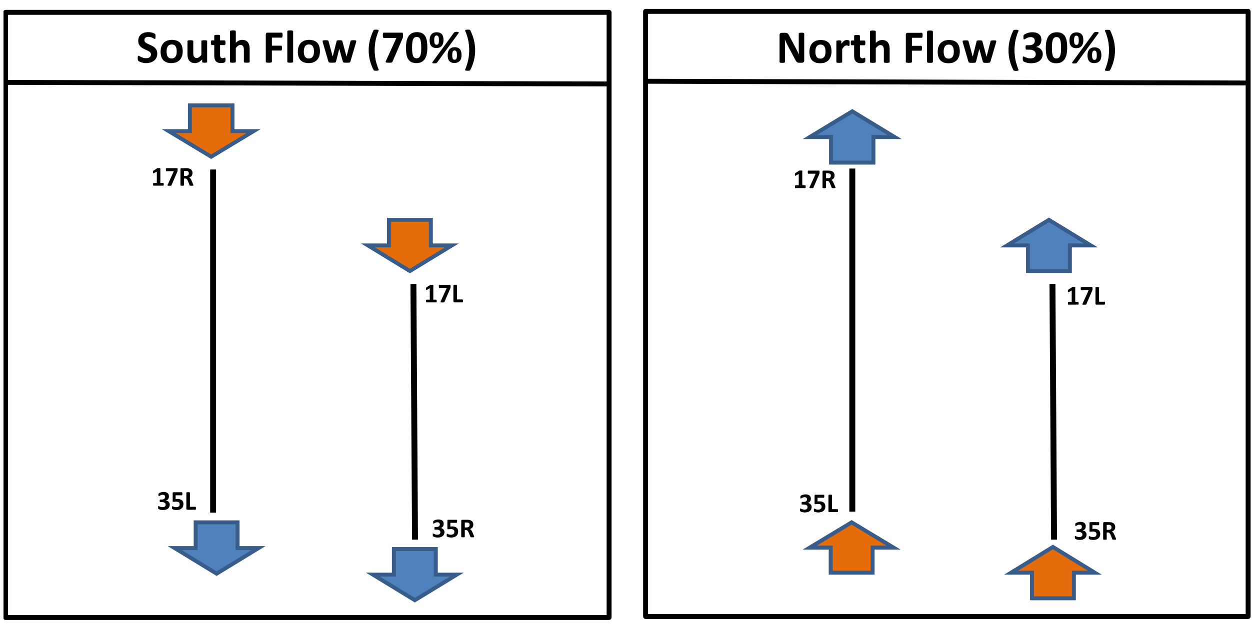
- Runway 17R will typically handle all narrow-body arrivals coming in from the west arrival fixes and all wide-body arrivals. Runway 17R will also handle all narrow-body departures to the west departure fixes and all wide-body departures.
- Runway 17L will handle all narrow-body arrivals coming in from the east arrival fixes and all narrow-body departures to the east departure fixes. Runway 17L will also typically handle most of the operations to and from the General Aviation (GA) apron because of the proximity to that runway.

North Flow: Arrivals and departures use Runways 35L and 35R. Both runways are operated in a mixed mode.

- Runway 35L will typically handle all narrow-body arrivals coming in from the west fixes and all wide-body arrivals. Runway 35L will also handle all narrow-body departures to the west fixes and all wide-body departures.
- Runway 35R will handle all narrow-body arrivals coming in from the east fixes and all narrow-body departures to the east departure fixes. Runway 35R will also typically handle majority of the operations to and from the GA apron because of the proximity to that runway.

The basic runway use in South and North Flows is shown in **Exhibit 4.3-2**. Based on detailed analysis of FAA's Avionics System Performance Metrics (ASPM) data for the past six years (2012 - 2017), it was determined that ABIA operates in the South flow approximately 70 percent of the time and North Flow about 30 percent of the time. Similarly, based on 2012 – 2017 ASPM data analysis, it was determined that Visual Meteorological Conditions occur approximately 70 percent of the year, while Instrument Meteorological Conditions are prevalent 30 percent of the time. During the summer months (June – September) for the same years, the VMC/IMC split was 80 percent and 20 percent respectively.

Exhibit 4.3-2: ABIA Runway Operating Configurations



Source: FAA Avionics System Performance Metrics data (2012-2017).

4.3.1.4 Airspace Structure

The airports, airways, arrival and departure procedures, navigation aids NAVAIDS, equipment, and thousands of other component parts of the aviation system make up the National Airspace System (NAS) of the United States. It is one of the most complex aviation systems in the world and enables safe and expeditious air travel in the U.S. and over large parts of the world's oceans.

In order to handle the increased traffic volumes, the FAA developed a system structure that generally separates traffic flows. This structure allows traffic to transition to and from the high altitude enroute airspace to the airports in and around Austin with low risk of crossing or conflicting with other traffic flows. The standard arrival and departure routes are published by the FAA as Standard Terminal Arrival Routes (STARs) and Standard Instrument Departures (SIDs). Aircraft arriving at ABIA transition from the enroute environment on a published STAR procedure, while departing aircraft transition from the runways to the enroute environment on a published SID procedure. STARs and SIDs may be categorized as “conventional” or “RNAV” (Area Navigation) procedures:

- Conventional procedures are designed for aircraft that are not RNAV capable using headings and references to ground-based navigational aids; usually low- or high-altitude VORs. A VOR is a “Very High Frequency Omni-directional Range” transmitter that is located on a known position on the ground. VORs transmit a signal of 360 “radials” that correspond to the magnetic compass rose. Aircraft with VOR receivers can tell which radial they are using to or from the VOR. If an aircraft determines its position from the intersection of two or more radials from different VORs, its position can be precisely determined. These intersections are often referred to as a “fix.”

- RNAV systems are self-contained navigation systems that reside on the aircraft and may be calibrated based on known position reference provided from a number of different sources, such as Automated Global Positioning System (A-GPS) update, manual crew update at a known position, or Distance Measuring Equipment (DME) cross-reference. Once the RNAV system is calibrated to a known position, it can be used to navigate without constant reference to ground-based NAVAIDS.

- Required Navigational Performance (RNP) systems provide improvements on the operation integrity. This may permit closer route spacing and provide sufficient integrity to allow only RNAV systems for navigation in a specific airspace. RNP systems may therefore offer significant safety, operational and efficiency benefits. Modern aircraft are better equipped and using RNP arrivals and transition to a visual approach. RNP arrivals may slightly increase capacity by improving sequencing prior to descent.

These STARs and SIDs were used to define the airspace structure in the simulation model. To create the AirTOp simulation model’s airspace structure, existing radar data provided by the ABIA Air Traffic Control Tower (ATCT) was analyzed and used to determine origin and destination city pair airspace fix assignments for input into the simulation flight schedule. The airspace simulated is an approximately 80 nautical mile (NM) radius circle around ABIA.

4.3.1.4.1 Arrival Airspace Structure

The existing terminal airspace consists of four arrival STARs. The STARs feed the terminal airspace from the, northeast, northwest, southeast and southwest corners of the airspace. **Table 4.3-1** provides a summary of the existing STARs procedures that are located at the entry corners of the terminal airspace. The table also provides a summary of the sample arrival regions that were programmed into the simulation model. **Exhibits 4.3-3** and **4.3-4** depict the arrival route structure for the South and North Flows, respectively.

Table 4.3-1: Existing Arrival Terminal Airspace STARs

ARRIVAL PROCEDURES (STARS)		
PROCEDURE	DIRECTION	SAMPLE ARRIVAL REGIONS
SEWZY FOUR (RNAV)	Northeast	Europe, Northeastern and Midwestern States
LAIKS TWO (RNAV)	Northwest	West Coast, Mountain West
WLEEE FOUR (RNAV)	Southeast	Southeastern States and Houston

Exhibit 4.3-3: South Flow Arrival Route Structure

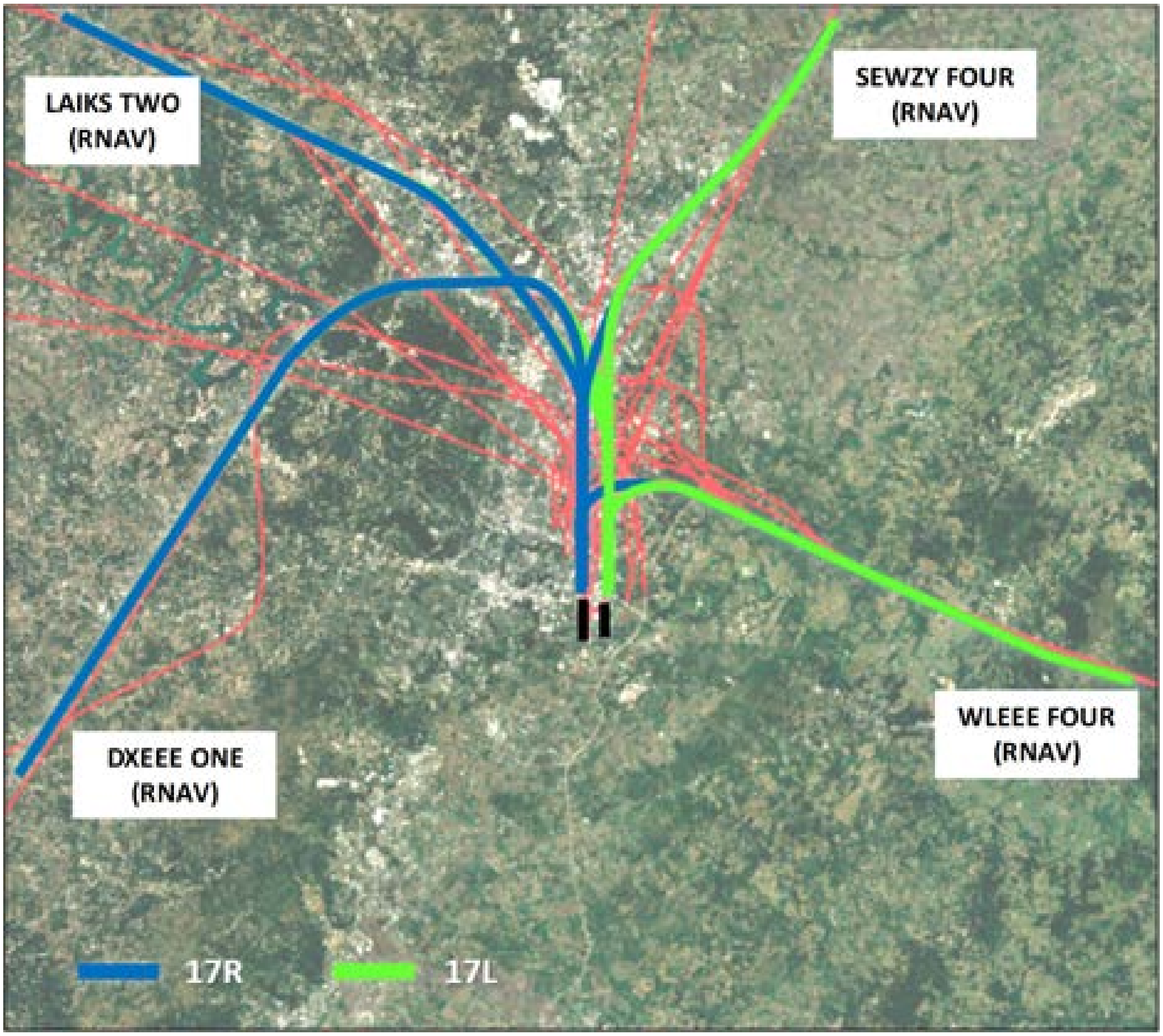
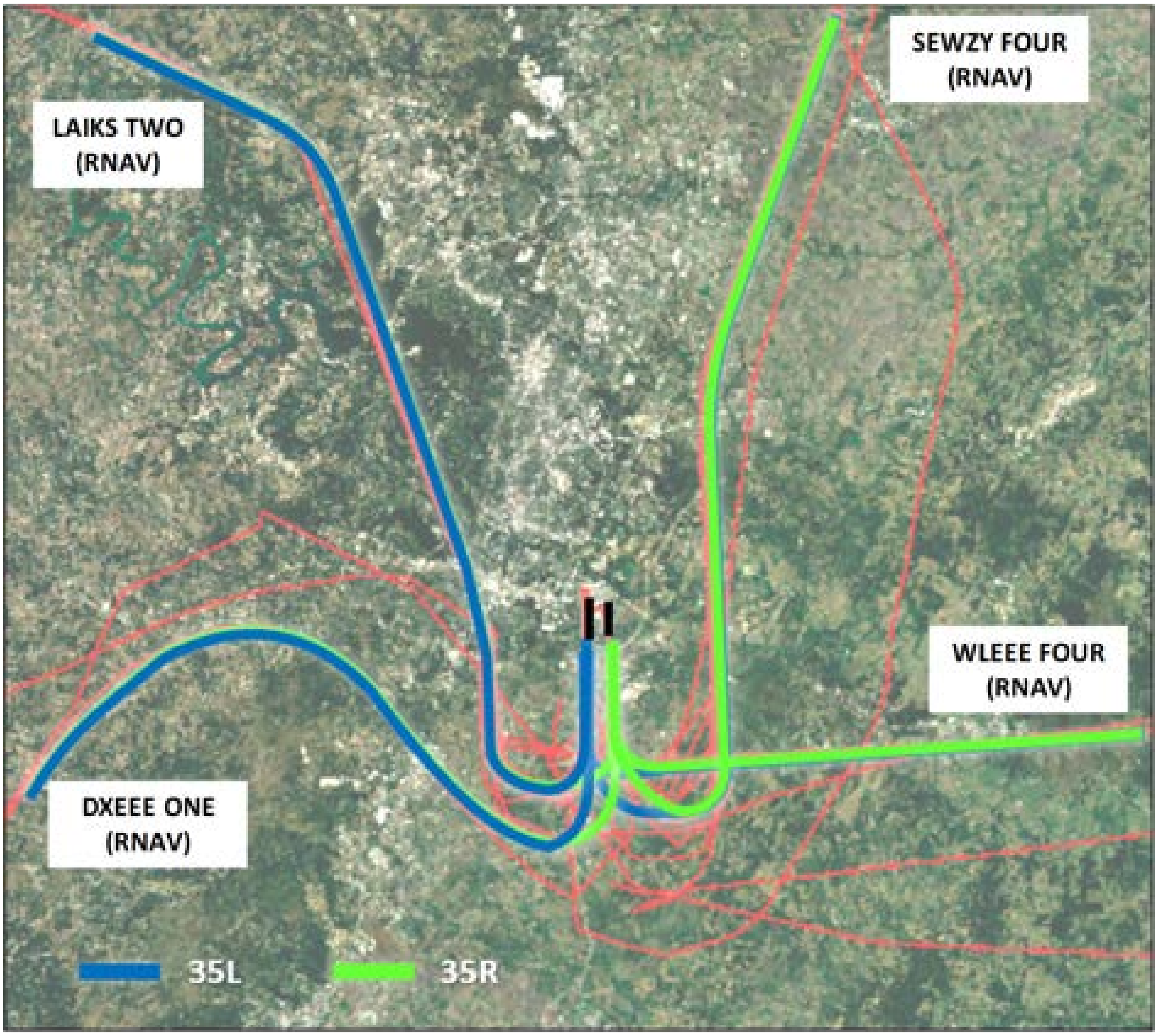


Exhibit 4.3-4: North Flow Arrival Route Structure



4.3.1.4.2 Departure Airspace Structure

The standard departure SID procedures at ABIA were modelled. The existing departure airspace consists of the standard departure SID procedures which cover the north, northeast, east, southwest, and west departure gates of the terminal airspace. **Table 4.3-2** provides a summary of the existing departure gates and SIDs and sample destination airports for each of the fixes. Propeller and piston aircraft were assigned to existing vectored departure routes. **Exhibits 4.3-5** and **4.3-6** depict the departure route structure for the South and North Flows, respectively.

Table 4.3-2: Existing Departure Terminal Airspace SIDs

DEPARTURE PROCEDURES (SIDS)			
PROCEDURE	DEPARTURE FIX	DIRECTION	SAMPLE DEPARTURE AIRPORTS
CENTEX SIX (RNAV)	MUNCH	North / Northeast	DAL
ILEXY TWO (RNAV)	ILEXY	East / Northeast	ATL, MIA, IAH, HOU, JFK, EWR
AUSTIN FIVE	BETTI	Southwest	SAT, MEX
MUCKY TWO (RNAV)	MUCKY	West	LAX, SFO, SAN, LAS
AUSTIN FIVE	JASMO	Northwest	DEN, SEA, YVR, DFW, ORD
ELOEL TWO (RNAV)	ELOEL	North / Northwest	DEN, SEA, YVR, DFW, ORD

Exhibit 4.3-5: South Flow Departure Route Structure

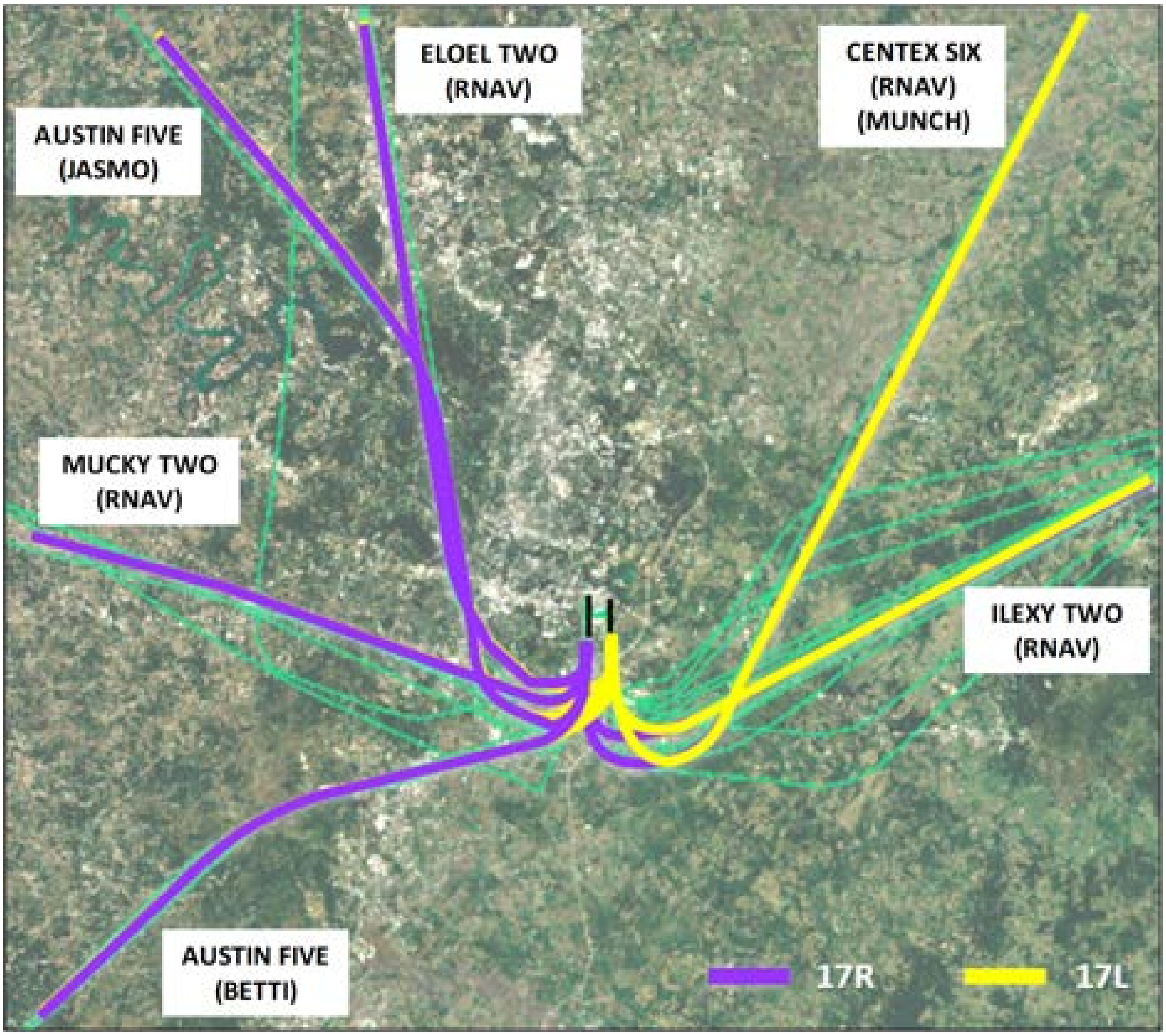
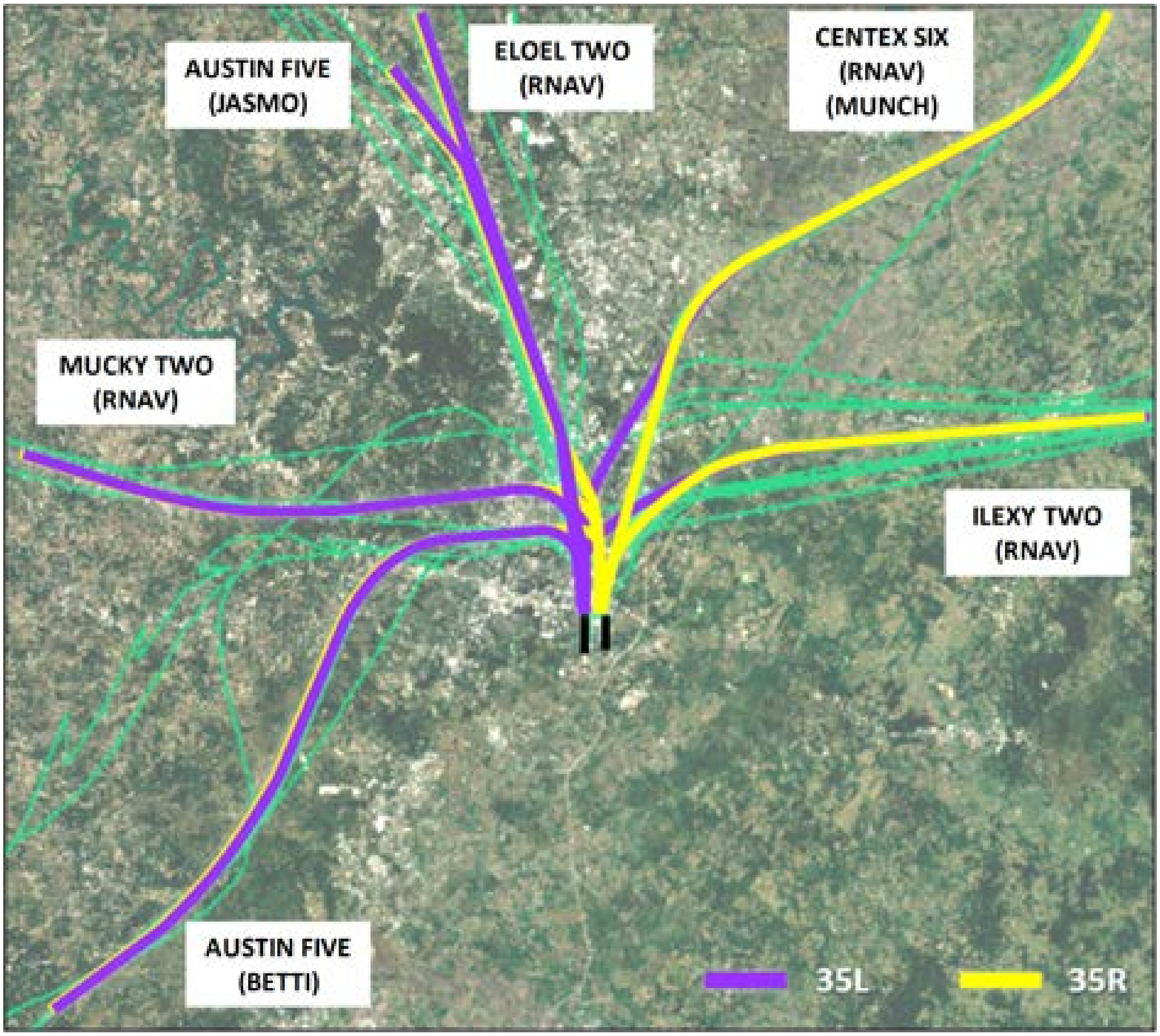


Exhibit 4.3-6: North Flow Departure Route Structure



4.3.1.5 Aircraft Separations

One of the goals of the simulation model is to reflect the aircraft-to-aircraft separation observed in the actual data, since this separation has a large effect on the operating capacity of the Airport. The aircraft separation data, which is measured as the distance between consecutive aircraft operations, may be presented in terms of distance (nautical miles), or time (seconds).

Flight tracks data (TARGETS) obtained from the FAA-ATCT was analyzed to evaluate current aircraft wake turbulence separations at ABIA. This separations analysis assumes aircraft wake re-categorization (RECAT) proposed by the FAA was fully implemented at ABIA. These statistics were compared to the FAA standard aircraft approach minimum separations presented in **Table 4.3-3**.

Table 4.3-3: Aircraft Approach Minimum Separations – FAA ATC Regulation

FAA RECAT MINIMUM SEPARATIONS [NM]							
		FOLLOWING					
		A	B	C	D	E	F
Leading	A	3	5	6	7	7	8
	B	3	3	4	5	5	7
	C	3	3	3	3.5	3.5	6
	D	3	3	3	3	3	5
	E	3	3	3	3	3	4
	F	3	3	3	3	3	3

Notes: Shaded cells indicate minimum radar separation (MRS) which can be 2.5nm or 3.0nm, depending on equipment. Minimum separation was assumed to be 3.0 nm for this study. Typical aircraft in each category: A: Airbus A380; B: Airbus A330, Boeing B777; C: Boeing B767; D: Boeing B757, Airbus A320, Boeing B737; E: Regional Jets; F: Small / General Aviation Aircraft.

Source: FAA Safety Alert for Operators SAFO 12007, dated October 22, 2013.

The separations analysis revealed that ABIA-ATCT/TRACON usually adds a buffer ranging from 0.1 to 0.5 nm to standard FAA aircraft separations, although 0.3 nm appeared to the most common buffer. Therefore, a buffer of 0.3 nm was applied uniformly to the standard aircraft approach minimum separations shown in the previous table. **Table 4.3-4** shows the buffered separations between arriving aircraft used in the simulation models more closely reflect actual operations at the airport and surrounding airspace.

Table 4.3-4: ABIA Aircraft Approach Separations in Nautical Miles

ABIA AIRCRAFT APPROACH SEPARATIONS [NM]							
		FOLLOWING					
		A	B	C	D	E	F
Leading	A	3.3	5.3	6.3	7.3	7.3	8.3
	B	3.3	3.3	4.3	5.3	5.3	7.3
	C	3.3	3.3	3.3	3.8	3.8	6.3
	D	3.3	3.3	3.3	3.3	3.3	5.3
	E	3.3	3.3	3.3	3.3	3.3	4.3
	F	3.3	3.3	3.3	3.3	3.3	3.3

Sources: AUS ATCT, Radar / Flight tracks data; Landrum & Brown analysis.

For departing aircraft, the simulation models used minimum separations mandated by the FAA. The validity of these separations was confirmed through discussions with the ABIA ATCT. Unlike the arrival separations, the departure separations are calculated with respect to time (not distance). **Table 4.3-5** shows the separations between departing aircraft that were used in this simulation study.

Table 4.3-5: Aircraft Takeoff Separations – FAA ATC Regulation (seconds)

DEPARTURE FOLLOWING	SEPARATION [SECONDS]
Group A (A380)	150
Group B (A330, B777)	120
Group C (B767)	90
Group D (B757, B737)	60
Group E (RJ)	60
Group F (GA)	45

Source: FAA Safety Alert for Operators SAFO 12007, dated October 22, 2013.

4.3.1.6 Taxi Flows

ABIA has a midfield terminal complex with one runway on either side. Runway 17L-35R is supported by the following taxiways:

- Taxiway A (full length parallel)
- Taxiway B (full length parallel)
- Taxiway G (RET)
- Taxiway J (90-degrees)
- Taxiway K (RET)
- Taxiway L (RET)
- Taxiway M (90-degrees)

Runway 17R-35L is supported by the following taxiways:

- Taxiway C (full length parallel)
- Taxiway G (90-degrees)
- Taxiway T (90-degrees)

In addition to these taxiways, ABIA is supported by the following cross-field taxiways:

- Taxiway G is the main cross-field taxiway and runs between Runways 17L-35R and 17R-35L.
- Taxiway H is a partial cross-field taxiway and runs between Taxiways A and C.
- Taxiways G and H provide most of the taxiway flow between the terminal gate apron areas and the parallel runways.

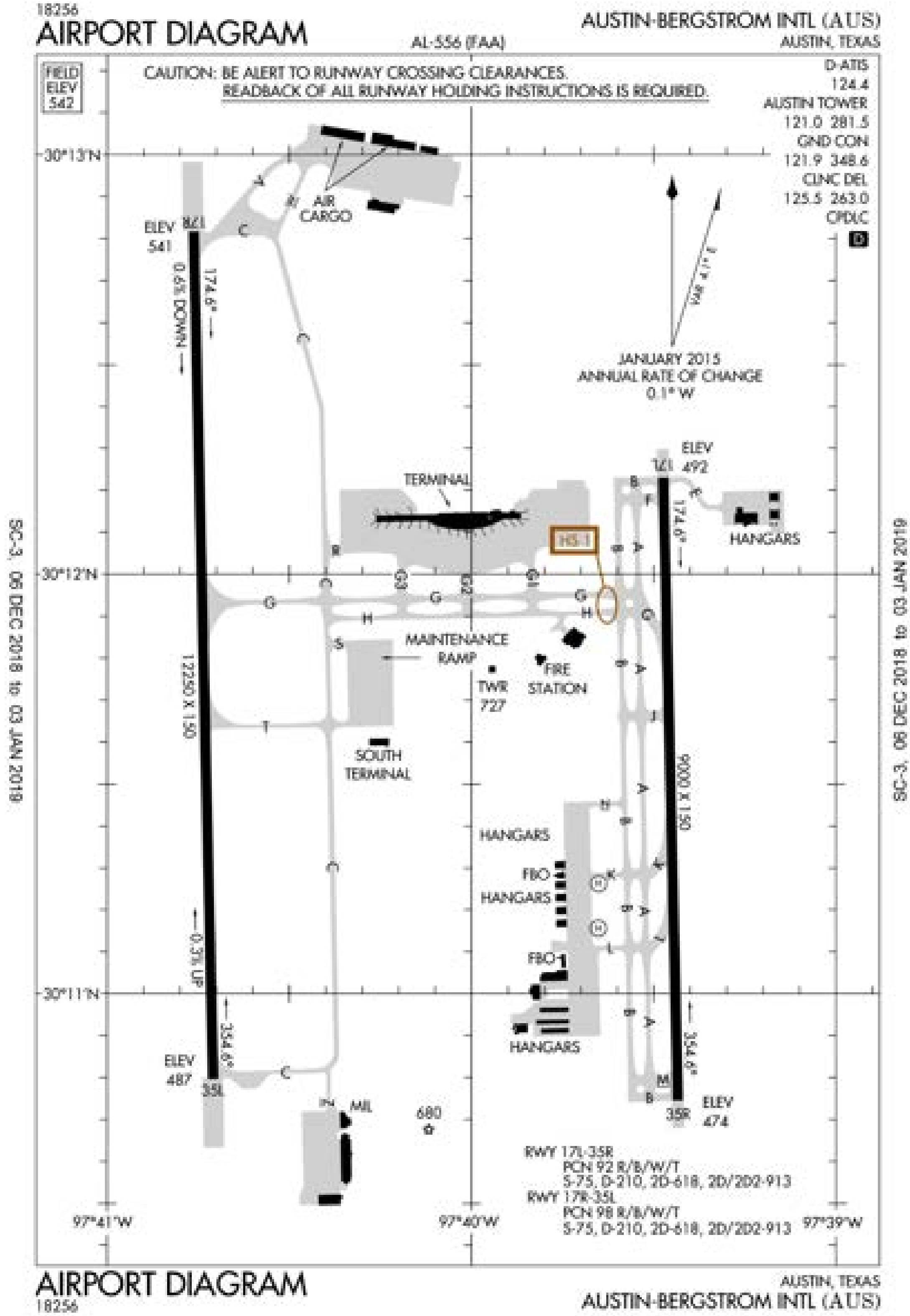
- Taxiways G1, G2 and G3 connect the main passenger terminal apron to the cross-field Taxiways G and H.
- Taxiway R provides an additional connection between the passenger terminal apron and Taxiway C. Air Traffic Control will utilize Taxiway R for arrivals and departures for aircraft using Runway 17L-35R (depending on apron traffic). Aircraft can use Taxiway R to move between the main passenger terminal apron and Runway 17R-35L, bypassing the crossfield Taxiways G and H.
- Taxiways S and T connect the Aircraft Maintenance Apron and South Terminal to the airfield.
- Taxiways K, L and N provide connectivity to the GA aprons.
- Taxiways V and W provide connectivity to the north cargo apron.

Runway 17L-35R is equipped with three rapid exit taxiways (RETs): Taxiway G, K and L. These RETs allow arriving aircraft to exit the runway soon after landing, thus making way for the next arrival or departure. Runway 17R-35L does not have any RETs and, as a result, aircraft landing on this runway must slow down considerably before exiting the runway onto Taxiways G and T.

Exhibit 4.3-7 is the official airport diagram published by the FAA and shows the taxiway network described above. For accurate simulation, the aircraft movements in the simulation model should mimic the actual taxi flows at the Airport. The aircraft taxi flows as modeled were reviewed and verified by the ABIA ATCT for accuracy.

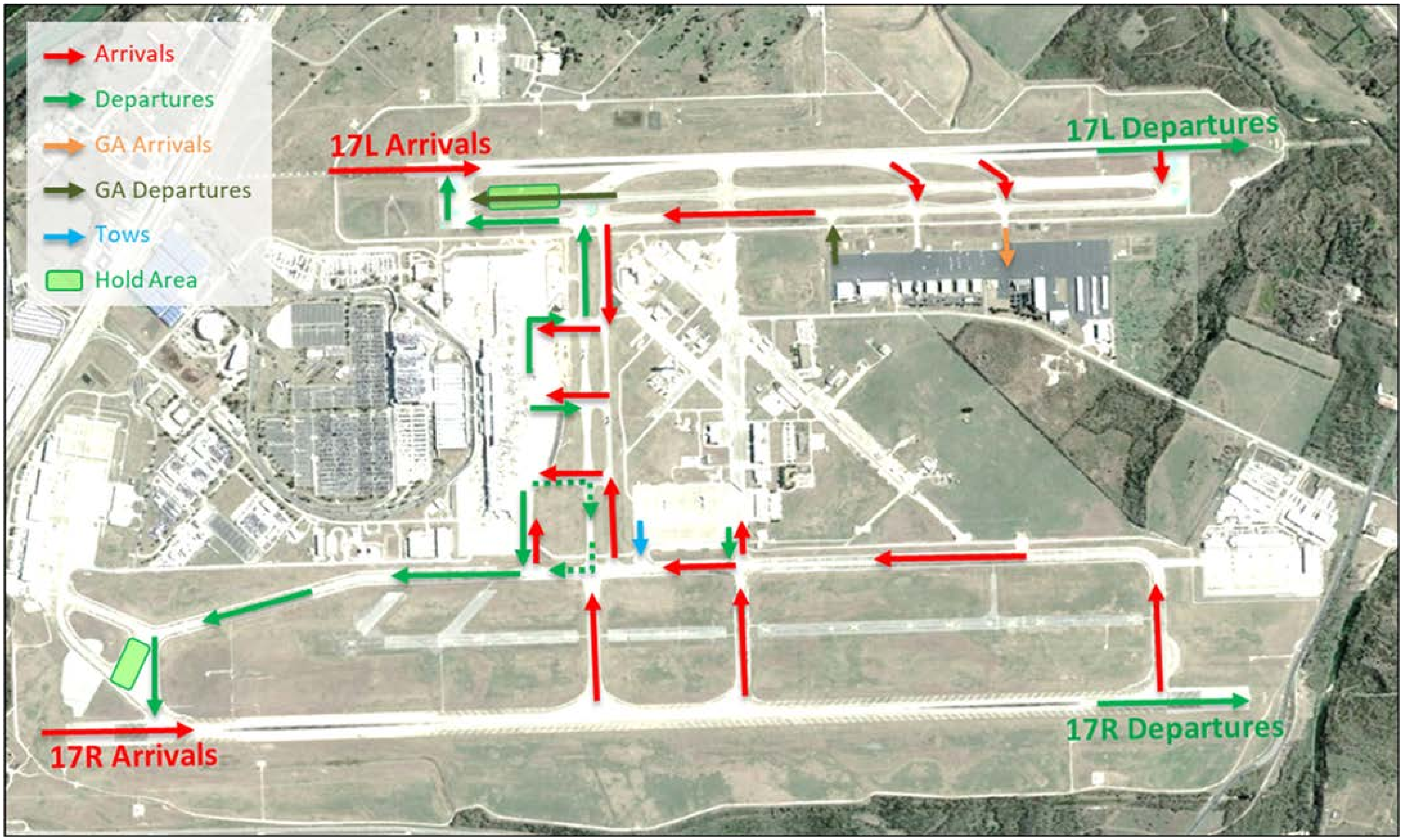
Aircraft taxi flow routes at ABIA are organized by the two South Flow and North Flow operating configurations. These aircraft taxi flow configurations are depicted in **Exhibits 4.3-8** and **4.3-9**. Each configuration shows entry and exit taxiways used to gain access to the appropriate runway, along with taxiway routes to and from the passenger terminal areas.

Exhibit 4.3-7: ABIA Airport Diagram



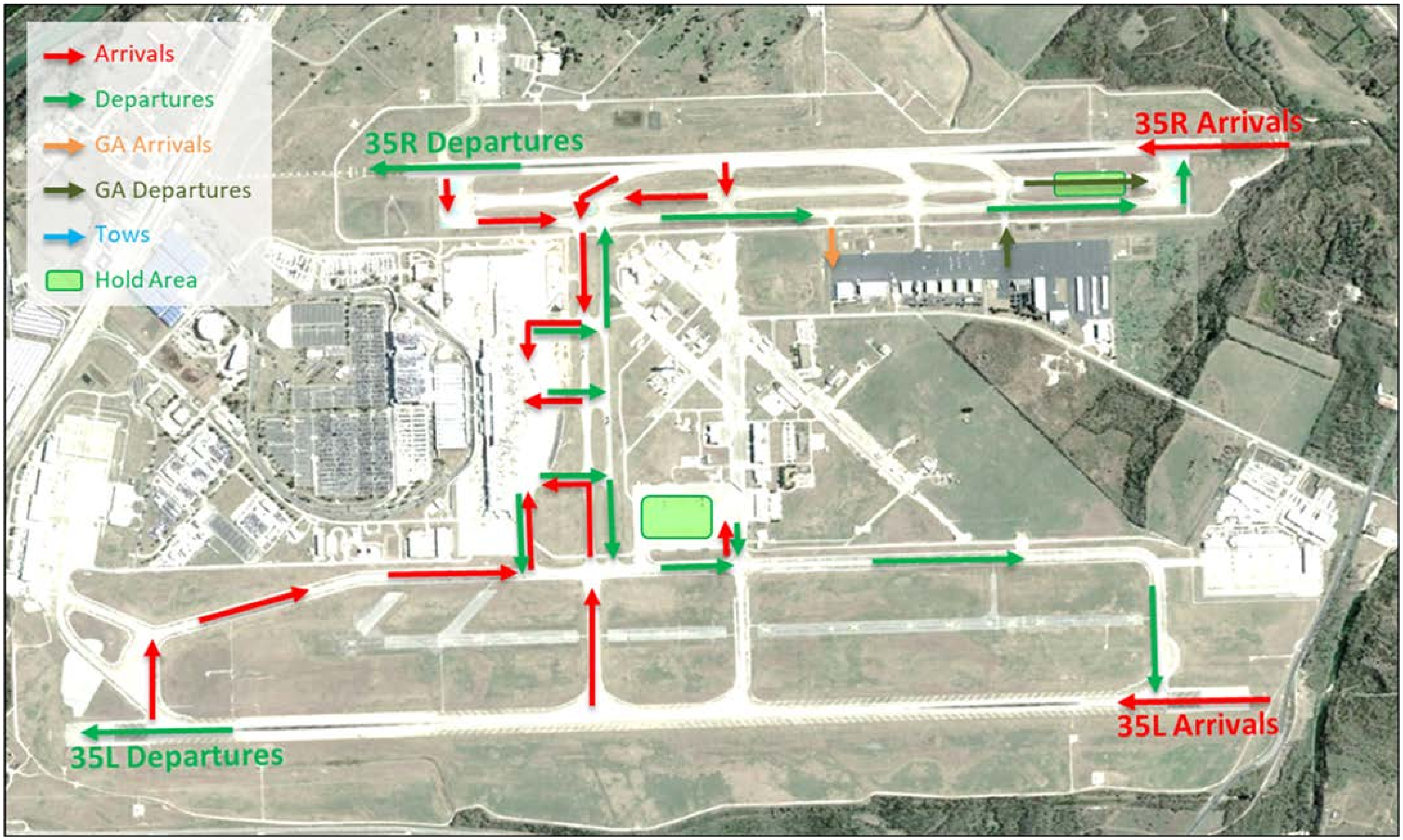
Source: FAA, December 2018.

Exhibit 4.3-8: ABIA South Flow Taxiway Flow Routes



Source: FAA and Landrum & Brown analysis.

Exhibit 4.3-9: ABIA North Flow Taxiway Flow Routes



Source: FAA and Landrum & Brown analysis.

4.3.1.7 Airline Gate and Remain Overnight Allocation

A majority of passenger gates are located on the Barbara Jordan Terminal. Due to construction of the east gate expansion at the time of the Master Plan Study, the simulation includes a combination of existing gates as well as the gates that will be added to the eastern end of the main passenger terminal to accurately depict the anticipated 2019 gate allocation layout as shown in **Exhibit 4.3-10**. The Barbara Jordan Terminal will have a total of 33 gates (Gate 11 is ground loading with no boarding bridge). Gates 1 and 3 and Gates 2 and 4 can be operated in a wide-body (double bridge) configuration or individually in a narrow-body configuration. The following configuration are available:

- International Configuration A – 4 gates
    - 3 wide-body gates (2 double bridges)
    - 1 narrow-body gate
- International Configuration B – 6 gates
    - 6 narrow-body gates

These gates will be supported by a total of 32 remain overnight positions (non-active passenger gates).

There is also a smaller, low-cost carrier (LCC) South Terminal that has three (3) narrow-body “walk-out” gate positions. There are ten additional RON positions available within this same apron area as shown on **Exhibit 4.3-11**.

Exhibit 4.3-10: ABIA Barbara Jordan Terminal Gate Allocation (2019)

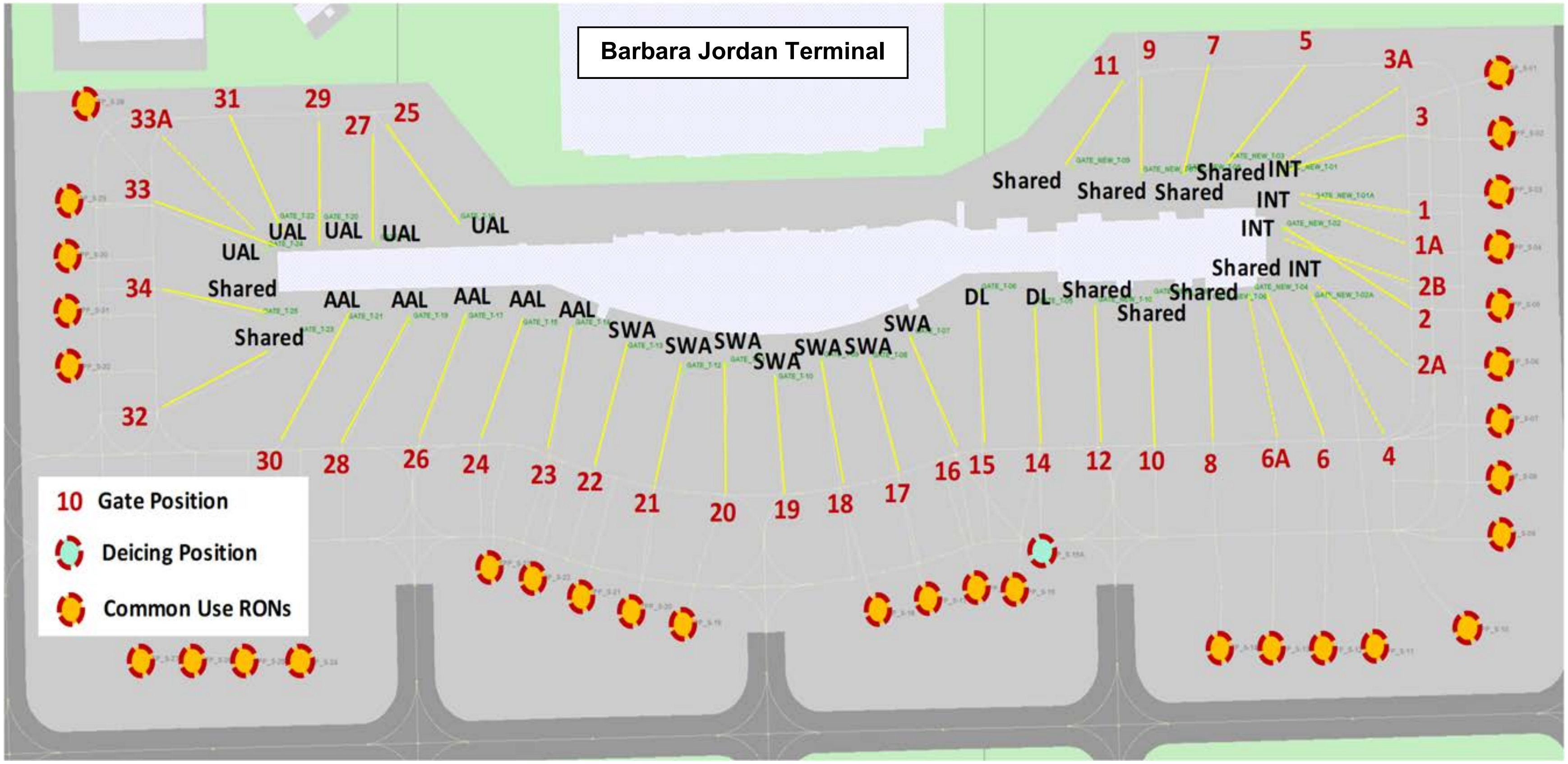
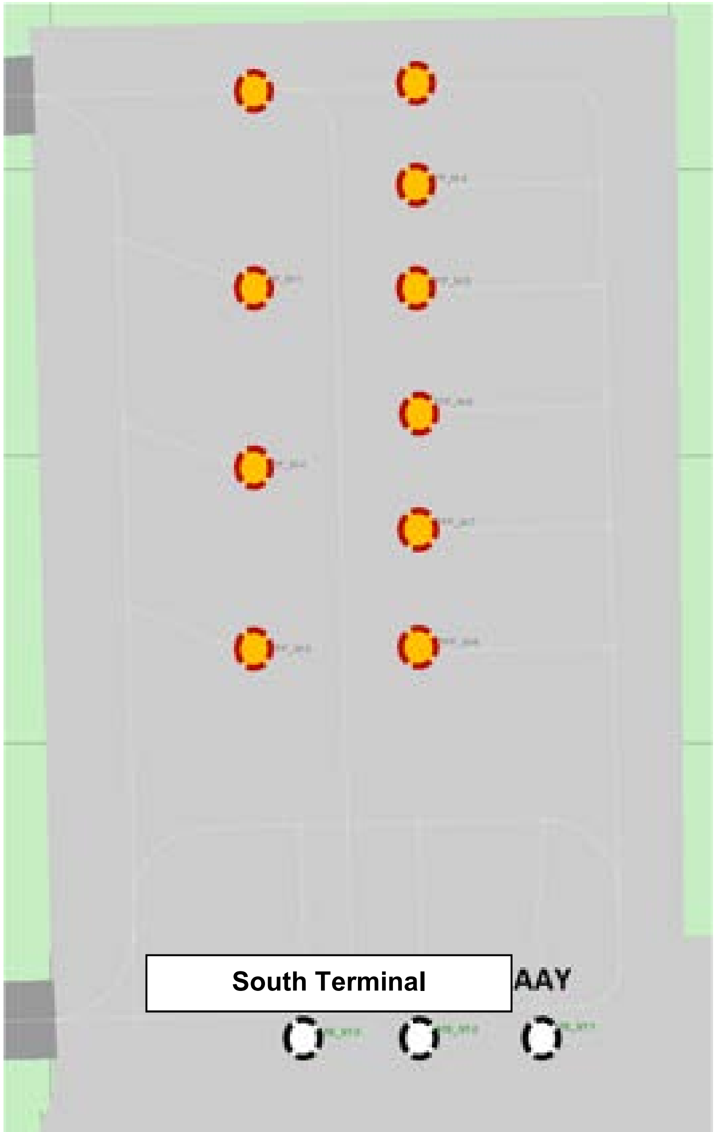


Exhibit 4.3-11: ABIA South Terminal Gate and Apron Layout (2018)



4.3.1.8 Aircraft Speed Assumptions

In order to ensure that the simulations produce reasonable output metrics, the aircraft speeds used in the simulations need to be in the range of actual speeds observed at the airport. This includes various taxiing speeds on different parts of the airfield, pushback speeds on aprons, and aircraft approach speeds etc.

Flight tracks data obtained from the ABIA ATCT, as well as data collected from flight tracking websites such as www.flightradar24.com was analyzed to determine aircraft speeds while on final approach, while vectoring in the terminal airspace. In addition to airborne aircraft speeds, data on taxiing, pushback and towing speeds was also collected and analyzed to form a set of aircraft speed assumptions that were entered into the simulation models.

All aircraft speed assumptions were thoroughly reviewed and vetted by the ABIA ATCT. **Table 4.3-6** summarizes the speed assumptions reflective of different phases of flight that were used in the simulation models.

Table 4.3-6: Aircraft Speed Assumptions

AIRCRAFT SPEED ASSUMPTIONS [KNOTS]	
Final Approach (Jet / Turboprop Aircraft)	150
Final Approach (Piston Aircraft)	100
High-speed Runway Exits	25
Standard Runway Exits	10
Taxiing on Parallel Taxiways	20-25
Taxiing on Ramp Area Taxiways	12-15
Taxiing on Apron / Taxilanes	8
Towing on Apron / Taxilanes	8
Gate Power-in	5
Gate Pushback	3

Source: FAA and Landrum & Brown analysis.

4.3.1.9 Model Calibration/Visual Validation

Since the models use a future 2019 design day flight schedule, actual operational data was not available for model calibration purposes. Hence, we chose to validate the models through workshops with the ABIA ATCT instead of calibrating the model to actual operations. All input assumptions were thoroughly reviewed and vetted by the ABIA ATCT staff. The models were refined to generate a reasonable representation of the airfield and airspace flows, runway throughput rates, taxi times and delays.

4.3.1.10 Simulation Results

This section presents the results of the simulation models for predicted demand levels in 2019. As previously noted, South and North Flow, the two runway operating configurations that are most commonly used at ABIA were considered.

Table 4.3-7 presents an overview of AirTOp simulation analysis results. These simulation models assume normal operating conditions in VFR weather. The purpose of these models is to evaluate the capacity of the airport under normal operating conditions. These models do not consider Irregular Operations (IROPs), ground delays, diversions, etc.

Table 4.3-7: AirTOp Simulation Results Summary

SIMULATION RESULTS SUMMARY		
	SOUTH FLOW	NORTH FLOW
Taxi Times [minutes]		
Avg. Arrival Taxi Time	6.4	5.1
Avg. Departure Taxi Time	12.4	13.7
Avg. Total Taxi Time	9.4	9.4
Delays [minutes]		
Avg. Arrival Delay	0.6	0.5
Avg. Departure Delay	0.6	0.5
Avg. Total Delay	0.6	0.5
Peak Arrival Delay	2.0	2.0
Peak Departure Delay	1.9	1.3
Throughput Rates		
Peak Hour Arrival	29	28
Peak Hour Departure	29	28
Peak Hour Overall	52	52

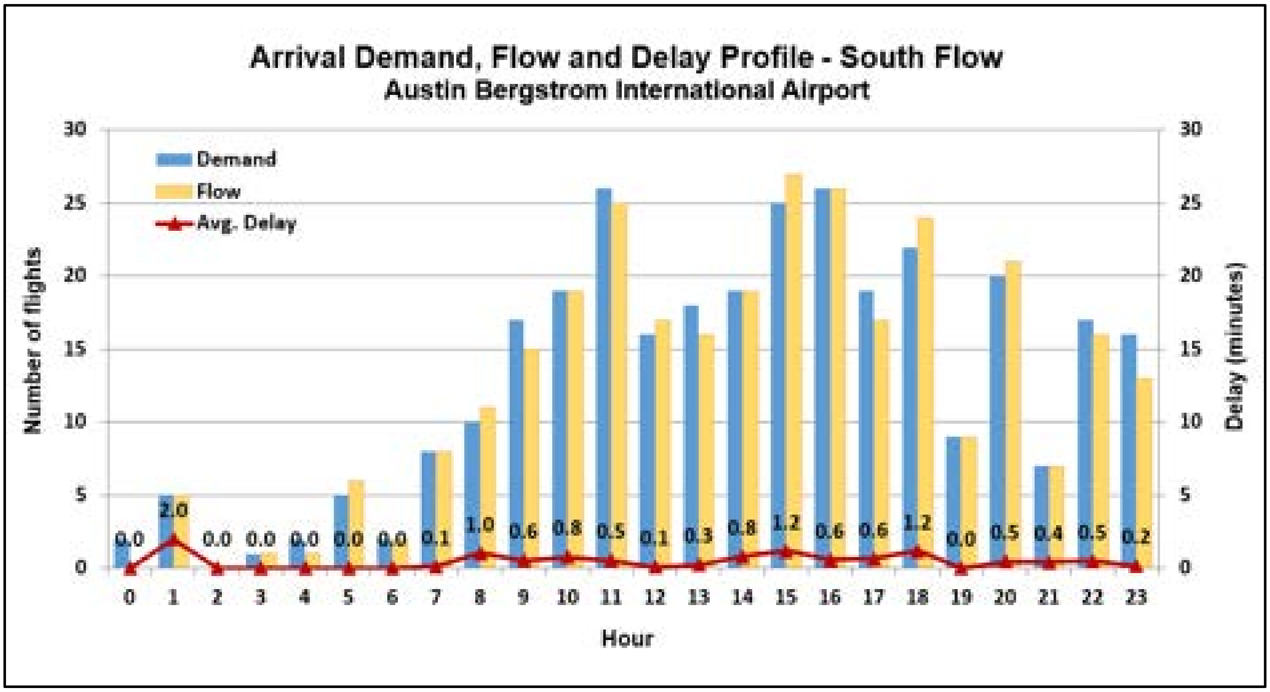
Source: Landrum & Brown analysis

It can be inferred from the simulation analysis that ABIA is a very low delayed airport. The current airfield typically provides ample capacity to handle all scheduled commercial, General Aviation (GA), cargo and military aviation activity efficiently. The average arrival and departure delays per operation are approximately 0.5 per minute in the south and north flow operating configurations. Although the delays are very low, almost all arrival delays occur while aircraft are still airborne and are a result of sequencing, holding and vectoring implemented by the TRACON and ABIA ATC to ensure adequate separation between consecutive arrivals. Departure delays mainly occur due to apron congestion and departing aircraft waiting in the departure queue.

Presence of aircraft and other ground vehicles on the apron can impede aircraft pushbacks and tows from other gates in the vicinity. Aircraft must also taxi at slower speeds on the apron during peak hours due to the presence of other taxiing aircraft on the apron. During departure peak hours, aircraft must wait longer in the departure queue that will result in departure delays.

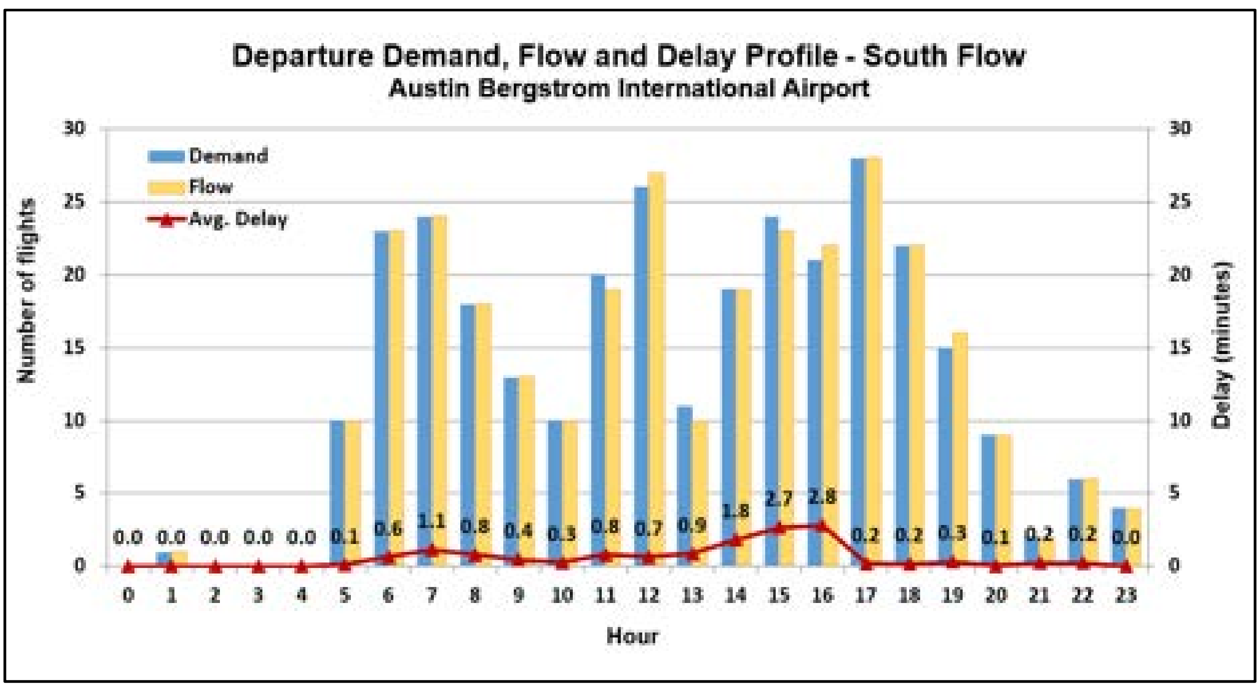
Exhibits 4.3-12 through **4.3-15** present a comparison of the airport arrival/departure demand and its available throughput (flow), which results in average delays by time of day.

Exhibit 4.3-12: ABIA Arrival Demand, Flow and Delay Profile – South Flow



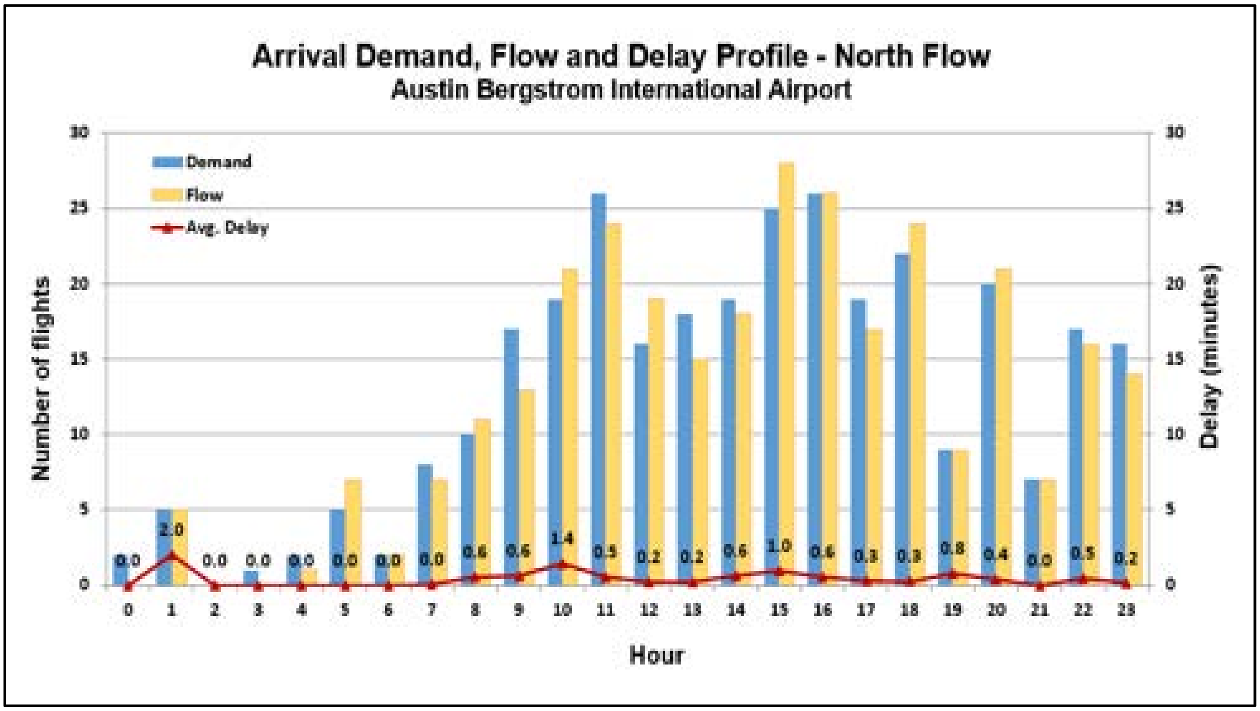
Source: Landrum & Brown analysis

Exhibit 4.3-13: ABIA Departure Demand, Flow and Delay Profile – South Flow



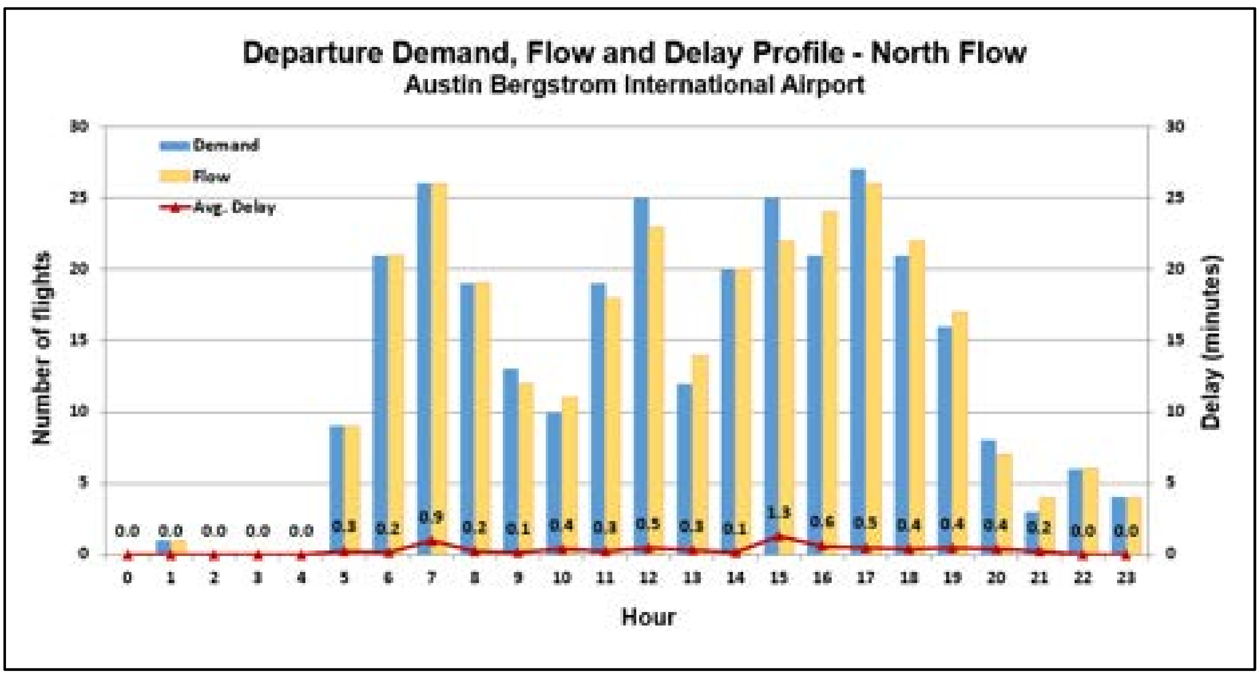
Source: Landrum & Brown Analysis

Exhibit 4.3-14: ABIA Arrival Demand, Flow and Delay Profile – North Flow



Source: Landrum & Brown analysis

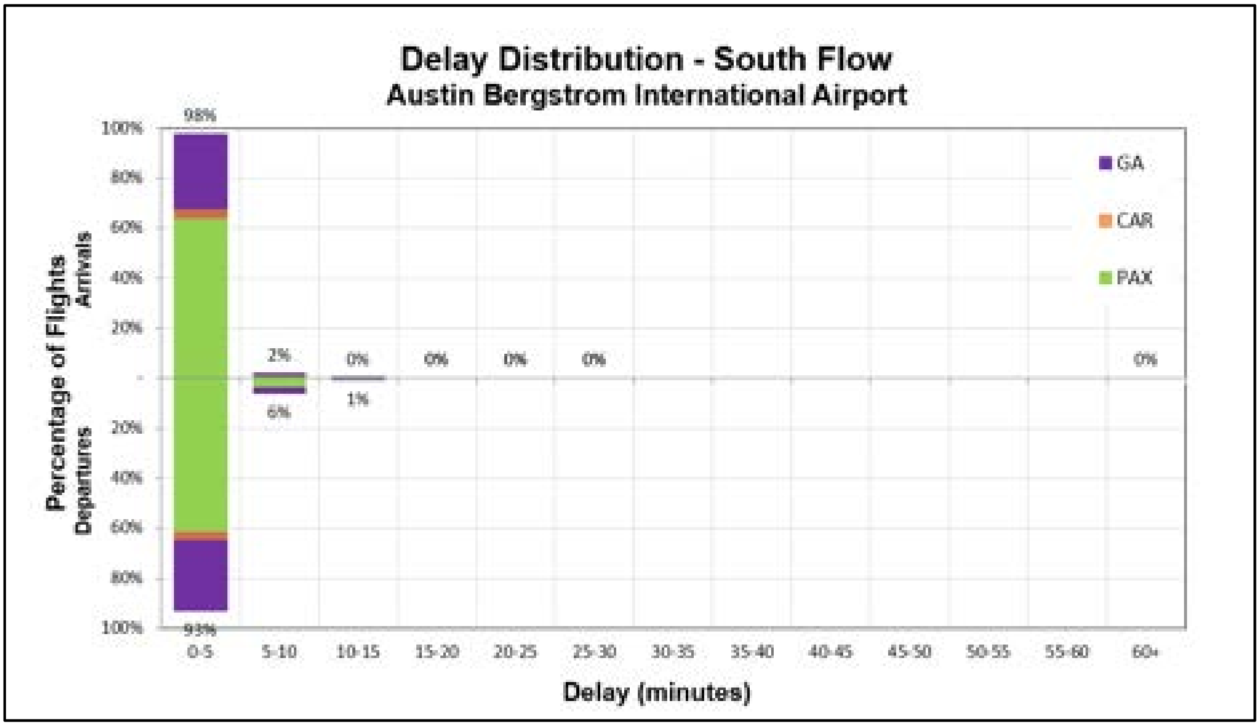
Exhibit 4.3-15: ABIA Departure Demand, Flow and Delay Profile – North Flow



Source: Landrum & Brown analysis

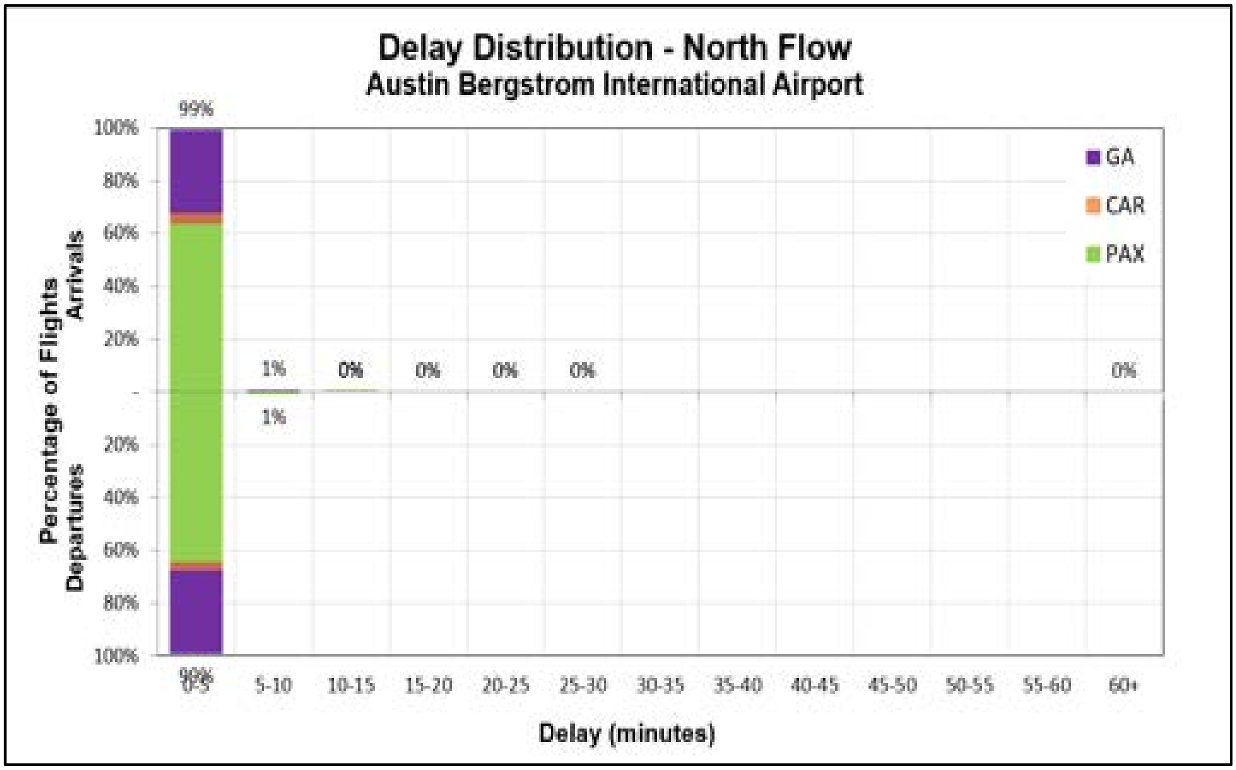
Exhibits 4.3-16 and **4.3-17** depict the distribution of delays in the South and North operating configurations respectively. In the South Flow, 98% of arrivals and 93% of departures are delayed less than 5 minutes. Only 2% of arrivals and 6% of departures are delayed between 5 and 10 minutes. In the North Flow, 99% of arrivals and 99% of departures are delayed less than 5 minutes. Only 1% of arrivals and 1% of departures are delayed between 5 and 10 minutes.

Exhibit 4.3-16: Delay Distribution – South Flow



Source: Landrum & Brown analysis

Exhibit 4.3-17: Delay Distribution – North Flow

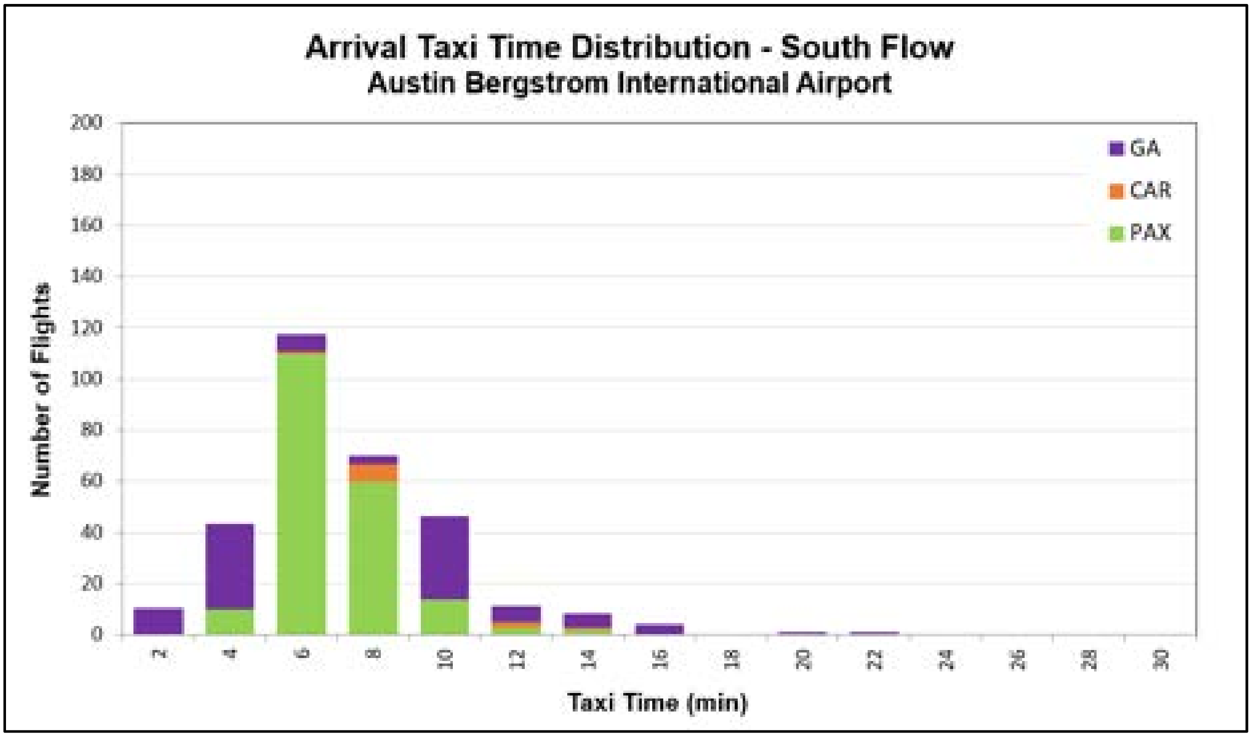


Source: Landrum & Brown analysis

Exhibits 4.3-18 through **4.3-21** show the arrival and departure taxi time distributions for the two operating configurations. In the South Flow, approximately 90% of arrivals have an average taxi time of 10 minutes or less, and approximately 90% of departures have an average taxi time of 20 minutes or less. In the North Flow, 97% of arrivals have an average taxi time of 10 minutes or less and approximately 95% of departures have an average taxi time of 20 minutes or less.

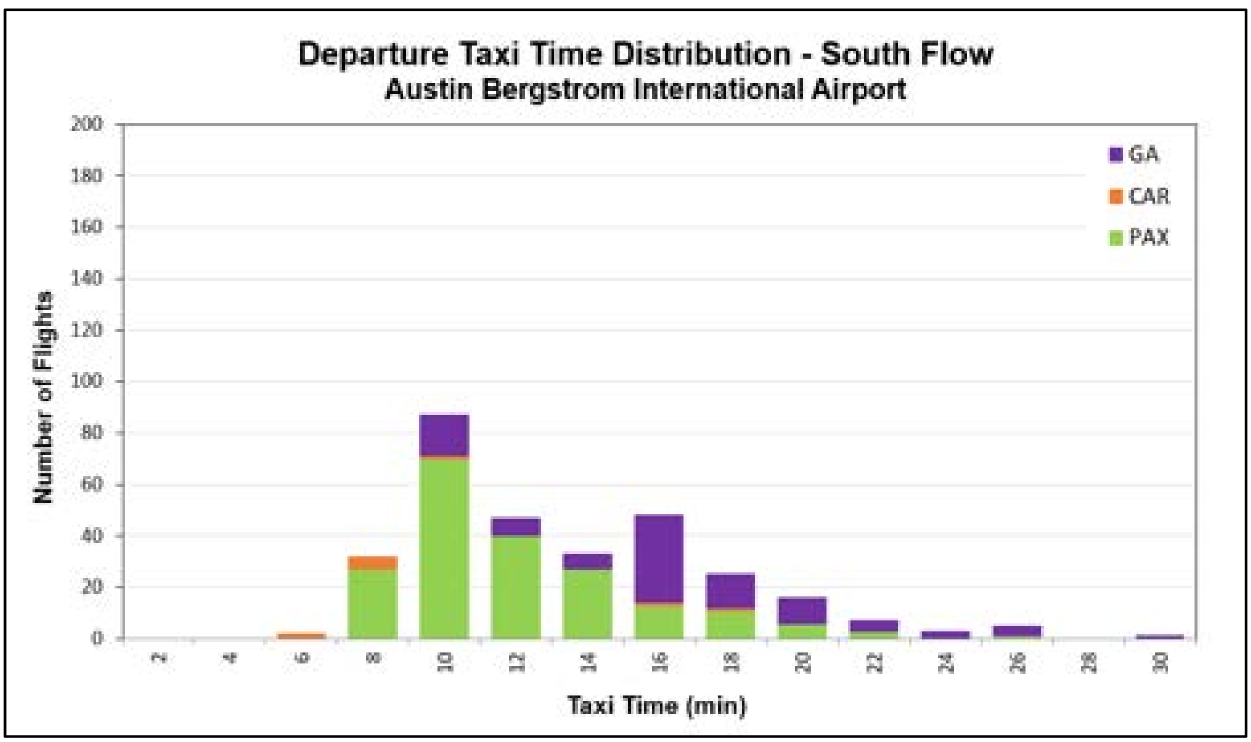
Average arrival taxi times in the North Flow are shorter as compared to the South Flow because arriving aircraft exit the runway closer to the Barbara Jordan Terminal. Similarly, average departure taxi times are shorter in the South Flow as compared to the North Flow because of the proximity of the runway entry points to the Barbara Jordan Terminal.

Exhibit 4.3-18: Arrival Taxi Time Distribution – South Flow



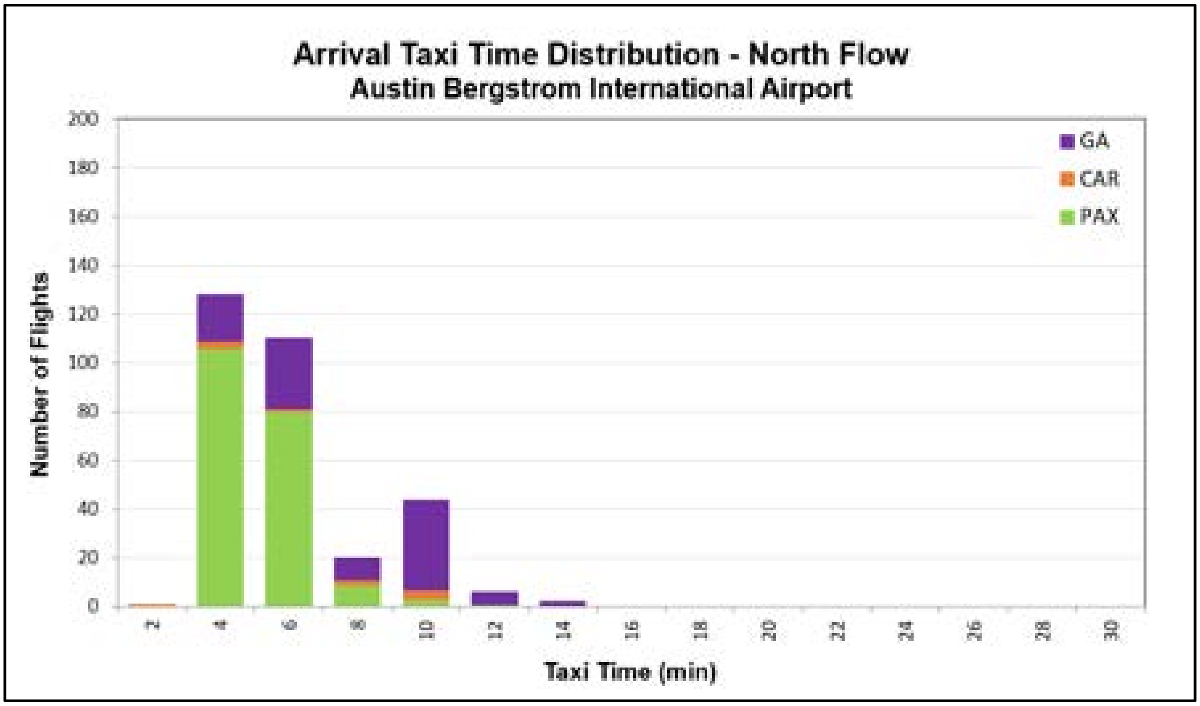
Source: Landrum & Brown analysis

Exhibit 4.3-19: Departure Taxi Time Distribution – South Flow



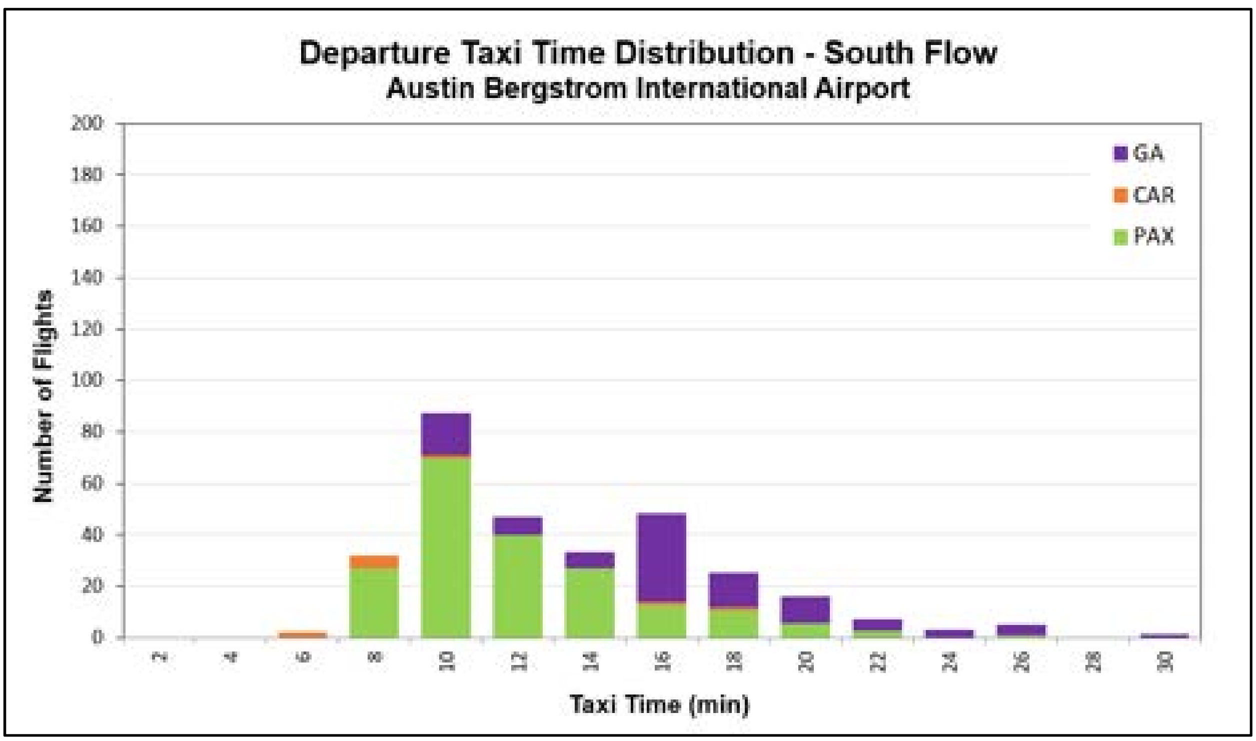
Source: Landrum & Brown analysis

Exhibit 4.3-20: Arrival Taxi Time Distribution – North Flow



Source: Landrum & Brown analysis

Exhibit 4.3-21: Departure Taxi Time Distribution – North Flow



Source: Landrum & Brown analysis

4.3.1.11 Existing Airfield Capacity Analysis

This section presents results of the Existing Airfield Capacity Analysis conducted using the runway queue model. This analysis was conducted to determine the following:

- A high-level estimate of when the existing airfield will "max-out", and thus be unable to sustain further growth at the airport while keeping the average delay per operation below the acceptable threshold of 10 minutes. This analysis will help to determine the potential trigger points for the development of an additional runway and/or other airfield infrastructure.
- A high-level estimate of when the average delay per operation will exceed the acceptable threshold of 10 minutes when only one runway is operational at the airport. This analysis will be used to determine the least-impactful schedule to carry out rehabilitation works on existing runways (full or partial closures). Three scenarios were considered using the RQM, including:

  - existing airfield geometry
  - closure of Runway 17R-35L
  - closure of Runway 17L-35R

4.3.1.11.1 Runway Queue Model

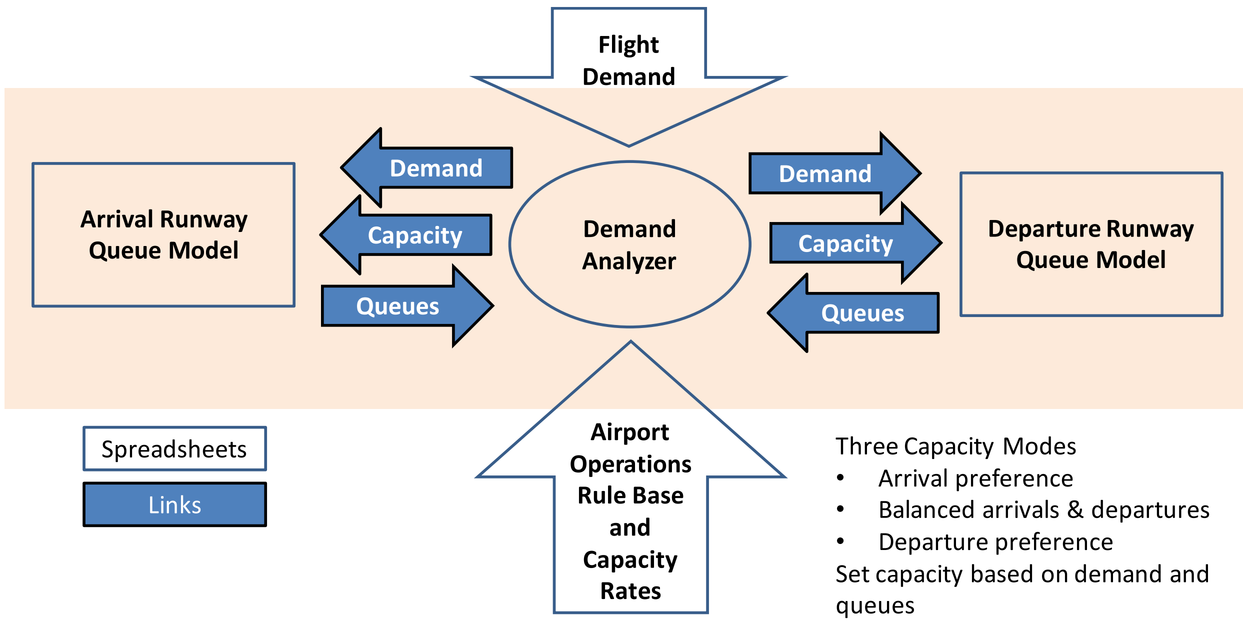
Average arrival and departure delays were computed using a queue modeling methodology. Demand, defined in terms of the number of arrivals and departures, is modeled against the estimated hourly capacity of the existing airfield geometry. The hourly demand and capacity values are converted into 5-minute interval values. Three capacity values are input into the model:

- Arrival preference capacity, where the operational rules and runway uses provide a greater arrival capacity than departure capacity.
- Departure preference capacity, where the operational rules and runway uses provide a greater departure capacity than arrival capacity.
- Balanced mode capacity, where the operational rules and runways uses provide essentially equal arrival and departure capacities.

The model evaluates the demand to determine which of the three capacity modes to use for a given period of time. Arrival push and departure push capacities are usually used during arrival and departure peak periods, respectively. The balanced operation capacity is used when arrival and departure demand are similar. Unserved demand remains in the queue and accumulates delay. The model outputs are queue length, delay, and throughput. Average delay statistics generated by the queue model can be shown by the time of day for arrivals and departures.

As shown in **Exhibit 4.3-22**, the RQM used in the delay analysis consists of five linked spreadsheets: Flight Demand, Capacity, Arrival Runway Model, Departure Runway Model, and the Demand Analyzer.

Exhibit 4.3-22: Runway Queue Model



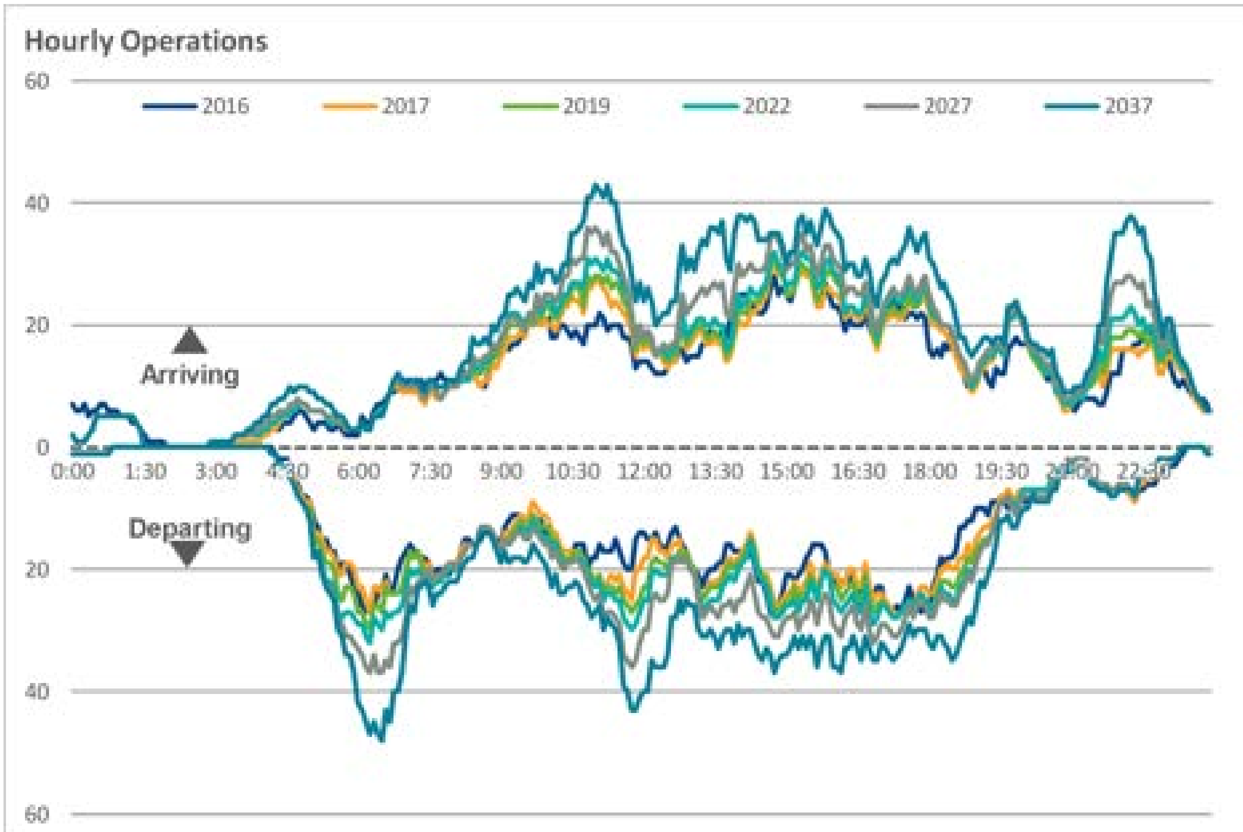
The RQM emulates capacity management practices used when air traffic controllers choose the capacity mode appropriate to accommodate demand. It is current practice for air traffic controllers to anticipate the near-term arrival and departure demand and determine the most effective runway configuration to accommodate this demand. The same process is included in the RQM. The Demand Analyzer evaluates the scheduled demand for each 5-minute period and projects ahead 20 minutes to determine the appropriate capacity mode. The Demand Analyzer then sends the demand and capacity by 5-minute periods to the Arrival Runway and Departure Runway Queue Models. For each 5-minute period, the Arrival Runway and Departure Runway Queue Models compare the demand against the arrival or departure capacity and calculate the number of operations in the RQM and the time each operation is delayed. Operations that are delayed in the RQM are sent back to the Demand Analyzer and added to the scheduled demand of the next 5-minute period. The scheduled demand and the delayed demand for each 5-minute period are then analyzed again to determine the appropriate mode of operation for the next iteration.

The RQM is only designed to evaluate operational delays associated with runway capacity, but ignores other capacity constraints such as airspace and airfield congestion, inefficient taxiway network and bottlenecks, apron congestion, etc. Therefore, the results of RQM analysis tend to be high-level and are to be treated as indicative only.

4.3.1.12 Design Day Flight Schedules and Demand Profiles

This analysis is based on the FAA-approved forecasts (see Chapter 2, *Existing Conditions and Issues*). Design Day Flight Schedules (DDFS) were developed for the years 2019, 2022, 2027 and 2037. **Exhibit 4.3-23** shows these DDFS and their corresponding demand profiles for each of the planning years. These DDFS and demand profiles were used as inputs to the RQM.

Exhibit 4.3-23: DDFS Demand Profiles



Source: Landrum & Brown analysis

4.3.1.13 Runway Capacity

Runway capacity was calculated using the Airfield Capacity Estimation Spreadsheet Model and the Airfield Capacity Model (ACM) that were developed in part by L&B and other industry experts in association with the Transportation Research Board (TRB) Airport Cooperative Research Program. The ACRP Report 79, *Evaluating Airfield Capacity*, guidelines were used to determine the runway capacity for each of the runway operating configurations.

ACM considers various inputs such as the number of runways, their configurations (alignment, separation, etc.), the mix of aircraft operating at the airport over the forecast period, and separations between successive arrivals or departures on the runway(s). **Exhibit 4.3-24** shows peak hour capacities of the existing runways (by runway) for the arrival preference, departure preference, and balanced modes as calculated by the ACM. **Table 4.3-8** shows the peak hour airfield capacities at ABIA for the three airfield operating modes. According to our models, the existing dual runways accommodate approximately 445,000 annual aircraft operations, and approximately 40 MAP. This annual runway capacity assumes an average delay at or below 10 minutes per aircraft operation. The airport will require additional runway(s) and associated airfield infrastructure to grown beyond 445,000 annual operations, while maintaining average delays at or below 10 minutes per aircraft operation.

Exhibit 4.3-24: Runway Peak Hour Capacities – Existing Airfield

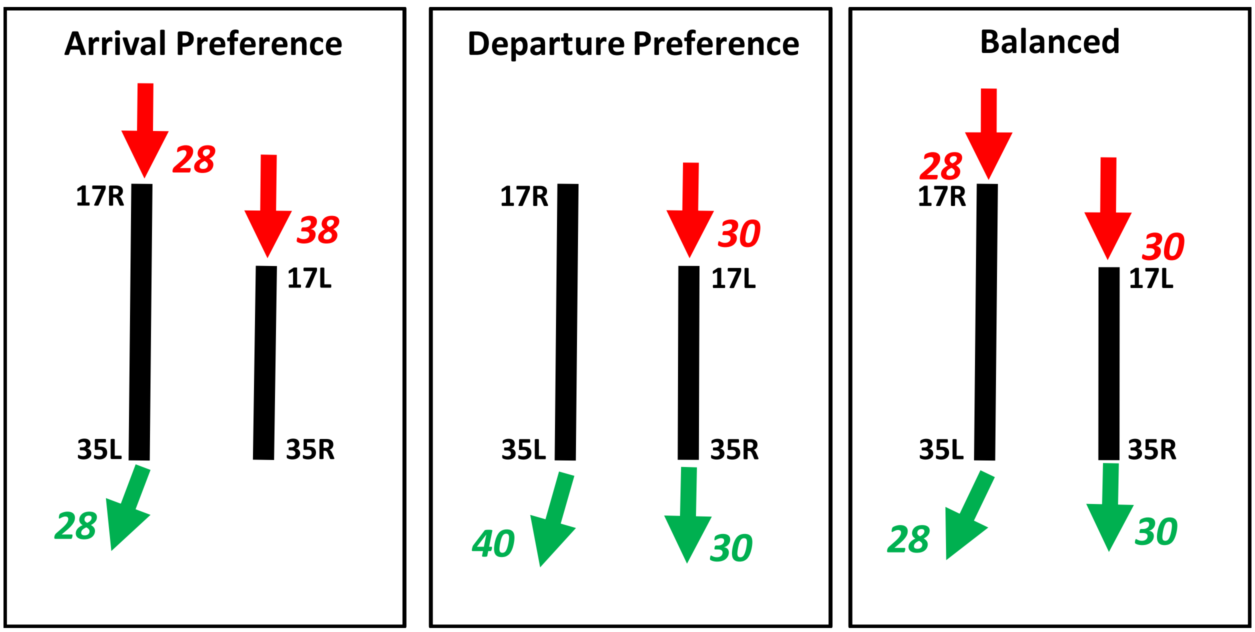


Table 4.3-8: Peak Hour Airfield Capacity – Existing Airfield

PEAK HOUR AIRFIELD CAPACITY					
ARRIVAL PREFERENCE		DEPARTURE PREFERENCE		BALANCED MODE	
ARRIVALS	DEPARTURES	ARRIVALS	DEPARTURES	ARRIVALS	DEPARTURES
66	28	30	70	58	58

In an arrival preference mode, one runway will handle only arrivals and the other runway will operate in a mixed mode, therefore, achieving a higher arrival throughput. In a departure preference mode, one runway will handle only departures and the other runway will operate in a mixed mode, therefore, achieving a higher departure throughput.

Both runways at ABIA are typically operated in a mixed mode (both runways handle arrivals and departures). The total maximum achievable airfield capacity when both runways are operating in a mixed mode is 58 arrivals and 58 departure per hour (balanced capacity).

4.3.1.14 RQM Analysis

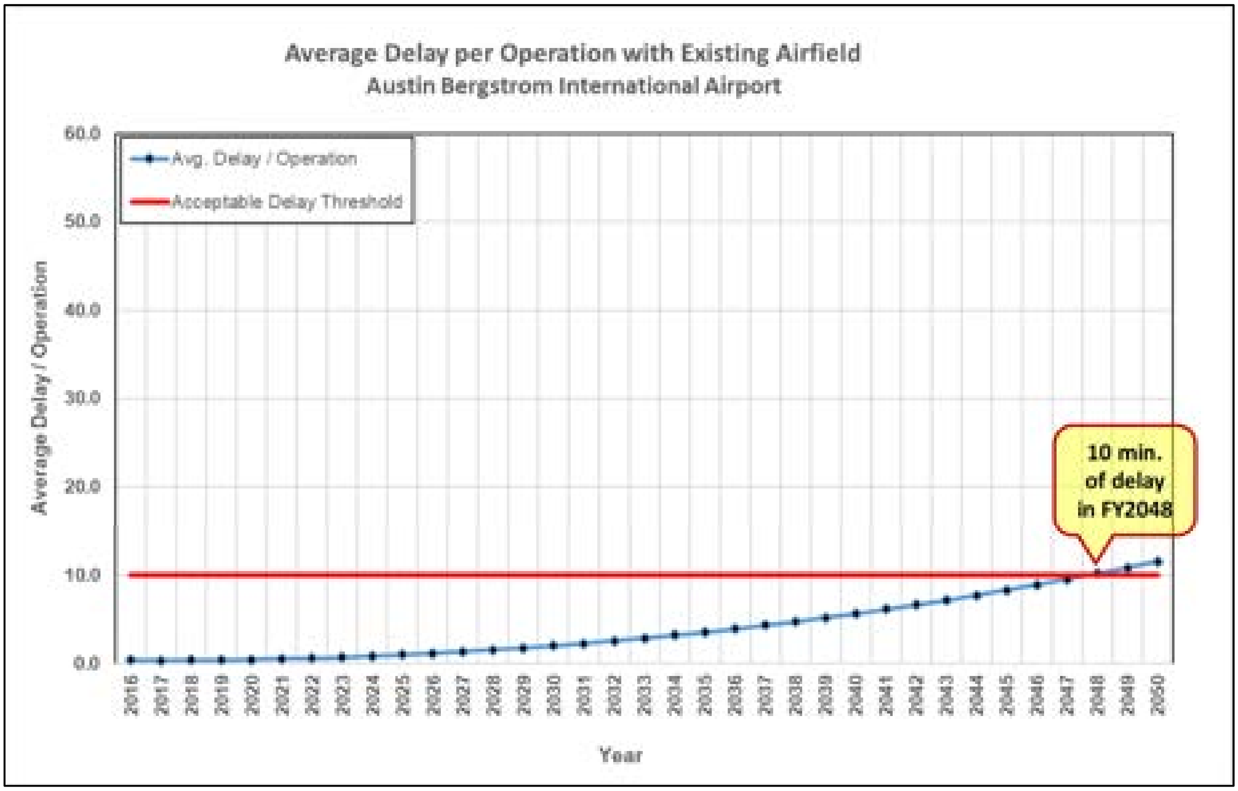
Average delays per operation were calculated using the RQM for the years 2016, 2017, 2019, 2022, 2027 and 2037. Delays for these years were used as data points to generate delay curves. The equation of the resulting curve was used to calculate delay values for intermediate years using interpolation and to calculate delays beyond 2037 using extrapolation.

As previously noted, a 10-minute threshold of acceptable delay was used in this analysis. Comparing this threshold with the aforementioned delay curves helped identify the approximate activity level when the average delay per operation will exceed acceptable levels.

4.3.1.15 Existing Airfield

Based on the RQM analysis, the existing ABIA airfield provides sufficient capacity to carry out operations at the airport efficiently, and it will continue to do so for the next several decades. **Exhibit 4.3-25** shows the average delay curve associated with the existing airfield geometry. The average delay per operation is expected to exceed the 10-minute threshold in approximately year 2048. As noted above the existing airfield should be able to accommodate approximately 445,000 annual aircraft operations, while the high case aviation forecast projects that the demand in 2037 will be approximately 426,500 annual aircraft operations (includes commercial, cargo, air taxi, GA, and military). Based on this analysis, it is not necessary to construct any additional runways within the next 20-year timeframe for capacity or delay reasons.

Exhibit 4.3-25: Average Delay Curve – Existing Airfield



Source: Landrum & Brown analysis

4.3.1.16 Closure of Existing Runway 17R-35L

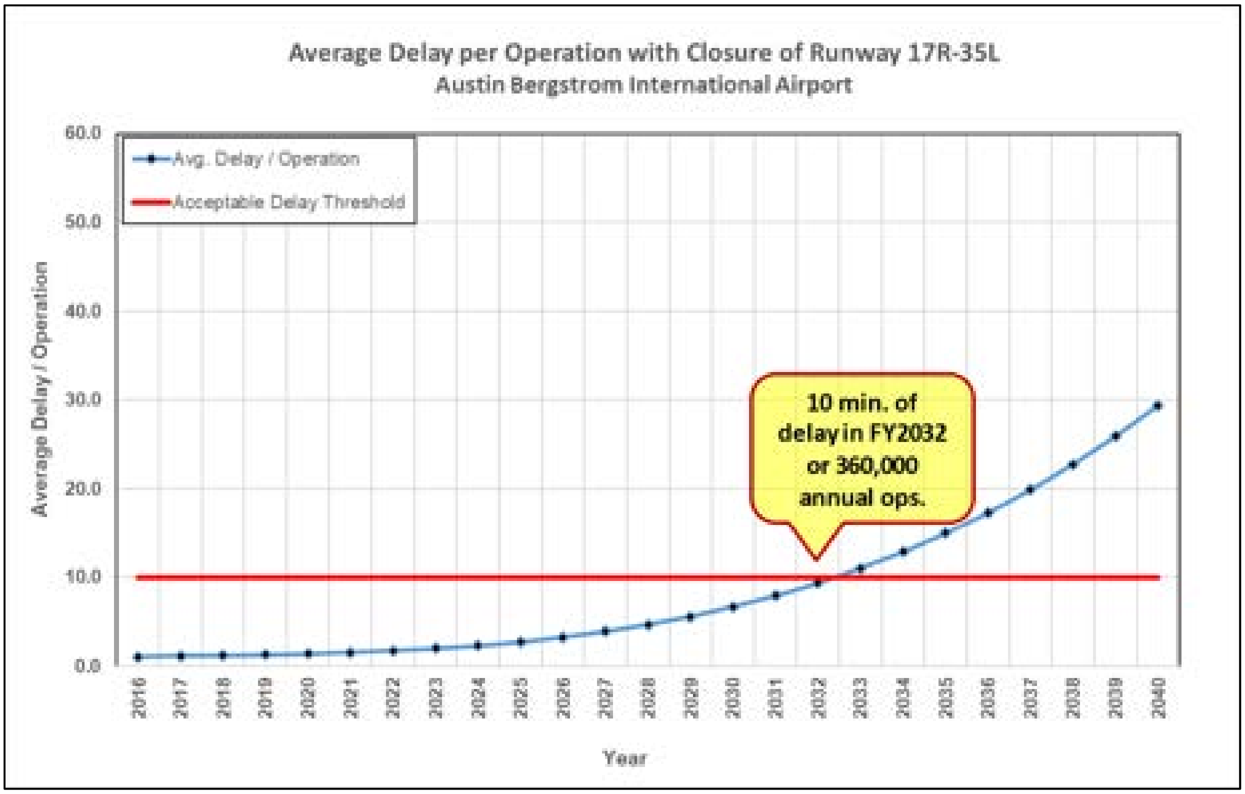
The runway pavement has a finite life expectancy. Due to the anticipated deterioration of the runway pavement over time, airports are required to renew this surface periodically. These runway rehabilitation projects might require full or partial closure of the runway during construction. The duration of these runway closures generally depends on the type of rehabilitation work to be carried out and can range from several weeks to several months.

Runway closures results in reduced capacity and longer delays at an airport. When one of the two parallel runways at ABIA is closed for rehabilitation works, all operations will take place on the single runway that is still open. Therefore, in order to minimize the impact to operations and not impede the growth in airport aviation activity, it is crucial to schedule runway rehabilitation projects carefully.

Runway 17R-35L is the longer runway (12,250 feet) and is used by all heavy and wide-body aircraft arriving and departing from ABIA. When this runway is closed, all heavy and wide-body aircraft will use the shorter Runway 17L-35R (9,000 feet) and might be restricted to a shorter range and / or lower take-off weight (loss in payload). It might also be necessary to incorporate an additional stopover to refuel the aircraft if the airline maintains a higher payload.

Exhibit 4.3-26 shows the delay curve if Runway 17R-35L is closed. The average delay per operation will exceed the 10-minutes threshold around year 2032, or approximately 360,000 annual operations (high case forecast).

Exhibit 4.3-26: Average Delay Curve – Closure of Runway 17R-35L



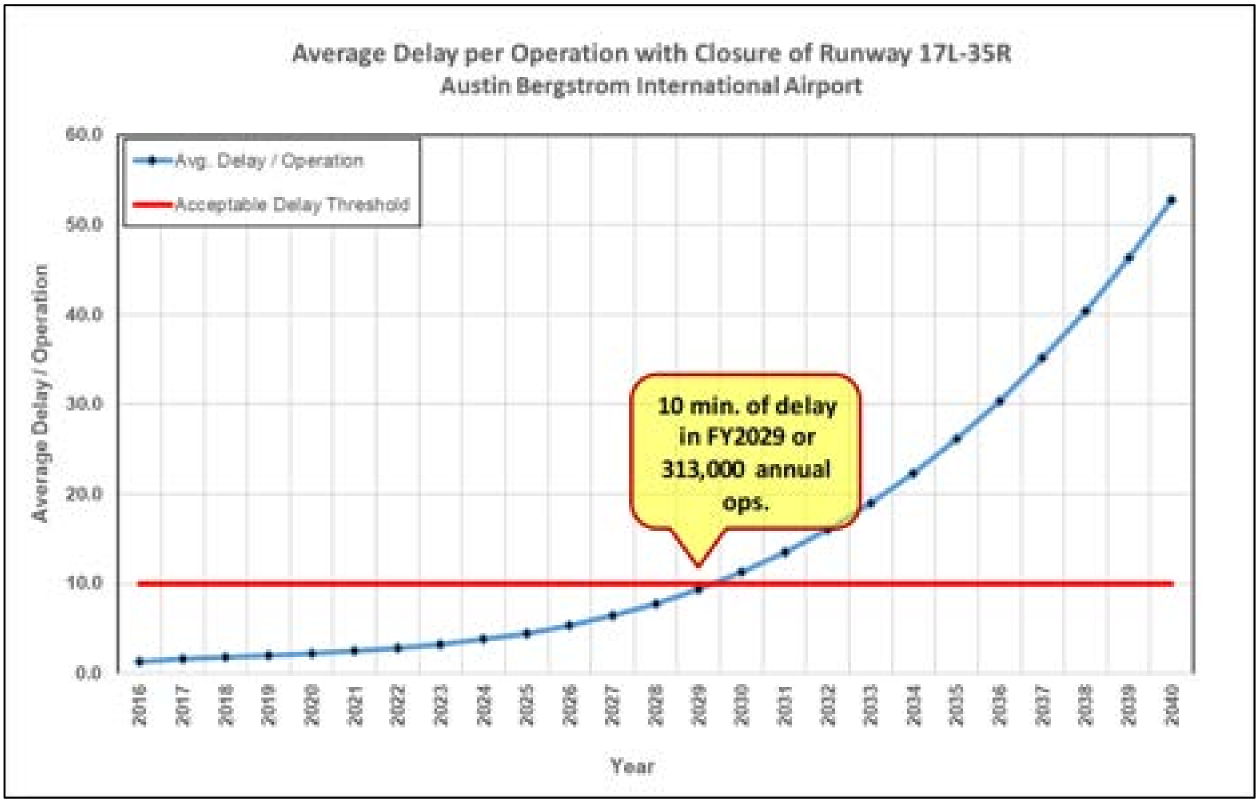
Source: Landrum & Brown analysis

4.3.1.17 Closure of Existing Runway 17L-35R

Runway 17L-35R is the shorter runway (9,000 feet), but is equipped with 3 high-speed exit taxiways (Taxiways K and L for Runway 17L, and Taxiway G for Runway 35R), and is also supported by full-length dual parallel Taxiways A and B. These taxiways allow Runway 17L-35R to operate at a higher capacity as compared to Runway 17R-35L. Therefore, delays at ABIA will rise faster when Runway 17L-35R is closed for rehabilitation. In addition, the only Category IIIB approach capability is on the Runway 17L end.

Exhibit 4.3-27 shows the delay curve if Runway 17L-35R is closed. The average delay / operation will exceed the 10-minute delay threshold around year 2029, or approximately 313,000 annual operations (high case forecast). Based on input from ABIA Operations, closure of Runway 17L-35R might also result in additional delays in the north flow operation. Aircraft departures must be queued up prior to Taxiway T and slow taxiing aircraft will adversely affect the departure flow. A north flow with general aviation will likely result in long taxi times.

Exhibit 4.3-27: Average Delay Curve – Closure of Runway 17L-35R



Source: Landrum & Brown analysis

4.3.1.18 Runway Capacity Results

Based on the above runway capacity analysis, additional runways are not necessary to meet the anticipated peak hour demand over the next 20-year timeframe. However, if it becomes necessary to close one of the existing runways for an extended period of time for maintenance, it is advisable to have a replacement runway available to avoid significant delays. Chapter 5, *Alternatives Analysis/Evaluation and Environmental Conditions* will assess various new runway locations which provide additional airfield capacity for the intermediate and long-term capacity needs. For planning purposes, it is recommended to begin the planning, programming, environmental, design and construction 6 to 8 years in advance of the need to construct an additional runway.

4.3.2 Aircraft Fleet Mix

Understanding the aircraft fleet mix operating at an airport is critical in determining airfield capacity. The current and projected aircraft fleet mix for ABIA is defined in Chapter 3, *Aviation Activity Forecast,* and a list of the major aircraft type are provided in **Table 4.3-9**.

Table 4.3-9: Future Aircraft Fleet Mix

AIRCRAFT	DEPARTURES					
	2016	2017	PAL 1 2019	PAL 2 2022	PAL 3 2027	PAL 4 2037
International Air Carrier						
Boeing 787-900	218	362	635	720	959	1,474
Domestic Air Carrier						
Boeing 737-700	13,150	15,523	21,505	23,579	25,446	27,026
Boeing 737-800	6,064	7,555	9,254	10,320	12,952	19,464
All-Cargo						
Boeing 767-200/300	65	250	521	721	977	1,176
Airbus 300-600	481	530	593	660	746	895

Source: Aviation forecast 2037 fleet mix

The combination of small, large, and heavy aircraft operating at an airport influences its operational capacity, both on the airfield and in the surrounding airspace. Combining faster jet aircraft with slower aircraft results in a need for greater spacing between arrivals and departures, which reduces the availability of the runway for operational use and overall capacity.

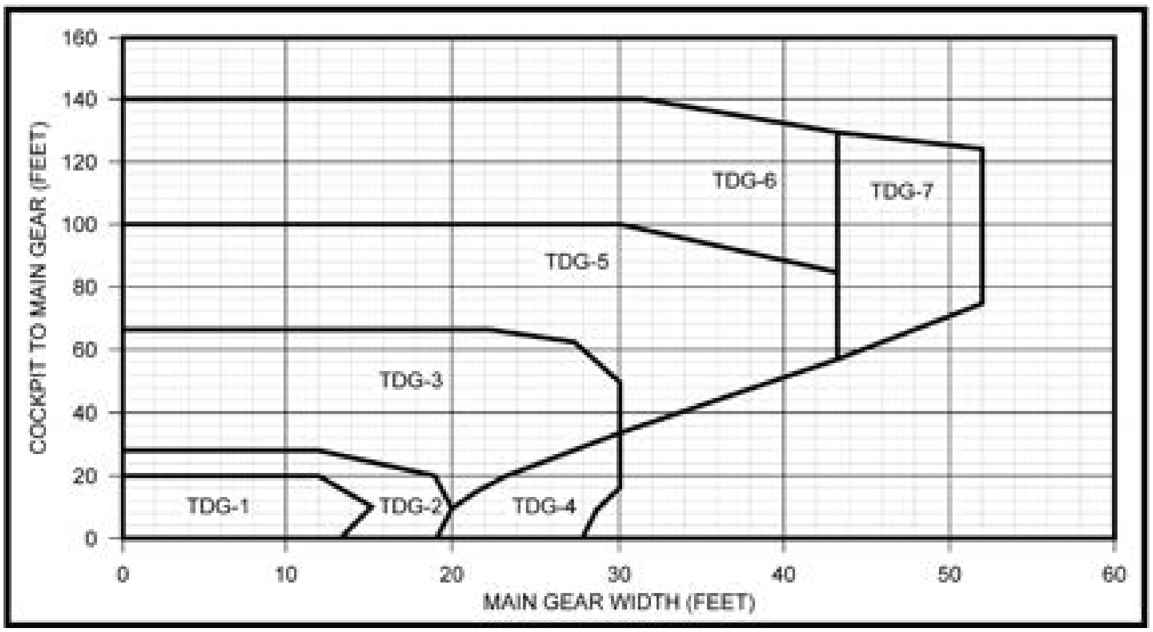
In addition to impacting airport capacity, the existing and future aircraft fleet mix operating at an airport sets many of the standards to which the physical airport facilities are planned and designed. "Design Aircraft" can be determined by examining the fleet mix. The future design aircraft for ABIA is the Boeing 787-900.

It is important to note that the aircraft fleet mix is also used to determine various airport codes, classifications, and designations that help categorize the existing capability of an airfield and to set the design standards used for planning purposes. The following is a listing of these codes, classifications and designations, and their appropriate use:

- Runway Reference Code (RRC): A code signifying the current operational capabilities of a runway and associated parallel taxiway. Consists of Aircraft Approach Category (AAC), Airplane Design Group (ADG), and Visibility Minimums.
- Runway Design Code (RDC): A code signifying the design standards to which the runway is to be built. Consists of AAC and ADG.
- Airport Reference Code (ARC): An airport designation that signifies the airports highest RDC, minus the third (visibility) component of the RDC. The ARC is used for planning and design only and does not limit the aircraft that may be able to operate safely on the airport. Consists of AAC and ADG.
- Taxiway Design Group (TDG): A classification of airplanes based on outer to outer main gear width (MGW) and Cockpit to Main Gear (CMG) distance.

The RDC (using the AAC and ADG, plus visibility minimums) is used primarily to determine standards for runways, runway-to-taxiway separations, and safety areas. Conversely, the TDG is used solely for the application of taxiway standards, taxiway-to-taxiway separations, taxiway turns, and Taxiway Object Free Areas (TOFA). As previously stated, the aircraft characteristics used to determine the TDG of any aircraft are MGW and CMG. **Exhibit 4.3-28** illustrates the different TDG classifications that result when MGW and CMG are combined to determine the TDG of the aircraft.

Exhibit 4.3-28: Taxiway Design Groups



Source: FAA Advisory Circular 150/5300-13A, Exhibit 4-1

4.3.3 Airfield Design Requirements

As previously noted, the future design aircraft for ABIA is the Boeing 787-900. For long-term planning purposes, all existing (where possible) and future airfield elements will be designed in accordance with the Federal Aviation Administration (FAA) Aircraft Design Group V and Taxiway Design Group 5 standards as specified in Advisory Circular 150/5300-13, *Airport Design*.

In terms of a strategy for accommodating potential ADG-VI aircraft operations, the existing west Runway 17R-35L is preferred due to its 300-foot overall pavement width (including shoulders). Therefore, in planning future airfield facilities consideration should be given to ADG-VI aircraft operations on Runway 17R-35L and associated taxiways.

4.3.4 Taxiway Configuration

Traditionally, taxiway systems are intended to help increase airport capacity by maximizing the efficient movement of aircraft to and from the runway. However, over the past decade more emphasis has been placed on taxiway configuration/design as not only a capacity generator, but as a way to increase the overall safety of the airfield. Culminating with the release of FAA Advisory Circular 150/5300-13A, *Airport Design* in late 2012, design guidelines and their ability to address safety concerns has been further emphasized. The primary objective of this new guidance is to decrease the likelihood of runway incursions, and increase overall pilot awareness, elimination of "hot spots", while providing for the efficient flow of aircraft. The FAA defines a "hot spot" as a runway safety related problem area or intersection on an airport. Typically, it is a complex or confusing taxiway/taxiway or taxiway/runway intersection. This may cause an aircraft separation standard to be compromised, then the probability of a collision with another aircraft, vehicle or person is increased.

Several taxiway deficiencies were identified at ABIA. These deficiencies will need to be addressed with the following proposed airfield geometry:

- Provide a new full-length parallel Taxiway D to existing Runway 17R-35L at 550-foot separation
- Provide rapid exit taxiways on Runway 17R-35L
- Reconfiguration of Taxiways 'B', 'G' and 'H' intersection with the airside service road (identified "hot spot")
- Provide Taxiway A separation of 550 feet from Runway 17L-35R
- Modification of various Taxiway C fillets to accommodate ADG-VI aircraft
- Modification of various multiple node taxiway configurations and direct access to the runway
- Use of End-Around Taxiways (EATs) with development of new runways

Some of these airfield configuration modifications are discussed below, while others are addressed in Chapter 5, *Alternatives Analysis/Evaluation and Environmental Conditions*.

4.3.5 Runway Length Requirements

A runway length analysis was performed for ABIA utilizing the forecast (2037) fleet mix to determine takeoff and landing length requirements. For each aircraft within the anticipated future fleet, takeoff and landing length requirements were determined based on guidance in FAA Advisory Circular 150/5325-4B, *Runway Length Requirements for Airport Design,* and the aircraft manufacturer's performance manuals. Takeoff and landing length requirements were assessed for the existing runways and potential future runways.

4.3.5.1 Existing Runway Lengths

ABIA has two existing runways that include Runway 17L-35R and Runway 17R-35L. Runway 17L-35R is 9,000 feet long, while Runway 17R-35L is 12,250 feet long. The full length of both runways is available for takeoffs and landings in both directions, and neither runways have restrictions that would require the application of declared distances.[2]

4.3.5.2 Runway Length Analysis Methodology

The aircraft manufacturer's performance manuals were utilized for the 2037 forecast fleet mix to determine the future runway length requirements specific to conditions at ABIA. The required runway length is based on of the following factors:

- Density altitude (air temperature and elevation)
- Aircraft fleet
- Runway characteristics (slope, wet and dry pavement)

4.3.5.2.1 Density Altitude

Density altitude is a natural phenomenon that decreases aircraft and engine performance. It is a function of the combination of an airport's elevation and air temperature. Higher density altitude decreases an aircraft's operational performance, thereby requiring longer runway distances for takeoff and landing operations.

The aircraft manufacturers' performance manuals contain charts to calculate takeoff runway length requirements based on air temperature and elevation. Takeoff length requirements are calculated based on "standard day" (defined as 59 degrees Fahrenheit) or a "hot day."[3] FAA recommends using the airport's mean daily maximum temperature to calculate takeoff length requirements. The mean daily maximum temperature at ABIA is 96 degrees Fahrenheit for the hottest month in the summer.

The aircraft manufacturers' performance manuals for landing requirements only contain charts for the standard day. The FAA does not require the airport to incorporate the mean daily maximum temperature when calculating landing length requirements. Therefore, landing length requirements were assessed at standard day temperatures.

[2] Per FAA Advisory Circular 150/5300-13A, *Airport Design*, declared distances are "the distances the airport operator declares available for a turbine powered aircraft's takeoff run, takeoff distance, accelerate-stop distance, and landing distance requirements."

[3] "Hot Day" is equal to "Standard Day" temperature (59ºF) plus 37ºF to equal the mean daily maximum temperature at the airport.

Density altitude also includes airport elevation. The higher the elevation of the airport, the longer the runway length requirement needed for each aircraft in the fleet. The airport elevation at ABIA is 541.5 feet Above Mean Sea Level (AMSL).[4]

4.3.5.2.2 Aircraft Fleet

Aircraft fleet operating at an airport in both the short- and long-term forecast period are a critical component to determining future runway length requirements at ABIA. The forecast 2037 design day aircraft fleet for ABIA was used to determine the takeoff and landing length requirements.

The fleet consisted of domestic passenger aircraft, international passenger aircraft, and cargo aircraft. The proposed fleet was narrowed down to the most demanding aircraft for determining the runway length requirements. This condensed fleet is depicted in **Table 4.3-10**. This fleet was used to conduct an analysis in order to ensure the existing runways could accommodate these aircraft at their Maximum Takeoff Weight (MTOW) and Maximum Landing Weight (MLW).

Table 4.3-10: ABIA 2037 Forecast Aircraft Fleet

TYPE	AIRCRAFT	TOTAL OPERATIONS
Domestic Passenger	Boeing 737-700	40,630
Domestic Passenger	Boeing 737-800	30,390
Domestic Passenger	Boeing 737 Max8	18,706
Domestic Passenger	Airbus A319	18,146
Domestic Passenger	Airbus A320	13,284
Domestic Passenger	Airbus A321	9,450
Domestic Passenger	Boeing 737-900	6,106
Domestic Passenger	Airbus A320neo	3,876
Domestic Passenger	Embraer 190/195	3,092
Cargo	Boeing 767-300F	1,410
Domestic Passenger	Boeing 737 Max9	1,276
International Passenger	Boeing 787-900	1,250
Cargo	Airbus A300-600	1,108
Domestic Passenger	Bombardier CS100	894
Cargo	Boeing 737-400	558
Domestic Passenger	Boeing 717-200	504
International Passenger	Boeing 777	172
International Passenger	Boeing 787-800/900	158
International Passenger	Boeing 767-300ER	138
Cargo	Boeing 757-200	124
Cargo	Boeing 747-400	90

[4] FAA Aeronautical Information Services- National Flight Data Center (NFDC), 2018.
Above Mean Sea Level is a standard measurement in feet (U.S.) of the elevation of a location in reference to a historic mean sea level.

TYPE	AIRCRAFT	TOTAL OPERATIONS
Cargo	Boeing 767-200/300	28
Cargo	Boeing 747-8F	8

Source: Aviation forecast 2037 fleet mix

4.3.5.2.3 Runway Characteristics

Runway characteristics such as surface contamination (rain, snow, ice, etc.) and runway gradients are also important inputs used to determine runway length requirements. Runways that are plagued by surface contaminants often require longer landing lengths than dry surfaces, while effective runway gradients[5] also require longer takeoff lengths in uphill conditions.

Some aircraft manufacturers have designated landing length charts for contaminated surfaces. For those manufacturers that do not offer these charts, the dry landing length requirements are increased by a standard 15 percent to account for contaminated surface conditions. The FAA recommends using dry surface conditions for takeoff length requirements. An additional 10 feet is added to the takeoff length requirement for each foot of difference in the high and low points of the runway centerline elevations. The manufacturer’s performance manuals assume a zero effective runway gradient; thus, this additional factor is required.

4.3.5.3 Existing Runway Takeoff Length Requirement

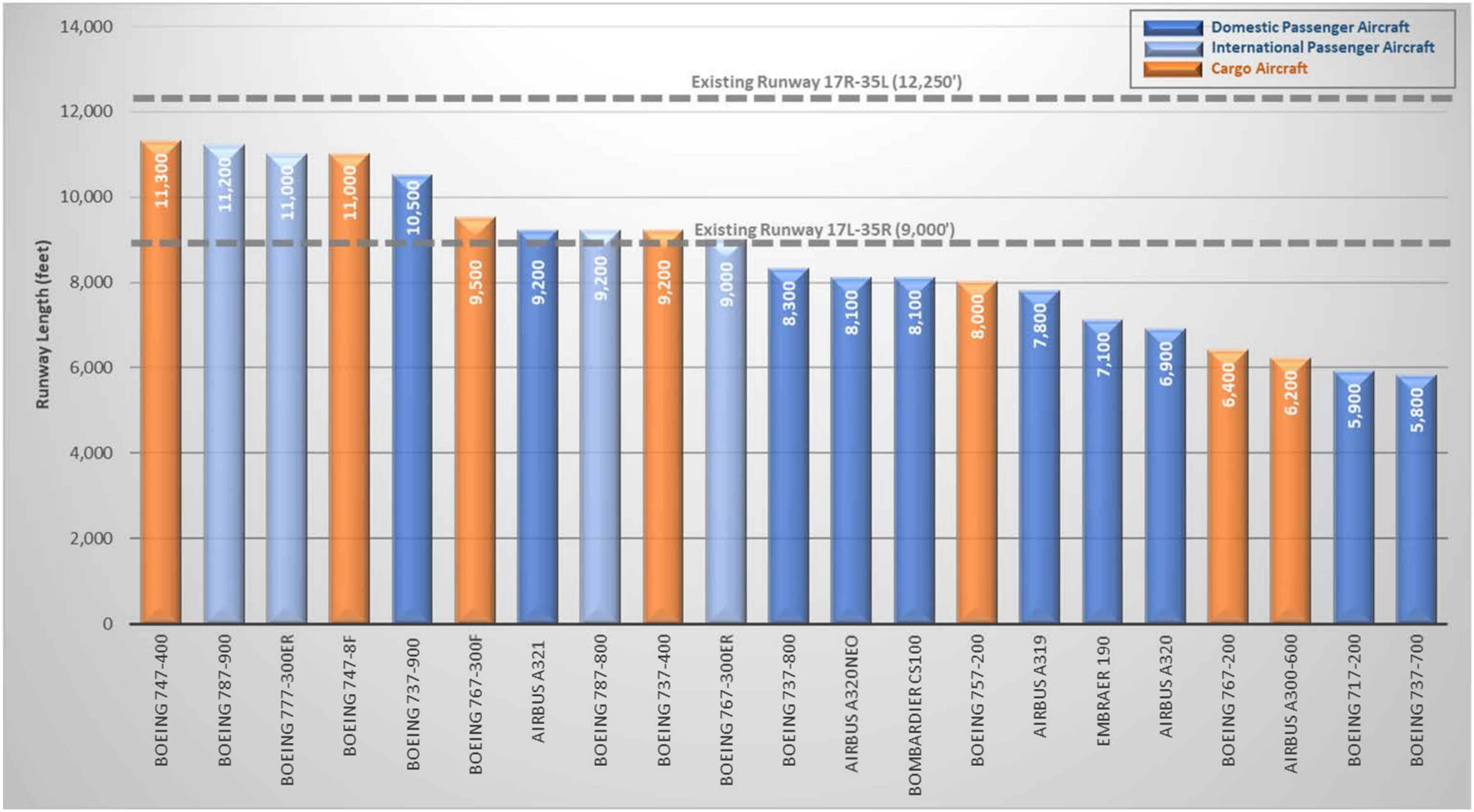
Runway takeoff length requirements were calculated using the aircraft MTOW. The MTOW takeoff length results are depicted in **Exhibit 4.3-29**. The most critical aircraft for takeoff length is the B-747-400, which will require a runway length of 11,300 feet. Nine aircraft type will require more than 9,000 feet for takeoff. These nine aircraft will need to request Runway 17R-35L when operating at MTOW or reduce their fuel or payload to compensate for the reduced Runway 17L-35L length of 9,000 feet. Twelve aircraft type can takeoff on either existing runway at MTOW without any weight penalties on a hot-day.

4.3.5.4 Existing Runway Landing Length Requirement

Runway landing requirements were calculated using the aircraft MLW in wet pavement conditions. All aircraft landing length requirements for the forecast 2037 fleet are depicted in **Exhibit 4.3-30**. Landing lengths ranged from 5,405 feet (Airbus 319) to 9,000 feet (Boeing 747-8F). All aircraft in the forecast 2037 fleet can safely land on either existing runway without weight penalties in wet pavement conditions.

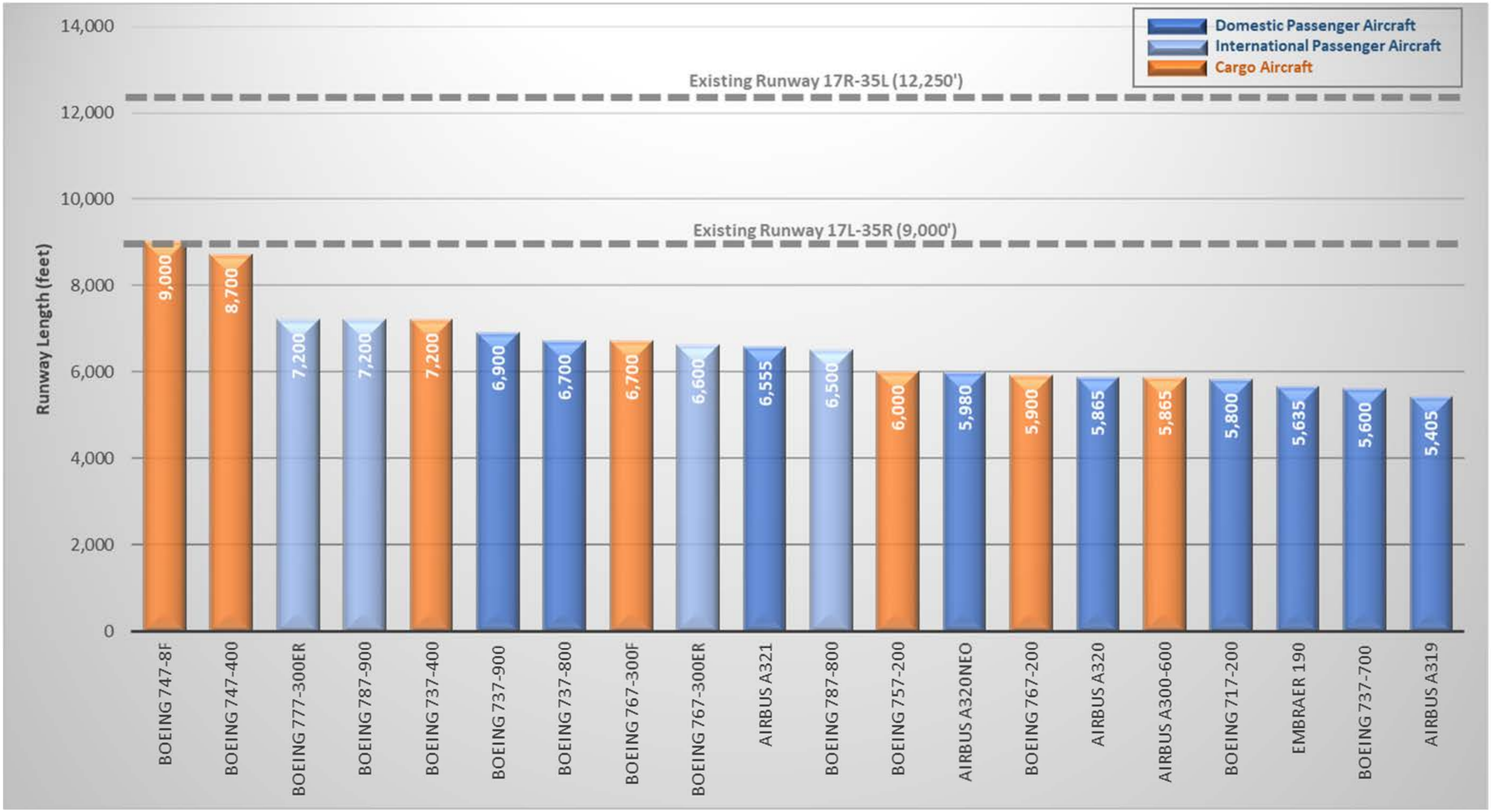
5 The difference between the highest and lowest elevations of the runway centerline divided by the runway length.

Exhibit 4.3-29: Existing Runways: Takeoff Length Analysis at MTOW



Note: Aircraft manufacturing planning charts were not available to calculate takeoff length analysis for the Boeing 737 Max 8 or Max 9 aircraft.
Source: Landrum & Brown analysis

Exhibit 4.3-30: Existing Runways: Landing Length Analysis at MLW



Note: Aircraft manufacturing planning charts were not available to calculate landing length analysis for the Boeing 737 Max 8 or 9, as well as, the Bombardier CS100.
Source: Landrum & Brown analysis

4.3.5.5 Existing Runway Length Requirements Summary

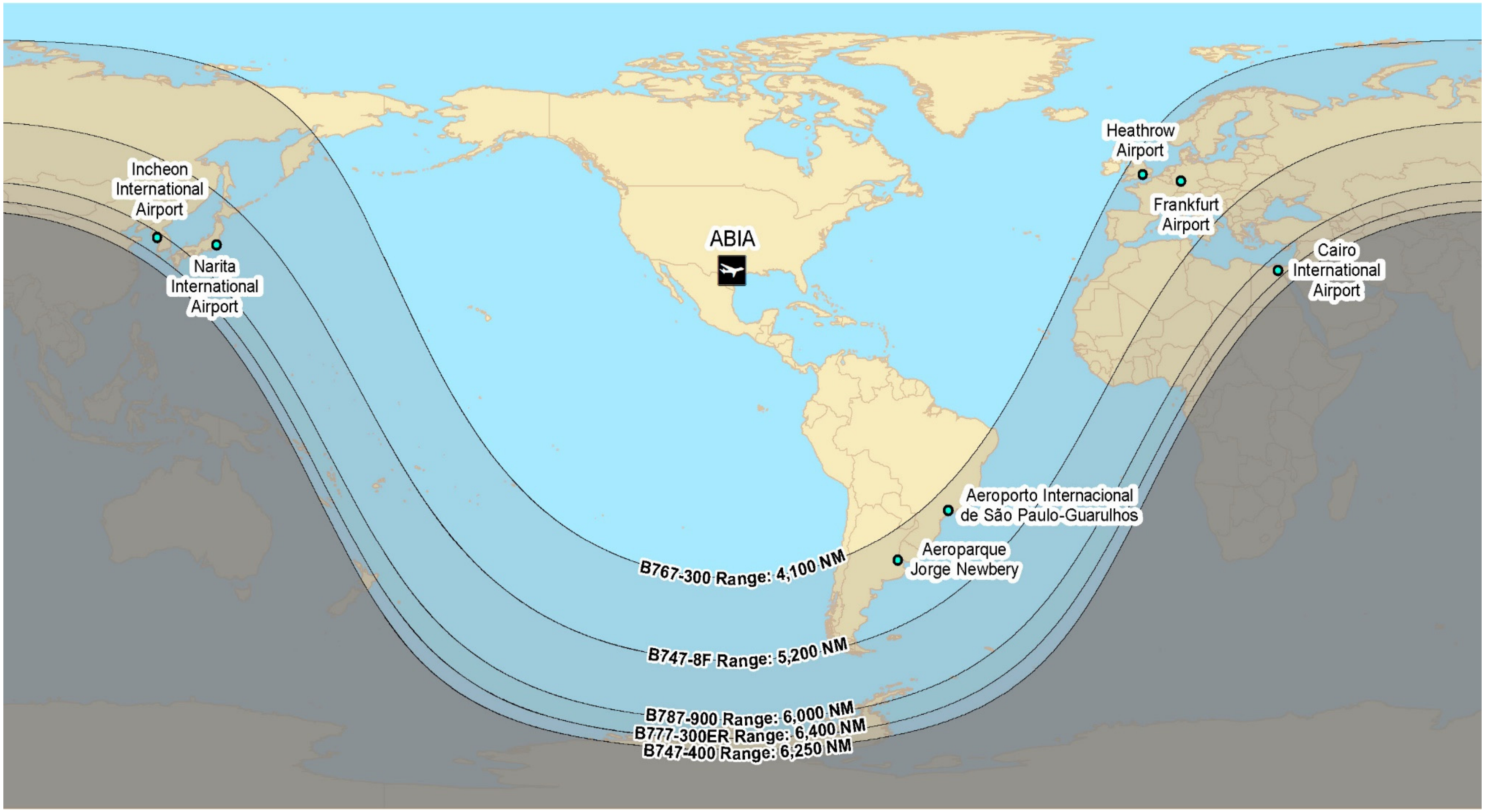
Runway 17R-35L is capable of accommodating every aircraft in the forecast 2037 fleet mix at MTOW. The 12,250-foot runway length allows international passenger and cargo aircraft flexibility in choosing to fly long distances and/or carry heavy payloads. Landings at maximum landing weight are also possible on Runway 17R-35L.

The 9,000-foot long Runway 17L-35R serves mostly domestic flights, allowing most aircraft the ability to take maximum payload to most domestic destinations from ABIA. All aircraft in the forecast 2037 fleet are capable of landing on Runway 17L-35R with maximum landing weight.
The overall takeoff length requirement for the existing runways at ABIA are 11,300 feet for takeoff (Boeing 747-400) and 9,000 feet for landing (Boeing 747-8F) operations.

4.3.5.6 Aircraft Range

Based on the existing 12,250-foot long Runway 17R-35L, **Exhibit 4.3-31** shows the maximum range for various aircraft type at maximum takeoff weight (MTW). All aircraft in the ABIA future fleet can reach all U.S. cities at MTW. Long-haul international destinations in Europe (London & Frankfurt) and Asia (Incheon and Narita) can be reached by a majority of the wide-body aircraft.

Exhibit 4.3-31: Aircraft Range Map (12,250' Runway)



Source: Landrum & Brown analysis

4.3.5.7 Future Runway Takeoff Length Requirements

In order to determine the optimum length for any future runway at ABIA, it was critical to look at the runway length analysis presented above for the existing runways. The length requirements for a new runway were determined based on the 2037 forecast aircraft fleet performance.

As noted in FAA Advisory Circular (AC) 150/5325-4B, *Runway Length Requirements for Airport Design,* "Additional primary runways for capacity justification are parallel to and equal in length to the existing primary runway, unless they are intended for smaller airplanes." In addition, FAA AC 150/5000-17, *Critical Aircraft and Regular Use Determination*, notes that the critical aircraft for determining runway length requirements is the most demanding aircraft type, or grouping of aircraft with similar characteristics, that make regular use of the airport. Regular use is 500 annual operations, including both itinerant and local operations. **Table 4.3-11** shows the critical aircraft at ABIA and their takeoff runway length requirement.

Table 4.3-11: Runway Length Requirements by Critical Aircraft

TYPE	AIRCRAFT	ANNUAL OPERATIONS	TAKEOFF LENGTH REQUIRED [FT.]
Cargo	Boeing 747-400	90	11,300
International Passenger	Boeing 787-900	1,250	11,200
International Passenger	Boeing 777-300ER	172	11,000
Cargo	Boeing 747-8F	8	11,000
Domestic Passenger	Boeing 737-900	6,106	10,500

Source: Aviation forecast 2037 fleet mix

The Boeing 747-400/8F, 787-900 and 777-300ER aircraft have similar characteristics, and therefore were considered for determining the future new runway length requirements. The B-747-400 requires the longest takeoff length of 11,300 feet, and the B-787-900 requires a runway length of 11,200 feet. Since the B-787-900 has the larger number of annual operations, this aircraft will be considered as the critical aircraft at ABIA for future planning design.

This future new runway length recommendation is evaluated in more detail In Chapter 5, *Alternatives Analysis/Evaluation and Environmental Conditions,* and could be adjusted depending on various operational criteria and site constraints.

4.3.6 Runway Exit Analysis

Entrance/exit taxiways, also referred to as runway exits; connect runways to the taxiway system. These taxiways provide paths for aircraft to enter the runway for departure or exit the runway after landing. The placement and type of runway exits depend on many factors, including the type of aircraft using the runway, airport specific environmental data, surface conditions, and human factors. This section presents the methodology and results of the ABIA runway exit analysis.

4.3.6.1 Runway Exit Analysis Input

The FAA's Runway Exit Interactive Design Model (REDIM) was used to analyze the forecast 2037 fleet mix at ABIA on the existing runways. The primary objective of the REDIM analysis is to minimize the Runway Occupancy Time (ROT), with an optimum average ROT of 50 seconds or less. The ROT for each runway is influenced by the number, type, and location of the runway exits. A reduced ROT also increases airfield capacity by reducing the in-trail separation between succeeding aircraft based on RECAT and wake turbulence requirements.

4.3.6.2 Aircraft Fleet Mix

The REDIM model requires various input data to determine exit utilization and average ROT. The analysis utilized the forecast 2037 aircraft fleet to ensure aircraft throughout the planning period are able to efficiently land on all runway ends. The aircraft fleet used in the analysis is depicted in **Table 4.3-12**. This represents the aircraft that are available within the FAA's REDIM model and may not reflect the complete forecast 2037 aircraft fleet mix. Many newer aircraft models (B-737-Max 8/9) are anticipated to perform in a similar manner as other models in this list.

Table 4.3-12: ABIA 2037 Aircraft Fleet

AIRCRAFT	OPERATIONS	% OF FLEET	ADJUSTED %
A300-600	1,108	1%	1%
A321-neo	44,756	30%	29%
B717-200	504	Less than 1%	1%
B737-300	41,188	27%	26%
B737-800	56,478	37%	34%
B747-400	90	Less than 1%	1%
B747-8F	8	Less than 1%	1%
B757-200	124	Less than 1%	1%
B767-300	1,576	1%	1%
B777	172	Less than 1%	1%
B787-800	1,408	1%	1%
CRJ-700	894	1%	1%
ERJ 17	3,092	2%	2%

Source: Aviation forecast 2037 fleet mix

4.3.6.3 REDIM Model Input

Airport specific data was included amongst many standard inputs used in the REDIM program to conduct the analysis. The ABIA specific input was applied to all runway analysis and included the following:

Environmental Data

- Wind Speed: 5 knots
- Airport Elevation: 541.6 feet
- Airport Temperature: 96 degrees Fahrenheit
- Surface Condition: 80% dry condition and 20% wet condition on runways

Operational Data

- Free Roll Time: Between 2 and 3 seconds
- Safety Factor: 100%
- Minimum High-Speed Exit Separation: 1,500 feet
- Minimum Right-Angled Exit Separation: 450 feet
- Surface Condition: 80% dry and 20% wet occurrence of surface conditions

4.3.6.4 Runway Input

Additionally, various input data is dependent upon each runway end analyzed at ABIA. Each runway end requires different input data that includes the following:

Environmental Runway Data

- Wind Direction: head winds for all analyses
  - Runways 17L and 17R: 354.6 degrees
  - Runways 35L and 35R: 174.6 degrees
- Runway Orientation:
  - Runways 17R and 17L: 174.6 degrees
  - Runways 35L and 35R: 354.6 degrees

Runway Length, Width, and Gradient

- Runway Length: full runway lengths for both existing runways
  - Runway 17L-35R: 9,000 feet
  - Runway 17R-35L: 12,250 feet
- Runway Width: All runways used 150 feet
- Runway Gradient:
  - Runway 17L: 0.20%
  - Runway 35R: 0.20 %
  - Runway 17R: 0.44%
  - Runway 35L: 0.44 %
- Existing Exit Locations
- Exit Speeds:
  - 90 Degree Exit: 41 feet/second
  - 45 Degree Exit: 59 feet/second
  - 30 Degree Exit: 87.6 feet/second

4.3.6.5 Existing Runway Exit Analysis

A runway exit analysis was conducted for the existing runway ends in both directions for Runways 17L-35R and 17R-35L. The average ROT for each runway end was analyzed using the REDIM model, and the results are summarized in the following sections. It should be noted that the actual runway exit usage will vary slightly from present usage due to the different aircraft fleet mix used in this analysis. More importantly, this analysis illustrates that the existing runway exit type and locations do not provide the optimum runway capacity. Therefore, the RETs should be located and designed to maximize its capacity.

4.3.6.5.1 Existing Runway 17L Arrivals

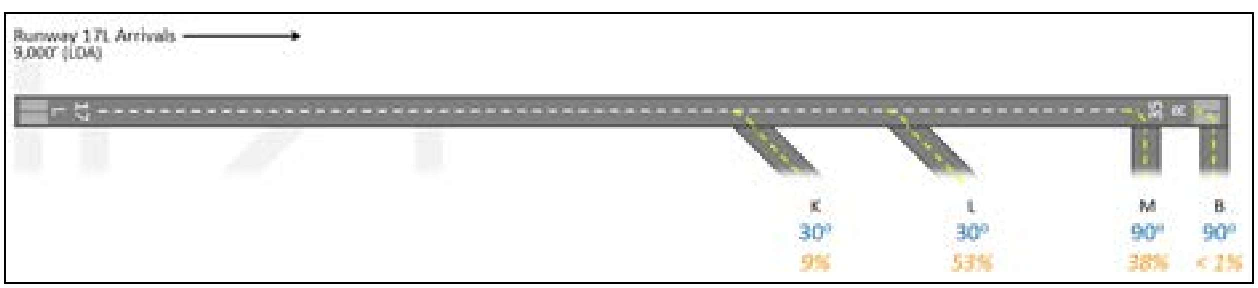
Existing Runway 17L has an average ROT of 52.98 seconds based on the existing number and type of existing runway exits. Taxiway L is used a majority of the time with an exit usage of 53 percent. Results are depicted in **Table 4.3-13** and **Exhibit 4.3-32**.

Table 4.3-13: Existing Runway 17L ROT Results

EXIT NAME	DISTANCE [FT.]	EXIT ANGLE	% USE
J	3,270	90°	0%
K	4,700	30°	9%
L	5,599	30°	53%
M	8,597	90°	38%
B	8,797	90°	0%
Weighted Avg. ROT = 52.98 seconds			100%

Source: Landrum & Brown analysis

Exhibit 4.3-32: Existing Runway 17L REDIM Layout



Notes: Taxiway exit angles in blue and exit utilization in orange.
Source: FAA's Runway Exit Interactive Design Model (REDIM) and Landrum & Brown analysis.

This runway end does not meet the desired 50-second ROT threshold. However, it is not recommended to make any modifications to the Runway 17L exits at this time due the runway's current length and location relative to the existing and future terminal gates.

4.3.6.5.2 Existing Runway 35R Arrivals

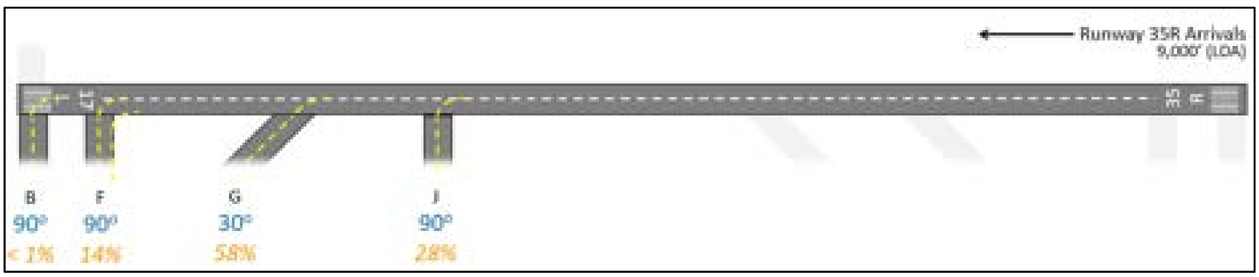
Existing Runway 35R has an average ROT of 49.44 seconds based on the number and type of existing runway exits. Taxiway G is used a majority of the time with an exit usage of 58 percent. Results are depicted in **Table 4.3-14** and **Exhibit 4.3-33**.

Table 4.3-14: Existing Runway 35R ROT Results

EXIT NAME	DISTANCE [FT.]	EXIT ANGLE	% USE
J	5,399	90°	28%
G	5,897	30°	58%
F	8,597	90°	14%
B	8,797	90°	0%
Weighted Avg. ROT = 49.44 seconds			100%

Source: Landrum & Brown analysis

Exhibit 4.3-33: Existing Runway 35R REDIM Layout



Notes: Taxiway exit angles in blue and exit utilization in orange.
Source: FAA's Runway Exit Interactive Design Model (REDIM) and Landrum & Brown analysis.

This runway end meets the desired 50-second ROT threshold. Therefore, no additional rapid exit taxiways or revisions to the existing exits are necessary.

4.3.6.5.3 Existing Runway 17R Arrivals

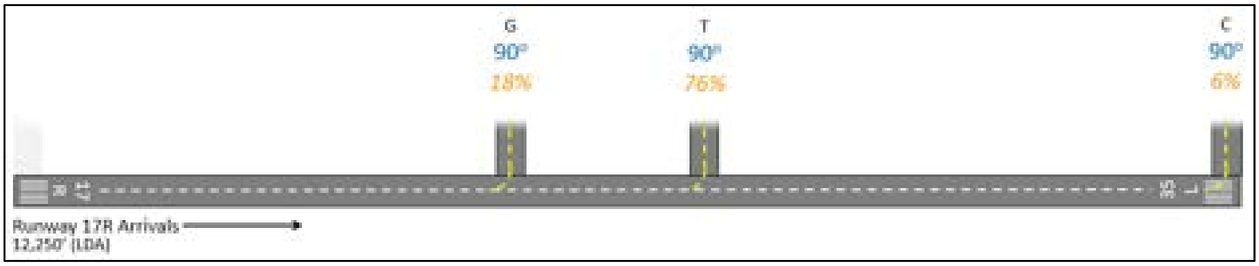
Existing Runway 17R has the highest ROT of any existing runway ends at ABIA, with an average ROT of 58.46 seconds based on the number and type of existing runway exits. Taxiway T is used a majority of the time with an exit usage of 76 percent. Results are depicted in **Table 4.3-15** and **Exhibit 4.3-34**.

Table 4.3-15: Existing Runway 17R ROT Results

EXIT NAME	DISTANCE [FT.]	EXIT ANGLE	% USE
G	5,399	90°	18%
T	7,200	90°	76%
C	12,047	90°	6%
Weighted Avg. ROT = 58.46 seconds			100%

Source: Landrum & Brown analysis

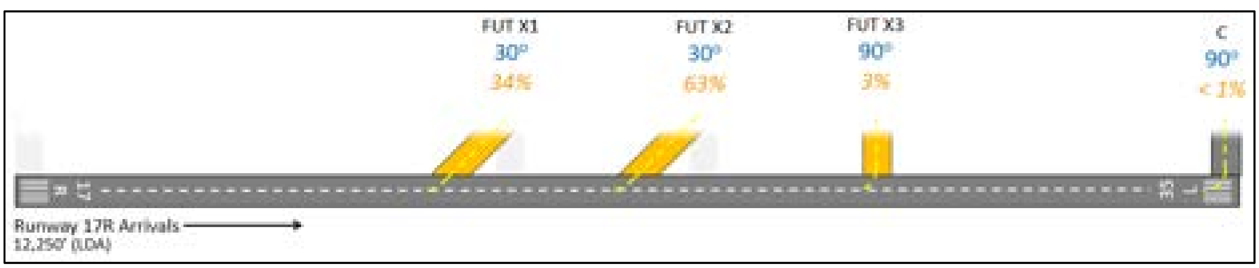
Exhibit 4.3-34: Existing Runway 17R REDIM Layout



Notes: Taxiway exit angles in blue and exit utilization in orange.
Source: FAA's Runway Exit Interactive Design Model (REDIM) and Landrum & Brown analysis.

This runway end is approximately 8 seconds over the desired 50-second ROT threshold. In order to reduce the Runway 17R average ROT, it is recommended that 90-degree Taxiways G and T exits be removed and reconstructed into rapid exit taxiways. In addition, a fourth 90-degree runway exit is recommended between Taxiways T and C (35L threshold). These new Runway 17R exits are depicted in **Exhibit 4.3-35**.

Exhibit 4.3-35: Optimized Runway 17R REDIM Layout



Notes: Taxiway exit angles in blue and exit utilization in orange. Proposed exits are depicted in yellow.
Source: FAA's Runway Exit Interactive Design Model (REDIM) and Landrum & Brown analysis.

The optimization of Runway 17R exits brings the average ROT down roughly 8 seconds from 58.46 to 50.42 seconds as shown in **Table 4.3-16**. This is near the desired 50-second ROT threshold and will have a significant impact on the Runway 17R occupancy times during landing operations.

Table 4.3-16: Optimized Runway 17R ROT Results

EXIT NAME	DISTANCE [FT.]	EXIT ANGLE	% USE
A	5,248	30°	34%
B	6,888	30°	63%
C	9,020	90°	3%
D	12,047	90°	0%
Weighted Avg. ROT = 50.42 seconds			100%

Source: Landrum & Brown analysis

4.3.6.5.4 Existing Runway 35L Arrivals

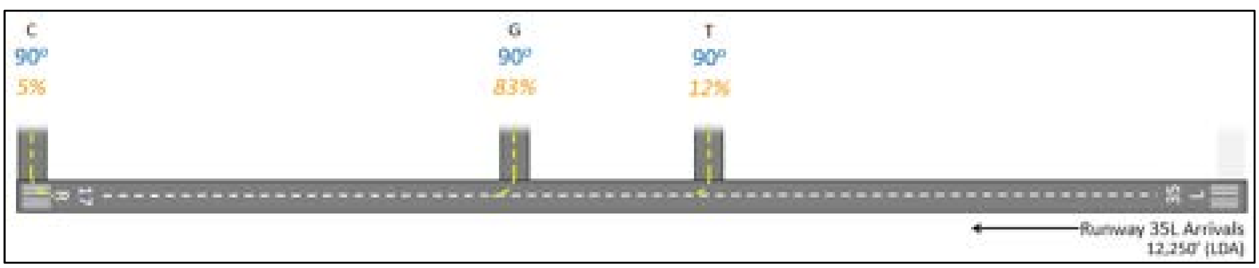
Existing Runway 35L has an average ROT of 56.70 seconds based on the existing location and type of runway exits. Taxiway G is used a majority of the time with an exit usage of 83 percent. Results are depicted in **Table 4.3-17** and **Exhibit 4.3-36**.

Table 4.3-17: Existing Runway 35L ROT Results

EXIT NAME	DISTANCE [FT.]	EXIT ANGLE	% USE
T	5,097	90°	12%
G	6,898	90°	83%
C	12,047	90°	5%
Weighted Avg. ROT = 56.70 seconds			100%

Source: Landrum & Brown analysis

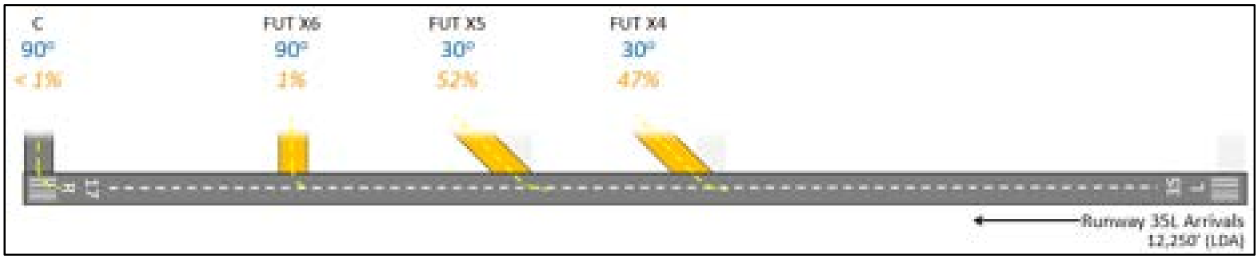
Exhibit 4.3-36: Existing Runway 35L REDIM Layout



Notes: Taxiway exit angles in blue and exit utilization in orange.
Source: FAA's Runway Exit Interactive Design Model (REDIM) and Landrum & Brown analysis.

The average ROT for Runway 35L is almost 7 seconds higher than the desired 50-second ROT to take advantage of the RECAT arrival separations. The higher average ROT is a result of the runway length and presence of only 90-degree runway exits. In order to optimize the Runway 35L ROT, it is recommended that the 90-degree Taxiways T and G be removed and reconstructed into rapid exit taxiways. In addition, a fourth 90-degree runway exit is recommended between Taxiways G and C (17R threshold). The optimized layout of the Runway 35L exits is depicted in **Exhibit 4.3-37**.

Exhibit 4.3-37: Optimized Runway 35L REDIM Layout



Notes: Taxiway exit angles in blue and exit utilization in orange. Proposed exits are depicted in yellow.
Source: FAA's Runway Exit Interactive Design Model (REDIM) and Landrum & Brown analysis.

The optimization of Runway 35L brings the average ROT down approximately 8 seconds from 56.70 to 48.55 seconds as shown in **Table 4.3-18**. This is under the desired 50-second ROT threshold and will have a significant impact on the Runway 35L occupancy times during landing operations.

Table 4.3-18: Optimized Runway 35L ROT Results

EXIT NAME	DISTANCE [FT.]	EXIT ANGLE	% USE
A	5,248	30°	47%
B	6,888	30°	52%
C	9,020	90°	1%
D	12,047	90°	0%
Weighted Avg. ROT = 48.55 seconds			100%

Source: Landrum & Brown analysis

4.3.6.6 Existing Runway Exist Analysis Summary

Based on the runway exit analysis presented above for existing Runways 17L-35R and 17R-35L, it is recommended to provide additional rapid exist taxiways and 90-degree exit taxiways on Runway 17R-35L in both directions to reduce the average ROT to 50 seconds or less.

4.3.7 Airfield Safety Areas

There are three primary safety areas that provide for the safety of aircraft moving about the airport. These three safety areas include:

- Runway Protection Zone (RPZ)
- Runway End Safety Area (RESA)
- Runway Object Free Area (ROFA)

While ABIA is not completely in compliance with these safety areas, the FAA Southwest Texas Region Airport District Office (FAA TX ADO) has determined them to be “acceptable” in their existing conditions. When any associated runway is significantly improved, a requirement to address any non-compliant safety area as part of the project is likely. Examples of significant improvement include runway extension, runway widening, or shifting of the runway centerline. The following sections show the requirements for full compliance of the safety area standards for the runways in their existing configuration.

4.3.7.1 Runway Protection Zone

The RPZs function is to enhance the protection of people and property on the ground. This is best achieved through airport owner control over RPZs. Control is preferably exercised through the acquisition of sufficient property interest in the RPZ and includes clearing RPZ areas (and maintaining them clear) of incompatible objects and activities[6].

Of the four RPZs at ABIA (one for each runway end), two are completely on airport property and are located on the ends of Runway 35R and Runway 35L. For Runway 17R, there is a small portion of the northwest corner (Controlled Activity Area) that is over the north exit ramp from US Highway 183 onto westbound State Highway 71. In addition, the Greenwood/Martin Cemetery is located just west of the Runway 17R extended centerline and inside the Central Portion of the RPZ. For Runway 17L, there is a small portion of the northeast corner (Controlled Activity Area) that is over the westbound SH 71 lanes and entrance ramp. In addition, a small portion of Hotel Drive and Presidential Blvd. are located in the northwest corner (Controlled Activity Area) of the 17L RPZ. Even though the Runway 35L RPZ is completely on airport property, the Burleson Roadway runs across the entire width of the RPZ in an east-west direction.

In accordance with FAA Memorandum, *Interim Guidance on Land Uses Within a Runway Protection Zone*, dated September 27, 2012, was used to determine the appropriate action required for mitigation of incompatible land uses within the existing RPZs at ABIA. However, this interim policy only addresses the introduction of new or modified land uses to the RPZ and proposed changes to the RPZ size or location. Based on this policy, the ABIA will continue to coordinate with the FAA TX ADO on possible mitigation measures to rectify these potential incompatible land uses within the RPZs.

6 FAA Advisory Circular 150/5300-13A, Airport Design, Paragraph 310.

4.3.7.2 Runway End Safety Area and Runway Object Free Area

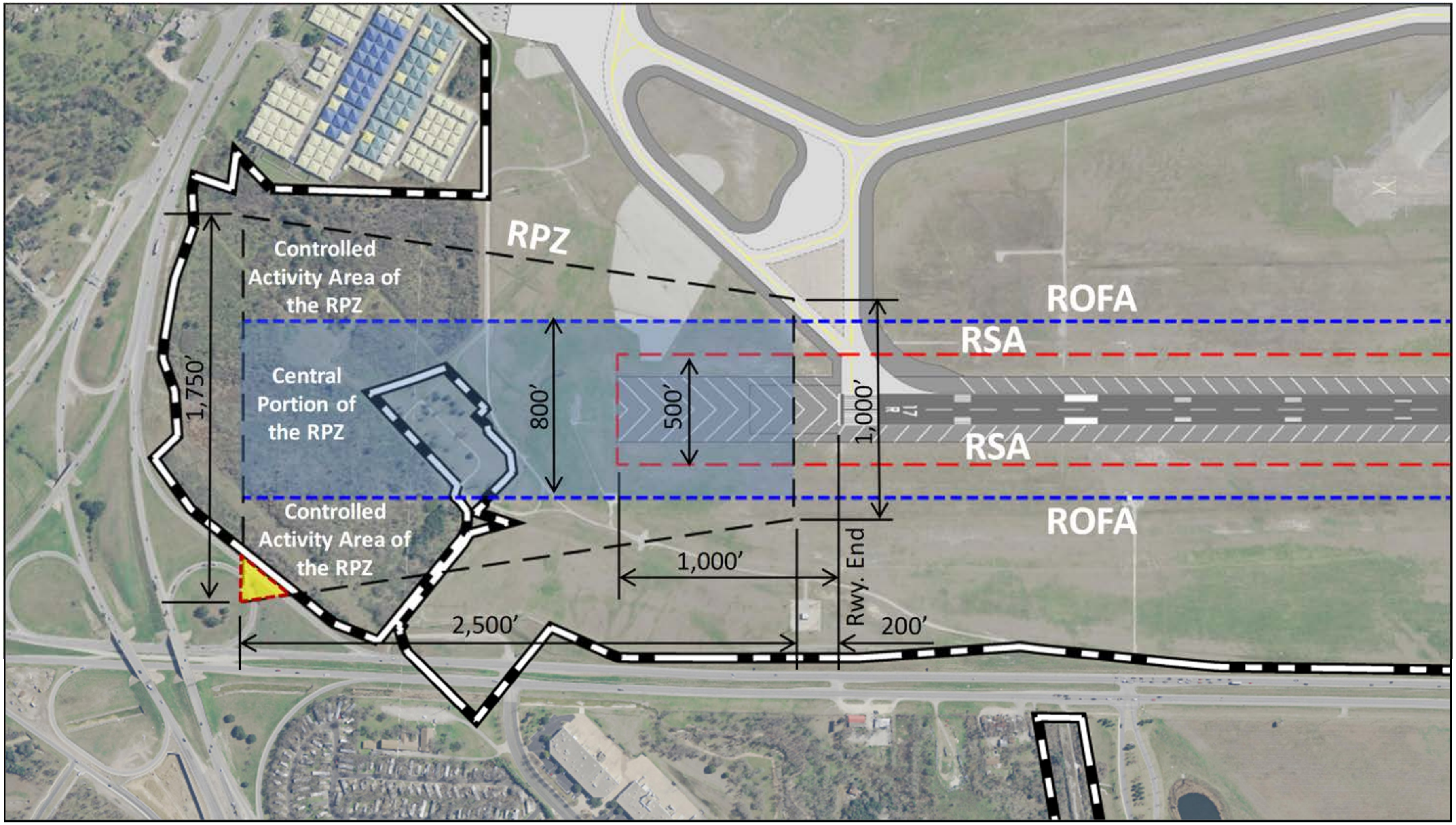
All four of the RSA ends meet current design standards of 500 feet wide and 1,000 feet long are shown in **Exhibit 4.3-38** through **Exhibit 4.3-41**. In addition, the full length of the RSA along the entire runway length is also in compliance with FAA design guidelines. Based on a clear RSA, there is no requirement to apply declared distances or reduced runway length to comply with FAA design guidelines. In addition to RSAs, this section also addresses ROFAs due to the co-dependency of these to safety areas. All four of the ROFAs meet current design standards of 800 feet wide and 1,000 feet long. The full length of the ROFA along the entire runway length is also in compliance with FAA design criteria.

4.3.8 Identification of Actions Required to Comply with FAA Design Standards

For future planning purposes, the critical aircraft at ABIA is the Boeing 787, which is in the ADG-V category. All future airfield and terminal projects will need to follow ADG-V design requirements. Where feasible, the following areas of the existing airfield will need to be reviewed and updated for compliance with ADG-V design standards.

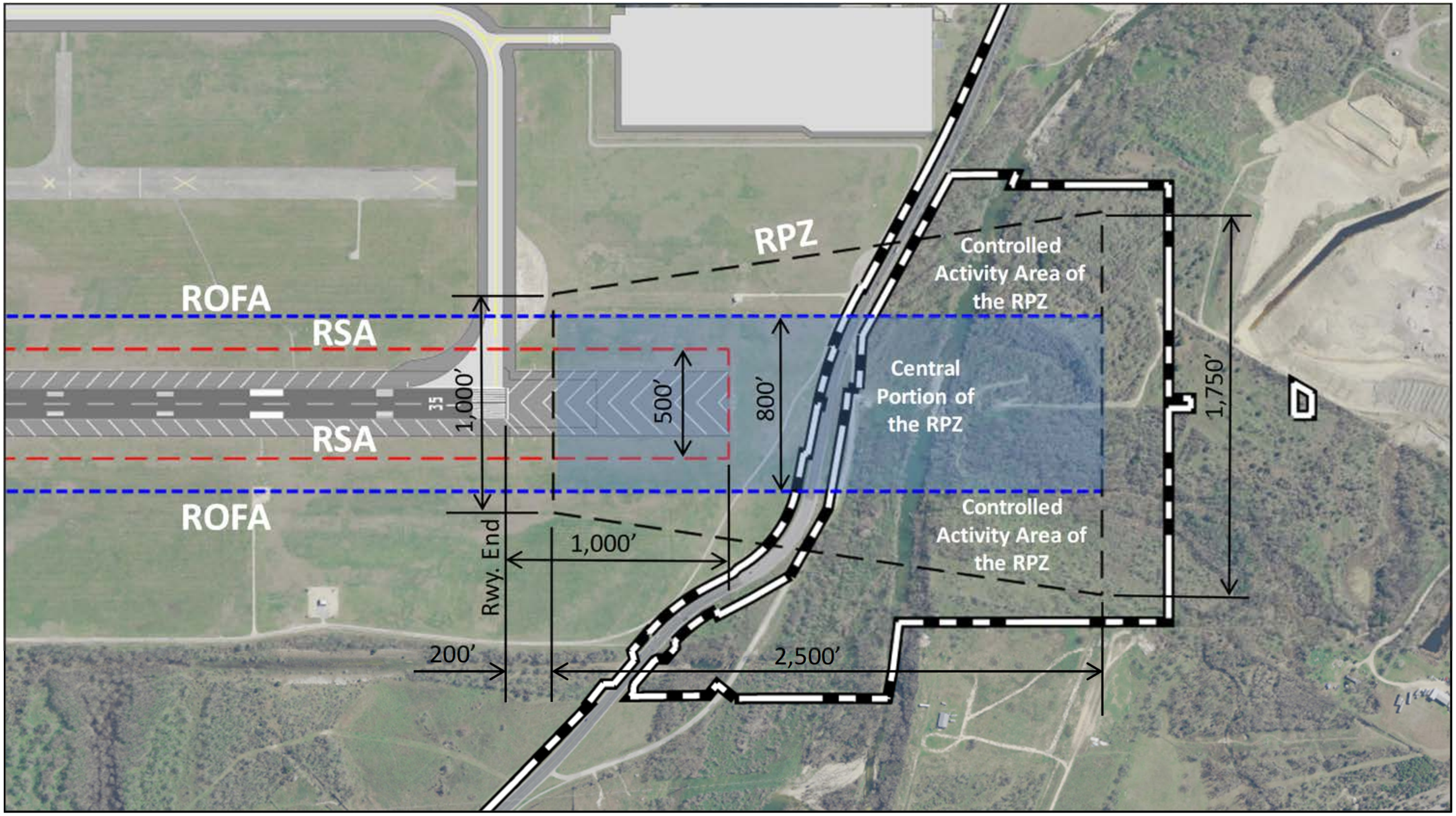
- *Taxiway Alpha:* The Taxiway A centerline separation from Runway 17L-35R is 400 feet, which only meets current ADG-III design standards for runway safety area clearance. Runway 17L-35R cannot be used if an ADG-IV or larger aircraft is using Taxiway A. This will require a minimum runway to taxiway centerline separation of 500 feet.
- *Taxiway C Fillets:* As a reliever airport, ABIA will occasionally receive ADG-VI aircraft as diversions from other surrounding airports. Runway 17R-35L can accommodate these aircraft due to its overall length and width. However, several of the Taxiway C fillets are not sufficient to accommodate aircraft greater than ADG-V. It is recommended to construct a new full-length parallel Taxiway D to Runway 17R-35L with a separation of 500 feet. Additional rapid exit taxiways and 90-degree exits will also be provided to improve the average runway occupancy time.

Exhibit 4.3-38: 17R Runway End Safety Areas



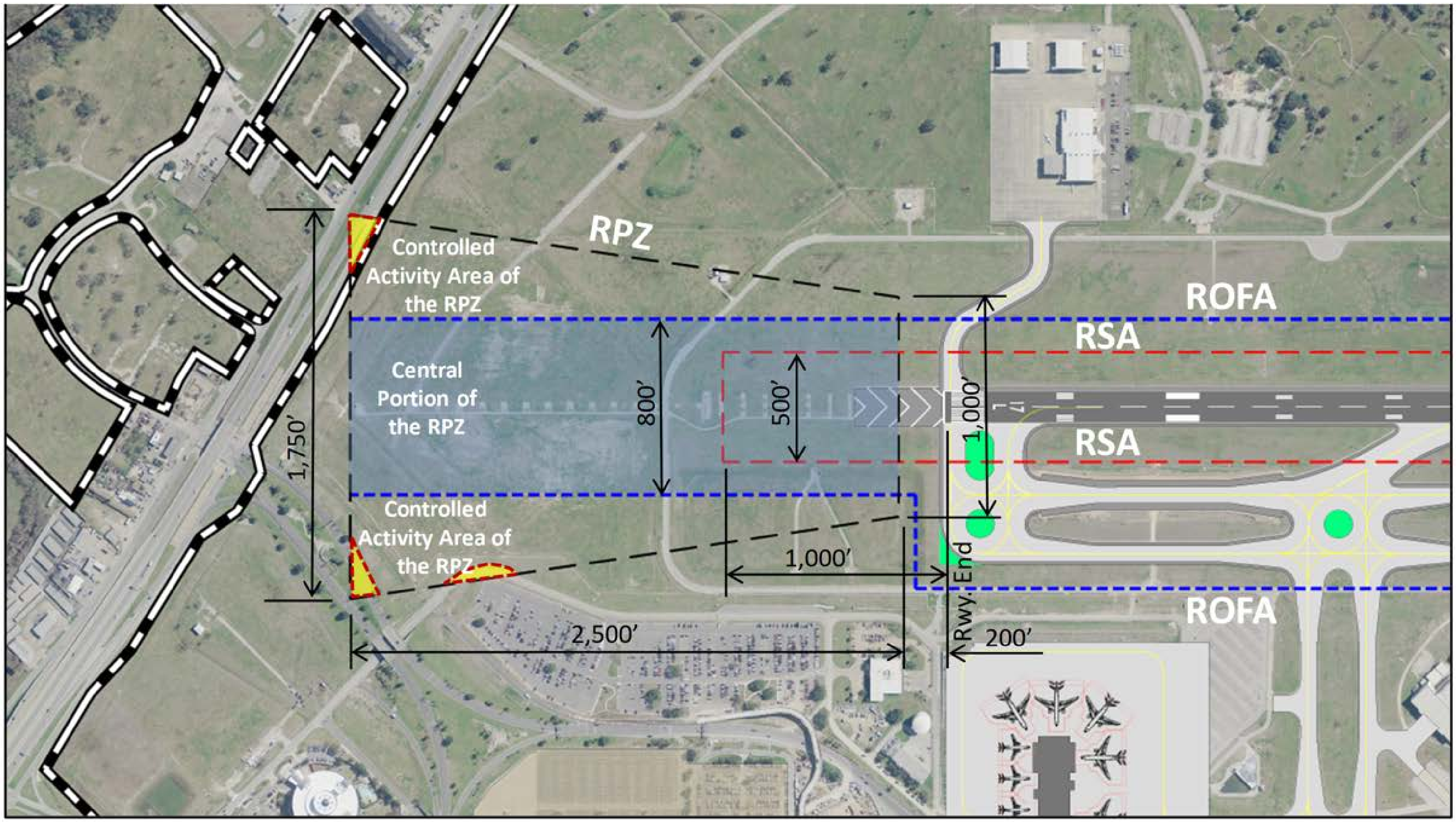
Source: Landrum & Brown analysis

Exhibit 4.3-39: 35L Runway End Safety Areas



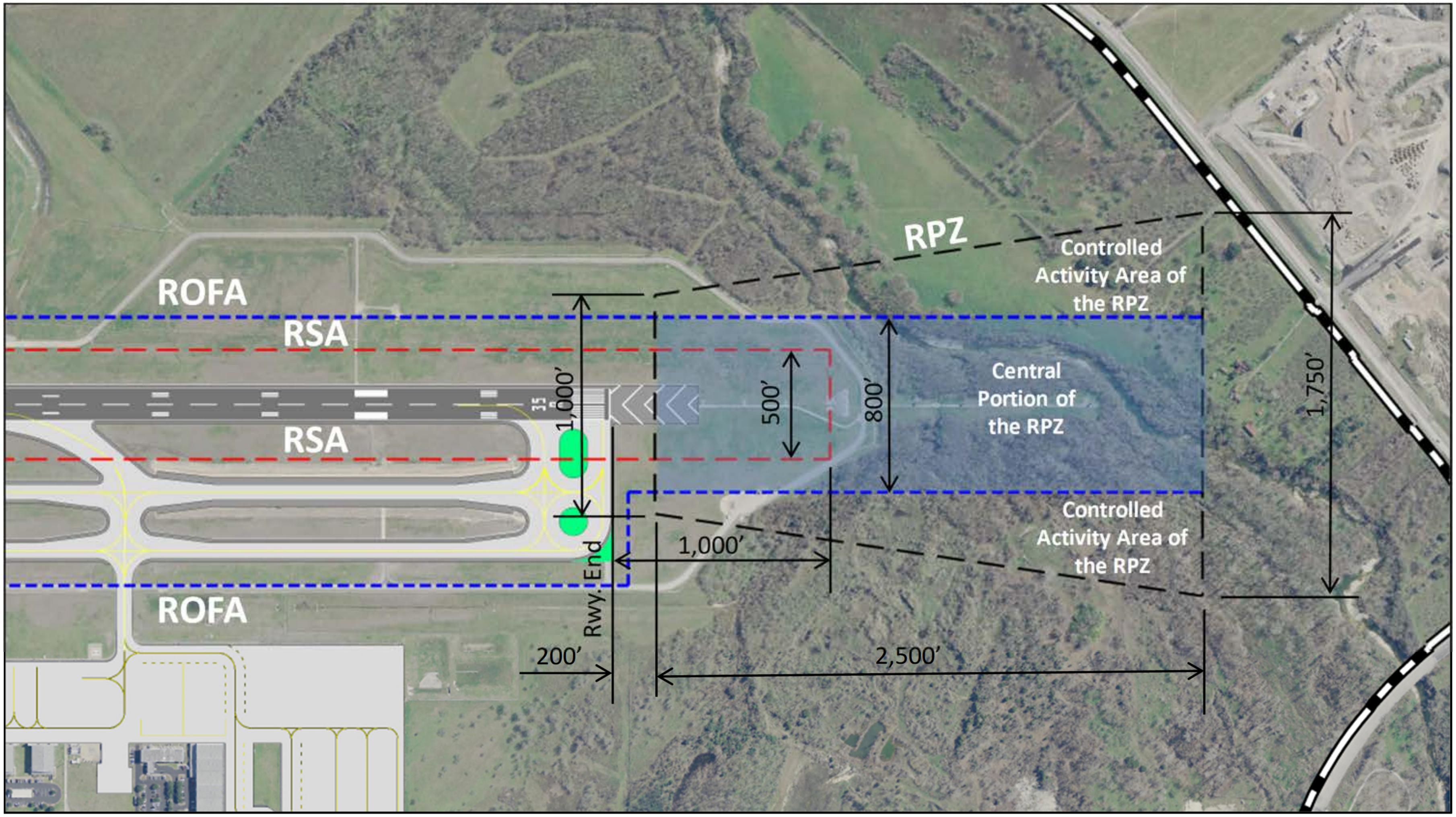
Source: Landrum & Brown analysis

Exhibit 4.3-40: 17L Runway End Safety Areas



Source: Landrum & Brown analysis

Exhibit 4.3-41: 35R Runway End Safety Areas



Source: Landrum & Brown analysis

4.4 Terminal Demand/Capacity Analysis

Terminal demand/capacity analysis examines the passenger terminal facilities' ability to accommodate passenger demand as well as the needs of other tenants and users. Facility and space requirements for the terminal cover all the key functional components (i.e., aircraft gates, ticketing/check-in, passenger security screening, baggage handling systems, gate holdrooms, concessions, etc.), assessing the ability of the individual areas to serve existing and forecast demand.

Spreadsheet models applying industry standard planning parameters were used to assess the ability of the passenger terminal facilities to accommodate the projected demand as established in the Design Day Flight Schedules (DDFS) described in Chapter 3, *Aviation Activity Forecast*. From the DDFS, the peak hour aircraft and passenger volumes were identified and services as the basis the demand / capacity assessment and facility requirements. The planning parameters selected provide an optimum LOS, as defined by the International Air Transport Association (IATA), during the peak periods.

4.4.1 Demand / Capacity Analysis Summary

A high-level summary of the analysis results is provided in **Table 4.4-1**, which are described in greater detail later in this section. When the East Expansion opens in 2019, most of the terminal components at ABIA will be operating at or above capacity. By 2022 (PAL 2), substantial capacity expansion will be required.

Table 4.4-1: High-Level Terminal Demand / Capacity Analysis Results

FACILITIES	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
AIRCRAFT GATES				
TICKETING/CHECK-IN				
OUTBOUND BAGGAGE HANDLING				
PASSENGER SECURITY SCREENING				
CONCOURSE / HOLDROOMS				
BAGGAGE CLAIM				
CONCESSIONS				
U.S. CUSTOMS & BORDER PROTECTION				

Notes: Sufficient = meets stated requirements
Deficient = **significantly below one or more of the stated requirements**
Source: Landrum & Brown analysis

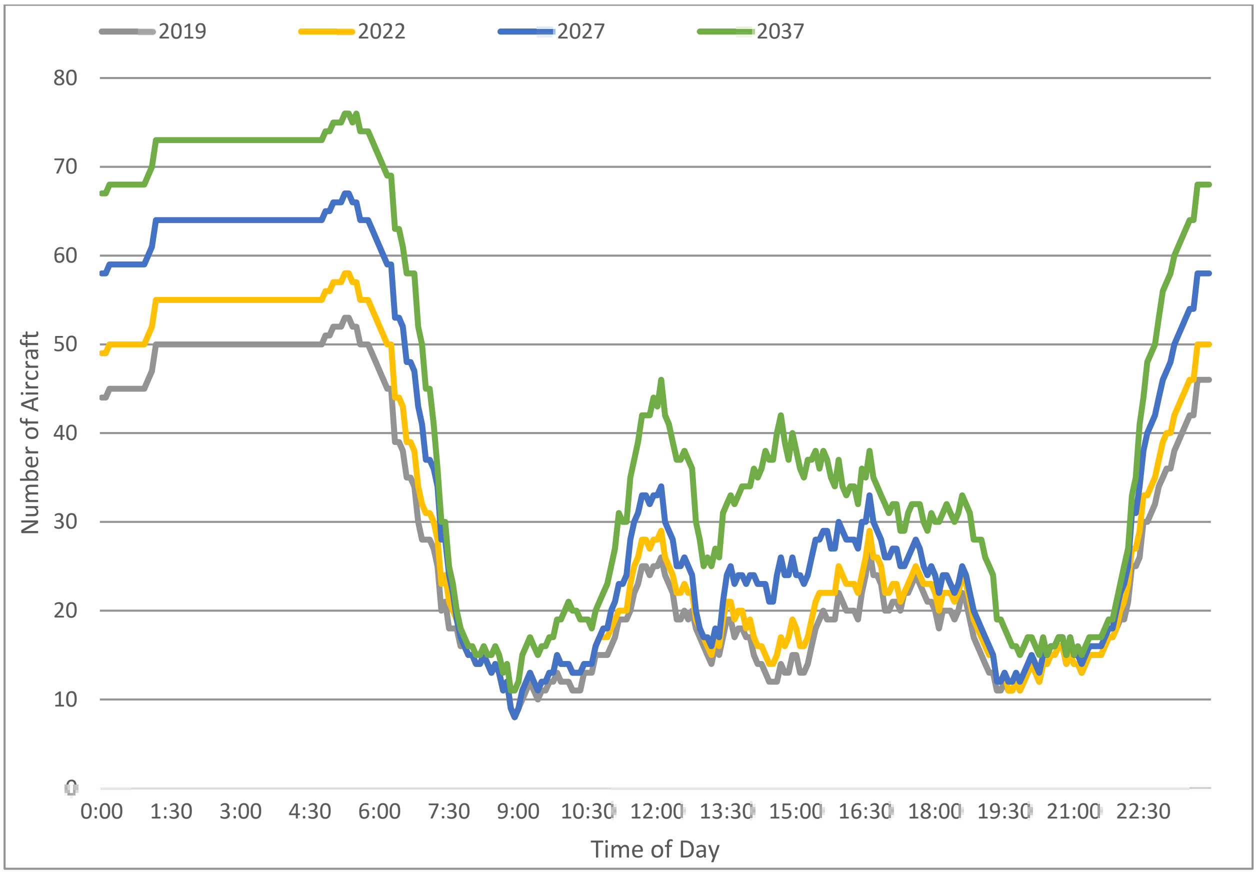
4.4.2 Aircraft Gate Requirements

Aircraft gate requirements were analyzed for each of the planning years based on the Aviation Activity Forecasts and DDFS, which consider changes in the aircraft fleet mix, airline operations, and the split between domestic and international flights.

4.4.2.1 Methodology and Assumptions

DDFS developed for each of the planning years establish the design day aircraft activity that forms the basis for the aircraft gating requirements analysis. The rolling hour aircraft on the ground, as shown in **Exhibit 4.4-1**, derived from the DDFS identifies the number of aircraft that require either a contact gate or remote aircraft parking positions.

Exhibit 4.4-1: Aircraft on the Ground Analysis



Source: Landrum & Brown analysis

Using the aircraft on the ground results, gate operational and utilization rules were applied to establish the target number of contact and remote gates or Remain Overnight parking positions that are required. The following gate operational and utilization rules were used for this analysis:

- All airlines are assumed to be “preferential use” except for Allegiant and the foreign flag carriers.
- Some “common use” gates are required to handle “preferential use” carriers’ overnight parking and mid-day peaks.
- 20-minute Inter-Gate Time (IGT) between flights.
- No passenger processing will be conducted on the RON positions.
- RON aircraft will be towed off 30 minutes after arrival and towed on 45 minutes before departure and towing time to the remote airport parking positions is 15 minutes. Aircraft will remain at the remote parking position for at least 60 minutes.
- A minimum of one RON position per contact gates is required due to departure and arrival flight timings. A 15-percent operational reliability factor was applied in addition to the minimum requirement to account for peak season charters and weather-related diversions.
- Precleared flights are treated as domestic.
- A 10-percent gate supply-versus-demand operational reliability factor provides operational continuity during periods when aircraft are diverted to ABIA due to weather or other issues, such as gate equipment maintenance or temporary gate closures during capacity expansion programs.
- Gate requirements for international flights will be accommodated on dedicated gates not shared with domestic flights except for periods outside the international carrier operating times. Due to ABIA’s geographic location and other market factors affecting the flight schedules for international flights, a dedicated gate will be required for each flight from a given region, such as Europe, Asia or South America, many of which seek similar arrival and departure times.

4.4.2.2 Gate Requirements Analysis

Aircraft gate requirements for each of the planning years based on the methodology and assumptions described in the previous section is shown in **Table 4.4-2**.

Table 4.4-2: Aircraft Gate Requirements

GATES	EXISTING (2019) *	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
DOMESTIC	32	32	34	42	57
INTERNATIONAL	4	3	5	6*	7
SUB-TOTAL GATES	**36**	**35**	**39**	**48**	**64**
RONS	42	42	45	58	74
TOTAL POSITIONS	**78**	**77**	**84**	**106**	**138**
ADG III GATES	34	33	36	44	59
ADG V GATES	2	3	3	4	5

Notes: * Includes Barbara Jordan Terminal East Expansion and South Terminal
Source: Landrum & Brown analysis

4.4.3 Terminal Facility Requirements

The terminal space requirements indicate the approximate area and number of processors required to accommodate future demand in optimal conditions. Not all facility requirements are of equal importance, and many requirements could vary greatly depending on the building geometry and other factors related to the detailed design of the passenger terminal(s). Additionally, assumptions are made regarding future processes, procedures, technologies, and user preferences that significantly influence the facility requirements.

4.4.3.1 Methodology and Assumptions

Requirements for the passenger terminal facilities were prepared individually for the major functional areas (e.g., ticketing/check-in, passenger security screening, outbound baggage handling, etc.). Requirements for the various functions within each major category were based either on the volume of activity (e.g., passengers or baggage) to be accommodated during peak periods or industry-accepted standards and allowances. Requirements based on activity were derived by mathematically relating the projected peak volume of activity to several other variables, including:

- Passenger dwell times and flow rates
- Baggage volumes and flow rates
- Processor sizes
- Maximum allowable queue sizes or times
- Space required per unit of queue
- Space required per unit volume

Assumptions for processing rates, queue length, and spatial requirements were based on IATA optimum LOS standards, as shown in **Table 4.4-3**. The IATA LOS framework basically specifies the minimum service requirements at various terminal sub-systems such as space provision and waiting times. Terminal facilities that are designed according to the optimum LOS typically provide sufficient space to accommodate all necessary functions in a comfortable environment; provide stable passenger flows with acceptable waiting times; denote and overall good service (comfort level) to passengers while keeping capital and operating expenses at a reasonable level; and, balance economic terminal dimensions with passenger expectations. Professional judgment was employed throughout the analytical model to reflect conditions local to ABIA (e.g., passenger behavior and operational preferences) and existing conditions.

This Page Left Intentionally Blank

Table 4.4-3: IATA Level of Service

PASSENGER TERMINAL PROCESSOR ADRM 10TH EDITION		SPACE STANDARD FOR WAITING AREAS [FT2/PAX]			WAITING TIME STANDARDS FOR PROCESSING FACILITIES [MINUTES] ECONOMY CLASS			WAITING TIME STANDARDS FOR PROCESSING FACILITIES [MINUTES] BUSINESS CLASS / FIRST CLASS			PROPORTION OF SEATED OCCUPANTS [%]		
		OVER DESIGN	OPTIMUM	SUBOPTIMUM	OVER DESIGN	OPTIMUM	SUBOPTIMUM	OVER DESIGN	OPTIMUM	SUBOPTIMUM	OVER DESIGN	OPTIMUM	SUBOPTIMUM
PUBLIC DEPARTURE HALL		> 24.8	24.8	<24.8									
Check-In	Self Service Boarding Pass / Tagging	>19.4	14 - 19.4	<14	0	0 - 2	>3	0	0 - 2	>3			
Check-In	Bag Drop Desk (queue width 4.6-5.2 FT)	>19.4	14 - 19.4	<14	0	0 - 5	>3	0	0 - 3	>3			
Check-In								Business Class Check-In Desk					
Check-In	Check-In Desk (queue width 4.6-5.2 FT.)	>19.4	14 - 19.4	<14	<10	10 - 20	>5	<3	3 - 5	>5			
Check-In								First Class Check-In Desk					
Check-In								0	0 - 3	>3			
Security Checkpoint (queue width 3.9 FT.)								Fast Track					
		>12.9	10.8 - 12.9	<10.8	<5	5 - 10	>10	0	0 - 3	>3			
Emigration (Passport Control) (queue width 3.9 FT.)								Fast Track					
		>12.9	10.8 - 12.9	<10.8	<5	5 - 10	>10	0	0 - 3	>3			
Boarding Gate Lounge	Seating	>18.3	16.1 - 18.3	<16.1									
Boarding Gate Lounge	Standing	>12.9	10.8 - 12.9	<10.8							>70%	50% - 70%*	<50%
Immigration (Passport Control) (queue width 3.9 FT.)								Fast Track					
		>12.9	10.8 - 12.9	<10.8	<10	10	>10	<5	5	>5			
Transfers					<5	5	>5	0	0 - 3	>3			
Baggage Claim Area					First Passenger to First Bag			First Passenger to First Bag					
Narrow Body		>18.3	16.1 - 18.3	<16.1	<0	0 - 15	>15	0	0 - 15	>15			
Wide Body		>18.3	16.1 - 18.3	<16.1	<0	0 - 25	>25						
Public Arrival Hall		>18.3	12.9 - 18.3	<12.9				n.b. Priority bags to be delivered before Economy			>20%	15% - 20%	<15%
CIP Lounges			43.1										

Note: The lower limit is only to be considered if extensive F + B seating is provided in the departure lounge, or, concession zone seating available.
Source: International Air Transportation Association, Airport Design Reference Manual, 10th ed.; adapted by Landrum & Brown

This Page Left Intentionally Blank

4.4.3.2 Passenger Terminal Facility Requirements Summary

Upon completion of the East Expansion in early 2019, the passenger terminal facilities at ABIA (Barbara Jordan Terminal and South Terminal) will provide approximately 984,300 square feet of total floor area. Based on the requirements analysis shown in **Table 4.4-4**, approximately 2 million square feet of terminal area is required in 2037 (PAL 4), which is more than twice the total area of the existing terminals. Demand within the next 5 years (PAL 2) is 1.2 million square feet and by 2027 (PAL 3), demand is more than 1.5 million square feet.

Table 4.4-4: Summary of Passenger Terminal Facility Requirements

FACILITIES	UNITS	EXISTING (2019)	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
GATES (TOTAL)		**36**	**36**	**39**	**50**	**64**
ADG III		34	33	36	46	59
ADG V		2	3	3	4	5
TICKETING / CHECK-IN						
Curbside Check-in	Positions	18	10	13	15	19
Curbside Check-in Area	sq. ft.	2,400	1,955	2,530	2,875	3,680
Full-Service Agent Positions	Positions	91	24	27	33	44
Bag Drops	Positions		71	80	98	135
Kiosks	Devices	64	84	95	117	162
Check-in Area	sq. ft.	36,150	61,410	69,230	84,755	115,805
Airline Ticket Offices	sq. ft.	12,450	9,545	10,235	13,225	16,790
OUTBOUND BAGGAGE HANDLING						
Outbound Baggage Screening Machines	Units	6	6	5	6	7
Outbound Baggage Screening Area	sq. ft.	20,000	20,000	17,000	20,000	24,000
Outbound Baggage Make-up Area *	sq. ft.	43,150	43,150	55,000	60,000	75,000
PASSENGER SECURITY SCREENING						
Security Checkpoint	Lanes	17	22	23	28	38
Security Checkpoint Area, incl. queue	sq. ft.	22,750	52,100	54,400	66,300	89,800
PASSENGER HOLDROOMS						
Narrowbody Holdrooms		31	33	36	46	59
Narrowbody Holdroom Area	sq. ft.	106,200	98,670	107,640	137,540	176,410

FACILITIES	UNITS	EXISTING (2019)	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
Wide-body Holdrooms		2	3	3	4	5
Wide-body Holdroom Area	sq. ft.	9,000	16,215	16,215	21,620	27,025
Circulation Corridor	sq. ft.	89,600	125,350	135,125	173,650	221,950
DOMESTIC BAGGAGE CLAIM AND INBOUND BAGGAGE HANDLING						
Baggage Claim	Devices	7	7	7	10	15
Baggage Claim Frontage	LF	1,050	980	980	1,400	2,100
Baggage Claim Hall	sq. ft.	53,500	58,075	60,950	82,800	120,000
Baggage Service Offices	sq. ft.	3,050	4,370	5,060	6,210	8,625
Inbound Baggage Handling Area	sq. ft.	8,100	13,340	13,340	18,975	28,000
CONCESSIONS						
Pre-security Concessions	sq. ft.	3,950	10,695	11,730	13,685	18,055
Post-security Concessions	sq. ft.	67,900	95,680	105,340	122,590	162,150
Concessions Support	sq. ft.	5,500	15,985	17,595	20,470	27,025
U.S. CUSTOMS AND BORDER PROTECTION						
Sterile Corridor	sq. ft.	17,800	29,900	34,900	43,100	51,400
Document Verification Officer	Positions	10	6	8	12	12
Global Entry Kiosks	Devices	8	8	8	8	8
Automated Passport Control Kiosks	Devices	8	13	13	13	13
Primary Processing and Inspection	sq. ft.	8,400	8,600	11,300	16,700	16,700
Secondary Processing and Inspection	sq. ft.	3,000	2,700	2,835	2,835	2,835
Operational Support	sq. ft.	8,000	6,345	9,180	10,395	10,395
Baggage Claim Devices		1	2	3	3	3
Baggage Claim Frontage	LF	198	440	660	660	660
Baggage Claim Hall	sq. ft.	6,500	18,975	30,590	31,280	31,280
OTHER AREAS						
Public Restrooms	sq. ft.	24,300	29,440	30,935	36,225	50,600
Airline Support Space	sq. ft.	81,450	176,180	188,945	243,455	310,615

FACILITIES	UNITS	EXISTING (2019)	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
Airline Clubs / Premium Lounges	sq. ft.	23,000	25,875	34,500	34,500	34,500
Airport Operations	sq. ft.	117,900	100,400	109,800	131,400	171,200
Other – Maintenance, Mechanical, Electrical, Vertical Circulation, Open/Covered	sq. ft.	197,350	186,100	206,100	255,400	322,600
TOTAL BUILDING AREA	sq. ft.	**971,400**	**1,212,836**	**1,342,514**	**1,662,538**	**2,119,848**

Note: * Sixing of Area reflects the number of baggage make-up units required under the current exclusive/shared use model used at AUS today

Source: Landrum & Brown analysis

4.4.3.3 Ticketing/Check-in

Check-in methods vary by airline and include agent counter positions, self-service kiosks, bag drop positions, and curbside positions. Agent counter positions are used to provide full-service transactions (i.e., ticketing, check-in, and bag check) and special services such as group check-in and premium passenger check-in. Self-service kiosks allow passengers to check-in and print boarding passes and bag tags. Bag drop positions service passengers who are utilizing self-service kiosks at the airport or who have possibly printed bag tags at a remote location. A growing number of passengers are utilizing online check-in. These passengers typically bypass the ticketing/check-in areas completely and proceed directly to the security screening checkpoint or bag drop. Curbside check-in positions, located adjacent to the departure's roadway, are full-service operations provided by some airlines.

The following assumptions were used to develop the ticketing/check-in facility requirements:

- Airlines will continue to expand their self-service offerings with a target of meeting the International Air Transport Association Fast Travel Program target of 80 percent of passengers utilizing self-service kiosks and bag drops. The Fast Travel Program is an airline industry initiative to expand self-service options for passengers across multiple areas of their airport journey and to lower costs for the industry.
- All counters and kiosks will be considered common use. However, due to airline flight schedules, the number of ticket counters assigned to each airline likely will not fluctuate much during the day, thereby not creating spare capacity during off-peak periods.
- Curbside check-in utilization will remain consistent with current utilization at ABIA – approximately 5 percent of total departing passengers.

Table 4.4-5 provides the key planning parameters used in the ticketing/check-in facility requirements analysis.

Table 4.4-5: Ticketing/Check-in Planning Parameters

PARAMETER	METRIC	BASIS
Ratio of Pax Using Agent Check-in	15%	IATA Fast Travel Program Target ***
Ratio of Pax Using Self-Service Check-in	60%	IATA Fast Travel Program Target ***
Ratio of Pax Using Online Check-in Only*	20%	IATA Fast Travel Program Target ***
Ratio of Pax Using Curbside Check-in	5%	Similar to ABIA operations
TOTAL	**100%**	
Ratio of Pax in First/Business/Premium	10%	Typical for other similar airports
Ratio of Pax Using Bag Drop**	45%	Typical for other similar airports
Allowance for Counter/Kiosk Redundancy	10%	Industry planning standard
Agent Check-in Processing Time [sec.]	150	Industry planning standard
Curb Check-in Processing Time [sec.]	120	Industry planning standard
Kiosk Processing Time [sec.]	90	Industry planning standard
Bag Drop Processing Time [sec.]	120	Industry planning standard
Agent Check-in Max Queue Time [min.]	2-10	IATA Optimum LOS
Curb Check-in Max Queue Time [min.]	2	IATA Optimum LOS
Kiosk Max Queue Time [min.]	2	IATA Optimum LOS
Bag Drop Max Queue Time [min.]	5	IATA Optimum LOS
Queue Area per Pax [sq. ft.]	12	IATA Optimum LOS
Depth of Circulation Corridor [ft.]	30	Industry planning standard
Airline Ticket Office Area per EQA [sq. ft.]	200	ACRP Report 25

Notes: Seconds [sec.]; EQA = equivalent aircraft; * Passengers who check-in online and go straight to the Security Checkpoint; ** Passengers who check-in at a kiosk or online and have bags to check; *** IATA Fast Travel Program targets 80% self-service utilization by 2020

Source: Landrum & Brown analysis

The Ticketing/Check-in planning parameters listed above were applied to the peak hour departing passenger volumes shown in the **Table 4.4-6**. As indicated, the total peak hour is the same as the domestic peak hour, which is the demand used to determine the terminal facility requirements.

Table 4.4-6: Ticketing/Check-in Demand

DEMAND	PAL 1 16.0 MAP	PAL 2 17.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
Peak Hour Departing Domestic Passengers	3,084	3,499	4,320	5,980
Peak Hour Departing International Passengers	431	450	601	753
Total Peak Hour Departing Passengers	**3,084**	**3,499**	**4,320**	**5,980**

Source: Landrum & Brown analysis

Based on the Ticketing/Check-in requirements provided in Table 4.4-3, additional agent, kiosk and bag drop positions are required to meet the 2019 (PAL 1) demand. Significant expansion of the Ticketing/Check-in area is required to meet the 2022 (PAL 2) demand and beyond. Additional area to improve passenger flow between kiosks and counters, security measures, and threat resiliency should be considered in the future expansion plans.

Additional sensitivity analysis has been conducted to examine the impacts of changes in the utilization of the various check-in methods. This analysis is described in Section 4.3.4.

4.4.3.4 Baggage Handling Services

Baggage handling services are critical within the passenger processing function. Checked baggage arriving early requires fast and accurate response within the airlines' designated time requirements. Checked baggage arriving late, such as baggage transferred between flights or mishandled, must be integrated into the baggage handling processes.

In addition, visibility and tracking within the baggage handling function are important due to the numerous parties involved in processing checked baggage. ABIA's ability to grow, support the needs of its airline tenants, and adapt the baggage handling system to new service level expectations influence BHS development. To meet the demand and airport operational needs, the following requirements would need to be met by any future BHS enhancement projects.

4.4.3.4.1 Reliability

Reliability is a key aspect of the outbound BHS. The following criteria should be considered in the future development of the outbound BHS:

- Cross-utilization capabilities between all EDS machines and CBRA functions;
- Mainline conveyor cross-over capabilities for either single or dual matrix configurations;
- Ability to mitigate EDS and mechanical single points of failure with efficient and cost-effective redundancy solutions; and,

- Safe and efficient access by operations and maintenance staff to all areas of the system that provides fast and efficient response to system events and failures.

4.4.3.4.2 Maximized Capacity

Maximizing the outbound BHS capacity should consider the following criteria:

- CBRA space for 28 to 30 positions and oversized baggage processing;
- BHS is configured to deliver and remove bags from the Check Baggage Inspection System (CBIS) in time to meet the bag delivery times to the baggage makeup areas as required by the airlines;
- Minimize lost bags; and,
- Minimize bag jams within the BHS.

4.4.3.4.3 Future Flexibility

Future flexibility of the outbound BHS is necessary to adjust to new technologies. The following criteria should be considered:

- CBIS configured for anticipated EDS unit replacement with high-speed EDS machines
- Controls architecture with scalability, redundancy, and upgradability incorporated into the core products and design scheme.

4.4.3.4.4 TSA Compliance

The following Transportation Security Administration (TSA) criteria should be considered:

- Meets TSA Planning Guidelines and Design Guidelines (PGDS) standards;
- Law Enforcement Office (LEO) and Threat Containment Unit (TCU) access to exterior areas; and,
- TSA support space (breakrooms, restrooms, etc.) co-located with the CBIS functions.

ABIA must meet these foundational requirements consistently in response to the anticipated growth in baggage handling services as described in the following section.

4.4.3.4.5 Methodology

Estimating baggage handling requirements necessitates an understanding of anticipated checked baggage demand, which is a product of originating departure and arriving passenger demand. The most accurate basis for quantifying demand is with projected flight schedules that have been generated by the project team. Using the projected flight schedules, this analysis utilized critical data elements, including flight departure/arrival times, seats/load factors, and checked bags per originating and arriving passenger, to stratify the volumes of flights and bags processed during the hours of operation.

For outbound checked baggage, the busiest hours of operation are utilized to establish a peak and average peak (a measure of reasonable planning) number of hourly checked baggage capacity required which drives the remaining planning effort.

For inbound checked baggage, the busiest hours of operation are utilized to establish peak hours of incoming flights to be processed within a rolling 15-minute window during the day and the estimated number of checked baggage to be delivered to passengers to both domestic and international bag claim areas.

Once checked baggage demand is understood, industry standards, actual system designs and TSA's Planning Guidelines and Design Standards are utilized to estimate the terminal space and equipment required to process those volumes within the time required.

4.4.3.4.6 Assumptions, Planning and Design Standards

Utilizing the flight schedules projected for each design year, Vic Thompson Company (VTC) bagStream planning tool translates passenger volumes into check baggage volumes for both outbound and inbound flights.[7] The projected flights schedules include critical information that affect the baggage projections including Airplane Seats, Load Factors and Arrival/Departure Times used to identify peak hours of activity. Two elements assumed to calculate baggage demand are:

- Bags Per Passenger (BPP) assumed to be .6 for all flights based on Southwest Airlines actual rates of .68[8] averaged with an assume rate of 0.5 for OAL,
- Originating Passengers assumed to be 1.0 to reflect the morning volumes of originating flights.

The forecast shows that additional CBIS capacity is required by 2019. ABIA approved a BHS Replacement Program, but it will likely not be in place before that time. Therefore, operational contingencies may become necessary. A more likely scenario for needed capacity to be available is 2021-2022 timeframe. The new outbound BHS will be compliant with TSA's Planning Guidelines and Design Standards that will aid in providing future flexibility and optimal system reliability. Inbound BHS is not impacted by PGDS and will be estimated based on current configurations and practices.

7 Southwest Airlines Station Intelligence Report, June 2017
8 Southwest Airlines Station Intelligence Report, June 2017

4.4.3.4.7 Outbound Baggage Handling Demand

The hourly number of originating passengers drives the demand for outbound baggage handling systems. The demand anticipated for the main terminal overall according to the planning years and projected flight schedules are shown in **Table 4.4-7**.

Table 4.4-7: Outbound Checked Baggage Demand

DEMAND	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
Daily Checked Bags Processed	15,855	17,374	19,913	26,926
Hourly Peak Bags per Hour [BPH]	1,850	2,099	2,592	3,588
Surged Hourly Peak [BPH]	2,061	2,324	2,841	3,881

Source: VTC bagStream 7.2 AUS Future Projections

The figures above represent the total main terminal checked baggage demand factoring in Southwest Airline (SWA) and other carriers' baggage profiles. These values are used in assessing the capacity requirements for a centralized baggage screening function for all airlines currently serving within this terminal which is a major factor in determining outbound baggage handling capacity overall.

In addition to checked bags from departing flights, bags transferred from international arrival flights to downline U.S. airports will be reintroduced into the outbound BHS once processed through the Federal Inspection Services. In accordance with TSA requirements, those bags must be rescreened prior to sortation. The timing of international arrivals do not overlap with the morning peak and are not factored into the hourly demand numbers.

4.4.3.4.8 Outbound Baggage Handling Capacity Estimates

The peak hour volumes of checked bags processed for originating passengers drive the demand for outbound BHS. The following sub-systems will require additional capacity in accordance with the growth projects provided.

The Checked Bag Inspection System is the portion of the BHS that tracks and screens the outbound checked baggage. All bags introduced into the BHS will be screened prior to sortation and, once cleared, will be sorted to baggage makeup carousels assigned by airline and flight.

Checked baggage demand calculated in Table 4-4.6 for the total main terminal serves as the basis for estimating capacity needs for a future centralized CBIS. Through PAL 1 (2019), it is assumed that the current split-matrix CBIS configuration will remain in place. Both sides of the CBIS are already constrained in every aspect of the screening process. The capacity of this existing CBIS configuration will be exceeded at PAL 2 (2022). Estimated PAL 2 CBIS capacity requirements shown in **Table 4.4-8** are based on a consolidated CBIS design with an optimized configuration. PGDS provides guidelines to estimate capacity to meet PAL 2 through PAL 4 demand for the terminal.

Table 4.4-8: CBIS Requirements

REQUIREMENTS	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
Peak Bags to Screen [BPH]	1,850	2,099	2,592	3,588
CBIS Capacity [BPH]	1,950*	2,696**	3,370**	4,044**
EDS [Units]	6*	4**	5**	6**
EDS with "N+1" Redundancy [Units]	6*	5**	6**	7**

Notes: * Units in current non-optimized configuration prior to BHS Project completion with EDS speeds of approximately 350 bph, ** Calculated per PGDS based on projected demand: Medium-speed EDS ((674 bph); "N+1" required redundancy factor of one additional machine above estimated capacity needs

Sources: *TSA Planning Standards and Design Guidelines (PGDS) Version 6*, VTC bagStream 7.2 AUS Future Projections

The Checked Bag Reconciliation Area is the area within the CBIS that processes the tertiary level of screening. This screening requires TSA agents to perform some level of manual screening. To support this step of the process, workstations are provided that facilitate the agents' efforts, and, once cleared, the screened bags are reintroduced back into the system for sortation. Through 2019 (PAL 1), it is assumed that the current CBRA configuration will remain in place. For 2022 (PAL 2) through 2037 (PAL 4), TSA PGDS provides guidelines to estimate capacity shown in **Table 4.4-9** to meet projected demand.

Table 4.4-9: CBRA Requirements

REQUIREMENTS	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
Peak Bags into CBRA [BPH]	292	360	460	540
ETD Workstations [Units]	12*	22**	28**	32**
ETD Devices [Units]	6*	11**	14**	16**

Notes: * Units in current non-optimized configuration prior to BHS Project completion, ** Calculated requirements per PGDS based on projected demand; EDS clear rates for Level 1 (automated) and Level 2 (on-screen image resolution); TSA agent manual processing times per bag; ETD devices per workstation ratio

Sources: *TSA Planning Standards and Design Guidelines (PGDS) Version 6*, VTC bagStream 7.2 AUS Future Projections

The baggage makeup function is the terminating end of the BHS. At the baggage makeup function, checked bags are delivered to assigned makeup carousels and circulated before they are removed by airline operators and placed into carts for planeside delivery. Through 2019 (PAL 1), it is assumed that the current BMU configurations will remain in place. For 2022 (PAL 2) through 2037 (PAL 4), peak baggage demand and cart sizing is used to estimate the capacity required to meet projected demand, as shown in **Table 4.4-10**. Carousel unit size and the resulting space allocations may change when terminal programming is conducted based on airport policies and airline operational needs.

Table 4.4-10: Baggage Make-up Requirements

REQUIREMENTS	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
Peak Bags for Sortation [BPH]	1,850	2,099	2,592	3,588
Est. Peak Carts Required [Units]	69	74	89	109
Common Use: BMU Carousels	10*	6**	7**	9**
BMU Presentation Length (lf)	1,670*	987**	1,187**	1,453**
Exclusive/Shared: BMU Carousels	10*	11**	12**	15**
BMU Presentation Length (lf)	1,670*	1,760**	1,920**	2,400**

Notes: * 10 units in current non-optimized confined configurations and does not account for lost presentation space; Exclusive use of 7 carousels, 2 shared use between the other airlines and 1 not assigned. ** Calculated capacity requirements according to flight schedule with 45 bags per cart: assumes optimized unit sizing and cart spacing allowing for a minimum use of 12 carts per unit.

Source: VTC bagStream 7.2 AUS Future Projections

A number of operational assumptions drive these calculations. Used as a constant, an estimated 45 bags have been measured to fit into an individual cart; this value serves as the primary driver of the calculation for the number of carts and linear feet of bag presentation space needed. Baggage makeup carousel calculations are based on a constant of 12 carts per unit and a uniform size carousel of 160 linear feet capacity through the terminal for these estimating purposes.

As illustrated in Table 4.4-10, ABIA may have some ability to optimize the utilization of its baggage make-up carousels through increasing common and/or shared use agreements between airlines. Those opportunities will need to be reviewed in greater detail given the overlap of daily peak hour activity between the airlines.

4.4.3.4.9 Results Overview

Outbound baggage processing capacity is a critical path element of the terminal capacity enhancement plan at ABIA. Given the growth projections provided with the projected flight schedules, the anticipated replacement of the existing outbound BHS in the Barbara Jordan Terminal is needed as soon as possible in order to meet both the near and longer-term needs for baggage processing at ABIA. With the new BHS design, the ability to expand processing capacity and adjust TSA screening protocols as needed should be streamlined and relatively low-impact effort as EDS machines are removed, replaced and upgraded. Another significant feature of the new outbound baggage handling system will be the ability to cross-utilize machines and screening matrices to safeguard service level and reliability operational targets. This anticipated flexibility supports the method for estimating equipment needs over time allowing for only the appropriate amount of equipment needed without added equipment for contingency purposes.

Inbound baggage processing expansion is less complicated to estimate but more likely to impact the passenger. Plans to accommodate this service will consider passenger circulation and adequate claim space availability to meet the airlines' passenger service levels. Based on the projected flight schedules, domestic inbound baggage will continue to utilize existing equipment until 2023 flight activity potentially pushes existing passenger claim capacity. For international arrivals, checked baggage also will continue to utilize existing equipment for the near-term future, but additional flight activity in 2019 should be examined to ensure adequate capacity is available for those international flight banks examined.

4.4.3.5 Security Screening Checkpoint

All departing passengers must pass through the TSA security screening checkpoint prior to entering the secure airside concourse. The TSA's Checkpoint Design Guide (CDG) provides guidance for the checkpoint performance and configuration for facility planning. For this study, the TSA Standard lanes and Pre-Check lanes were used for the baseline analysis. New Automated Screening Lanes have been installed at some airports and are considered in the sensitivity analysis found in Section 4.4.4. **Table 4.4-11** provides key planning parameters used in the checkpoint requirements analysis.

Table 4.4-11: Security Screening Checkpoint Planning Parameters

PLANNING PARAMETERS	METRIC	BASIS
Standard Lane Throughput [PPH]	150	TSA CDG
Pre-Check Lane Throughput [PPH]	210	Typical for other similar airports
Ratio of Passengers using Pre-Check	40%	Current ABIA operation*
Area per Standard Lane [sq. ft.]	1,500	TSA CDG – Optimal Footprint
Queue Area per Person [sq. ft.]	12	IATA Optimum LOS

Notes: passengers per hour = PPH, * Based on interviews with TSA representatives at ABIA – 30 to 40% of passengers are registered or eligible for Pre-Check
Source: Landrum & Brown analysis

The Security Screening Checkpoint planning parameters listed above were applied to the peak hour departing passenger volumes shown in the **Table 4.4-12**. As indicated, the total peak hour is the same as the domestic peak hour, this demand drives the facility requirements.

Table 4.4-12: Ticketing/Check-in Demand

DEMAND	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
Peak Hour Departing Domestic Passengers	3,084	3,499	4,320	5,980
Peak Hour Departing International Passengers	431	450	601	753
Total Peak Hour Departing Passengers	**3,084**	**3,499**	**4,320**	**5,980**

Source: Landrum & Brown

Based on the Security Screening Checkpoint requirements provided in Table 4.4-3, additional security screening lanes and area are required to meet the 2019 (PAL 1) demand. The shortfall in area is due primarily to the configuration of Checkpoint 2 and 3, which have insufficient space for the screening lanes and queuing. Four additional screening lanes and just over double the amount of area for the screening equipment and queueing are required for 2022 (PAL 2).

4.4.3.6 Airside Concourse

The Airside Concourse includes the primary passenger services and functions located on the secure side of the security checkpoint, including gate holdrooms, circulation corridor and concessions. Gate holdrooms include the seating and queuing areas for each gate and the gate counter. The circulation corridor allows passengers to move about the airside concourse. Concessions include food and beverage, retail, and duty-free outlets available to passengers. **Table 4.4-13** provides the key planning parameters for these components.

Table 4.4-13: Airside Concourse Planning Parameters

PLANNING PARAMETER	METRIC	BASIS
Holdroom Area – ADG V Gate [sq. ft.]	4,700	ACRP Report 25
Holdroom Area – ADG III Gate [sq. ft.]	2,600	ACRP Report 25
Circulation Corridor Width [ft.]	35	Similar to BJT East Expansion
Concessions Area per 1,000 Enplaned Passengers [sq. ft.]	11.75	ACRP Report 54 – moderate to high range. Includes Duty Free.
Concessions Support Space (percent of total concessions area)	15	ACRP Report 54
Area per Airline / Premium Lounge [sq. ft.]	7,500	Average of ABIA lounges, including new Delta Sky Club

Sources: ACRP Report 25 – Airport Passenger Terminal Planning and Design; ACRP Report 54 – Resource Manual for Airport In-Terminal Concessions, Landrum & Brown analysis

The Airside Concourse planning parameters listed above were applied to the required number of aircraft gates and annual enplaned passengers, as shown in the **Table 4.4-14**, to derive the facility requirements shown in Table 4.4-3.

Table 4.4-14: Airside Concourse Demand

DEMAND	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
ADG III Gates	33	36	46	59
ADG V Gates	3	3	4	5
Annual Enplaned Passengers [millions]	7.85	8.60	10.10	13.35

Source: Landrum & Brown analysis

The Airside Concourse components will be included in any future terminal expansion that increases the number of aircraft gates. Additional space in the future expansion may be required to overcome the shortage in the existing terminal facilities, particularly for concessions.

4.4.3.7 Domestic Baggage Claim

The baggage claim function is the terminating end of the inbound BHS for domestic checked bags. As described in Section 2.4.1.3, arriving bags are delivered from the terminal ramp area and placed onto the assigned bag claim belt according to the assigned airline and flight number. Typically, all bags from a specific flight go to a single claim unit. Oversized bags and odd-sized articles are placed on an oversized belt behind Carousel #3 for passenger claim. At peak periods, it is challenging to adequately process domestic inbound baggage due to issues with inadequate belt length and tug access to the inbound belts caused by congestion.

Through 2019 (PAL 1), it is assumed that the current configurations and capacity will remain in place. For 2022 (PAL 2) through 2037 (PAL 4), a peak volume of inbound domestic flights arriving within a rolling 15-minute period was used to estimate estimated capacity needed. The claim unit size and the resulting space allocations may change when terminal programming is conducted based on airport policies and airline operational needs. Given the projected inbound flight volumes, the requirements as shown in the **Table 4.4-15** should be met for domestic arrivals.

Table 4.4-15: Domestic Baggage Claim Planning Factors and Requirements

FACTORS AND REQUIREMENTS	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
Peak 15 Minute Bank of Flights	7	7	10	12
Bag Claim Units [Units]	7*	7**	10**	12**
Bag Claim Presentation Length (lf)	980*	980**	1,400**	1,680**

Notes: * Units and space in current configuration, ** Estimated equipment and passenger circulation space based on current equipment and space allocation standards.
Source: VTC bagStream 7.2 AUS Future Projections

A number of operational assumptions drive these calculations. Used as a constant, an allocation of one bag claim unit per flight within the 15-minute daily peak serves as the primary driver of the calculation for the number claim units required.

4.4.3.7.1 U.S. Customs and Border Protection Facilities

The U.S. Customs and Border Protection (USCBP) facilities process passengers arriving from non-U.S. locations. The requirements for these facilities are described in detail in the latest version of the USCBP Airport Technical Design Standards (ATDS). The standards are primarily based on the volume of peak hour passengers arriving from locations outside the U.S. The requirements identified in Table 4.4-3 are based on the standards established in the ATDS and the peak hour passenger volumes identified in **Table 4.4-16**.

Table 4.4-16: U.S. Customs and Border Protection Facilities Demand

DEMAND	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
Peak Hour Arriving International Passengers	585	609	814	1,021

Source: Landrum & Brown analysis

As indicated in Table 4.4-3, the USCBP facilities are marginally undersized for 2019, with the exception of the need for two additional baggage claim devices. By 2022 (PAL 2), three additional baggage claim devices and an expansion of the Primary Processing and Inspection area will be required to maintain reasonable wait times for passengers seeking admission to the United States.

4.4.3.7.2 International Baggage Claim Capacity Estimates

The USCBP Federal Inspection Services area is the terminating end of the inbound BHS for international checked bags. Arriving bags are delivered to an FIS designated claim carousel to be collected by passengers awaiting the USCBP processes. Oversized bags are hand-delivered by the airlines to the FIS area for passenger claim. Once USCBP processes are complete, passengers continuing on from ABIA to another destination drop their bags back into the outbound BHS for sortation onto the remaining downline flight.

The peak volume of inbound international flights arriving within a rolling 15-minute period of time drives the demand for this equipment. Given the projected inbound flight volumes, the requirements as shown in **Table 4.4-17** should be met for international arrivals. For 2019, it is anticipated that the current configuration will remain in place. The addition of a third concurrent flight will not be sustainable to be processed by the current equipment. Therefore, in 2019, an increase in inbound flight activity indicates that additional inbound claim units will likely be necessary; related USCBP and airline operational needs should be confirmed.

Table 4.4-17: International Baggage Claim Planning Factors and Requirements

FACTORS AND REQUIREMENTS	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
Peak 15 Minute Bank of Flights	2	3	3	3
Bag Claim Units	2*	3*	3*	3*
Bag Claim Presentation (lf)	400*	600*	600*	600*

Notes: * Estimated based on current equipment sizes and configurations
Source: VTC bagStream 7.2 AUS Future Projections

A number of operational assumptions drive these calculations. Used as a constant, an allocation of one bag claim unit per flight within the 15-minute daily peak serves as the primary driver of the calculation for the number claim units required. In examining the project flight schedules, bags reintroduced from the FIS back into the outbound BHS do not affect the overall outbound peak baggage demand given that the arrival times of international flights.

4.4.4 Impacts of Changing Processes and New Technologies on Terminal Facility Requirements

Changes in passenger processing utilization and throughput due to new technologies will impact the future facility requirements, particularly those beyond the 5-year planning horizon (2022). Two of the key areas of passenger processing that have been significantly impacted in recent years by new technologies and changes in passenger processing utilization are check-in and security screening. This section includes sensitivity analysis to the planning parameters identified in the previous section that examines the impacts of continuous change in these two functional components.

4.4.4.1 Check-in Sensitivity Analysis

Airlines have been facilitating the transition from full-service agent-based check-in to self-service check-in services utilized by a majority of passengers for well over a decade. Passengers have embraced these services as they seek for more control over their trip and shorter wait times generally provided by self-service technology. A stated in Section 4.3.3.3, IATA's Fast Travel Program targets 80-percent self-service utilization by 2020. However, the self-service methods and utilization will change facility requirements. The following scenarios examine the impact to the facility requirements based on alternative self-service utilization ratios.

Scenarios 1 and 2, as indicated in **Table 4.4-18** examine different ticketing and check-in utilization parameters. Self-service and bag drop utilization, and lower online check-in utilization. When Scenario 1 is compared to the baseline requirements, the number of bag drops, and kiosks increases marginally.

Table 4.4-18: Ticketing/Check-in Utilization Parameters

PARAMETERS	SCENARIO 1	SCENARIO 2
	METRIC	METRIC
Ratio of Pax Using Agent Check-in	15%	5%
Ratio of Pax Using Self-Service Check-in	70%	70%
Ratio of Pax Using Online Check-in Only*	10%	20%
Ratio of Pax Using Curbside Check-in	5%	5%
TOTAL	**100%**	**100%**
Ratio of Pax Using Bag Drop**	50%	50%

Notes: passengers = Pax, * Passengers who check-in online and go straight to the Security Checkpoint, ** Passengers who check-in at a kiosk or online and have bags to check
Source: Landrum & Brown analysis

Scenario 2 examines the maximum reasonable self-service, online and bag drop utilization. Full-service agent-based check-in would be reduced to a level necessary to provide full-service to premium passengers and other passengers who need special assistance. The biggest change in Scenario 2 as compared to the baseline is the nearly 60 percent reduction in full-service agent positions as shown in **Table 4.4-19**.

Table 4.4-19: Ticketing/Check-in Facility Requirements

REQUIREMENTS	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
SCENARIO 1				
Curbside Positions	10	13	15	19
Full-Service Agent Positions	24	27	33	44
Bag Drop Positions	79	88	108	150
Kiosks	98	110	137	189
SCENARIO 2				
Curbside Positions	10	13	15	19
Full-Service Agent Positions	9	10	13	16
Bag Drop Positions	79	88	108	150
Kiosks	98	110	137	189

Source: Landrum & Brown analysis

The primary conclusion that can be drawn from this sensitivity analysis is that future terminal expansion should provide for flexibility in converting agent check-in positions to bag drop positions with minimal investment and should be configured such that kiosks and bag drop positions can be implemented with maximum efficiency.

4.4.4.2 Security Screening Checkpoint Sensitivity Analysis

Advancements in passenger screening processes and technology have been made over the last few years, most notably in the form of trusted traveler programs (such as TSA Pre-Check) and Automated Screening Lanes (ASLs). Both offer higher throughput passengers per hour (PPH) than standard security checkpoint lanes. Automated screening lanes consist of highly mechanized equipment, such as automated bin returns, and enhanced divestiture processes that speed the flow of carry-on baggage into the x-ray units, taking advantage of their capacity. As shown in **Table 4.4-20**, three scenarios have been developed with varying utilization factors of TSA Pre-Check and ASLs. **Table 4.4-21** shows the TSA Pre-Check and ASL facility requirements based on these utilization parameters for the planning activity levels for Scenarios 1, 2 and 3.

Table 4.4-20: Security Screening Checkpoint Planning Parameters

PARAMETER	SCENARIO 1	SCENARIO 2	SCENARIO 3
	METRIC	METRIC	METRIC
Pre-Check Lane Throughput [PPH]	210	210	210
Automated Screening Lane Throughput [PPH]	210	250	210
Ratio of Passengers using Pre-Check	40%	40%	0%

Source: Landrum & Brown analysis

Table 4.4-21: Security Screening Checkpoint Facility Requirements

REQUIREMENTS	EXISTING (2019)	PAL 1 16.0 MAP	PAL 2 18.0 MAP	PAL 3 22.0 MAP	PAL 4 31.0 MAP
SCENARIO 1					
Automated Screening Lanes	-	9	11	13	17
TSA Pre-Check Lanes	6	9	9	11	14
Standard Lanes	11	-	-	-	-
TOTAL	**17**	**18**	**20**	**24**	**31**
SCENARIO 2					
Automated Screening Lanes	-	8	9	11	15
TSA Pre-Check Lanes	6	9	9	11	14
Standard Lanes	11	-	-	-	-
TOTAL	**17**	**17**	**18**	**22**	**29**
SCENARIO 3					
Automated Screening Lanes	-	15	17	21	28
TSA Pre-Check Lanes	6	-	-	-	-
Standard Lanes	11	-	-	-	-
TOTAL	**17**	**15**	**17**	**21**	**28**

Source: Landrum & Brown analysis

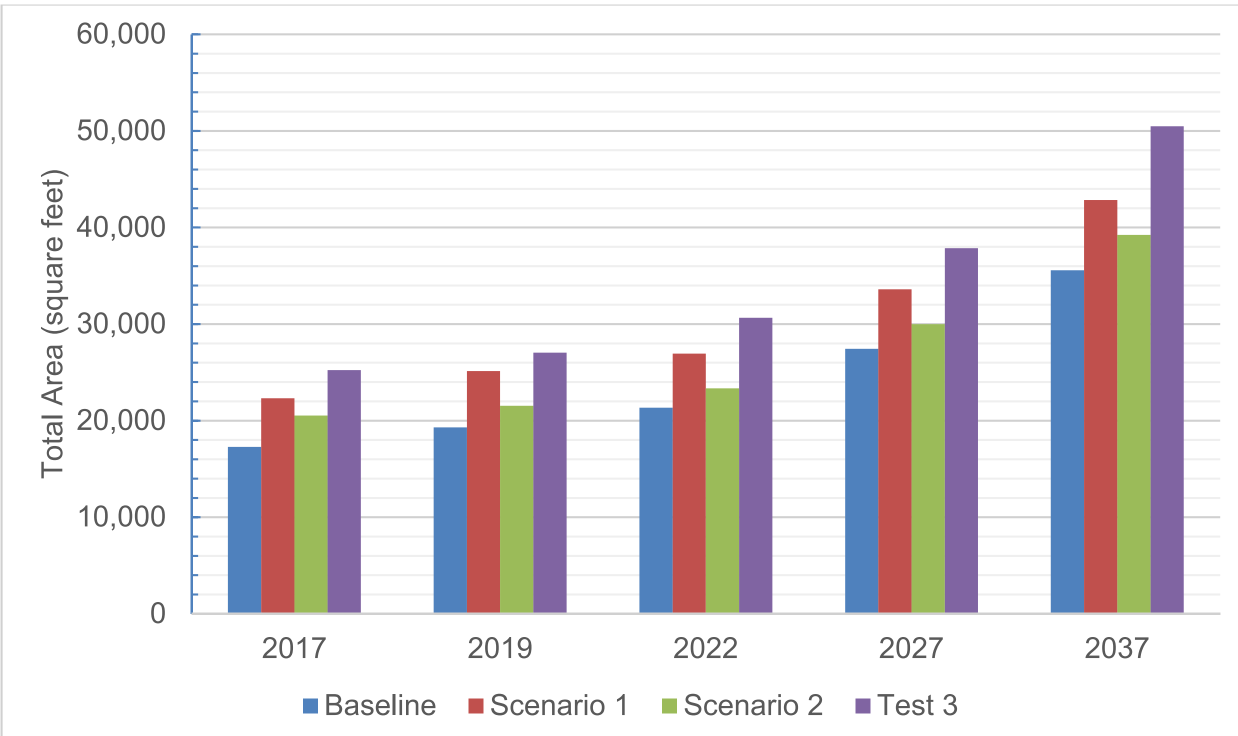
Scenario 1 examines the impact of replacing the standard lanes with ASLs while maintaining the current utilization of TSA Pre-Check. ASLs have a target through of 210 passengers per hour per lane – a 40 percent increase over standard lanes. The result is roughly four fewer ASLs are required as compared to standard lanes in 2019 (PAL 1) up to seven fewer by 2037 (PAL 4).

Scenario 2 examines the impact of increasing the throughput of ASLs closer to the anticipated level that could be achieved after they have been in use for several years. The result is one to two fewer ASLs are required as compared to Scenario 1 for each of the planning activity levels.

Scenario 3 examines the implementation of 100-percent ASLs with no TSA Pre-Check lanes since the throughput is similar. The result is an overall reduction of four security checkpoint lanes in 2019 (PAL 1) as compared to the baseline analysis presented in Table 4.4-3. By 2037 (PAL 4), seven fewer total lanes would be required.

While the partial or full implementation of ASLs results in a reduction of the total lanes required, it is important to understand that ASLs require nearly 80-percent more space than a standard lane. **Exhibit 4.4-2** provides a graphical comparison of the total area (square feet) required for each of the security screening checkpoint scenarios. It is likely that in the near term, Standard and TSA Pre-Check lanes will continue to be utilized as space is not available to implement the ASLs.

Exhibit 4.4-2: Security Checkpoint Scenarios Area Comparison



Note: Security Checkpoint area requirements do not include queueing space, only the area for the checkpoint.
Source: Landrum & Brown analysis

4.5 Landside Development Needs

4.5.1 Airport Parking

A summary of the existing airport parking facilities is provided in Section 2.5. This section provides the existing utilization of each parking facility and the future requirements needed to meet the future parking demand. A parking study was performed by PGAL and Ricondo & Associates in January 2013[9]. New data was collected for this analysis in order to account for changes to parking that occurred after the 2013 study.

4.5.1.1 Methodology Discussion

4.5.1.1.1 On-Site Passenger Parking

ABIA provided transaction records for each calendar day in 2016. Each transaction record included data for date and time of entry, date and time of exit, and exit location. The exit locations were grouped into three areas:

- Garage #1/CONRAC
- Long-Term/Long-Term Overflow
- Valet

A sample of the transaction data is shown for illustrative purposes in **Table 4.5-1**.

Table 4.5-1: Sample Transaction Data

MONTH / YEAR	PRODUCT	EXIT LANE	DATE OF ENTRANCE	TIME ENTRY	DATE OF EXIT	TIME EXIT
Jan. 2016	Garage #1/CONRAC	Short-Term Lane 41	01/01/16	2:51:00	01/01/16	4:46:00
Jan. 2016	Long-Term	North Exit Lane 41	12/23/15	6:12:00	01/01/16	0:02:00
Jan. 2016	Valet Fee Computer	Valet Fee Computer	12/24/15	15:03:00	01/01/16	0:19:00

9 ABIA 25 Year Parking Plan, prepared by PGAL in association with Ricondo & Associates, Inc., January 2013.

These transaction records were used to determine the daily utilization of each of the three passenger parking areas. For each day of the year, the number of vehicles that resided on each parking area were totaled and compared to the parking space capacity for that specific parking area. The capacity of each passenger parking areas is (excluding the South Terminal and Cargo overflow lot) listed in **Table 4.5-2**.

Table 4.5-2: Passenger Parking Area Capacity

PASSENGER PARKING AREA	SPACES
Garage #1 (Short-Term)	2,927
CONRAC (short-term)	595
Long-Term	7,268
Valet	603
TOTAL	**11,393**

The daily passenger parking totals are shown in **Exhibit 4.5-1** through **Exhibit 4.5-5** for the short-term, long-term and valet parking areas.

Short-Term parking consisted of transactions from the parking Garage #1 and Lot A. The total number of vehicles parked per day often exceeded the number of parking spaces due to the short-term nature of their transaction. In order to obtain a better representation of the peak daily usage, August 11, 2016 (which was a Thursday during the busiest season) was selected to represent a busy day. Transactions for that day were analyzed on an hourly basis to develop a usage curve for that day. There were total of 5,979 vehicles parked that day. These records were analyzed on an hourly basis and a curve was developed which showed that at the peak hour of 2:00 p.m., the number of parked cars was 3,666, or 62.15 percent of the total number of cars parked during that entire day. The daily curve for August 11, 2016 is shown in Exhibit 4.5-2. This factor was applied to the daily transactions for short-term parking.

Exhibit 4.5-1: ABIA Daily Total Parking Usage

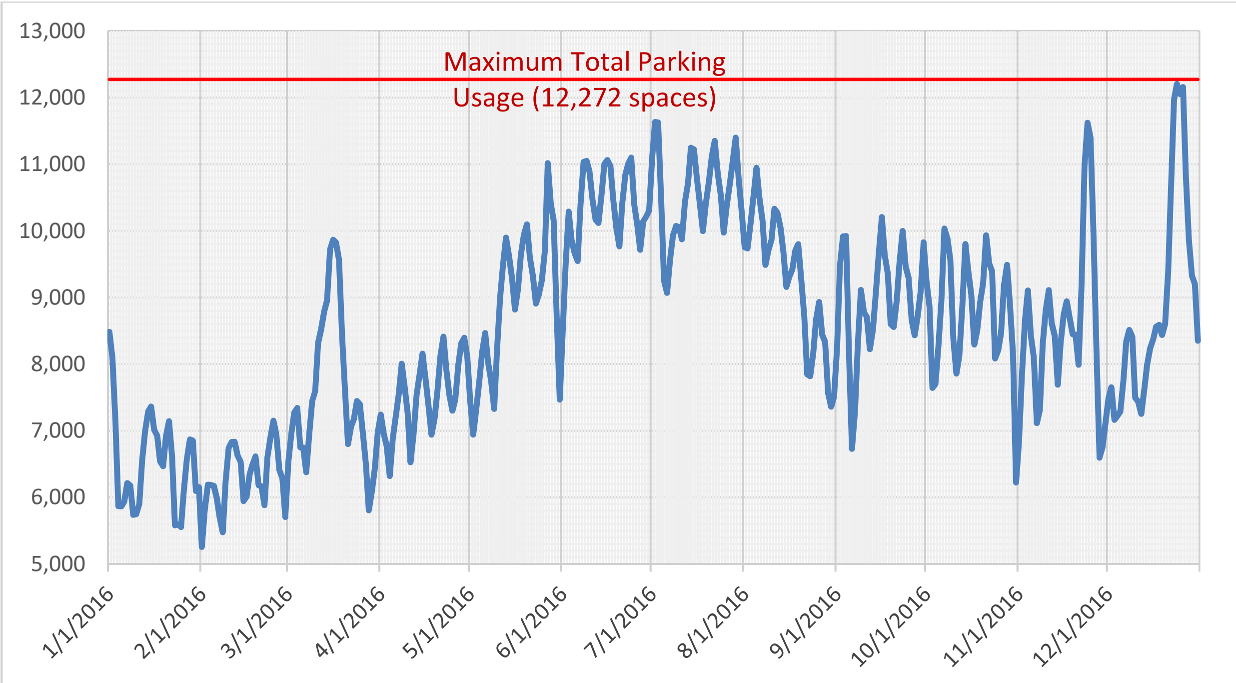


Exhibit 4.5-2: ABIA Short-Term Daily Residence Curve – August 11, 2016

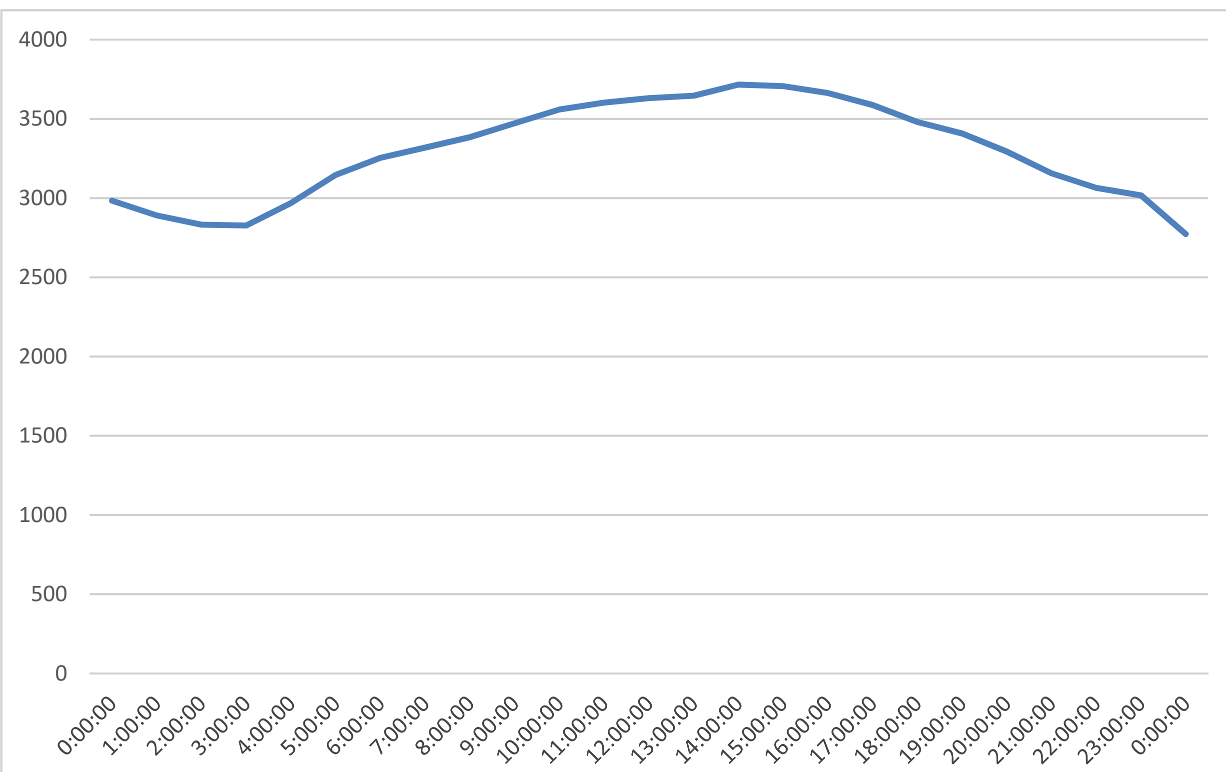


Exhibit 4.5-3: ABIA Daily Short-Term Parking Usage

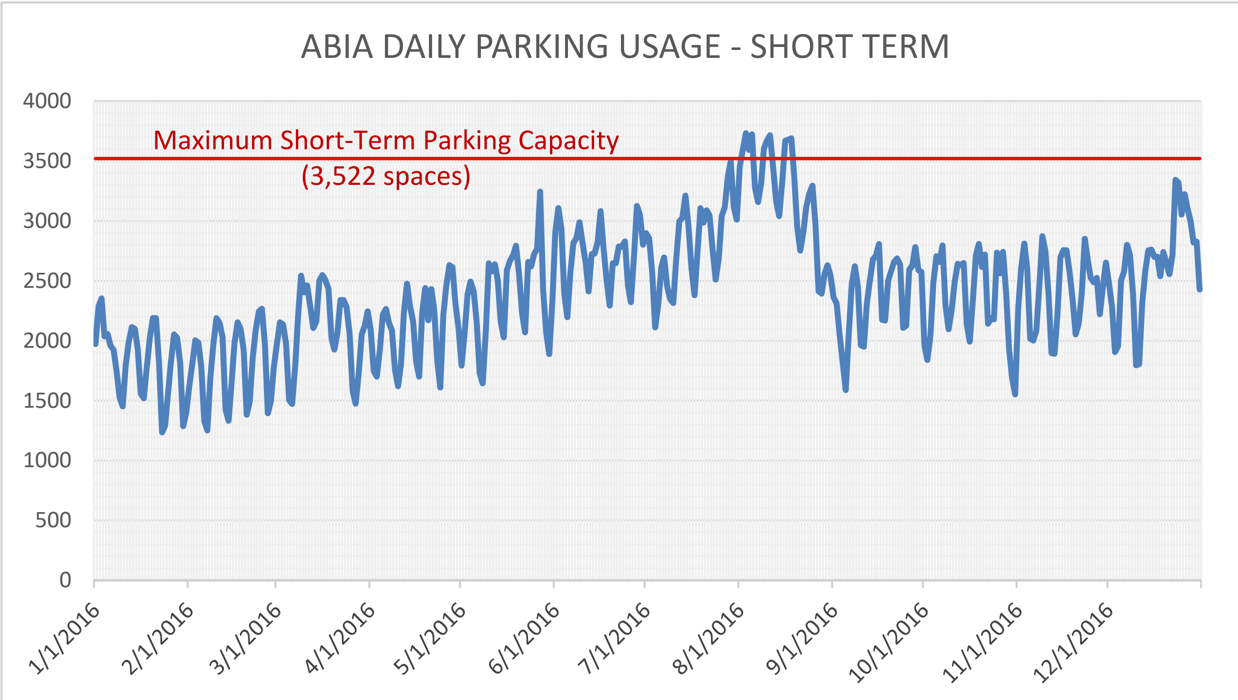


Exhibit 4.5-4: Daily Long-Term Parking Usage

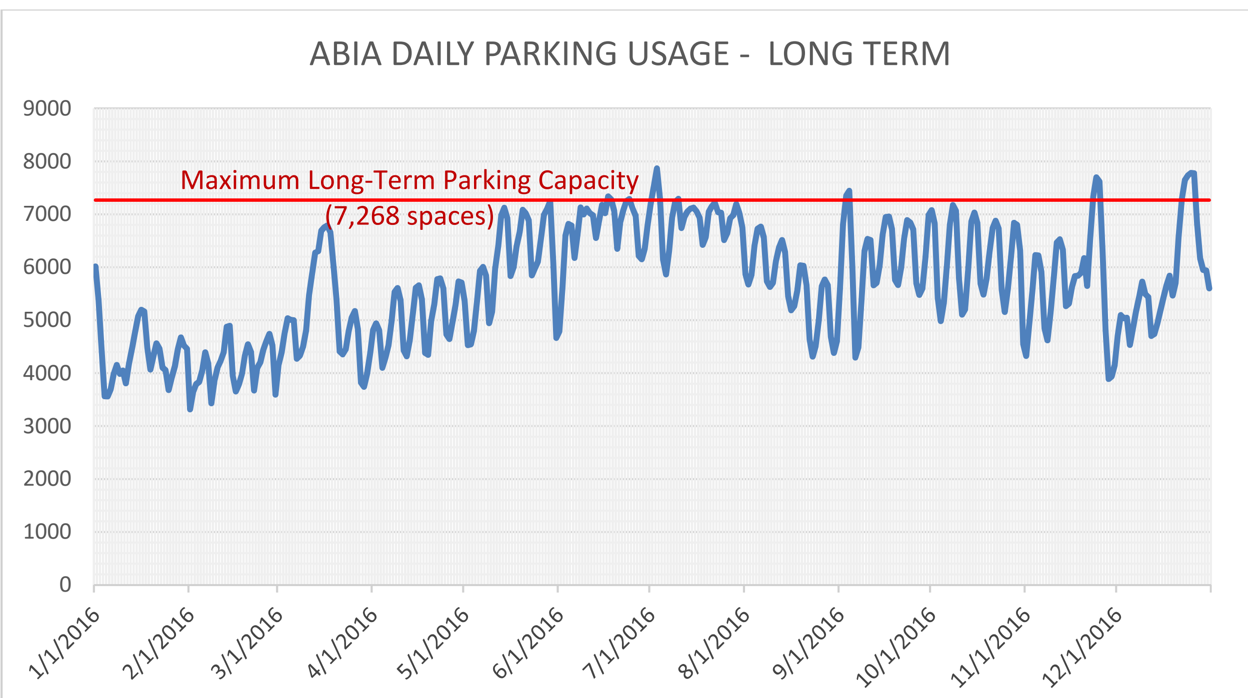
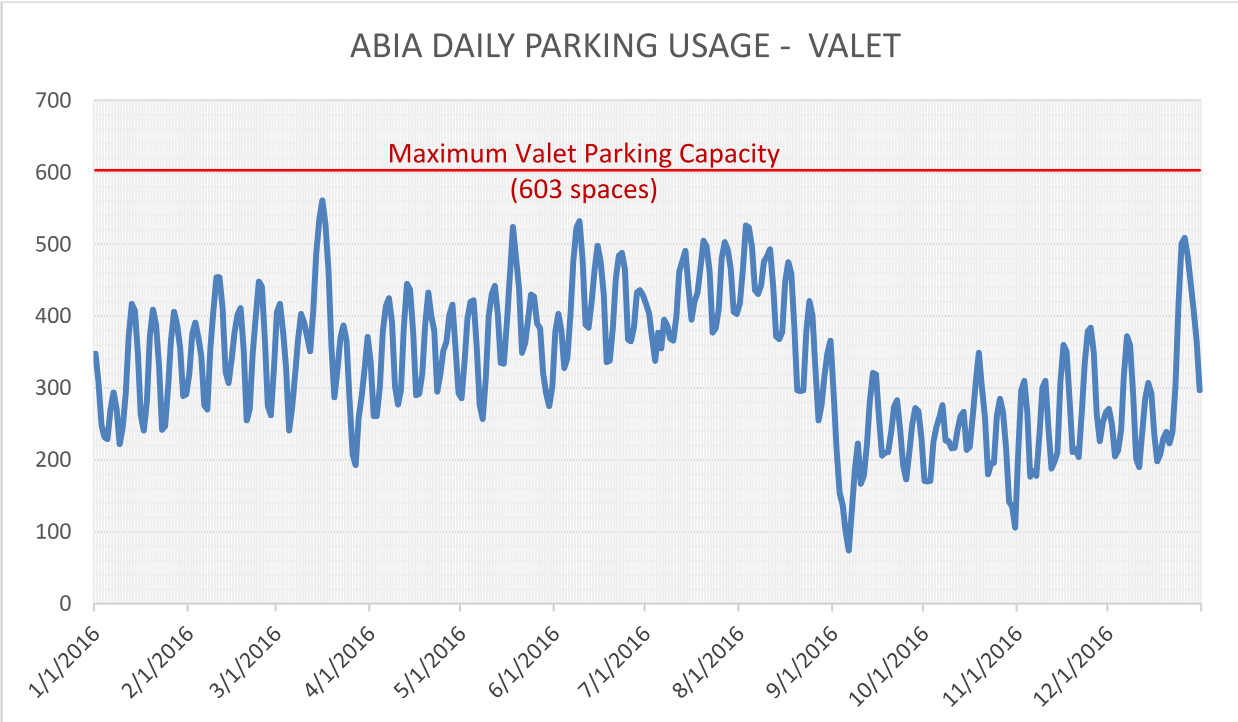


Exhibit 4.5-5: Daily Valet Parking Usage



A number of trends were determined by examination of the parking transaction summaries. For instance, a weekly peak passenger parking demand routinely occurs on Friday. In addition, low points on each Sunday. Periodic spikes in parking demand were observed on dates corresponding to special events. For instance, a large peak in parking demand occurred in the period of March 13 to 17, 2016, which corresponds with spring break of the University of Texas and the local independent school districts. This was also the week of the 2016 South by South West Music Festival. The highest demand date in 2016 was on Friday, July 29. Other peak demand periods correspond with major holidays like Thanksgiving, Christmas, and New Year's. A general rise in demand was also observed during the summer months of June through August.

The results of this analysis also show that the short-term and long-term parking areas experience periods of demand in excess of their capacity several times during the year. Long-term parking overflow is often directed to the north cargo parking areas. The valet parking area had a peak demand of 93 percent on March 16, 2016 during the spring break week. Therefore, the airport parking facilities are currently at 100 percent utilization, and that demand will continue to increase as the number of passenger enplanements increases in the future.

4.5.1.1.2 Employee Parking

There are currently 1,785 employee parking spaces at ABIA. Based on ABIA information, the employee parking areas are currently operating at their capacity, and future demand will increase at the same rate as on-airport passenger parking demand.

4.5.1.1.3 Off-Airport Passenger Parking

There are currently 11,908 off-site parking spaces at ABIA. There was no data available on the current utilization of these off-airport passenger parking lots. These off-airport parking providers include:

- Park & Zoom
- The Parking Spot West
- Fast Park and Relax
- Bark & Zoom
- The Parking Spot East

For this study, it was assumed that the off-airport parking areas are currently operating at their capacity and that future demand will increase at the same rate as on-airport passenger parking demand.

4.5.1.1.4 CONRAC

Current rental car utilization numbers are proprietary and unavailable for this Master Plan Study. Informal outreach revealed that several rental car operators are currently operating at capacity, or capacity will be reached in the near future (within 5 years). For the purposes of this study, it was assumed that the CONRAC is currently operating at capacity and future demand will increase at the same rate as on-airport passenger parking demand.

4.5.1.2 Calculation Tables

The four planning activity levels are forecast (high case scenario) to have the following number of enplaned passengers:

- (PAL 1) 2019: 7.94 million enplaned passengers
- (PAL 2) 2022: 8.96 million enplaned passengers
- (PAL 3) 2027: 10.88 million enplaned passengers
- (PAL 4) 2037: 15.70 million enplaned passengers

These annual passenger enplanement forecasts were used to compute an annual growth rate for the four planning activity levels. The results of this analysis are summarized in **Table 4.5-3**.

Table 4.5-3: Summary of Enplanement Forecast

YEAR	PASSENGER ENPLANEMENT FORECAST	AVERAGE ANNUAL GROWTH RATE
2017	6,967,541	5.17%
2018	7,539,600	
2019	7,943,100	
2020	8,277,700	
2021	8,615,800	
2022	8,964,200	
2023	9,324,000	3.93%
2024	9,695,200	
2025	10,078,900	
2026	10,473,000	
2027	10,878,600	
2028	11,297,700	3.77%
2029	11,729,300	
2030	12,173,400	
2031	12,631,000	
2032	13,102,200	
2033	13,589,100	3.68%
2034	14,092,600	
2035	14,612,700	
2036	15,150,600	
2037	15,705,200	

Since all parking areas are operating at their current capacity, the growth rates from Table 4.5-3 were used to determine the peak demand for the four planning activity levels. These results are summarized in **Table 4.5-4**.

Table 4.5-4: Baseline Peak Parking Demand

PARKING AREA	EXIST. CAPACITY	EXIST. VOLUME	PAL 1 BASELINE VOLUME	PAL 2 BASELINE VOLUME	PAL 3 BASELINE VOLUME	PAL 4 BASELINE VOLUME
On-Site Public (Short Term)	3,522	3,522	4,303	4,959	5,686	6,519
On-Site Public (Long Term)	8,947	8,947	10,930	12,598	14,444	16,560
On-Site Public (Valet)	603	603	737	849	973	1,116
On-Site Employee	1,785	1,785	2,181	2,513	2,882	3,304
Off-Site Public	11,908	11,908	14,458	16,767	19,224	22,040
CONRAC	3,498	3,498	4,273	4,925	5,647	6,474

4.6 Airport and Airline Support Facility Needs

This section presents the future airport and airline support facility requirements to meet the forecast demand for the planning years 2019, 2022, 2027 and 2037 (PAL 1 through PAL 4) based on the high case scenario aviation forecast.

4.6.1 Catering

LSG Sky Chefs is the current catering company at ABIA. The current facility serves 1,500 to 3,000 meals per day in approximately 65,000 square feet of building space. Based on discussions with the operator, the following expansion opportunities are available within the current 100,000 square foot (2.3 acres) lease area:

- Expand existing facility, which can include a 2nd level
- Add a 2nd shift to double output capacity

It is anticipated that up to 6,000 daily meals will be required within the next 20-year period. **Table 4.6-1** depicts the projected catering facility requirements over the next 20-year period. By PAL 3 (2027), it is anticipated that the existing catering facilities will need to expand to accommodate the additional demand. It is anticipated that the needed expansion requirements can be contained within the existing catering facility lease area. They have a 20-year lease from March 3, 1998, with one 5-year option.

Additional dry storage will be needed. If located on site, 10- to 11-day capacity dry storage is required. If located off site, as much as 17-day capacity dry storage is required. Increasing the autoclave facility size for burning trash is also required due to the increased number of meals and aircraft operations. Currently, the autoclave facility performs 4 burns per day.

All meals must be served within 36 hours of preparation, which includes multiple meals on long-haul flights. All catering meals are inspected at the building truck dock prior to delivery to the aircraft. Inspection takes approximately 12 minutes per flight.

Table 4.6-1: Catering Facility Requirements

YEAR	DAILY MEALS		BUILDING		PARKING		TOTAL SITE	
	AREA REQUIRED	SURPLUS (DEFICIT)	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]
Actual								
2017	2,600	400	48,800	16,200	41,300	13,700	75,000	25,000
Forecast (High Scenario)								
PAL 1 (2019)	3,000	0	55,100	9,900	46,600	8,400	84,700	15,300
PAL 2 (2022)	3,400	(400)	61,600	3,400	52,100	2,900	94,700	5,300
PAL 3 (2027)	4,100	(1,100)	74,100	(9,100)	62,600	(7,600)	113,800	(13,800)
PAL 4 (2037)	5,900	(2,900)	103,000	(38,000)	87,100	(32,100)	158,300	(58,300)

4.6.2 Airport Rescue and Firefighting Station and Training Facility

4.6.2.1 ARFF Station

There is a single Airport Rescue and Firefighting (ARFF) station that is centrally located between the two parallel runways, just south of Taxiway H. The ARFF station is currently certified as Classification I, Index D. However, due to the larger aircraft forecasted to be operating at ABIA, the ARFF certification must be updated to Index E. Current Index E requirements include the following.[10] FAA Advisory Circulars contain methods and procedures for ARFF equipment and extinguishing agents that are acceptable to the FAA.

The existing ARFF equipment at ABIA and their quantities of extinguishing agents is shown in **Table 4.6-2**. Based on the current ARFF equipment capabilities, no additional extinguishing agent vehicles will be needed to meet the Index E requirements. The existing ARFF station will need to be expanded to accommodate the additional services and vehicles needed to provide the highest standard of safety response at ABIA. Therefore, it is recommended to increase the size of the existing ARFF station by 2 vehicle bays and an additional 2,000 square feet of support space by the PAL 3 (2027) timeframe to support the additional aircraft gates. The ARFF station expansion can be provided within the existing site area with no impact on surrounding facilities.

Table 4.6-2: Existing ARFF Equipment Extinguishing Agent Capabilities

VEHICLE	TANK SIZE			
	WATER [GAL.]	AFFF [GAL.]	DRY CHEMICALS [LBS.]	ARGON [LBS.]
2003 Oshkosh Stryker 1500	1,500	200	450	460
2005 Oshkosh Stryker 3000	3,000	400	450	460
2013 Oshkosh Stryker 3000	3,000	420	N/A	460
1997 Oshkosh T-3000	3,000	420	450	N/A

Source: AUS Airport, Omni Air International ARFF Status Report.

A second ARFF station will be necessary on the west side of the airport to support future development in this area. The new ARFF station is not linked to the growth in annual passenger or aircraft operations since its main function is to respond to structure fires and Emergency Medical Services associated with the west development area and serve as a backup for airfield incidents. Based on interviews with the ABIA Fire Chief, the new station should contain three vehicle bays for a fire truck, crash truck and EMS vehicle, and support facilities for 3 to 4 staff per shift. The minimum overall building area should be 10,000 sq.ft. and the total site area should be approximately 2 acres (including auto parking, ramp area, etc.). Timing of this new ARFF station should coincide with any west side development, such as cargo or other supporting facilities.

[10] Federal Aviation Regulations (FAR) Part 139.317, Aircraft Rescue and Firefighting: Equipment and Agents.

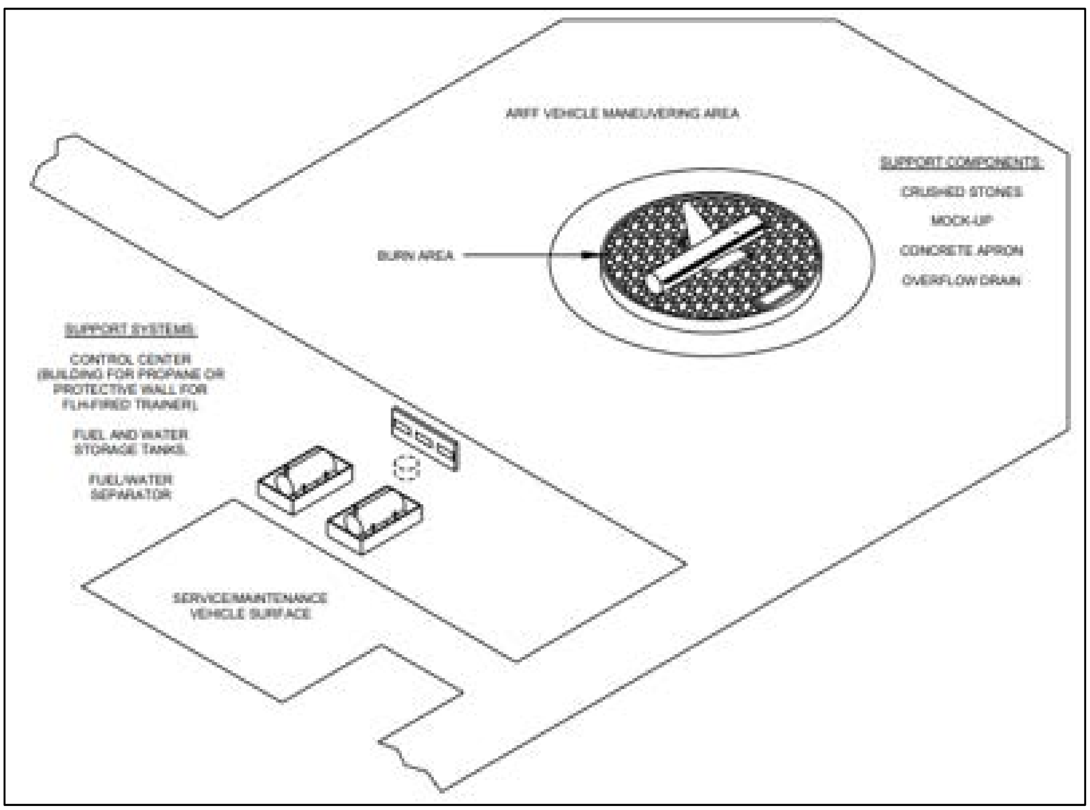
4.6.2.2 ARFF Training Facility

A fixed fire training facility should be provided at ABIA. The facility should provide vital training services for the ARFF staff and the Texas A&M Forest Service. This training facility should be designed to provide the following requirements in accordance with FAA Advisory Circular 150/5220-17B, *Aircraft Rescue and Fire Fighting (ARFF) Training Facilities*:

- B-747 Fuselage Mock-up, or similar type aircraft determined by the airport
- Vehicle Maneuvering Area
- Burn Area
- Systems Control Station
- Support Systems:
    - Fuel delivery / collection
    - Water delivery / collection
    - Electrical

The total area for this training facility layout should be approximately 4 to 6 acres as shown on **Exhibit 4.6-1**. Construction of a fixed ARFF training facility should occur as determined by the fire department and their specific needs.

Exhibit 4.6-1: Basic Fire Training Facility Layout



Source: FAA AC 150/5220-17B, *Aircraft Rescue and Fire Fighting (ARFF) Training Facilities*, 9/30/2010.

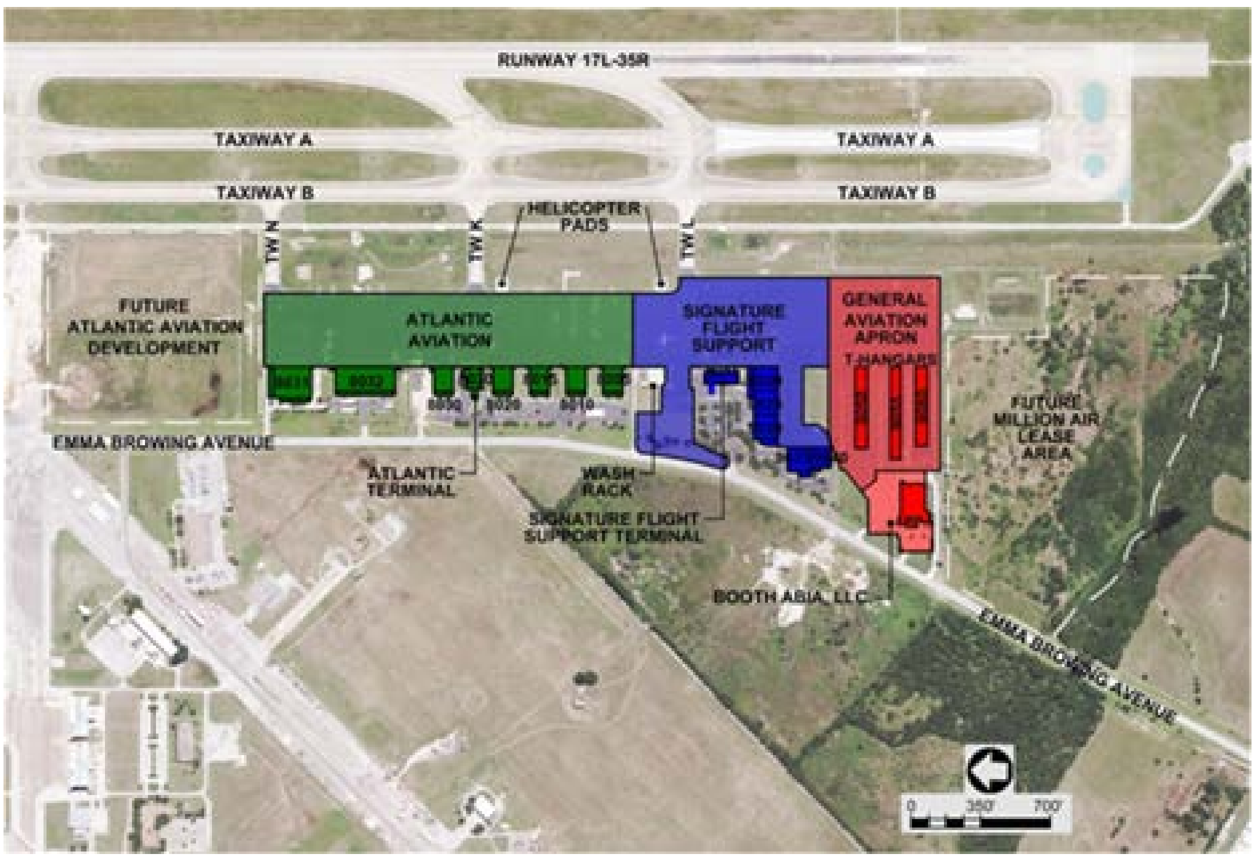
4.6.3 FBO and General Aviation Facility Needs

This section provides an overview of the potential infrastructure changes that might be needed based on the GA and Air Taxi (AT) 2037 forecast. This analysis concentrates specifically on future facility changes or additions that might be needed for the general aviation facilities, TXDOT's Flight Services facility, and the on-airport United States Army Reserve facility.

4.6.3.1 General Aviation Facility

For analysis of the existing general aviation facilities as shown in **Exhibit 4.6-2**, the existing infrastructure was segmented into four categories: hangar space, ramp space, terminal space, and vehicle parking.

Exhibit 4.6-2: Existing General Aviation Areas



Since these facilities are utilized by general aviation and air taxi aircraft, both the GA and AT forecasts were used to determine future facility requirements. **Table 4.6-3** shows the GA and AT aircraft operations forecast. The combined general aviation and air taxi operations forecast show a small decline of approximately 4.1 percent in combined aircraft operations (arrivals and departures) during the forecast period. Annual general aviation operations are forecasted to decrease 0.8 percent per annum during the forecast period, and air taxi annual operations are forecast to have an average annual growth rate of 1.9 percent during the forecast period.

Table 4.6-3: Annual Air Taxi and General Aviation Operations Forecast

CATEGORY	EXISTING 2017	PAL 1 (2019)	PAL 2 (2022)	PAL 3 (2027)	PAL 4 (2037)
Air Taxi Operations	11,880	12,420	13,230	14,850	17,280
General Aviation Operations	51,160	49,350	47,680	45,740	43,650
Total - Air Taxi and General Aviation Operations	**63,040**	**61,770**	**60,910**	**60,590**	**60,930**

Source: Aviation Forecast 2037

4.6.3.2 Hangar Area Requirements

The demand for hangar space at an airport is a function of the forecasted number of based aircraft and the number of itinerant aircraft operations requiring hangar space. **Table 4.6-4** through **Table 4.6-6** provide an estimate of the hangar space requirements during the forecast period.

Table 4.6-4: Hangar Space Requirements for Non-Based Aircraft

ITEM	EXISTING 2017	PAL 1 (2019)	PAL 2 (2022)	PAL 3 (2027)	PAL 4 (2037)
GA Design Day Arrivals	89	86	83	79	76
AT Design Day Arrivals	15	15	16	18	21
Design Day Total	104	101	99	97	97
Aircraft in Hangars (%)	10%	10%	10%	10%	10%
Average Aircraft Area	3,000	3,000	3,000	3,000	3,000
Est. Hangar Space Required for Non-Based Aircraft	**31,200**	**30,300**	**29,700**	**29,100**	**29,100**

Source: Garver analysis

Table 4.6-5: Hangar Space Requirements for Based Aircraft

AIRCRAFT TYPE	AVERAGE AIRCRAFT REQUIREMENT [SQ. FT.]	EXISTING 2017		PAL 1 (2019)		PAL 2 (2022)		PAL 3 (2027)		PAL 4 (2037)	
		# OF BASED AIRCRAFT USING HANGARS	HANGAR SPACE REQUIRED [SQ. FT.]	# OF BASED AIRCRAFT USING HANGARS	HANGAR SPACE REQUIRED [SQ. FT.]	# OF BASED AIRCRAFT USING HANGARS	HANGAR SPACE REQUIRED [SQ. FT.]	# OF BASED AIRCRAFT USING HANGARS	HANGAR SPACE REQUIRED [SQ. FT.]	# OF BASED AIRCRAFT USING HANGARS	HANGAR SPACE REQUIRED [SQ. FT.]
Jet	3,000	47	141,000	49	151,900	51	163,200	57	188,100	70	245,000
Turbo/Multi	2,850	8	22,800	8	22,800	8	22,800	8	22,800	8	22,800
Piston	1,300	79	71,890	74	67,340	66	60,060	56	50,960	39	35,490
Helicopter	1,600	9	14,400	9	14,400	9	14,400	9	14,400	9	14,400
Loss of Hangar Space for Less than Optimal Use	**1.12**	**0**	**30,011**	**0**	**30,773**	**0**	**31,255**	**0**	**33,151**	**0**	**38,123**
Est. Total Hangar Space Required for Based Aircraft	0	**143**	**280,101**	**140**	**287,213**	**134**	**291,715**	**130**	**309,411**	**126**	**355,813**

Source: Garver analysis

This Page Left Intentionally Blank

Table 4.6-6: Total Hangar Space Requirements

ITEM	EXISTING 2017	PAL 1 (2019)	PAL 2 (2022)	PAL 3 (2027)	PAL 4 (2037)
Total Hangar Space Required (Based Aircraft + Non-Based Aircraft)	311,301	317,513	321,415	338,511	384,913
Current Hangar Space	329,224	329,224	329,224	329,224	329,224
Hangar Space Surplus/Deficiency	**17,923**	**11,711**	**7,809**	**(9,287)**	**(55,689)**

Source: Garver analysis

4.6.3.3 Methodology

To define future hangar space requirements for ABIA, future based aircraft was estimated. To estimate the number of based aircraft at each interval during the forecast period, the 2017 Form 5010 based aircraft data was used as a baseline, and the annual GA and Air Taxi forecast fleet mix growth rates were applied. The State Pooling Board aircraft fleet were removed from the data since they operate at a separate facility. Additionally, based on meetings with the stakeholders, it was agreed that only 70 percent of the piston aircraft would be in hangars. In addition, the number of T-hangar bays at ABIA (54) is approximately 70 percent of the total number of single engine piston aircraft (82) in the 2017 Form 5010.

The average area requirements for each aircraft category (e.g. jet, turbo, piston, and helicopter) was based on the wingspan and length of the most common aircraft from the GA and AT fleet mix forecast. An additional 500 square feet was added to the average area to account for clearances around the parked aircraft. To account for the anticipated continued increase in larger business jet aircraft, the average area requirements for jets was increased by 100 feet for PAL 1, 200 feet for PAL 2, 300 feet for PAL 3, and 500 feet for PAL 4 demand. This trend was confirmed by the FBO operators during interviews and identified by the aircraft manufacturers nationwide. Additionally, a factor was added to the total based aircraft hangar space requirements to account for less than optimal utilization of the available hangar space. Less than optimal utilization occurs when a tenant or sub-lease has exclusive use of a facility and does not have an aircraft fleet that would occupy the entire hangar space. There are three hangar leases on the general aviation ramp that are private hangars not operated by the FBO and presumed to have some amount of unused hangar space (Raptor hangar, ABIA Booth hangar, and Ford Smith hangar). These three leases account for approximately 24 percent of the total hangar space on the general aviation ramp. In addition, at least 50 percent of each hangar was assumed utilized for this study. Therefore, a less-than-optimal hangar space utilization factor of 12 percent was calculated and used in the analysis based on this utilization of hangar space.

Additional analysis was conducted to establish the future demand for hangar space for non-based aircraft. The number of GA and AT design day operations were divided by two to determine the approximate number of design day arrivals. Based on discussions with the FBOs, it was estimated that approximately 10 percent of the non-based aircraft utilize hangar space at ABIA. The jet aircraft category area requirement was used for the average non-based aircraft size since a majority of non-based aircraft operations are from jet or turbo/multiengine aircraft. Totaling the forecasted hangar space demand for based and non-based aircraft at each forecast interval, an analysis was completed to determine the ability of the existing hangar infrastructure to meet future demands.

4.6.3.4 Results

The analysis shows that ABIA has sufficient hangar space to support GA and AT demands in the short-term; however, additional hangar space will be required to meet the PAL 3 and PAL 4 forecast demand. The additional hangar space requirements can be met with the construction of the proposed new Million Air/Capital Jet Center FBO facility to the south. The conceptual plans for this facility, once fully developed, will provide approximately 123,200 square feet of additional hangar space.[11]

Atlantic Aviation also has a lease option to develop a 20-acre area north of the existing GA ramp. Additional hangars can be developed in this area. With the planned Million Air development and the potential development of the Atlantic Aviation optional lease area, ABIA will have sufficient hangar space to accommodate the GA and AT forecasted demand.

Both Atlantic Aviation and Signature Flight Support have indicated that they regularly receive requests from potential tenants about hangar space availability. Consequently, if additional hangars are constructed within their lease areas in the short-term (0 to 10 years), immediate occupation by these interested tenants is anticipated.

Atlantic Aviation and Signature Flight Support both noted during interviews that demand has increased for hangars that can accommodate larger corporate jet aircraft (G550, Global Express, etc.). Options to accommodate this demand will be considered in development of alternatives in Chapter 5, *Alternatives Analysis/Evaluation and Environmental Conditions*.

4.6.3.5 Ramp Space Requirements

The demand for ramp space at an airport is a function of the number of aircraft using the ramp as a permanent parking location and the number of aircraft using the ramp as a temporary parking location before or after a departure or arrival. **Table 4.6-7** provides an estimate of the ramp space requirements during the forecast period.

[11] Capital Jet Center Website - http://capitaljetcenter.com/available-hangars/. Accessed 11/21/17.

Table 4.6-7: Ramp Space Requirements

ITEM	EXISTING 2017	PAL 1 (2019)	PAL 2 (2022)	PAL 3 (2027)	PAL 4 (2037)
Peak Month Average Day (General Aviation and Air Taxi Combined Operations)	208	203	199	195	195
% Traffic on Ramp at Same Time	70%	70%	70%	70%	70%
Jet (3,600 sq. ft.)	253,000	263,898	276,949	293,957	332,392
Turbo (3,450 sq. ft.)	85,021	84,747	84,345	83,614	83,086
Piston (1,600 sq. ft.)	59,356	52,296	45,880	35,275	29,077
Helicopter (1,900 sq. ft.)	25,803	25,701	25,550	25,281	25,028
Large Aircraft (Military/Charter)	40,000	40,000	40,000	40,000	40,000
Total for Aircraft Parking [sq. ft.]	**463,180**	**466,642**	**472,724**	**478,127**	**509,583**
Circulation Factor (2.5)	1,157,953	1,166,605	1,181,810	1,195,320	1,273,958
Total Ramp Required [sq. ft.]	1,621,134	1,633,247	1,654,534	1,673,447	1,783,541
Current Ramp Space [sq. ft.]	1,689,993	1,689,993	1,689,993	1,689,993	1,689,993
Surplus/Deficiency [sq. ft.]	**68,859**	**56,746**	**35,459**	**16,546**	**(93,548)**

Source: Garver analysis

4.6.3.6 Methodology

For this analysis, the average aircraft area requirements for each aircraft category (e.g., jet, turbo, piston, and helicopter) were developed based on the wingspan and length of the most common aircraft from the forecast GA fleet mix. A 10-foot wingtip/nose/tail clearance was added to ensure sufficient spacing between aircraft and other objects. Due to the increasing number of larger business jet aircraft using ABIA, the average area requirements for jets was increased by 100 feet for PAL 1, 200 feet for PAL 2, 300 feet for PAL 3, and 500 feet for PAL 4 demand. This results in an average aircraft area requirement of 3,600 square feet for jets and 3,450 square feet for turbo props.

The total area needed for aircraft parking on the ramp is 70 percent of the Peak Month Average Day for the GA and AT forecasts. It has been assumed that 70 percent of traffic will be on the ramp at the same time based on estimates provided by the FBOs. Additionally, a military/charter aircraft parking factor was included to account for large military/charter aircraft that occasionally use the ramp. It was assumed that there would be no more than two large aircraft on the ramp at any time. The area requirement was estimated to be 20,000 square feet (approximately 141-foot wingspan by 141-foot length) per large aircraft. It was also assumed that 30 percent of the single engine piston fleet and two small multi-engine piston aircraft use the ramp as a permanent parking location. Combining these parking space requirements resulted in a total estimated amount of ramp space required for aircraft parking.

In addition, a circulation factor was included to account for the following:

- Other aircraft to pass
- The clearing of areas for aircraft to taxi to/and from terminal
- Clearways in front of hangars where aircraft typically will not be parked
- The loss of space when parking aircraft of different sizes together

4.6.3.7 Results

The existing ramp area is sufficient to accommodate future demand at ABIA until the PAL 4 forecast period. However, the future Million Air/Capital Jet Center facility is expected to provide approximately seven acres of ramp space (304,920 square feet) which will provide sufficient ramp space to meet the entire future demand requirements. If Atlantic Aviation develops their additional 20-acre lease option area, additional ramp space will further exceed the 2037 forecast ramp facility needs. Approximately 50 percent of the 20-acre area would be developed for ramp space.

Portions of the existing ramp area are not efficiently configured to provide an efficient operation and creates operational constraints for the movement of aircraft. The grass strip south of Hangar 9040 was cited as an operational constraint during discussions with Signature Flight Support. The grass strip constrains movement to and from various hangars. This issue and alternative aircraft parking layouts will be considered in the Chapter 5, *Alternatives Analysis/Evaluation and Environmental Conditions*.

4.6.3.8 General Aviation Terminal Space Requirements

GA terminal space requirements are based on the number of aircraft operations, pilot/passenger averages per aircraft operation, and employee numbers. **Table 4.6-8** provides an estimate of the terminal space requirements during the forecast period.

Table 4.6-8: Terminal/FBO Space Requirements

FACILITY	EXISTING 2017	PAL 1 (2019)	PAL 2 (2022)	PAL 3 (2027)	PAL 4 (2037)
Peak Hour Operations (AT & GA)	30	29	28	27	26
Peak Hour Multiplier	5	5	5	5	5
Sq. Ft. Per Person	150	150	150	150	150
Total Terminal Sq. Ft. Requirement	22,500	21,750	21,000	20,250	19,500
Current Terminal Sq. Ft.	22,506	22,506	22,506	22,506	22,506
Surplus/Deficiency	**6**	**756**	**1,506**	**2,256**	**3,006**

Source: Garver analysis

4.6.3.9 Methodology

The future GA terminal space requirements are based on planning criteria contained in Airport Cooperative Research Program (ACRP) Report 113, *Guidebook on General Aviation Facility Planning*. The demand for GA terminal space is a function of an airport's forecasted peak hour AT and GA operations multiplied by a per square footage allotment per person and the average number of persons per aircraft.

In 2017, the peak hour operations for AT and GA operations was 30 aircraft per hour. In PAL 4 (2037), the peak hour operations for AT and GA operations is forecasted at 26 aircraft per hour. The forecast AT and GA peak hour aircraft operations shows a slight decrease over the planning period. The 2017 FAA Terminal Area Forecast also shows a decline in GA operations at ABIA. The combination of the FAA's TAF and the rising trend of small single engine piston aircraft utilizing the nearby Austin Executive Airport rather than ABIA, supports the forecast decline in GA operations. However, larger corporate aircraft are forecasted to continue to utilize ABIA's GA facilities.

Per ACRP Report 113 guidelines, the average number of pilots/passengers per aircraft is approximately 2.5. However, due to the number of larger jet aircraft currently using ABIA, this number was increased to 5.0 person per aircraft for each of the planning years. ACRP Report 113 recommends between 100 square feet and 150 square feet of space be allocated per person. Therefore, 150 square feet of area per person was used to provide the maximum comfort/support in determining the terminal space requirements.

4.6.3.10 Results

ABIA has sufficient GA terminal space to meet the forecasted demand. Currently, there is 22,506 square feet of Terminal/FBO space available at ABIA. The 2037 aviation forecasts require 19,500 square feet of Terminal/FBO space to meet the PAL 4 (2037) demand. Due to the projected decrease in peak hour GA/FBO aircraft operations at ABIA. There will be a surplus of 3,006 square feet of terminal space during the forecast period. In addition, the proposed Million Air/Capital Jet Center will provide an additional 11,925 square feet of terminal space.

During discussions with the FBO operators, the need for an on-site GA U.S. Custom's Clearance facility was recommended to reduce passenger wait times. Additionally, Signature Flight Support noted the need to add a Ground Service Equipment (GSE) maintenance facility. Signature currently utilizes a 250-square-foot building located adjacent to their fuel farm and a portion of their existing aircraft wash rack to conduct GSE maintenance. A proposed 1,000-square-foot GSE maintenance facility is recommended for this function. The location and size of these facilities will be considered in the Chapter 5, *Alternatives Analysis/Evaluation and Environmental Conditions*.

4.6.3.11 Vehicle Parking Requirements

Vehicle parking space requirements are based on the number of pilots/passengers using the GA facilities and the number of employees working at those facilities. **Table 4.6-9** provides an estimate of the vehicle parking space requirements during the forecast period.

Table 4.6-9: Vehicle Parking Space Requirements

FACILITY	EXISTING 2017	(PAL 1) 2019	(PAL 2) 2022	(PAL 3) 2027	(PAL 4) 2037
- Peak Hour Operations (AT & GA)	30	29	28	27	26
- Peak Hour Multiplier	2.5	2.5	2.5	2.5	2.5
- Parking Space Need for Passenger/Pilot	75	73	70	68	65
- Hangar Space Requirement	311,301	317,513	321,715	338,511	385,213
- Employee Parking Multiplier per 1,000 sq. ft.	1.1	1.1	1.1	1.1	1.1
- Parking Space Need for Employees	342	349	354	372	424
Total Parking Required	417	422	424	440	489
Total # of Spaces Currently	496	496	496	496	496
Total Deficiency/Surplus	**79**	**74**	**72**	**56**	**7**

Source: Garver analysis

4.6.3.12 Methodology

Vehicle parking space requirements were determined using the planning criteria in ACRP Report 113, which recommends 2.5 average number of vehicle parking spaces per aircraft operation. In 2017, the peak hour aircraft operations for AT and GA was 30 and is forecast to be 26 aircraft operations per hour for PAL 4 (2037) demand, which is a slight decrease in aircraft operations over the planning period. The parking requirements for passengers/pilots was 79 spaces in 2017 and will decrease to 65 spaces to meet the PAL 4 demand (2037).

The amount of vehicle parking required for employees is a function of hangar/office space. ACRP Report 113 recommends that, on average, one vehicle parking space is needed per 1,000 square feet of required hangar space. For this study, this factor was increased to 1,100 square feet to account for office space/maintenance areas where there might be a higher concentration of employees. The employee parking space demand in 2017 is 342 spaces, and the space requirement increases to 424 spaces to meet the PAL 4 (2037) demand.

4.6.3.13 Results

ABIA currently has sufficient vehicle parking space to accommodate existing and future demand. The analysis shows 417 spaces were required to meet the 2017 demand, and 489 spaces will be required to meet the PAL 4 (2037) demand. Currently, there are 496 available parking spaces, thus creating a surplus of seven spaces for the PAL 4 (2037) demand.

Although sufficient auto parking currently exists, the parking is not efficiently located to meet the needs of tenants at the southern end of the GA ramp. A majority of the parking is located on the north end of the GA site area. Signature Flight Support has stated that they have insufficient parking (currently 91 spaces) at their facility to accommodate current demand. Consequently, alternatives for providing additional parking on the southern end of the GA complex will be evaluated in the Chapter 5, *Alternatives Analysis/Evaluation and Environmental Conditions*.

Additional parking will also be needed in areas where future hangars/ramp area are added (e.g., the northern Atlantic lease option area and the Million Air/Capital Jet Center development). The additional parking spaces will be provided by the tenant in these areas as the hangar facilities are developed in the future.

4.6.4 TXDOT Aviation Services Department Facility

The TXDOT Flight Services facility is located east of the Runway 17L threshold along Golf Course Road. An overview of the existing TXDOT facilities is provided in **Table 4.6-10**. No need for future expansion outside of their current leased area is anticipated during the forecast period. Consequently, this facility does not have any future demand requirements requiring consideration.

Table 4.6-10: TXDOT Existing Facilities

TXDOT FACILITIES	AREA
Hangar/Office [sq. ft.]	80,500
- Hangar 1, 2, Office Area	48,500
- Hangar 3	16,000
- Hangar 4	16,000
Ramp [sq. ft.]	387,700
Vehicle Parking Spaces	169

Source: Garver analysis

4.6.5 Aerial Firefighting Facility

The Texas A&M Forest Service currently leases a small area adjacent to the Air Cargo Ramp to use as a base for aerial firefighting operations. The lease includes a grass area, utilization of the Transient Air Cargo Ramp, and the vehicle parking spaces close to the facility. A summary of these existing facilities is provided in **Table 4.6-11**.

Table 4.6-11: Texas A&M Forest Service Facilities

FACILITIES	AREA
Leased Grass Area [sq. ft.]	1,000
Ramp [sq. ft.]	262,486
Vehicle Parking Spaces	77

The potential relocation of this facility is being considered and will be reviewed in Chapter 5, *Alternatives Analysis/Evaluation and Environmental Conditions*. No additional facilities are anticipated during the forecast period.

4.6.6 Military Facility

The United States Army Reserve Center located at the southern end of Runway 35L is a 57-acre lease area and operates a number of military helicopters. This facility will not be expanded beyond its existing lease area during the forecast period. Consequently, this facility does not have any future demand requirements for consideration in this master plan.

4.6.7 Aircraft Fueling

The existing fuel farm contains the following facilities:

- Tank #1 (478,800 gallons)
- Tank #2 (688,800 gallons)
- Three refueler loading positions (400 gallons per minute each)
- 14 refueler storage parking positions
- Four transfer pumps and one spare
- One oil/water separator
- Two truck offloading positions (300 gallons per minute each)
- Tank to tank transfer pumps
- Operations building
- Staff auto parking (14 stalls)
- Fire Department access road

The Jet-A fuel storage requirements for each planning activity level (PAL) and deficit are shown in **Table 4.6-12**.

Table 4.6-12: Jet-A Fuel Requirements

PAL / YEAR	FUEL DEMAND [MILLION GALLONS]	FUEL DEFICIT [MILLION GALLONS]
2017	1.2	-
(PAL 1) 2019	2.1	0.9
(PAL 2) 2022	2.3	1.1
(PAL 3) 2027	2.6	1.4
(PAL 4) 2037	3.5	2.3

Source: Landrum & Brown analysis

The ultimate PAL 4 (2037) demand will require an additional 2.3 million nominal gallons. The current Airline Consortium has proposed an expansion of the existing fuel farm area that will include the following facilities and operate from the existing site over the next 20 years as shown in **Table 4.6-13**. Projections for the long-term future are preliminary and will require adjustment based on actual airport activity and aircraft fleet usage.

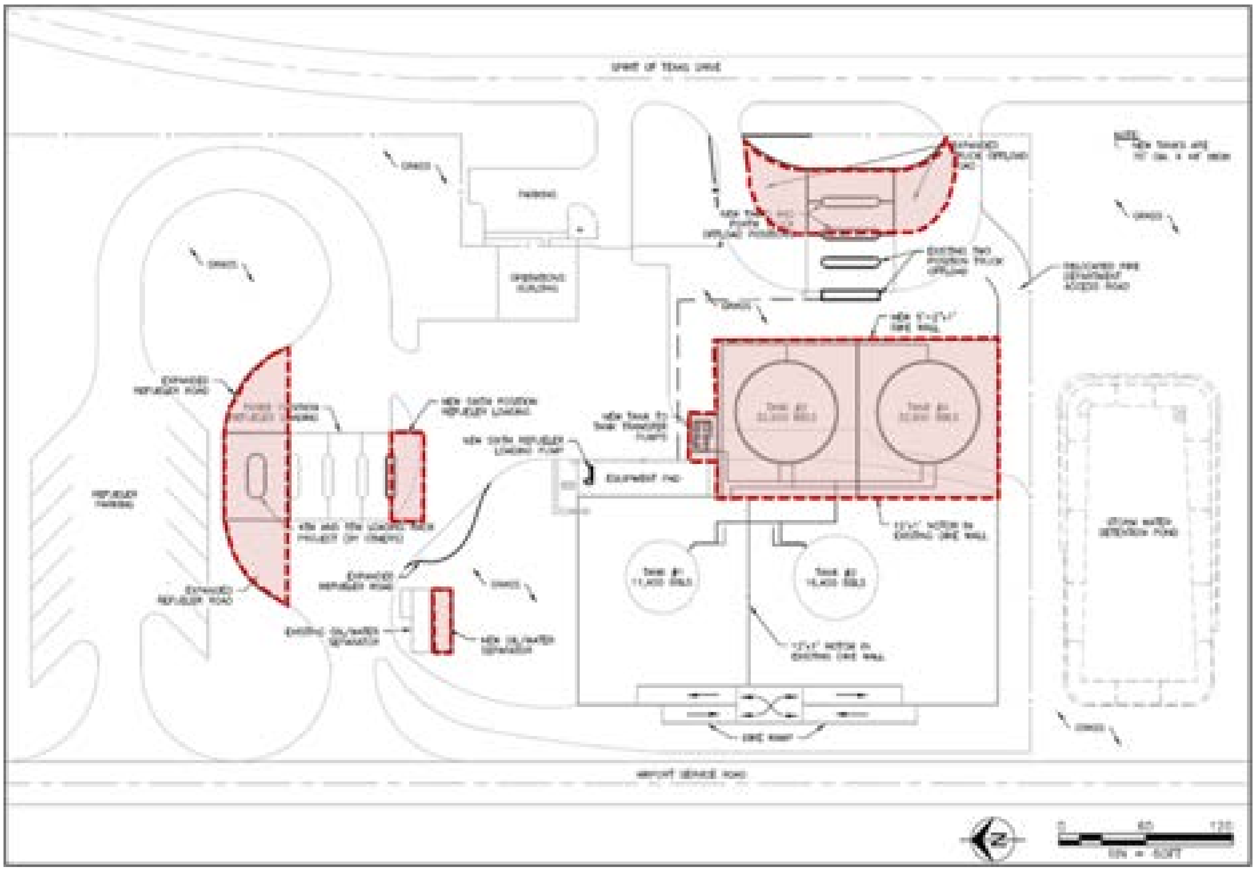
Table 4.6-13: Future Fuel Farm Facilities

FUEL FARM FACILITY	EXISTING	PAL 4 (2037)
Number of Fuel Tanks	2	4
Fuel Tank Capacity [million gallons]	1.2	4.0
Refueler Loading Positions [400 gal/min each]	3	6
Refueler Storage Parking Positions	14	20
Refueler Transfer Pumps/Refueler Transfer Pump Spares	4/1	6/1
Oil/Water Separator	1	2
Truck Offloading Positions [300 gal/min each]	2	4*
Tank to Tank Transfer Pumps	2	4
Operations Building [sq.ft.]	2,500	2,500
Staff Auto Parking [stalls]	14	14

Note: * If no fuel pipeline, minute = min., each = ea.
Source: Landrum & Brown analysis

Assuming a 2.5-year design and construction timeframe, it will be necessary to begin the fuel farm expansion process by early 2019 in order to meet the PAL 2 demand. Construction of additional tanks and supporting equipment to meet the 20-year demand can be contained within the current fuel farm lease area based on a preliminary design layout provided by the Airline Consortium (see **Exhibit 4.6-3**).

Exhibit 4.6-3: Preliminary Fuel Farm Expansion Layout



Source: Argus Consulting, Inc., AUS Tank Farm Upgrade Facility Layout – Option 1.

It is recommended that all new commercial aircraft contact gates and cargo aircraft positions be equipped with a hydrant fueling system. A new hydrant fueling system should also be considered and implemented, if economically feasible, during design of the existing tank farm expansion. A pipeline into the south side of the airport should be routed from the Flint Hills Bastrop Terminal that has 8.2 million gallons of nominal Jet-A storage capacity. If there is a larger expansion of e-commerce cargo activity, this fueling need could be met by existing facilities, or a remote refueler loading position could be constructed. This assumes a future direct pipeline into the airport and all aircraft parking positions will be equipped with a hydrant fueling system. This cargo activity would occur on the southwest side of the airport. Additional land area will be preserved on the southwest side of the airport for a potential remote refueler loading position as a secondary source of aircraft fueling.

The existing fuel farm will need to be relocated when the 3rd parallel Runway 17C-35C is constructed in the future. Based on the timing of this new runway, it will need to be determined if expansion of the existing fuel farm facility is more cost effective than constructing a new long-term fuel farm on the west side of the airport, along U.S. 183.

4.6.8 Airport Administration Offices

The current airport administration offices are on the mezzanine level of the Barbara Jordan Terminal. In addition, other airport departments are located in the Department of Aviation engineering and operations offices located at the intersection of Spirit of Texas Drive and Hotel Drive. Many departments will relocate to the new airport administration offices currently being constructed adjacent to the new Garage #3. These include the following:

- Airport Administration
- Operations & Security (partial)
- Information Systems
- Finance
- Support Services & Property Management
- Business development & Customer Relations
- Enterprise Business Services (partial)

The new administration office building will have five levels, with a total area of 81,800 sq.ft. Staff and visitor parking will be located within the new Garage #3. This new facility will be adequate to meet the 20-year (PAL 4) 2037 demand.

The existing Department of Aviation engineering and operations office will continue to house the Planning and Engineering department. This is a single level building with a total area of approximately 33,200 square feet and 55 parking spaces. No additional area will be required over the next 20-year timeframe for this facility.

4.6.9 Proposed Airport Maintenance and Police Department

ABIA proposed a new Consolidated Maintenance Facility located on the east side of Golf Course Road, northeast of Runway 17L end, as shown on **Exhibit 4.6-4**. This 13.42-acre facility will house maintenance operations, motor pool, warehouse storage, truck wash, recycling, spoil bins, and airport police department facilities as shown on **Exhibit 4.6-5**. In addition, the 0.84-acre deicing material storage facility will be located immediately north of the existing TxDOT Aviation Services facility, west of Golf Course Road.

Exhibit 4.6-4: Proposed Consolidated Maintenance Facility Site Location

Exhibit 4.6-5: Proposed Consolidated Maintenance Facility Layout

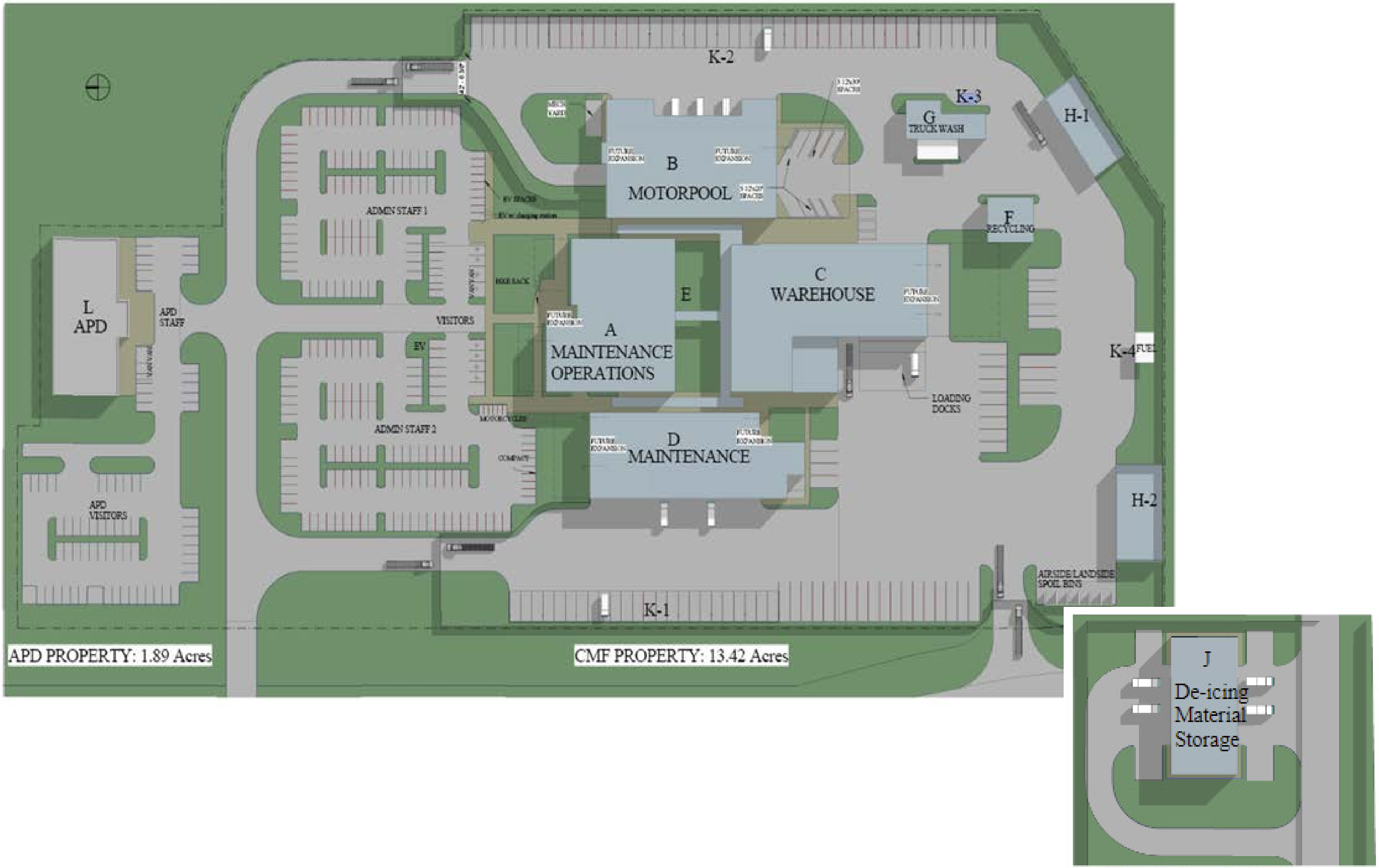


Table 4.6-14 provides a list and size of the major functional maintenance facilities. Based on meetings with ABIA Planning & Engineering (P&E), the CMF was designed to accommodate the future 20-year airport expansion. Each functional area has adequate space to accommodate future airport activity. This includes employee, visitor, and Americans with Disabilities Act-compliant auto parking, and truck loading and unloading areas.

Table 4.6-14: Consolidated Maintenance Facility

FACILITY NUMBER	DESCRIPTION	AREA [SQ. FT.]
	Buildings	
A	Maintenance Operations (1st floor)	9,145
A	Maintenance Operations (2nd floor)	8,835
B	Motor Pool	9,587
C	Warehouse	12,711
D	Maintenance	8,045
F	Recycling	1,089
G	Truck Wash	2,541
H	Garage H1	1,645
H	Garage H2	2,071
J	Deicing Material Storage	3,392
K-4	Fuel (awning area)	0
L	Airport Police Department	11,055
	Auto Parking Spaces	
	Maintenance Operations Administration	228
	Work Vehicles	131
	Airport Police Department	68

Source: 2017 0414 ABIA CMF Preliminary Submittal Plans.

4.6.10 Aircraft Maintenance

Currently only minor aircraft maintenance is conducted at the gate/ramp areas. The airlines do not have any aircraft maintenance hangars at ABIA, and, for planning purposes, all major aircraft maintenance will occur at other airports.

Airline Maintenance Centers are usually located at airports served by a sizable number of airline flights or at an airline hub. If an airline were to consider building a maintenance center at ABIA, approximately 35 to 40 acres should be devoted to airline maintenance at ABIA.

4.6.11 Ground Service Equipment Maintenance

The Ground Service Equipment Maintenance (GSEM) facility is located in Building #7005 along Spirit of Texas Drive. **Table 4.6-15** shows the anticipated GSEM facility expansion, which is required immediately to accommodate the existing GSE demand and future increase in GSE needed to service the additional aircraft gate expansion. For this analysis, it was assumed that the existing GSEM facility is at 100 percent utilization. Tenants cannot service fuel trucks at the current GSEM facility. Access around the facility is difficult and the triturator is poorly designed and undersized. Tenants are currently maintaining ground service equipment in the cargo ramp warehouses and on the cargo ramp (Menzies and Triumph).

4.6.12 Federal Aviation Administration

The Federal Aviation Administration operates the Air Traffic Control Tower (ATCT) and Terminal Radar Approach Control (TRACON) facilities that were constructed for the opening of ABIA in 1999. These facilities are located between the two parallel runway and south of Taxiway H on 13 acres of land. The ATCT is 227 feet tall, with a cab floor elevation of 691.2 feet above MSL, and a controller eye-level elevation of approximately 696.7 feet above MSL. The existing ATCT has an unobstructed view of the four runway thresholds, approach surface area, and all airfield “movement areas.” There are no plans for construction of a new ATCT or TRACON over the next 20 years. Additional staff parking might be required around the tower to account for additional staff. This can be accommodated within the existing 13-acre site area.

Table 4.6-15: GSEM Facility Requirements

YEAR	BUILDING		STORAGE BUILDING		PARKING		SITE	
	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.].	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]
Actual								
2017	10,300	(70)	670	0	50,000	0	91,500	(20)
Forecast (High Scenario)								
PAL 1 (2019)	11,100	(870)	730	(60)	53,800	(3,800)	98,400	(6,920)
PAL 2 (2022)	11,900	(1,670)	780	(110)	57,800	(7,800)	105,700	(14,220)
PAL 3 (2027)	14,800	(4,570)	970	(300)	72,000	(22,000)	131,700	(40,220)
PAL 4 (2037)	22,000	(11,770)	1,440	(770)	106,900	((56,900)	195,500	(104,020)

Source: Landrum & Brown analysis

4.6.13 Air Cargo Facility Needs

The air cargo facilities at ABIA consist of the following facilities:

- Aeroterm cargo
- City of Austin Department of Aviation Cargo (COA-DOA)
- U.S. Mail
- Freight forwarders
- Belly freight

Most, but not all of these facilities consist of cargo buildings, aircraft ramp area, truck docks and staging areas, auto parking, and GSE storage areas. Given the variety of business models and operational needs in the air cargo industry, there is no "one-size-fits-all" approach to cargo facilities planning.

Airport Cooperative Research Program (ACRP) Report 143: *Guidebook for Airport Cargo Facility Planning and Development*[12] includes planning ratios for cargo terminal buildings and other cargo facilities that are useful for long-term planning purposes. **Table 4.6-16** shows the current air cargo and belly freight facilities at ABIA.

While the level of automation varies from tenant–to-tenant and not controlled by ABIA, the typical cargo building processing ratio rates as shown in **Table 4.6-17** were applied to determine the area of cargo building required to meet the future air cargo tonnage demand levels for each planning year.

Air cargo facility requirements were determined based on two air cargo tonnage forecasts (base case and high case scenarios). The baseline case cargo forecast assumes a continuation of the current cargo market at ABIA with an average annual growth rate of 3.4 percent. While the high case cargo forecast assumes an e-commerce distribution center will be developed at ABIA, it was assumed that the distribution hub will begin service in 2027 with more than 25,500 annual aircraft operations and an average annual growth rate of 15.2 percent.

[12] ACRP Report 143, *Guidebook for Airport Cargo Planning and Development*, 2015.

Table 4.6-16: Existing Cargo Facilities

FACILITY NUMBER	FACILITY DESCRIPTION	UTILIZATION [%]	BUILDING AREA [SQ. FT.]	UTILIZED BUILDING AREA [SQ. FT.]
AIR CARGO BUILDING				
6040	Aeroterm (UPS)	100%	27,000	27,000
6040	Aeroterm (Air General)	100%	6,000	6,000
6040	Aeroterm (WFS) (Mail)	100%	12,000	12,000
6040	Aeroterm (City of Austin DOA Maintenance)	0%	24,000	0
6029	COA-DOA (Non-Aviation)	0%	22,080	0
6030	COA-DOA (DHL)	100%	31,500	31,500
6030	COA-DOA (UPS)	100%	2,500	2,500
6035	COA-DOA (FedEx)	100%	75,000	75,000
	Total Air Cargo Building Utilization [sq. ft.]		**200,080**	**154,000**
BELLY FREIGHT BUILDING				
7025	Belly Freight	100%	24,000	24,000
7030	Belly Freight	100%	33,000	33,000
	Total Belly Freight Building Utilization [sq. ft.]		**57,000**	**57,000**
AIRCRAFT RAMP AREA				
6040	Aeroterm Cargo Ramp	100%	265,150	265,200
6029, 6030, 6035	COA-DOA Cargo Ramp	100%	325,000	325,000
All	Additional North Ramp (current auto parking)	0%	175,000	0
	Total Aircraft Ramp Area Utilization [sq. ft.]		**765,150**	**590,200**
LANDSIDE TRUCK DOCKS & STAGING AREA				
6040	Aeroterm (UPS, Air General, WFS)	100%	52,500	52,500
6030	COA-DOA (DHL)	100%	91,700	91,700
6030	COA-DOA (UPS)	100%		
6035	COA-DOA (FedEx)	100%	101,500	101,500
6029	COA-DOA (Non-Aviation)	0%	7,800	0
	Sub-Total		**253,500**	**245,700**
7025	Belly Freight	100%	13,700	13,700

FACILITY NUMBER	FACILITY DESCRIPTION	UTILIZATION [%]	BUILDING AREA [SQ. FT.]	UTILIZED BUILDING AREA [SQ. FT.]
7030	Belly Freight	100%	17,400	17,400
	Sub-Total		**31,100**	**31,100**
	Total Landside Truck Docks & Staging Area		**284,600**	**276,800**
	AUTO PARKING AREA			
6040	Aeroterm (UPS, Air General, WFS)	100%	42,700	42,700
6030	COA-DOA (DHL)	100%	35,000	35,000
6030	COA-DOA (UPS)	100%		
6035	COA-DOA (FedEx)	100%	48,900	48,900
6029	COA-DOA (Non-Aviation)	0%	15,900	0
	Sub-Total		**142,500**	**126,600**
7025	Belly Freight	100%	10,600	10,600
7030	Belly Freight	100%	6,300	6,300
	Sub-Total		**16,900**	**16,900**
	Total Auto Parking Area		**159,400**	**143,500**
	GSE STORAGE AREA			
6040	Aeroterm (UPS, Air General, WFS)	100%	99,700	99,700
6030	COA-DOA (DHL)	100%	35,900	35,900
6030	COA-DOA (UPS)	100%		
6035	COA-DOA (FedEx)	100%	48,300	48,300
6029	COA-DOA (Non-Aviation)	0%	18,900	0
	Sub-Total		**202,800**	**183,900**
7025	Belly Freight	100%	5,500	5,500
7030	Belly Freight	100%	8,100	8,100
	Sub-Total		**13,600**	**13,600**
	Total GSE Storage Area		**216,400**	**197,500**
	Total Cargo Area [sq. ft.]		**1,682,630**	**1,419,000**
	Total Cargo Area (acres)		**39**	**33**

Source: Landrum & Brown analysis.

Table 4.6-17: Air Cargo Building Requirements Ratios

AIR CARGO OPERATOR	TONS/FT.^{2} RATIO
Integrated Express Carriers	
Domestic Building (warehouse)	0.92
Int'l Gateway Building (warehouse)	0.37
Passenger Airlines	
Domestic Building (warehouse)	0.64
Int'l Gateway Building (warehouse)	0.64
3rd Party Providers & All-Cargo Carriers	
Domestic Building (warehouse)	0.81
Int'l Gateway Building (warehouse)	0.81

Source: ACRP Report 143, *Guidebook for Airport Cargo Facility Planning and Development*, 2015. Landrum & Brown analysis

4.6.13.1 Baseline Forecast Cargo Facility Requirements

As shown in **Table 4.6-18**, the forecasted all-cargo growth Baseline Forecast for ABIA will require additional cargo building by the year 2027 (PAL 3), or when the capacity requirements will reach about 171,000 tons of cargo. This additional capacity need can be accommodated by converting the existing unused cargo buildings (Building #6029 and #6040) to cargo activity. These two buildings have a total area of 46,080 square feet available for cargo activity. In addition, building #6040 may be expanded to the west by approximately 212,000 square feet. Any combination of these options will provide adequate cargo building space to meet the long-term 2037 (PAL 4) demand.

The future belly cargo Baseline Forecast facility requirements are shown in **Table 4.6-19**. Belly cargo accounts for approximately 4.5 percent of the total year 2017 cargo tonnage at ABIA. It has been assumed that this percentage of belly cargo activity will remain consistent throughout the planning period. The baseline forecast future belly cargo facility requirements indicate no additional facility needs throughout the planning period.

However, it is important to protect the existing concentrated cargo area for the growth of its current cargo tenants and to accommodate other major cargo carriers that may arise during the next 20 years. By virtue of its additional green-field capacity, geographic location, and rise in e-commerce cargo potential, ABIA should be able to respond to such unforeseen opportunities more effectively than many other prospective competitors within the airports industry.

4.6.13.2 High Forecast Cargo Facility Requirements

The existing north cargo complex encompasses approximately 2.36 million square feet of land, including the expansion area, as shown in **Exhibit 4.6-6**. The forecasted cargo growth (High Forecast) for ABIA begins to address an increase in cargo activity due to additional e-commerce activity in the Austin area.

Table 4.6-18: All Cargo Facility Requirements (Baseline Forecast)

YEAR	ANNUAL AIR CARGO THROUGHPUT (TONS)	BUILDING		AIRCRAFT APRON		TRUCK DOCK & STAGING		AUTO PARKING		GSE STORAGE AREA	
		AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]
Actual											
2017	90,479	154,000		590,200		245,700		126,600		183,900	
Forecast (High Scenario)											
PAL 1 (2019)	105,990	133,390	20,610	340,620	249,580	145,521	100,179	29,100	97,500	95,486	88,414
PAL 2 (2022)	118,875	149,608	4,392	340,620	249,580	163,213	82,487	32,639	93,961	107,095	76,805
PAL 3 (2027)	136,550	171,850	(17,850)	367,046	223,154	187,479	58,221	37,490	89,110	123,018	60,882
PAL 4 (2037)	169,485	213,301	(59,301)	393,473	196,727	232,699	13,001	46,534	80,066	152,689	31,211

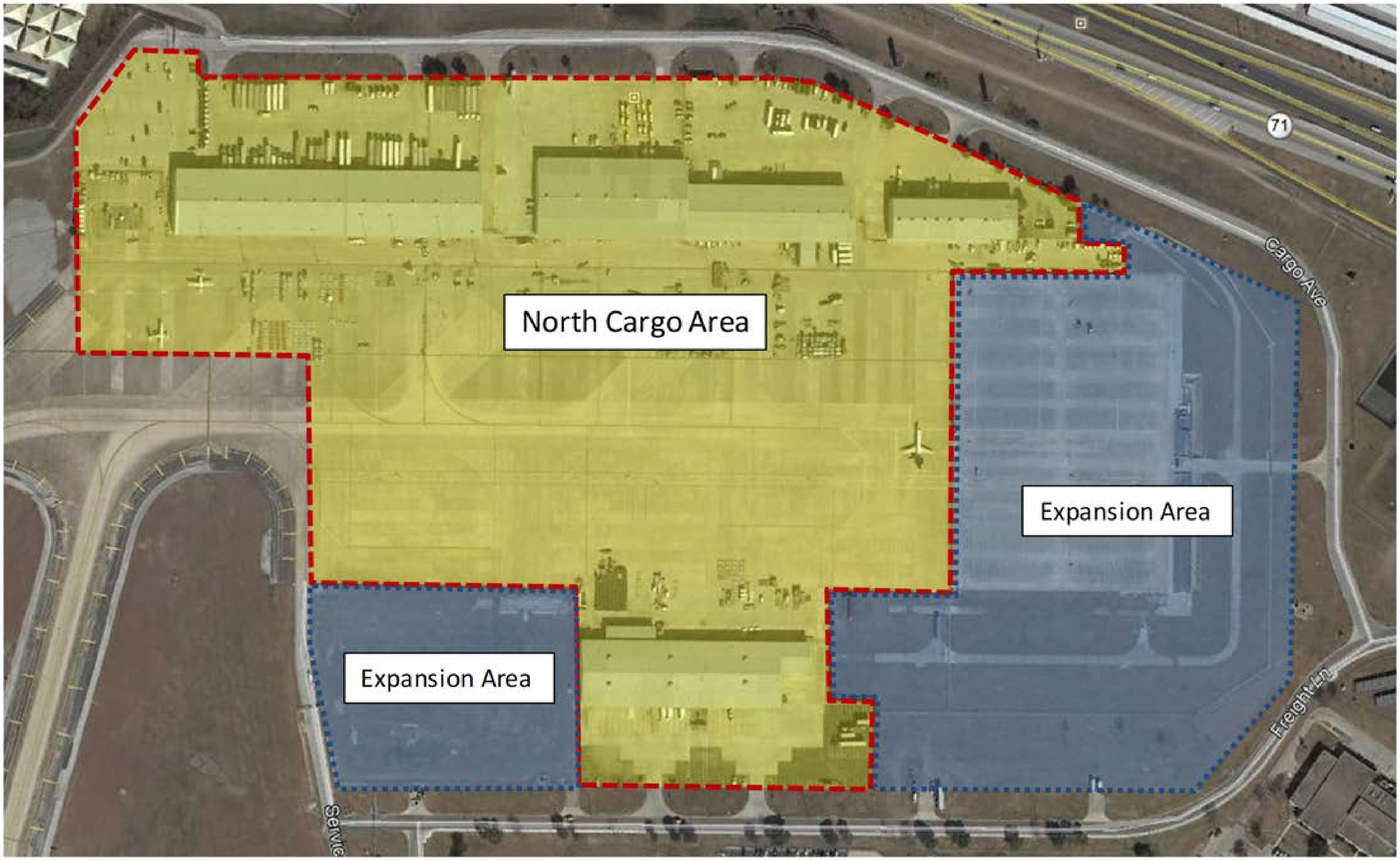
Source: Landrum & Brown analysis.

Table 4.6-19: Belly Cargo Facility Requirements (Baseline Forecast)

YEAR	ANNUAL BELLY CARGO THROUGHPUT (TONS)	BUILDING		AIRCRAFT APRON		TRUCK DOCK & STAGING AREA		AUTO PARKING		GSE STORAGE AREA	
		AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]
Actual											
2017	4,203	57,000		N/A		31,100		16,900		13,600	
Forecast (High Scenario)											
PAL 1 (2019)	5,010	6,185	50,815	N/A	N/A	7,422	23,678	1,600	15,300	4,514	9,086
PAL 2 (2022)	5,625	6,944	50,056	N/A	N/A	8,333	22,767	1,795	15,105	5,068	8,532
PAL 3 (2027)	6,450	7,963	49,037	N/A	N/A	9,556	21,544	2,061	14,839	5,811	7,789
PAL 4 (2037)	8,015	9,895	47,105	N/A	N/A	11,874	19,226	2,559	14,341	7,221	6,379

Source: Landrum & Brown analysis.

Exhibit 4.6-6: Existing North Cargo Complex and Expansion Area



Due to the anticipated increase in e-commerce-type cargo handling, it is anticipated that the cargo throughput rate will increase with new cargo facilities due to increased automation and less manual processing of the cargo materials. **Table 4.6-20** shows the anticipated increase in cargo throughput ratios per building area during the planning years. The throughput rates will increase by approximately 76 percent with development of modern cargo facilities.

Table 4.6-20: Cargo Building Throughput Rate

PAL / YEAR	ANNUAL CARGO (TONS)	THROUGHPUT RATE
Existing / 2017	90,479	0.43
PAL 1 / 2019	111,000	0.76
PAL 2 / 2022	124,500	0.76
PAL 3 / 2027	566,000	0.76
PAL 4 / 2037	1,707,500	0.76

Source: Landrum & Brown analysis.

As shown in **Table 4.6-21**, the introduction of a large cargo distribution center will drive the need for an extensive expansion of the all-cargo facilities at ABIA around the 2027 (PAL 3), when the capacity requirements will reach about 540,000 tons of cargo. The total all-cargo facility requirements will require approximately 7.28 million square feet of additional facilities (building, aircraft ramp, truck docks and staging, auto parking and GSE staging). This significant growth in all-cargo activity at ABIA and will require a separate location than the existing north cargo complex. **Exhibit 4.6-7** identifies an area on the west side of the airport that can accommodate this large growth in cargo activity, which is over triple the size of the existing north all-cargo complex. Alternative site locations will be explored in the Chapter 5, *Alternatives Analysis/Evaluation and Environmental Conditions*.

The existing belly cargo complex encompasses approximately 179,000 square feet of land as shown in **Exhibit 4.6-8**. The future belly cargo (High Forecast) requirements are shown in **Table 4.6-22**. As previously noted, the belly cargo accounts for approximately 4.5 percent of the total year 2017 cargo tonnage at ABIA. It was assumed that this percentage of belly cargo activity will remain constant throughout the planning period. The high case future belly cargo requirements indicate a need for additional belly cargo facilities around the 2027 (PAL 3) timeframe when the capacity requirements will reach about 25,500 tons of belly cargo. The total belly cargo will require approximately 185,000 square feet of additional facilities (building, truck docks and staging, auto parking and GSE staging), more than doubling in size of the existing belly cargo complex.

Table 4.6-21: All Cargo Facility Requirements (High Forecast)

YEAR	ANNUAL AIR CARGO THROUGHPUT (TONS)	BUILDING		AIRCRAFT APRON		TRUCK DOCK & STAGING		AUTO PARKING		GSE STORAGE AREA	
		AREA REQUIRED	SURPLUS (DEFICIT)	AREA REQUIRED	SURPLUS (DEFICIT)	AREA REQUIRED	SURPLUS (DEFICIT)	AREA REQUIRED	SURPLUS (DEFICIT)	AREA REQUIRED	SURPLUS (DEFICIT)
		[SQ. FT.]	[SQ. FT.]	[SQ. FT.]	[SQ. FT.]	[SQ. FT.]	[SQ. FT.]	[SQ. FT.]	[SQ. FT.]	[SQ. FT.]	[SQ. FT.]
Actual											
2017	90,479	154,000		590,200		245,700		126,600		183,900	
Forecast (High Scenario)											
PAL 1 (2019)	105,990	133,390	20,610	340,620	249,580	145,521	100,179	29,100	97,500	95,486	88,414
PAL 2 (2022)	118,875	149,608	4,392	340,620	249,580	163,213	82,487	32,639	93,961	107,095	76,805
PAL 3 (2027)	540,440	680,156	(526,156)	789,869	(199,669)	742,010	(496,310)	148,384	(21,784)	486,883	(302,983)
PAL 4 (2037)	1,630,365	2,051,859	(1,897,859)	2,369,606	(1,779,406)	2,238,452	(1,992,752)	447,640	(321,040)	1,468,797	(1,284,897)

Source: Landrum & Brown analysis

Exhibit 4.6-7: Future West Cargo Complex Area

Exhibit 4.6-8: Existing Belly Cargo Complex

Table 4.6-22: Belly Cargo Facility Requirements (High Forecast)

YEAR	ANNUAL BELLY CARGO THROUGHPUT (TONS)	BUILDING		AIRCRAFT APRON		TRUCK DOCK & STAGING AREA		AUTO PARKING		GSE STORAGE AREA	
		AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]	AREA REQUIRED [SQ. FT.]	SURPLUS (DEFICIT) [SQ. FT.]
Actual											
2017	4,203	57,000		N/A		31,100		16,900		13,600	
Forecast (High Scenario)											
PAL 1 (2019)	5,010	6,185	50,815	N/A	N/A	7,422	23,678	1,600	15,300	4,514	9,086
PAL 2 (2022)	5,625	6,944	50,056	N/A	N/A	8,333	22,767	1,795	15,105	5,068	8,532
PAL 3 (2027)	25,560	31,556	25,444	N/A	N/A	37,867	(6,767)	8,161	8,739	23,027	(9,427)
PAL 4 (2037)	77,135	95,228	(38,228)	N/A	N/A	114,274	(83,174)	24,621	(7,721)	69,491	(55,891)

Source: Landrum & Brown analysis.

4.7 Regional Traffic and Roadway Development Needs

The regional roadway network accessing ABIA mainly consists of Texas State Highway 71 (SH 71), a multi-lane-controlled access road that connects to Interstate 35 (I-35) via direct connector ramps to the west of ABIA and to Texas State Highway 130 (SH 130) to the east of ABIA. Regionally, U.S. Route 183 (US 183) connects to SH 71 just west of ABIA and continues through the City of Austin and the northwestern suburbs. SH 130 just east of ABIA connects to I-35 in Georgetown and routes north-south connecting to Interstate 10 (I-10) in Seguin. Passengers from the northern and eastern suburbs, such as Pflugerville, Manor, Round Rock, and Georgetown, will utilize SH 130 to access ABIA.

Burleson Road is a City of Austin-owned street that connects to US 183 and SH 130 on the south side of ABIA. Burleson Road provides access to the South Terminal, ATCT, GA/FBO, and other facilities located in the southern part of the airport.

4.7.1 Methodology

The Capital Area Metropolitan Planning Organization (CAMPO) maintains a regional travel demand model for all the region's major roadways. The travel demand model considers future land use and population growth to forecast future traffic demand on the regional roadways. The model uses Volume-to-Capacity (V/C) ratios to express the level at which a roadway facility is operating. V/C ratios serve as a simple representation of roadway segment performance. The Transportation Research Board of the National Academies Highway Capacity Manual defines a roadway's operation Level of Service by its V/C ratio. The LOS is expressed by the letters A through F, as shown in **Table 4.7-1**. Roadways with a LOS A through LOS C are considered acceptable, while a LOS D through LOS F are not acceptable and require upgrade to improve their LOS to a LOS C or above.

Table 4.7-1: LOS per V/C Ratio

LOS	V/C RATIO
A	0.35
B	0.55
C	0.77
D	0.92
E	1.0
F	>1.0

The CAMPO travel demand model was acquired and reviewed for the Master Plan study. The existing and forecasted V/C ratio for the regional roadways are summarized in **Table 4.7-2**.

Table 4.7-2: Regional Roadway V/C Ratios

ROADWAY	2017		PAL 1 (2019)		PAL 2 (2022)		PAL 3 (2027)		2032		PAL 4 (2037)	
	PK. HOUR VOL.	V/C RATIO	PK. HOUR VOL.	V/C RATIO	PK. HOUR VOL.	V/C RATIO	PK. HOUR VOL.	V/C RATIO	PK. HOUR VOL.	V/C RATIO	PK. HOUR VOL.	V/C RATIO
SH 130 – Harold Green to SH 71	2,231	0.18	2,246	0.18	2,551	0.30	3,478	0.59	4,741	0.88	6,464	1.17
SH 130 – Burleson Road/ Elroy Road to SH 71	1,553	0.17	1,675	0.18	1,992	0.30	2,793	0.61	3,917	0.92	5,494	1.23
SH 71 – US 183 to SH 130	5,809	0.82	6,211	0.84	6,732	0.81	7,574	0.70	8,521	0.60	9,587	0.49
US 183 Montopolis Colorado River to SH 71	6,920	0.83	8,136	0.83	9,199	0.62	10,212	0.84	11,336	1.06	12,584	1.28
US 183 – Burleson Rd. to SH 71	2,038	0.75	2,131	0.78	2,245	0.85	2,420	0.98	2,607	1.10	2,810	1.23
FM 973 – FM 812 to SH 71	724	0.46	772	0.51	894	0.56	1,186	0.64	1,574	0.72	2,089	0.80
FM 973 – FM 969 to SH 71	753	0.26	838	0.28	989	0.40	1,312	0.68	1,741	0.95	2,309	1.23
Burleson Road	1,152	0.47	1,172	0.49	1,198	0.52	1,240	0.57	1,283	0.62	1,327	0.67

4.7.1.1 Forecasting Methodology – Future Vehicle Traffic Volumes

To translate future passenger forecasts to vehicle traffic volumes, the correlation between flight data and traffic counts collected on the peak day of the peak month (Friday, July 21st in 2017) was analyzed. The actual full 2017 passenger data and flight data were not available at the time of this analysis, therefore an estimated flight scheduled was used. Variation and correlation of curbside traffic with the number of flights over 24 hours is presented in **Exhibit 4.7-1** and **Exhibit 4.7-2.** This shows a reasonable correlation between aircraft flight and vehicle data that was used as the basis of translating future passenger data to vehicle traffic volumes.

Exhibit 4.7-1: Correlation between Flight Data and Vehicle Traffic Counts Based on 2017 Data

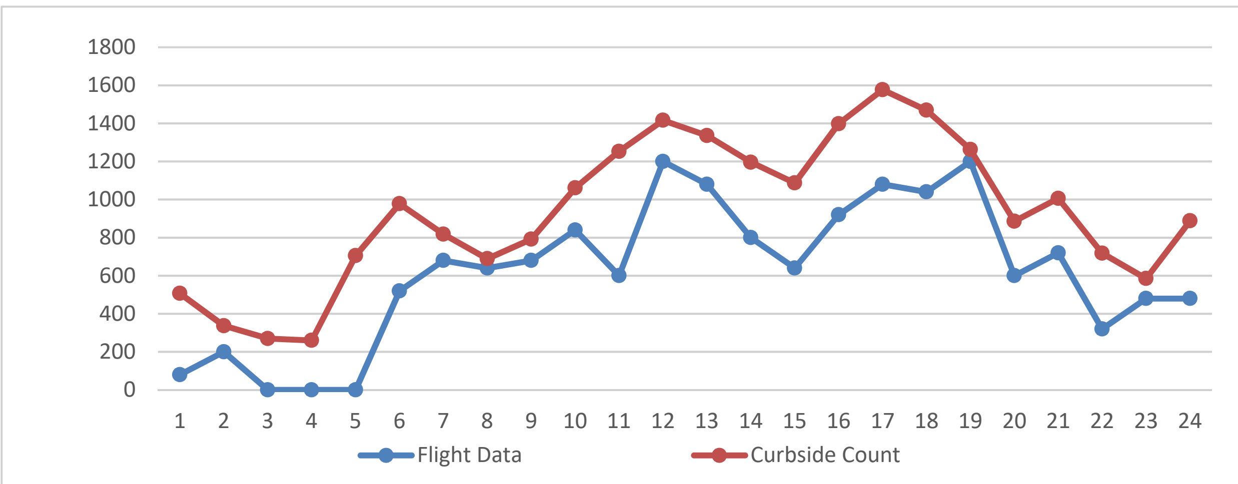
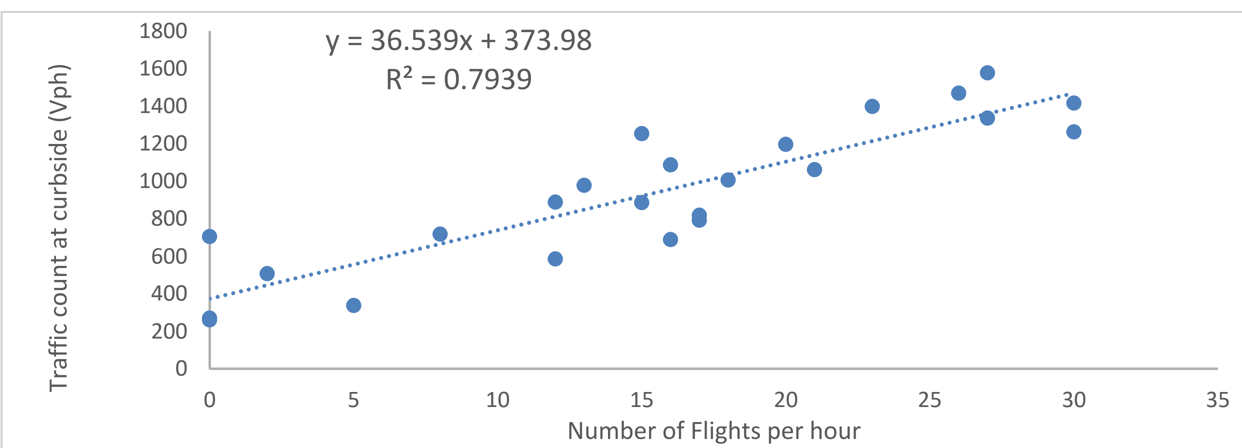


Exhibit 4.7-2: Correlation between Traffic Count and Number of Flights



Annual, peak month, peak day, and arriving and departing passenger volume annual growth rates were determined for each of the forecast 20-year period to evaluate how these rates differ at various aggregate levels. This comparison showed all growth rates were reasonably consistent and were used as shown in **Table 4.7-3**.

Table 4.7-3: Calculated Vehicle Traffic Volume Annual Growth Rates

YEARS	ANNUAL GROWTH RATES
2017-2019	6.21%
2019-2022	3.28%
2022-2027	2.99%
2027-2032	2.88%
2032-2037	2.88%

Based on the intermediate annual growth rates, an average growth factor of 2.1 was determined between year 2017 and the PAL 4 (2037) demand. This average growth factor was used in the Verehr Städten Simulations Model VISSIM analysis.

4.7.1.2 PAL 4 Demand (2037) Terminal Roadways VISSIM Traffic Analysis for No-Build Conditions

The traffic analysis presented in this section identified the traffic needs for ABIA's terminal roadway and curbside for the PAL 4 demand (2037). Based on a review of existing local transportation plans and information provided by the airport, the network system within the circulation area will not change. Therefore, the existing 2017 traffic models were used as the basis of future models and updated with the PAL 4 (2037) traffic volumes that were developed based on a growth factor of 2.1. Traffic analysis for the PAL 4 demand (2037) was performed consistent with the methodology used for the 2017 traffic analysis as described in Chapter 2, *Existing Conditions and Issues*. As shown in **Table 4.7-4**, the VISSIM results of the PAL 4 demand traffic conditions at the study intersections show unacceptable LOS D, E and F at all intersections, especially those unsignalized intersections during the PM peak hour. Results of the airport roadway segment analyses, excluding the terminal curbside, are presented in **Table 4.7-5**.

Table 4.7-4: PAL 4 Demand (2037) Terminal Roadway Intersection Traffic Operations

INTERSECTION	AM		PM	
	DELAY [SECONDS/ VEHICLE]	LOS	DELAY [SECONDS/ VEHICLE]	LOS
SH 71 WBFR at Spirit of Texas Drive (Unsignalized)	39	E	58	F
SH 71 EBFR at Spirit of Texas Drive (Unsignalized)	51	F	124	F
SH 71 WBFR at Presidential Boulevard (Signalized)	24	C	100	F
SH 71 EBFR at Presidential Boulevard (Signalized)	46	D	77	E
Spirit of TX Dr. at Hotel Dr. (Unsignalized)	163	F	239	F
Hotel Drive at Employee Avenue (Unsignalized	1	A	39	E
Hotel Drive at Presidential Boulevard (Unsignalized)	1	A	80	F
Spirit of Texas at Spirit of Austin Lane (Unsignalized)	52	F	252	F
Spirit of Texas Drive at Rental Car Rd (Unsignalized)	3	A	215	F
Burleson Road at General Aviation Avenue (Signalized)*	24	C	14	B

Note: * This intersection was not included in VISSIM models and was analyzed individually using Synchro software, WBFR - West bound frontage road, EBFR – East bound frontage road

Table 4.7-5: PAL 4 Demand (2037) Circulation Area Roadway Segment Traffic Operations

SEGMENTS		AM			PM		
FROM LINK	TO LINK	AVERAGE MODELED SPEED [MPH]	AVERAGE DENSITY [VEHICLES/ MILE/HOUR]	EQUIVALENT LOS BASED ON DENSITY	AVERAGE MODELED SPEED [MPH]	AVERAGE DENSITY [VEHICLES/ MILE/HOUR]	EQUIVALENT LOS BASED ON DENSITY
SH 71	Hotel Drive Exit	40	13	B	4	95	F
Hotel Drive Exit	Hotel Drive Entrance	44	16	B	6	99	F
Hotel Drive Entrance	Spirit of Austin Lane	42	13	B	3	114	F
Spirit of Austin Lane	Long Term Parking Entrance	43	15	B	9	81	F
		43	21	C	7	141	F
		38	14	B	6	105	F
Long Term Parking Entrance	Lower and Upper Curb Diverge	37	14	B	2	187	F
Start of Lower Curbside Roadway	Garage A Exit	31	6	A	1	143	F
Garage A Exit	Start of Lower Curbside	30	4	A	1	214	F
Start of Upper Curbside Roadway	Start of upper curbside	19	45	E	18	19	F
End of Lower Curbside	Garage A Entrance*	15	6	A	2	88	F
		15	8	A	2	145	F
End of Upper Curbside	Garage A Entrance	14	50	F	1	145	F
Garage A Entrance	Parking Lot G Exit	27	15	B	2	158	F
Parking Lot G Exit	CONRAC Entrance	44	12	A	2	165	F
CONRAC Entrance	Hotel Drive Exit	42	10	A	2	146	F
Hotel Drive Exit	SH 71	32	14	B	6	53	F

Note: * Includes multiple roadway segments.

Traffic conditions at all airport intersections will be unsatisfactory with LOS E and LOS F 2037 based on the PAL 4 demand. Furthermore, the most roadway segments operate at LOS D or better during the AM peak hour. However, all roadway segments fail operationally during the PM peak hour period mainly due to over-congested terminal curbside conditions and a queue at the terminal curb entry point that propagates to other segments of the entrance roadway. The VISSIM simulation results for "time spent in queue" in minutes, and the corresponding LOS, are presented in **Table 4.7-6**. The simulation results are consistent with the LOS presented based on density in Table 4.7-5.

Table 4.7-6: PAL 4 Demand (2037) VISSIM Simulation Results for Time Spent in Queue and LOS Measures

LOCATION	AM		PM	
	TIME SPENT IN QUEUE(S) [MIN.]	LOS	TIME SPENT IN QUEUE(S) [MIN.]	CURBSIDE LOS
Inner Curbside at Lower Level	1	A	472	F
Outer Curbside at Lower Level	11	A	418	F
Inner Curbside at Upper Level	46	C	20	B
Outer Curbside at Upper Level	62	C	32	B

The terminal lower level entry queue and delays primarily result from driver's behavior at the curbside entrance as observed with the current operation. The impacts of these human factors worsen with future conditions as passenger demand increases throughout the roadway system. This behavior consists of the following:

- A large portion of vehicles immediately maneuvering into the two right lanes upon entering the terminal curbside to secure their place and look for their passengers.
- These vehicles slowly driving down the curbside with brief but frequent stops to look for their passengers, as they are not permitted to stop and wait.
- Multiple crosswalks require frequent stops waiting for passengers to cross the lower roadway.

Pedestrians have the right-of-way at each crosswalk with no signalization requiring pedestrians to wait to cross the roadway. These uncontrolled pedestrian crossings cause significant delay to traffic movement at the lower level curbside.

4.7.1.3 Future Years Terminal Curbside Traffic Analysis for No-Build Conditions

Similar to the year 2017 analysis, the VISSIM traffic analysis was supplemented with ACRP Report 40, *Airport Curbside and Terminal Area Roadway Operations* analysis guidelines for the curbside traffic operations. The analysis of loading/unloading curbside lanes in **Table 4.7-7** show acceptable LOS D or better at all terminal curbsides across all planning activity levels, with the exception of the lower curbside for the PAL 4 (2037) demand. The PAL 4 utilization ratio on the lower curbside crosses the LOS D threshold of 1.7 and results in LOS E. LOS E means that the curbside capacity is deficient and geometric improvements should be considered. Analysis of the terminal curbside through lanes determined a LOS C for the upper curb and a LOS D for the lower curb for the PAL 4 (2037) demand as shown in **Table 4.7-8**.

Table 4.7-7: Future Years Loading/Unloading Curbside Lanes Utilization Factor and LOS

MODE	FUTURE PEAK HOUR TRAFFIC VOLUME STOPPED AT CURBSIDE	AVERAGE SAMPLE DWELL TIME [SECONDS]	DEMAND IN LINEAR LENGTH [FT.]	CURBSIDE LOADING / UNLOADING EFFECTIVE LENGTH [FT.]	CURB UTILIZATION RATIO	CURBSIDE LANES LOS BASED ON UTILIZATION FACTOR
PAL 1 (2019)						
Curbside Upper Level (Total)						
Individually Owned Vehicle	675	65	570	820	0.70	A
On-Site Parking Shuttle	27	125	114	200	0.57	A
Off-Site Parking Shuttle	29	125	190	210	0.90	A
Curbside Lower Level (Total)						
Individually Owned Vehicle	711	70	600	540	1.11	C
Taxi	98	375	510	590	0.86	A
On-Site Parking Shuttle	10	125	114	210	0.54	A
Off-Site Parking Shuttle	44	130	190	210	0.90	A
Transit	5	300	114	180	0.63	A
PAL 2 (2022)						
Curbside Upper Level (Total)						
Individually Owned Vehicle	743	65	600	820	0.73	A
On-Site Parking Shuttle	30	125	190	200	0.95	B
Off-Site Parking Shuttle	32	125	190	210	0.90	A
Curbside Lower Level (Total)						
Individually Owned Vehicle	783	70	690	540	1.28	C
Taxi	108	375	540	590	0.92	B
On-Site Parking Shuttle	11	125	114	210	0.54	A
Off-Site Parking Shuttle	48	130	190	210	0.9	A
Transit	5	300	114	180	0.63	A

MODE	FUTURE PEAK HOUR TRAFFIC VOLUME STOPPED AT CURBSIDE	AVERAGE SAMPLE DWELL TIME [SECONDS]	DEMAND IN LINEAR LENGTH [FT.]	CURBSIDE LOADING / UNLOADING EFFECTIVE LENGTH [FT.]	CURB UTILIZATION RATIO	CURBSIDE LANES LOS BASED ON UTILIZATION FACTOR
PAL 3 (2027)						
Curbside Upper Level (Total)						
Individually Owned Vehicle	861	65	690	820	0.84	A
On-Site Parking Shuttle	35	125	190	200	0.95	B
Off-Site Parking Shuttle	37	125	190	210	0.90	A
Curbside Lower Level (Total)						
Individually Owned Vehicle	907	70	750	540	1.39	D
Taxi	125	375	600	590	1.02	B
On-Site Parking Shuttle	13	125	114	210	0.54	A
Off-Site Parking Shuttle	56	130	228	210	1.09	B
Transit	6	300	114	180	0.63	A
(2032)						
Curbside Upper Level (Total)						
Individually Owned Vehicle	992	65	750	820	0.91	B
On-Site Parking Shuttle	40	125	190	200	0.95	B
Off-Site Parking Shuttle	43	125	190	210	0.90	A
Curbside Lower Level (Total)						
Individually Owned Vehicle	1046	70	870	540	1.61	D
Taxi	144	375	690	590	1.17	C
On-Site Parking Shuttle	15	125	114	210	0.54	A
Off-Site Parking Shuttle	65	130	228	210	1.09	B
Transit	7	300	114	180	0.63	A
PAL 4 (2037)						
Curbside Upper Level (Total)						

MODE	FUTURE PEAK HOUR TRAFFIC VOLUME STOPPED AT CURBSIDE	AVERAGE SAMPLE DWELL TIME [SECONDS]	DEMAND IN LINEAR LENGTH [FT.]	CURBSIDE LOADING / UNLOADING EFFECTIVE LENGTH [FT.]	CURB UTILIZATION RATIO	CURBSIDE LANES LOS BASED ON UTILIZATION FACTOR
Individually Owned Vehicle	1144	65	870	820	1.06	B
On-Site Parking Shuttle	46	125	190	200	0.95	B
Off-Site Parking Shuttle	50	125	190	210	0.90	A
Curbside Lower Level (Total)						
Individually Owned Vehicle	1205	70	990	540	1.83	E
Taxi	166	375	750	590	1.27	C
On-Site Parking Shuttle	17	125	114	210	0.54	A
Off-Site Parking Shuttle	75	130	228	210	1.09	B
Transit	8	300	114	180	0.63	A

Table 4.7-8: Curbside Thru Lanes (Inner Curbside Only) Demand, Capacity and LOS

	FUTURE PEAK HOUR VOLUME [VPH]	FUTURE CAPACITY [VPH]	V/C RATIO	LOS
PAL 1 (2019)				
Curbside Upper Level (Total)	710	2790	0.25	B
Curbside Lower Level (Total)	910	2220	0.41	C
PAL 2 (2022)				
Curbside Upper Level (Total)	780	2790	0.28	B
Curbside Lower Level (Total)	1000	2220	0.45	C
PAL 3 (2027)				
Curbside Upper Level (Total)	900	2790	0.32	B
Curbside Lower Level (Total)	1160	2220	0.52	C
(2032)				
Curbside Upper Level (Total)	1040	2790	0.37	B
Curbside Lower Level (Total)	1340	2220	0.60	C
PAL 4 (2037)				
Curbside Upper Level (Total)	1200	2790	0.43	C
Curbside Lower Level (Total)	1540	2220	0.69	D

Note: VPH = Vehicles per Hour

4.7.1.4 Intermodal Transportation Demands

ABIA is currently served by Capital Metro bus Route 20, Manor Road/Riverside. This route is part of Capital Metro's High-Frequency Network and runs every 15 minutes 7 days a week.

ABIA has recently completed construction on a new Capital Metro bus facility at the northern end of the terminal lower level curb. If signage is improved along with other measures to increase passenger awareness, the increased frequency and new bus facility could significantly increase ridership demand.

4.7.1.5 Conclusions

The VISSIM and ACRP Report 40 traffic analysis show unsatisfactory LOS mainly with future no-build conditions, especially to meet the PAL 4 (2037) demand. Inadequate capacity and operations at the entry point to the terminal curbside area will create bottlenecks throughout the roadway system. The calculated utilization factors and corresponding LOS for future years demonstrate deficient capacity by year 2037 that would require geometric improvements at the terminal curbside. The following mitigation measures are recommended to be analyzed as part of Chapter 5, *Alternatives Analysis/Evaluation and Environmental Conditions*:

- Signalization/optimization of unsignalized intersections throughout the circulation area.
- Optimization of signal timings at signalized intersections.
- Geometric improvements at intersections, especially at the two intersections that provide access to the airport circulation area.
- Operational improvements within the curbside area including controlling pedestrian movements, police enforcement to guide drivers through different zones, signage to increase passenger pick-up on upper curbside to relieve some of the congestion at the lower curbside, etc.
- Geometric improvements at the curbside area.
- Removal of some commercial vehicles into a Ground Transportation Center (GTC) located away from the terminal curbside.
- Reallocation of airline space inside the terminal to distribute the vehicle traffic more evenly along the upper and lower curbside.
- Move the terminal entrance and exit doors farther east along the curb. Such changes may require the re-assignment of baggage claim devices or reducing the number of exit points to the curb near the west end.

Each of these proposed mitigation options will be assesses in the Chapter 5*, Alternatives Analysis/Evaluation and Environmental Conditions,* to determine the most cost effective and prudent solution to resolve the existing and future terminal curb congestion issues. The addition of personnel to monitor and control the terminal curbside congestion has been attempted by the airport in the past and resulted in minimal or no improvement to congestion during peak periods. The addition of staff resources alone may not be adequate as experienced by the airport in previous attempts, it may be useful if augmented by improved signage

4.8 New Technology Impacts on Landside Facility Requirements

4.8.1 Introduction

Future landside facility traffic and parking demand was estimated based on historic relationships to airline passenger growth. However, it is likely that new technologies, such as the increased use of Transportation Network Companies (TNCs) and introduction of driverless cars at ABIA will disrupt historic relationships. This section presents the methodologies used to consider how these new technologies are likely to change the landside demand forecasts and the results of applying these methodologies. The numeric results of this analysis are presented in **Appendix 4.1**. In addition, this section shows the analysis in graphic form for ease of interpretation.

4.8.2 Methodology

The primary disruptive technology considered was the driverless taxi or Shared Driverless Car (SDC). These fleet-owned vehicles are the primary initial market for driverless cars as evidenced by numerous public statements by automobile manufacturers. These vehicles will behave much like driverless versions of taxis or TNC vehicles. They are expected to cost significantly less to operate per mile than taxis or TNC vehicles and therefore have a significantly higher market penetration. The reasons for the lower operating costs include:

- No driver required
- Lower insurance costs
  - Less at-fault accidents
- Lower fuel costs
  - Electric (or hybrid initially)
- Removal of middleman
  - No dealer markup
- Higher capital costs offset by lower operating and maintenance costs
  - 500,000-mile life

These lower costs are expected to result in taxi, TNC, and rental car vehicles switching to SDCs relatively rapidly. In addition, airport users are likely to use SDCs in place of their personal cars to the extent the switch results in time and money savings. The City of Austin appears likely to be among the first in the U.S. to receive a deployment of SDCs.

A literature review revealed a variety of events already occurring or projected that informed the estimates of the timeframes for switches to TNCs. For example, Waymo (Google's driverless car company) is testing self-driving vehicles on public roads without an occupant behind the wheel. By considering the conservative[13] and aggressive[14] projections in the literature, it was possible to develop high and low impact forecasts and estimate the probable impacts. These impacts were then applied to the forecast vehicle projections for the 2019, 2022, 2027, 2032 and 2037 planning years.

It is important to recognize that penetration by SDCs relative to Vehicle Miles Traveled (VMT) will be much quicker than penetration by SDCs relative to the overall automobile fleet. This is because the average personal vehicle is only used for less than five percent of the day, while SDCs will be used for more than fifty percent of the day (a factor greater than ten). Thus, when SDCs comprise a mere two percent of the personal vehicle fleet, they will likely comprise twenty percent of VMT.

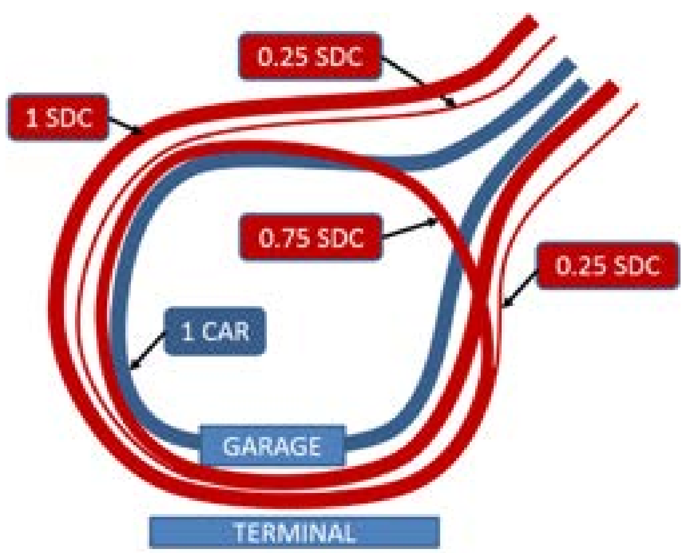
13 Regional Plan Association, New Mobility, Autonomous Vehicles and the Region.
14 Aribib, James et al, *Rethinking Transportation 2020-2030*.

Consider a passenger who parks in the long-term lot for five days at the cost of $35 per day. If that passenger instead uses an SDC at some lower cost for the round trip, the airport will have five unused parking stalls and lost $175 in revenue. Since an SDC round trip will likely take less than one hour, just one SDC could make ten roundtrips to the airport resulting in 50 unused stalls and the loss of over 1.5 million dollars in annual revenue.

In addition to determining which types of vehicles will switch to SDCs and over what timeframe, it was also necessary to determine how SDC traffic patterns may change from those of conventional cars, taxis, and TNCs. For example, cars drop off at the upper curbside and pick up at the lower curbside, while taxis only use the lower curbside. It was assumed SDCs will mimic cars and drop off at the upper curbside while picking up at the lower curbside. Two examples of changed traffic patterns are described below.

In **Exhibit 4.8-1**, the blue line represents the path of a passenger who drives into the airport, leaves their car in the parking garage, and retrieves their car on their return and leaves the airport. This results in one entrance/exit car trip.

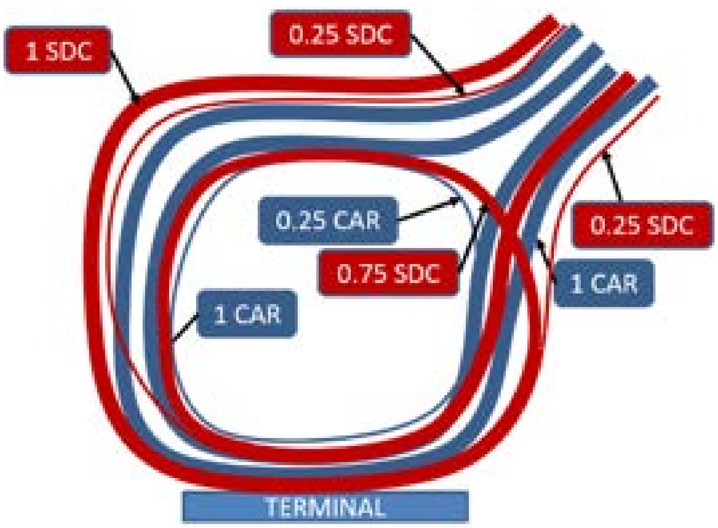
Exhibit 4.8-1: Structured Parking User Switches to SDC



Were this passenger to switch to an SDC (depicted by the red lines), the SDC would enter the airport and drop them off at the upper curbside. It is estimated that 75 percent of the time, the SDC will circle back to seek another passenger at the lower curbside. This means that when the passenger returns, there is a 75 percent chance of an SDC waiting for them that just dropped a passenger off at the upper curbside. To ensure a complete trip, there must be a 25 percent chance that an SDC at the curbside just entered the airport and proceeded directly to the curbside. This results in 1.25 entrance/exit SDC trips (a 25 percent increase over the car trip that was replaced). More significantly, it results in two curbside SDC trips where there were no car trips before.

While the previous examples have illustrated negative impacts on the airport roadway/curb, **Exhibit 4.8-2** illustrates a situation where the resultant impact is positive. In this situation, a passenger who has their family member drop them off and then return to pick them up upon return switches to using an SDC. The initial drop-off car trip is represented by the blue line entering the airport, passing through the upper curbside (closest to the terminal) and then exiting the airport. The pickup trip is similar but a bit more complex. The data indicates that some 25 percent of cars attempting pickups at the lower curbside are unsuccessful on their first attempt and must circle around for another attempt. This results in two entrance/exit trips and 2.25 curbside trips.

Exhibit 4.8-2: Passenger Drop-Off / Pick-up Switches to SDC



The equivalent SDC trips are identical to those described for the previous example and result in 1.25 entrance/exit trips (a reduction of 37 percent) and 2.0 curbside trips (a reduction of 11 percent). Combining the projected adoption rates of SDCs with the anticipated impacts and changes in traffic patterns for the different modes and trip purposes enabled development of the probable projected impacts and ranges of projected impacts presented below.

4.8.3 Projected New Technology Impacts

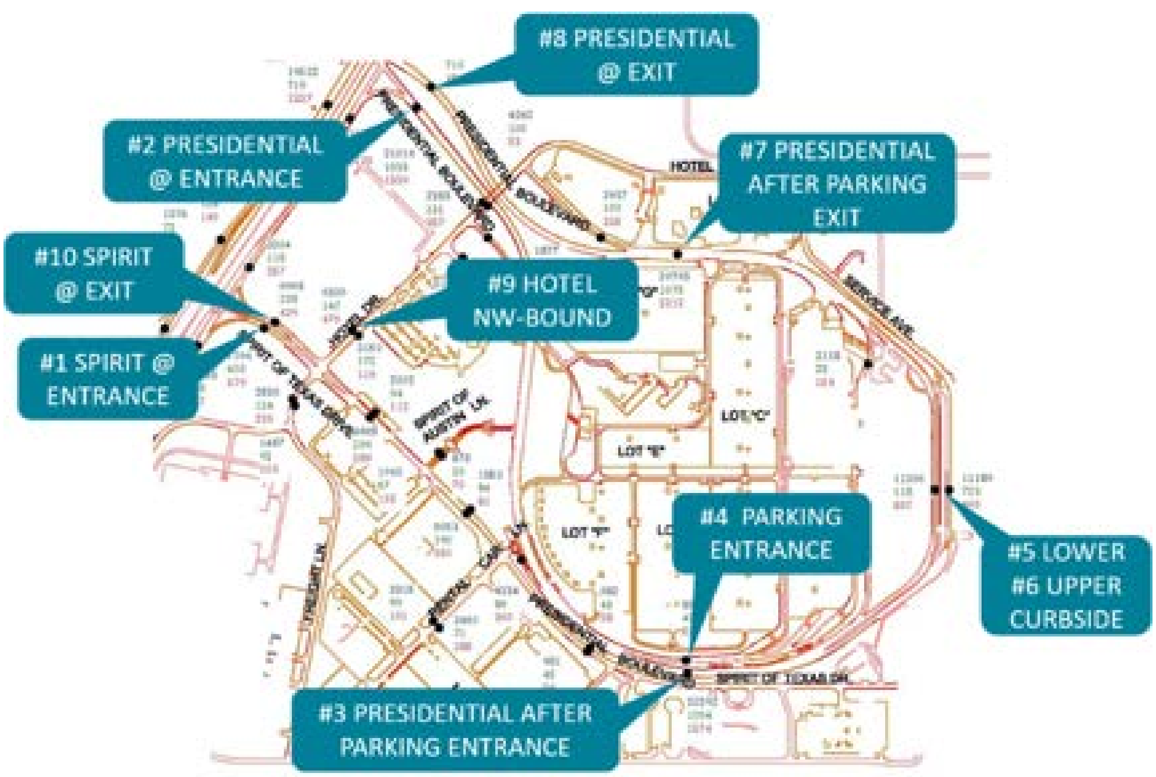
4.8.3.1 Regional Roadways

New technology impacts on regional roads have not been determined in detail due to the subjective nature of SDCs and their timing. SDCs are expected to comprise about 4 percent of all small vehicles by as soon as 2027. Since each SDC will likely be used more than 50 percent of the day, compared with less than 5 percent for the average small vehicle, they could comprise 40 percent of VMT by PAL 3 (2027) and 70 percent by PAL 4 (2032). SDCs are likely to encourage trips and will also drive around empty part of the time. Thus, they are likely to induce 10 to 30 percent additional VMT. This technology alone will thus likely increase regional road traffic by 4 to 12 percent by PAL 3 (2027) and 7 to 21 percent by PAL 4 (2032) above normal growth. The ability of capacity-enhancing measures enabled by driverless technology to mitigate such increases in traffic by the time they occur is uncertain.

4.8.3.2 Terminal Area Roadways

Impacts on terminal area roadway peak hour traffic were determined at the ten points shown in **Exhibit 4.8-3** and are discussed in numerical order below. The data is represented in vehicle trips per hour (VTP).

Exhibit 4.8-3: Terminal Roadway Analysis Points

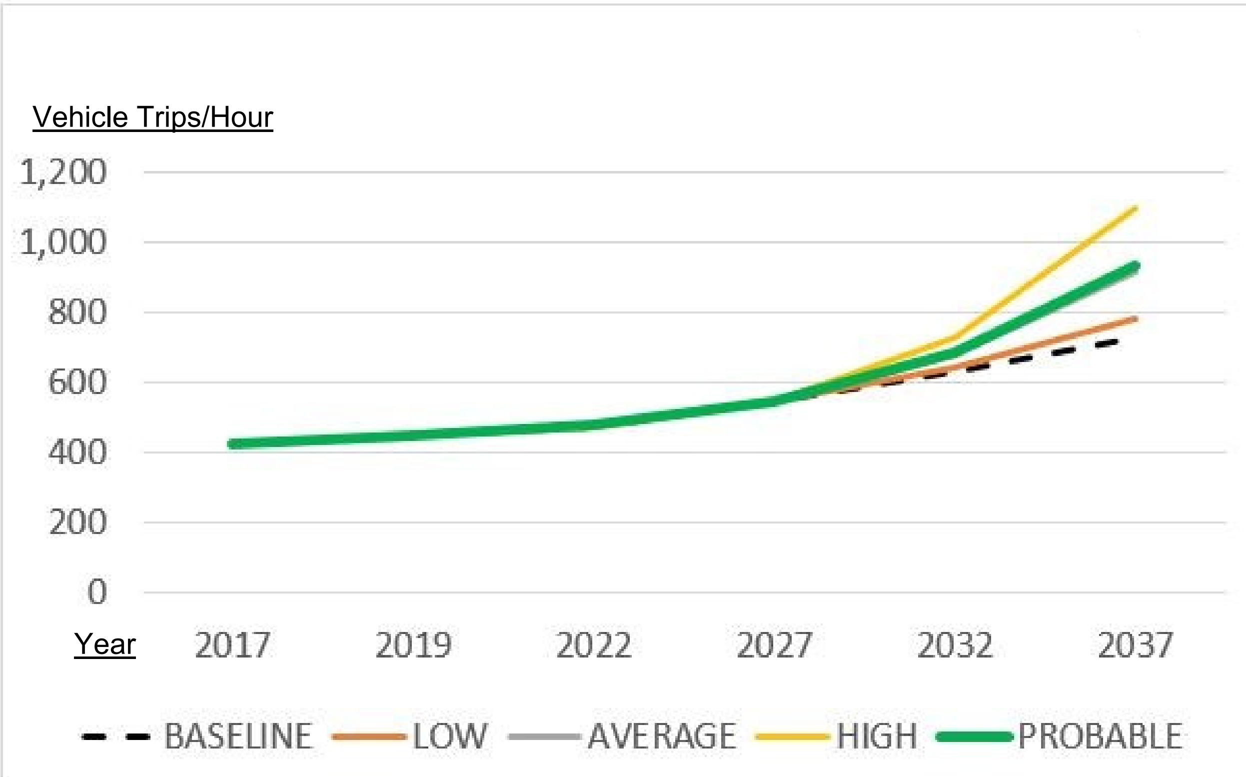


–

4.8.3.3 Point #1 - Spirit of Texas Drive at ABIA Entrance

At Spirit of Texas at the ABIA Entrance, impacts on baseline traffic only start appearing around the PAL 4 (2032) demand level. By 2030, they could increase the baseline traffic by about 28 percent as shown in **Exhibit 4.8-4**.

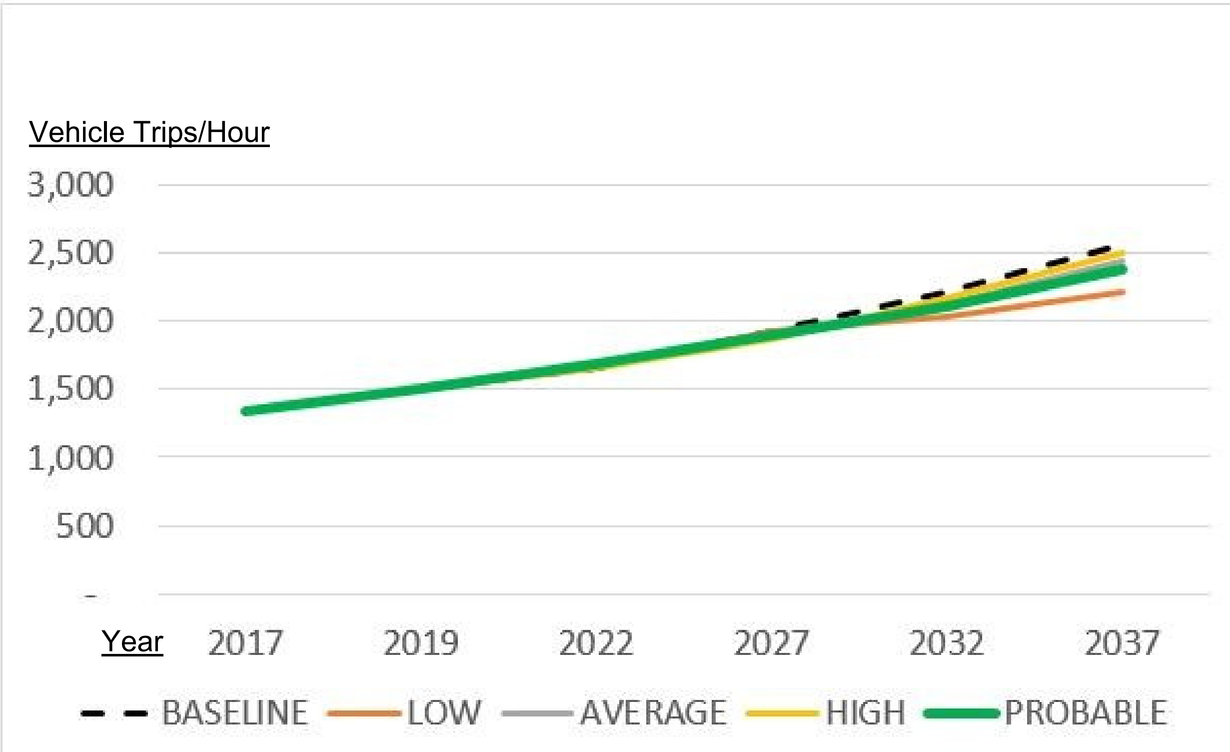
Exhibit 4.8-4: Point #1 - Spirit of Texas Drive at ABIA Entrance [VTP]



4.8.3.4 Point #2 - Presidential Boulevard at ABIA Entrance

At Presidential Boulevard at the ABIA Entrance, there is very little impact. The impact only occurs late in the planning horizon and is expected to be a slight decrease in traffic as shown in **Exhibit 4.8-5**.

Exhibit 4.8-5: Point #2 - Presidential Boulevard at ABIA Entrance [VTP]



4.8.3.5 Point #3 - Presidential Boulevard after Parking and Rental Car Entrance

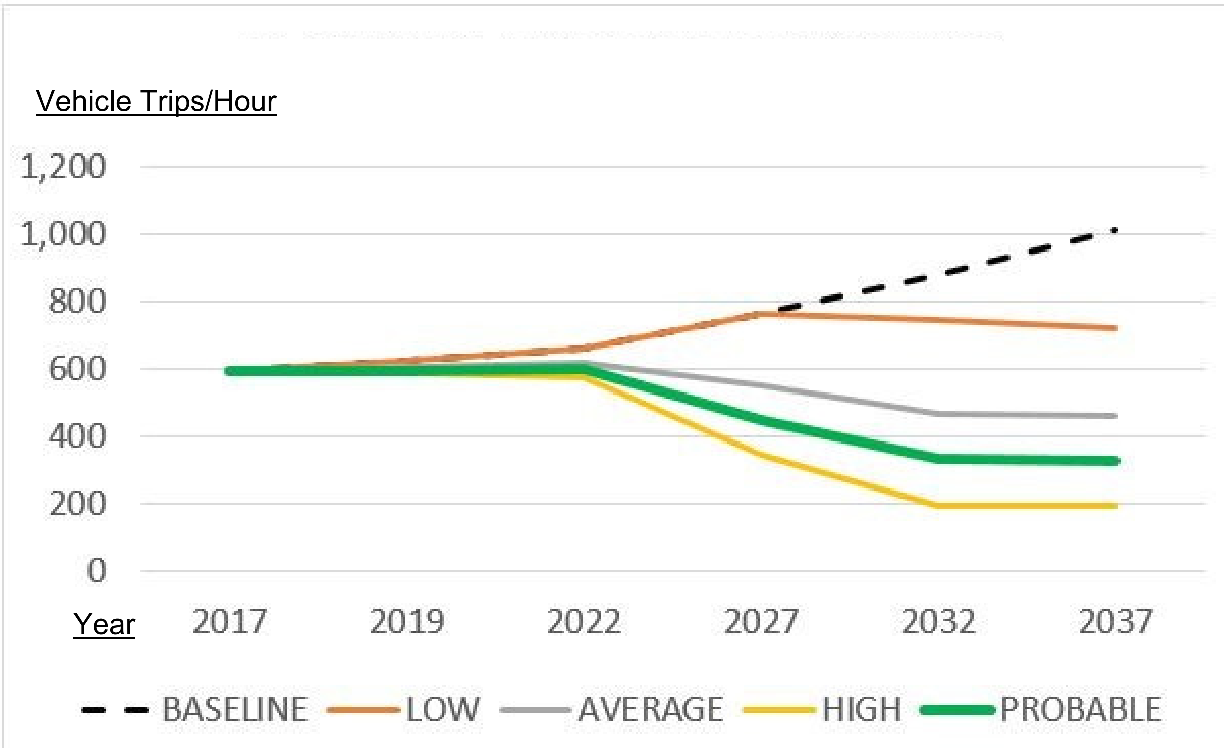
At Presidential Boulevard after parking and rental car entrance, impacts, mostly due to trips to the parking and rental car facilities being diverted to the curbside, are anticipated to commence around the PAL 2 (2022) demand level. By the PAL 4 (2037) demand level a 35-percent increase over baseline number of trips is anticipated as shown in **Exhibit 4.8-6**.

Exhibit 4.8-6: Point #3 - Presidential Blvd. after Parking and Rental Car Entrance [VTP]

4.8.3.6 Point #4 - Parking and Rental Car Entrance

At the parking and rental car entrance, impacts due to reduced trips to the parking and rental car facilities are anticipated to commence soon and start rapidly increasing around the PAL 2 (2022) demand level. The decline in peak hour vehicle trips should start to lessen around 2030 as shown in **Exhibit 4.8-7**. By the PAL 4 (2037) demand level, a 67-percent decrease over the baseline number of trips is probable. Note that the baseline number of trips is much lower than at Presidential Boulevard opposite the parking garage shown in Exhibit 4.8-6.

Exhibit 4.8-7: Point #4 - Parking and Rental Car Entrance [VTP]



4.8.3.7 Point #5 - Terminal Curbside Lower Level

At the terminal curbside lower level, impacts, mostly due to trips to the parking and rental car facilities being diverted to the terminal curbside, are anticipated to commence around the PAL 2 (2022) demand level. By the PAL 4 (2037) demand level, a 29-percent increase over the baseline number of trips is anticipated as shown in **Exhibit 4.8-8**.

Exhibit 4.8-8: Point #5 - Curbside Lower Level [VTP]

4.8.3.8 Point #6 - Terminal Curbside Upper Level

At the terminal curbside upper level, impacts, mostly due to trips to the parking and rental car facilities being diverted to curbside, are anticipated to commence around the PAL 2 (2022) demand level. By the PAL 4 (2037) a 42-percent increase over the baseline number of trips is anticipated. Note that, while the percentage change is much higher for the upper level, both curbside levels experience approximately the same 520 additional peak hour trips in 2037 as shown in **Exhibit 4.8-9**.

Exhibit 4.8-9: Point #6 - Curbside Upper Level [VTP]

4.8.3.9 Point #7 - Presidential Boulevard after Parking Exit

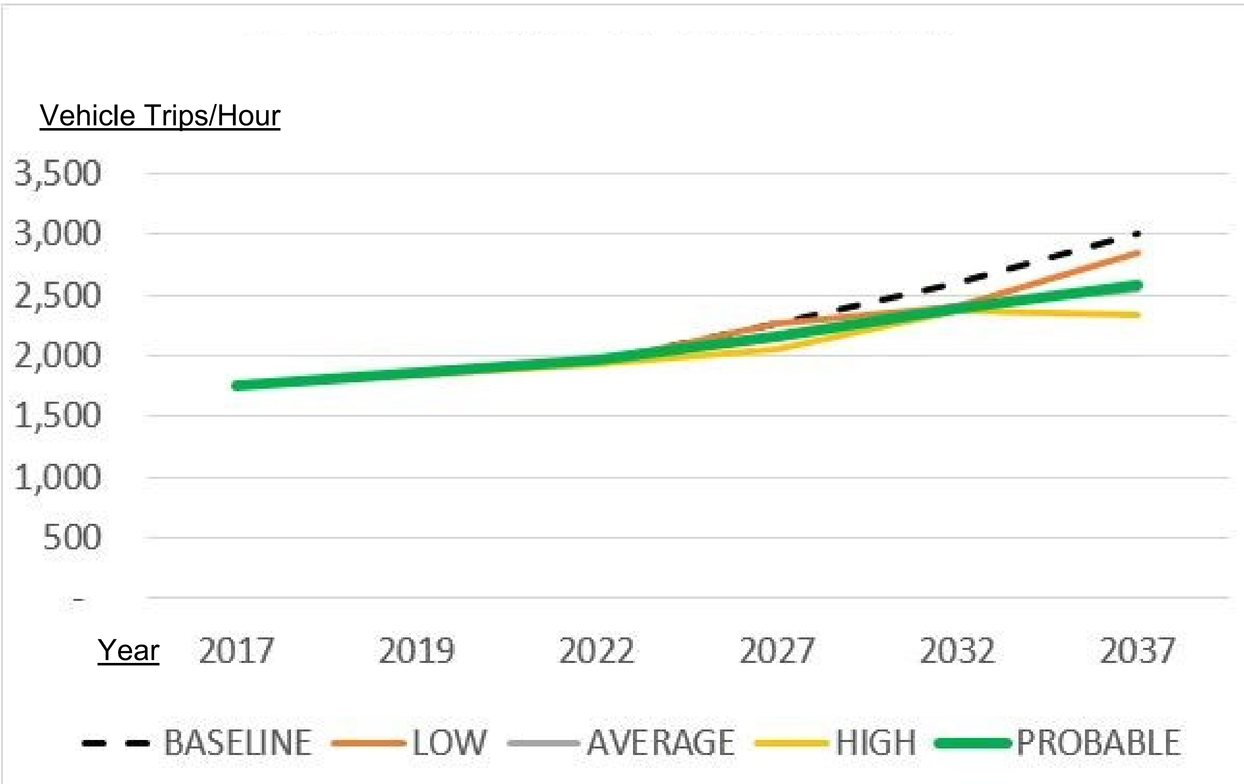
At Presidential Boulevard after the parking exit, the impacts are relatively low. The probable percentage increase in peak hour traffic in the PAL 4 (2037) demand level is only 9 percent as shown in **Exhibit 4.8-10**.

Exhibit 4.8-10: Point #7 - Presidential after Parking Exit [VTP]

4.8.3.10 Point #8 - Presidential Boulevard at ABIA Exit

At Presidential Boulevard at the ABIA exit, the impacts are positive and relatively low. The probable percentage reduction in peak hour traffic in the PAL 4 (2037) demand level is 14 percent as shown in **Exhibit 4.8-11**.

Exhibit 4.8-11: Point #8 - Presidential Blvd. at the Airport Exit [VTP]



4.8.3.11 Point #9 - Hotel Drive Northwest Bound at Spirit of Texas

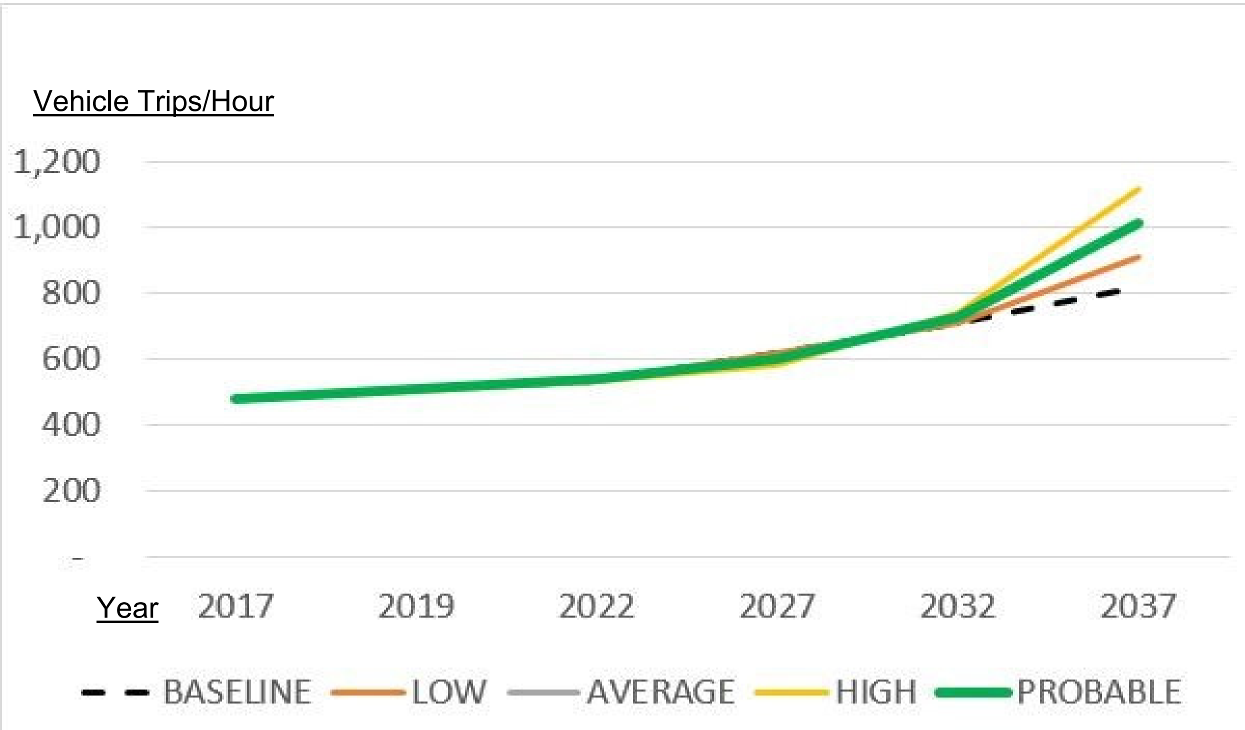
At northwest bound Hotel Drive at Spirit of Texas Drive, the impacts are relatively low and only start about year 2032. The anticipated percentage increase in peak hour traffic in the PAL 4 (2037) demand level is 12 percent as shown in **Exhibit 4.8-12**.

Exhibit 4.8-12: Point #9 - Hotel Dr. Northwest Bound at Spirit of Texas [VTP]

4.8.3.12 Point #10 - Spirit of Texas Drive at ABIA Exit

At Spirit of Texas Drive at the ABIA exit, the impacts are expected to begin about year 2032. The anticipated percentage increase in peak hour traffic in the PAL 4 (2037) demand level is 23 percent as shown in **Exhibit 4.8-13**.

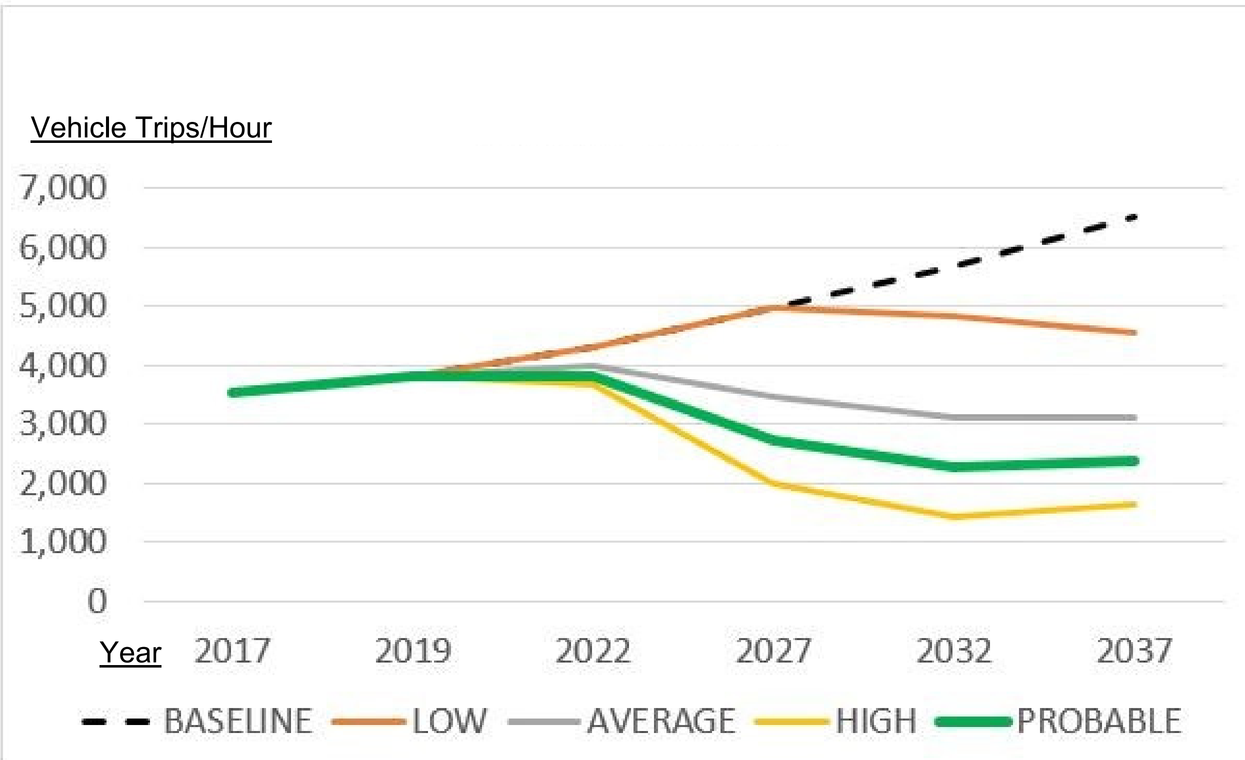
Exhibit 4.8-13: Point #10 - Spirit of Texas at Airport Exit [VTP



4.8.3.13 Short-Term On-Site Public Parking Facilities

TNCs are believed to already be impacting parking demand. Short-term parking is more expensive and used more by business travelers who are likely early adopters of new technology. The TNC impacts on parking demand are likely to commence sooner and be worse than for long-term parking. Impacts will probably normalize around year 2032, and the percentage decrease in demand for stalls is expected to be 64 percent in the PAL 4 (2037) demand level as shown in **Exhibit 4.8-14**.

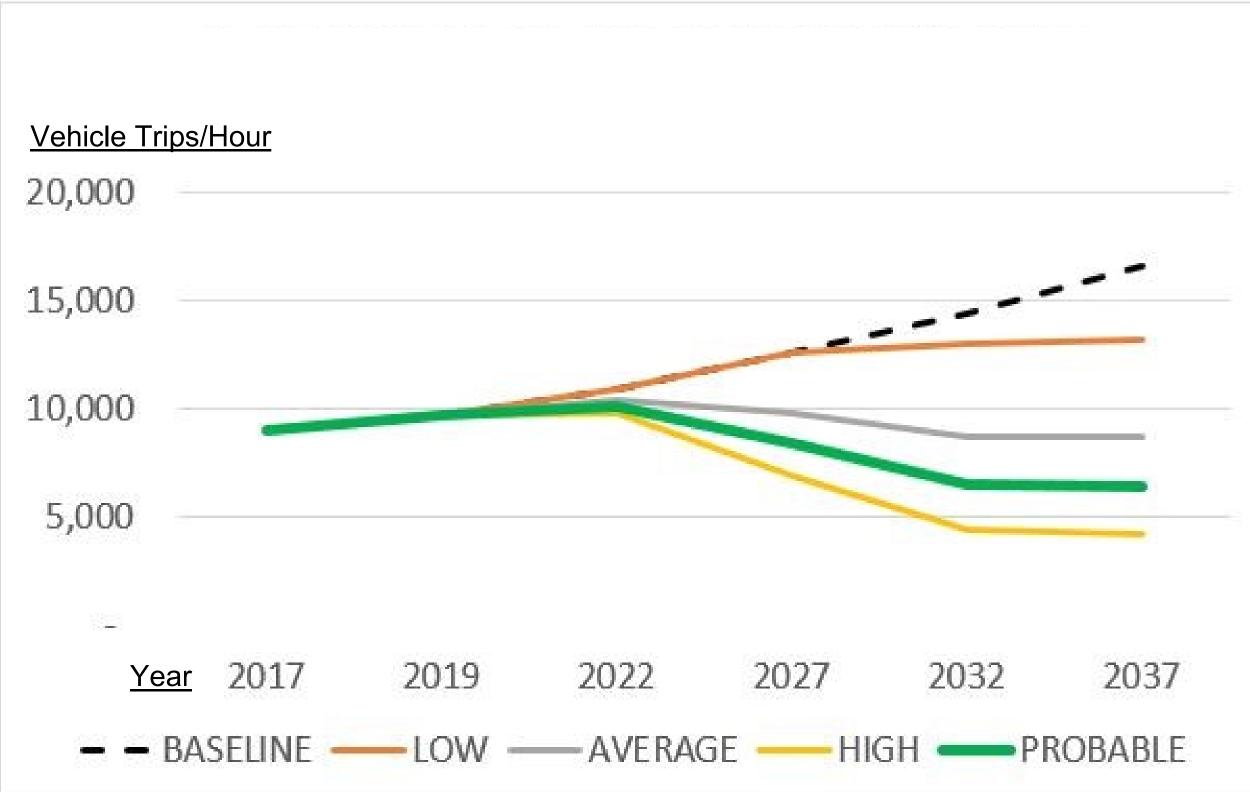
Exhibit 4.8-14: Short Term On-Site Public Parking Facilities [Stalls]



4.8.3.14 Long-Term On-Site Public Parking

The probable impacts on long-term on-site public parking are similar to those for short-term parking but slightly less. The percentage decrease in demand for stalls is expected to be 61 percent in the PAL 4 (2037) demand level as shown in **Exhibit 4.8-15**.

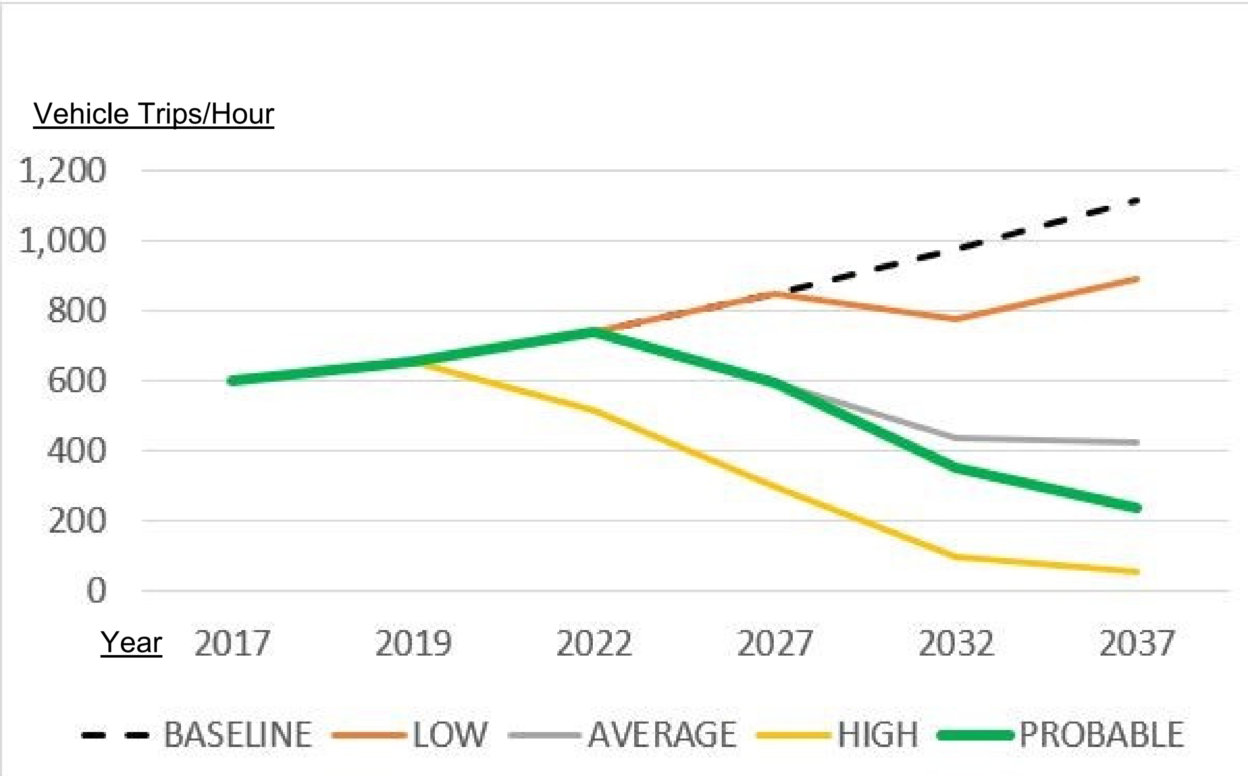
Exhibit 4.8-15: Long-Term On-Site Public Parking Demand [Stalls]



4.8.3.15 On-Site Valet Public Parking Demand

On-site valet public parking demand is expected to lessen at the same rate as the use of personal driven. Observable impacts are anticipated in a few years and, by the PAL 4 (2037) demand level, the demand is expected to have dropped by 78 percent, assuming valet service is still provided at that time as shown in **Exhibit 4.8-16**.

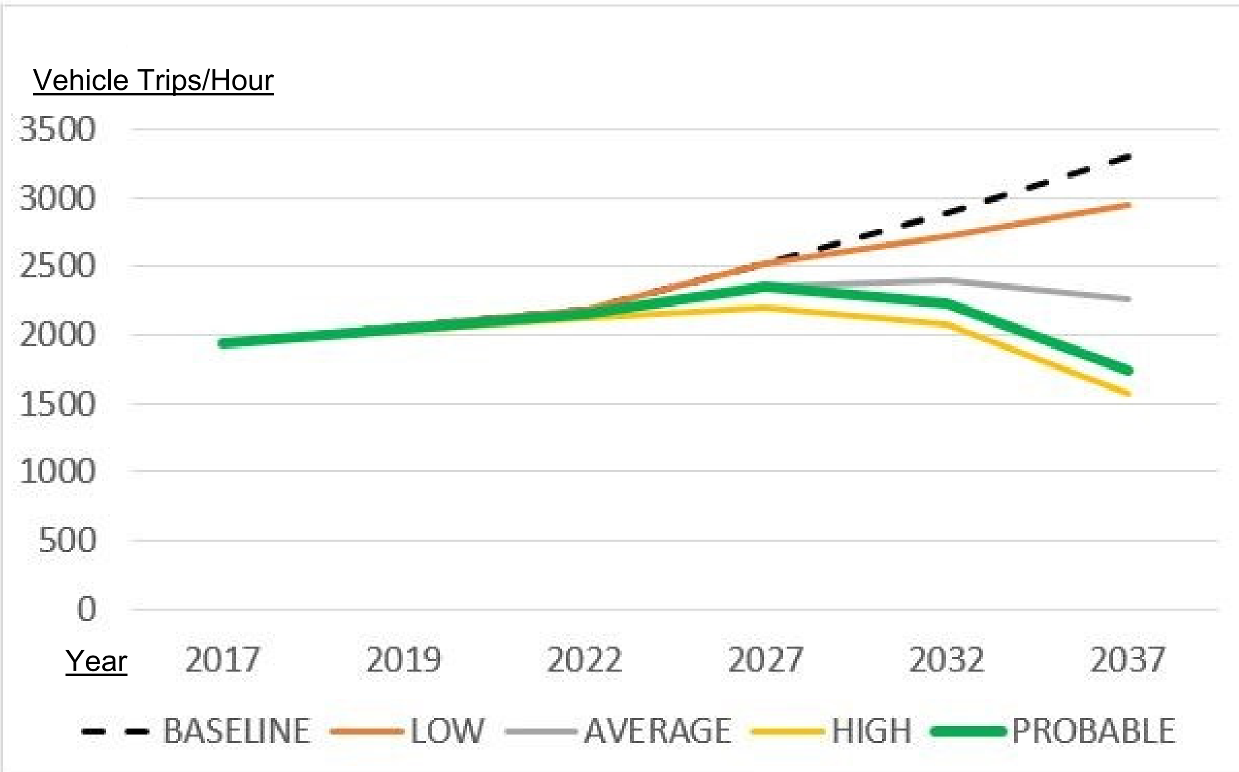
Exhibit 4.8-16: On-Site Valet Public Parking Demand [Stalls]



4.8.3.16 On-Site Employee Parking Demand

Since employees do not pay for parking, they will have less incentive to switch to driverless cars. However, a significant amount of regular travel is expected to switch to driverless modes by the 2030, and, by the PAL 4 (2037) demand level, the demand is anticipated to drop by 41 percent as shown in **Exhibit 4.8-17**.

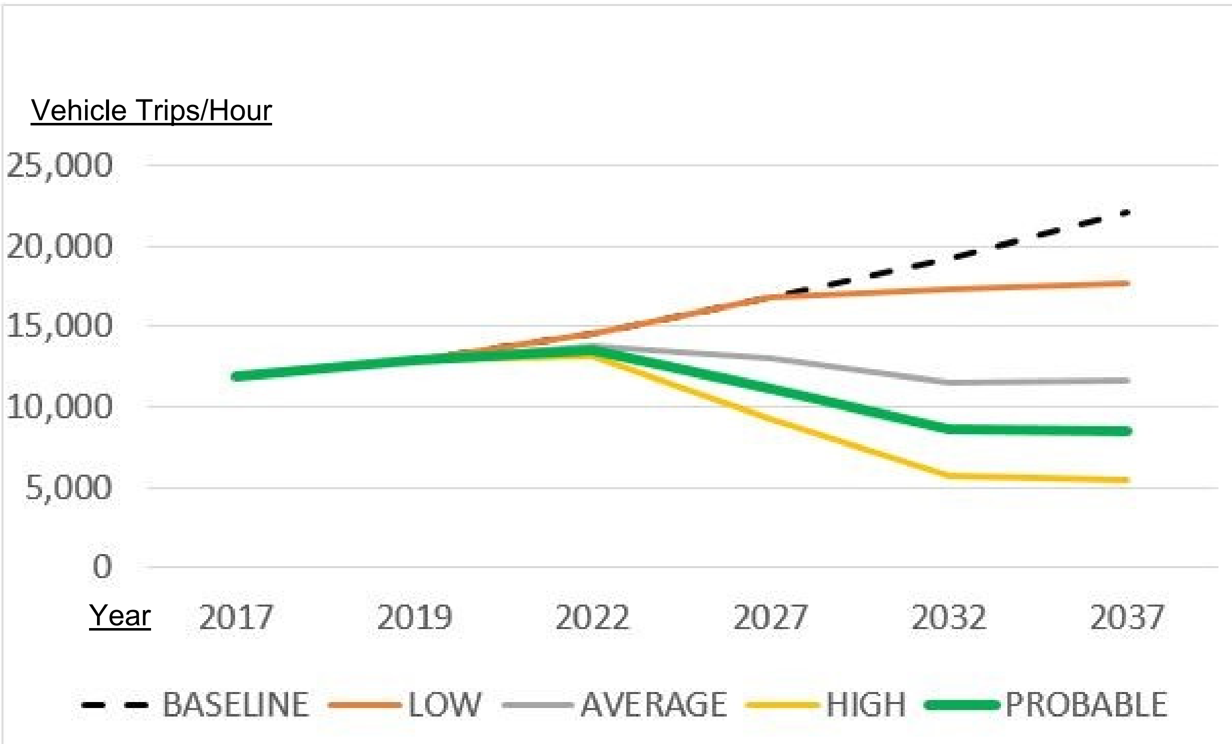
Exhibit 4.8-17: On-Site Employee Parking Demand [Stalls]



4.8.3.17 Off-Site Parking Demand

While the factors differ slightly, the overall incentive for off-site parkers to switch to new technology is similar to that for on-site parkers. The probable decrease in PAL 4 (2037) demand is 61 percent as shown in **Exhibit 4.8-18**.

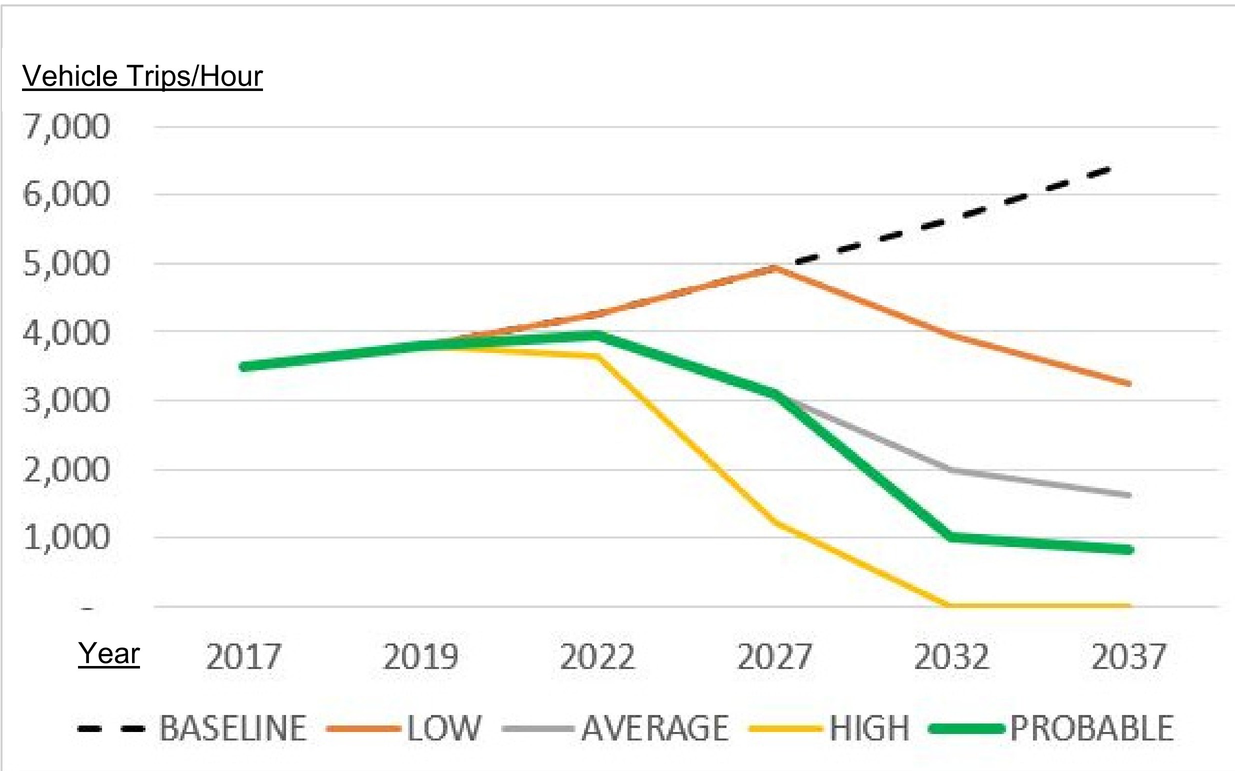
Exhibit 4.8-18: Off-Site Public Parking Demand [Stalls]



4.8.3.18 Rental Car Parking Demand

It is anticipated that all rental cars will become driverless and function more like taxis or TNC vehicles. Thus, the need for rental car parking is expected to become almost nonexistent around 2032 as shown in **Exhibit 4.8-19**. However, it is also anticipated that the rental car companies will be early adopters of driverless cars and require vehicle storage and maintenance facilities on-airport.

Exhibit 4.8-19: Rental Car Parking Demand [Stalls]



4.8.3.19 Summary of New Technology Impacts

In summary, parking demand and revenue is anticipated to decrease with noticeable impacts beginning in the next two to five years. The decrease in demand is projected to be significant (40 to 60 percent) in the 2025 to 2030 timeframe, but the decrease is expected to slow after about 2030.

Curbside congestion (both upper and lower) is anticipated to increase starting around the PAL 2 (2022) demand level and reach 30 to 40 percent additional vehicle trips over baseline projections by the PAL 4 (2037) demand level. On-campus roadway traffic is projected to increase over baseline projections but not as dramatically as at curbside. Some on-campus roadside traffic is anticipated to decrease slightly.

Traffic on regional roadways serving the airport is expected to increase over baseline projections. This increase in traffic is anticipated to occur before congestion mitigating measures enabled by driverless technologies can be implemented sufficiently to overcome the increase.

4.8.4 New Technology Opportunities

While this chapter highlights some anticipated negative impacts resulting from new technologies, the subsequent chapters will address potential opportunities provided to ABIA. These include:

- Parking facility redevelopment
    - Commercial
    - SDC staging, recharging and maintenance
    - Intermodal ground transportation center
- Possible revenue enhancement
    - Airport access tolls
    - Intermodal facility tolls
    - Commercial development
- Possible congestion solutions
    - Light rail
        - Decreases off-campus roadway congestion
    - Intermodal ground transportation facility
        - Decreases on-campus roadway and curbside congestion
    - Personal rapid transit
        - Decreases on-campus roadway and curbside congestion
        - Could provide one-seat ride to downtown
        - Could provide inter-terminal and/or concourse transportation
    - Roadway improvements
        - Decrease on-campus roadway congestion by adding capacity

4.9 Storm Water and Drainage Quality Development Needs

Drainage system improvements, including collection system elements, detention facilities, and water quality facilities, require addressing each project adding to the impervious cover at the ABIA campus. The ABIA Stormwater Drainage Master Plan Update (CDM, 2011) contains many of the anticipated elements of future development on the airport but will require updates based on these Airport Master Plan recommendations. As the preferred airport development plan is identified in subsequent chapters, specific recommendations on the sizing and locating new and expanded drainage and water quality facilities will be determined.

Stormwater collection pipelines and elements will require sizing and location with each phase of development, while understanding the ultimate airport development. It is anticipated that many existing lines will require removal and/or relocation as development occurs. New and expanded outfall structures must have capacity for increased runoff from new impervious cover, especially within the Onion Creek watershed where on-site detention will not be possible. Airport staff has identified Outfall No. 8 in the southwest area of the airport as requiring improvement as future development occurs.

For stormwater detention, the airport will either utilize their capacity in the Onion Creek Regional Stormwater Management Program (RSMP), or constructing new detention facilities for other watersheds, depending on the location of future impervious cover. Most of the airport and future developments fall within the Onion Creek watershed and RSMP. Currently, approximately 230 acres of remaining allowable RSMP impervious cover may be constructed within the Onion Creek watershed. It is likely that more than 230 acres of impervious cover will be constructed within the Onion Creek watershed once the full airport expansion program is complete, which will require either increasing ABIA's participation in the RSMP or construction of new detention facilities. As the proposed airport development plan is refined in subsequent chapters, the detention needs for the airport will be quantified.

Water quality requirements for future development must be addressed with each phase of development. It is anticipated that water quality on the airside will become more challenging as the proposed development program is implemented. The current use of filter strips for water quality on the airfield will be difficult to continue as grassy areas are filled with impervious cover and overall pavement widths increase in the terminal/concourse areas. Therefore, it is recommended to plan for opportunities to construct water quality treatment that can serve large areas of new airport development rather than on a project-by-project basis. This will be determined based on the preferred airport development program and can be further refined in an update to the Stormwater Master Plan.

4.10 Site Utilities

For site utility analysis, it has been assumed that to meet the PAL 4 (2037) demand, there will be an additional 1.08 million square feet of terminal/concourse building area, 64 total aircraft gates, and associated ramp and taxiways/taxilanes. In addition, there will be various support facility development projects throughout the airport that must be considered for utility consumption.

4.10.1 Potable Water & Fire Supply Facility Development Needs

For calendar year 2016, the ABIA campus had the following potable water uses based on water meter data as shown in **Table 4.10-1**. The summary below includes the available water meter data provided by ABIA. Although it does not include every water meter on campus, it does include all larger demands on the system. Peak hour usage was calculated assuming a 4.5 peaking factor over average flows in accordance with the City of Austin Utility Criteria Manual.

Table 4.10-1: Potable Water Usage (CY 2016)

LOCATION	2016 TOTAL USAGE [GAL./YEAR]	2016 AVERAGE USAGE [GAL./MIN]	2016 PEAK HOUR USAGE [GAL./MIN]
ABIA OWNED			
Main Terminal	32,503,900	62	278
Central Plant	11,180,900	21	96
Terminal Area Irrigation (Potable)	39,000	0	0
Parking Garage Irrigation (Potable)	4,351,100	8	37
Misc. Potable on ABIA Campus	3,031,534	6	26
ABIA Owned Totals	**51,106,434**	**97**	**438**
TENANTS			
National Guard	960,000	2	8
Private Hangars	1,032,000	2	9
South Terminal	540,000	1	5
Sky Chefs	1,764,000	3	15
Hilton	8,640,000	16	74
Hyatt*	13,800,000	26	118
Tenant Totals	***26,736,000***	***51***	***229***
CAMPUS WIDE TOTALS			
Campus Wide Totals	***77,842,434***	***148***	***667***

Note: *Hyatt data is estimated from more recent data. Calendar Year = CY

Using these yearly metered flows for the potable system, a linear relationship between potable water usage and passenger growth at the airport was used to forecast overall water demands for the proposed PAL 4 (2037) airport development. This assumption is conservative, since increased use of reclaimed water, use of lower demand fixtures, and other water saving measures are anticipated as the airport is expanded. Therefore, with the anticipated growth from 14.0 MAP in 2017 to the forecast 31.0 MAP in 2037, the anticipated total campus wide potable water usage in 2037 would be 172,366,502 gallons per year. This equates to an average usage of 328 gallons per minute and 1,477 gallons per minute peak hour for the entire airport campus in 2037. City of Austin criteria requires that velocities in mains be maintained below 5 feet per second at peak flows rates. **Table 4.10-2** provides the capacities of mains based on the maximum 5 feet per second flow rate. Note that looping of many of the mains could result in additional capacity being available at many locations throughout the airport site.

Table 4.10-2: Water Pipe Capacities Based on 5 Feet/Second Maximum Velocity

PIPE DIAMETER	CAPACITY AT 5 FPS [GPM]	CAPACITY AT 10 FPS [GPM]	NOTES
8-inch	783	1,566	Local service on the south side of the airfield
12-inch	1,763	3,526	Looped 12-inch mains serve the terminal area and other areas
16-inch	3,135	6,270	A 16-inch main runs through the airport from SH 71 to Burleson Road

Based on this maximum velocity requirement, it is anticipated that the existing 12-inch and 16-inch primary mains running through the ABIA campus will have sufficient capacity to serve the peak flow rates for the planned growth through 2037. Some realignment of mains, extension of mains, construction of new loops to serve future buildings, and ongoing maintenance of the infrastructure are anticipated. A proposed general layout of new mains for the proposed 2037 airport layout are shown in Chapter 5, *Alternatives Analysis/Evaluation and Environmental Conditions*.

While the airport is fed from both the north and the south with a 16-inch main, redundancy could be provided by a second 16-inch connection to the 24-inch main along SH 71, possibly located near Presidential Boulevard. This would provide for additional capacity, looping, and redundancy during maintenance or pipe failures.

Fire flow demands for new and expanded terminal buildings will vary depending on building types, sizes, and fire suppression systems installed. The velocities in the pipelines resulting from emergency demands (fire flows plus peak day) are required to be maintained below 10 feet per second. In general, it was assumed that the fire/emergency demands can be maintained at levels that will be served by the existing 12-inch and 16-inch looped mains running through the ABIA campus, with extensions as needed.

Additional discussion with Austin Water will be necessary to ensure overall system capacity is available to serve the airport as it is expanded in the future.

4.10.2 Wastewater Facility Development Needs

Removing irrigation and central plant demands from the 2016 water meter readings presented above results in total estimated airport wide wastewater flow of 35,535,434 gallons from other potable uses. Using current City of Austin wastewater system design criteria, **Table 4.10-3** shows the calculations for Average Dry Weather Flow (ADWF), Peak Dry Weather Flow (PDWF), and Peak Wet Weather Flow (PWWF) generated on the existing ABIA site area. For PWWF, it is assumed that the existing developed area of the terminal is currently 25 acres, and that other future developed areas (that would contribute to wastewater) within the airport boundary will total approximately 200 acres.

Table 4.10-3: Wastewater Flows (CY 2016)

LOCATION	2016 TOTAL USAGE [GAL./YEAR]	AVE. DRY WEATHER FLOW [GPM]	PEAK DRY WEATHER FLOW [GPM]	PEAK WET WEATHER FLOW [GPM]
Main Terminal	32,503,900	62	231	244
Misc. Potable on ABIA Campus	3,031,534	6	24	129
Tenants*	26,736,000	50	193	211
Campus Wide Total	**35,535,434**	**118**	**448**	**584**

Note: *Tenants include the National Guard facility, private hangars on Emma Browning, South Terminal, Sky Chefs, Hilton Hotel, and Hyatt Hotel (Hyatt estimated from recent data)

Using the 2016 wastewater flows, a linear relationship between wastewater flows and passenger growth at the airport was assumed to forecast future wastewater flows. This also assumes that developed acreage on the airport will increase linearly. Therefore, with the anticipated growth from 14.0 MAP in 2017 to the forecast 31.0 MAP in 2037, the total airport-wide PWWF in 2037 would be 1,293 gallons per minute.

The existing wastewater collection system on the airport is approximately evenly split, with flows directed north or south depending on the part of the airport served (see Exhibit 2.9-2). The specific development location on the airport will determine which existing water mains will serve this future development. Chapter 5, *Alternatives Analysis/Evaluation and Environmental Conditions* provides specifics on future water main requirements based on the preferred airport development. Selected primary gravity wastewater mains and their existing capacities are shown in **Table 4.10-4**.

Table 4.10-4: Wastewater Pipe Capacities

PIPE DIAMETER AND LOCATION (BASIN)	PIPE CAPACITY AT 85% of FULL [GPM]	ESTIMATED PEAK WET WEATHER FLOWS CY 2016 [GPM]
12-inch Main Serving Barbara Jordan Terminal (North)	608	244
15-inch Main Downstream of Barbara Jordan Terminal (North)	954	~345*
18-inch Main Downstream of Barbara Jordan Terminal to Govalle Tunnel (North)	1,552	~400*
12-inch Northern End of Emma Browning	608	~50*
15-inch Middle of Emma Browning (South)	1,156	~130*
18-inch Middle of Emma Browning (South)	1,880	~166*
21-inch From Emma Browning to Onion Creek Tunnel (South)	3,311	~246*

Note: *Peak wet weather flows are conservative estimates based on assuming allocations of various water meter data being served by certain wastewater lines using Austin Water criteria

Based on the estimated future flows and existing excess capacities of these larger diameter gravity mains serving most of the airport, it is predicted that these mains will have sufficient excess capacity to serve future development within the 2037 timeframe. Some of the smaller diameter mains (8-inch and smaller) will require a size increase depending on the development locations, flows, and available slopes. Realignments and extensions of mains to serve new buildings and ongoing infrastructure maintenance is anticipated.

Other items that may affect the wastewater system demands and design include:

- Use of reclaimed water for sanitary purposes inside buildings could lower projected flows
- The location and lowest elevation of future buildings may require life station construction as gravity flow into the existing gravity mains may not be possible

4.10.3 Reclaimed Water Facility Development Needs

For calendar year 2016, the ABIA site had the following reclaimed water uses based on meter data as shown in **Table 4.10-5**. Peak hour usage is calculated assuming an estimated 5.0 peaking factor over average flows.

Table 4.10-5: Reclaimed Water Usage (CY 2016)

LOCATION	2016 TOTAL USAGE [GAL./YEAR]	2016 AVERAGE USAGE [GPM]	2016 PEAK HOUR USAGE [GPM]
Campus Wide Total	19,669,700	37	187

The airport indicated that reclaimed water flows in calendar year 2017 increased to approximately 35,000,000 gallons per year after improvements to the reclaimed pump station, which equates to a peak hour usage of 333 GPM. The existing 8-inch diameter reclaimed water piping around the airport access roadway has a capacity of 783 GPM at a maximum flow rate of 5 feet per second (maximum per Austin Water criteria).

Reclaimed water is currently only used for irrigation purposes at the airport. Although some new irrigation areas may be included when new buildings are constructed, expanding the current terminal or building new terminal buildings are unlikely to have a significant impact on irrigation demands from the reclaimed water system. Alternate uses of reclaimed water such as indoor uses for bathrooms in future buildings or use in new central plant facilities could impact future demands on the reclaimed system.

A new reclaimed water service is currently being developed on the northeast side of the airport to serve the new Consolidated Maintenance Facility. An 8-inch main is being extended from the Travis County Correctional Complex. Currently, no reclaimed water service is available on the south side of the airport. As the airport expands, extending mains to the south should be considered.

Based on the existing mains serving the airport and their excess capacity, increasing the size of these mains is unlikely to be required unless significant new irrigation, bathroom, or central plant uses are added to the demands. As new terminal buildings and other large water users are added to the campus, evaluation of using reclaimed water for bathroom connections and central plants should be evaluated. Significant extension of mains to the south will be required to serve new development south of the existing Barbara Jordan Terminal.

4.10.4 Electrical Power

The anticipated electrical loads for future expansions to the airport facility will require new high-voltage circuits provided by Austin Energy, the local electrical utility company. To provide two levels of redundancy, the facility will require service by two high-voltage circuits from different substations, through automatic throw-over switches. This applies to the terminal area as well as the south portion of the airport facility. The high-voltage circuits will need to be closely coordinated with Austin Energy so that the utility company can plan for required upgrades to their affected substations (Bergstrom and Carson Creek) and the primary feeds along Highway 71. This topic will be discussed in further detail in Chapter 5, *Alternatives Analysis/Evaluation and Environmental Conditions,* in regard to facility options.

The Central Utility Plant chilled water capacity is based on the information acquired from the Chilled Water Thermal Storage Study performed and completed by Burns & McDonnell Engineering Company Inc. in January 2015. The existing CUP chilled water generation capacity will be exceeded when the area of facilities served exceeds 1.7 million square feet of conditioned space. Prior to reaching this threshold, the preferred approach to provide additional capacity to the CUP must be determined. The anticipated increase in chilled water requirements are shown in **Table 4.10-6**. The data included in this table reflects an estimated square foot per ton based on the added square footage of facilities at the airport. Each table indicates a different square foot per ton based on the value reflecting possible upgrades to building material efficiencies over a 20-year planning time period. **Table 4.10-7** shows the additional ton-hour capacity to meet the current 3-hour on-peak demand. The additional chilled water volume increases required to provide the additional ton-hour capacities are also listed in the tables. The overall tank volumes listed include the new tank volume added to the existing thermal energy storage (TES) storage tank volume located at the existing CUP. The options for upgrading the capacity would entail:

- Replacement of existing chillers with larger capacity chillers.
- Expansion of the CUP on the existing site, understanding there may be limitations on the site availability.
- Enlarge and upgrade the CUP and relocate to a new site location.
- Modify the chilled and hot water distribution systems to serve the new facilities.
- Build a new CUP with increased capacity to handle the anticipated terminal growth through 2037. The increased size of the CUP will allow the size and number of replacement chillers to be increased.

Table 4.10-6: Chilled Water Loading

YEAR	SQUARE FEET PER TON	ADDED TERMINAL SQUARE FOOTAGE [MM SQ. FT.]	REQUIRED TONNAGE [TONS]
2022	212	1.2	5,660
2027	212	1.5	7,075
2037	212	2.0	9,434
2022	300	1.2	4,000
2027	300	1.5	5,000
2037	300	2.0	6,667
2022	315	1.2	3,810
2027	315	1.5	4,762
2037	315	2.0	6,349

Note: MM SQ. FT. = million square feet

Table 4.10-7: Thermal Energy Storage Operational Capacity

YEAR	EXISTING TES CAPACITY [M TON-HRS.]	PROJECTED TONNAGE	TANK DISCHARGE TIME [HOURS]	REQUIRED TES CAPACITY** [M TON-HRS.]	ADDITIONAL TANK CAPACITY* [MM GALLONS]	TOTAL TANK CAPACITY REQUIRED [MM GALLONS]
2022	11.6	5,660	2.05	16,981	1.2	2.8
2027	11.6	7,075	1.64	21,226	1.5	3.1
2037	11.6	9,434	1.23	28,302	2.0	3.6
2022	11.6	4,000	2.90	12000	0.9	2.5
2027	11.6	5,000	2.32	15000	1.1	2.7
2037	11.6	6,667	1.74	28,302	1.4	3.0
2022	11.6	3,810	3.05	11429	0.8	2.4
2027	11.6	4,762	2.44	14286	1.0	2.6
2037	11.6	6,349	1.83	19048	1.4	3.0

Note: M: thousand; MM: Million
* Capacity of tank assumes 90% usable storage
*** For a 3-hour TES discharge time

4.10.5 Natural Gas Chilled Infrastructure

The natural gas infrastructure as currently configured should have ample capacity to serve the PAL 4 (2037) airport demand. However, modifications to the gas supply piping will be required if a new south CUP is constructed. Currently, all gas service for the airport is provided from the gas main located along SH 71 on the north side of the airport. To extend a gas main to serve a new CUP located on the south side of the airport will require additional modifications to the distribution lines. If a new CUP is built to serve a terminal expansion to the south side of the airport, extension of the gas lines would require installation across existing ramps and taxiways. Texas Gas Service should determine if there is existing infrastructure at the south side of the airport which could be utilized to provide service to a new CUP. If an alternate source is not available, alternate routing will be required to mitigate routing across the existing ramps and taxiways. Redundancy, if deemed necessary, could be incorporated in the system if an alternate source distribution main can be utilized for service to the south side of the airport. The distribution system would require modifications to loop the service so the distribution lines could be back-fed if a rupture in any of the service lines occur.

This Page Left Intentionally Blank