Lehigh Valley International Airport

Allentown, Pennsylvania

Airport Master Plan Update
Section 4 –
Forecasts of Aviation Demand

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Section 4 – Forecasts of Aviation Demand

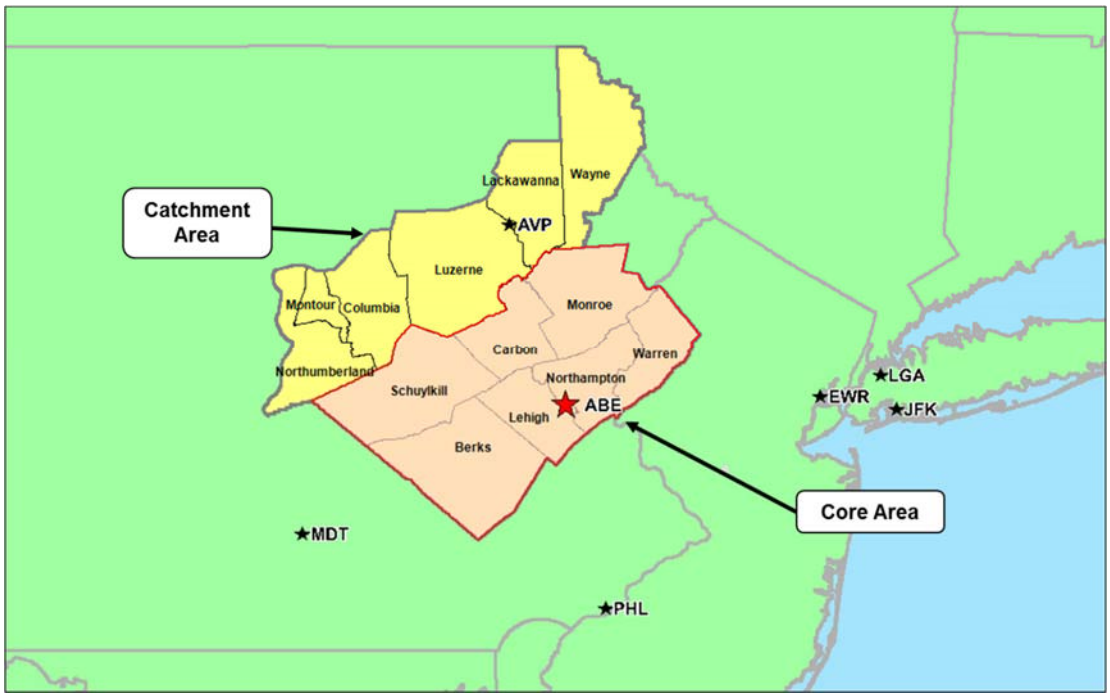
4.1 Introduction

This section presents the forecasts for aviation demand for LVIA through 2040. Aviation forecasts are prepared for passengers, cargo and general aviation activity. The forecasts serve as the basis for establishing facility requirements for the analyses necessary for Master Planning.

Socioeconomic Data

Aviation demand at an airport is a function of the economic and demographic characteristics of the area served by the airport. Such an area is often referred to as the "catchment area". Based on the Airport's catchment area location relative to large hub airports in the New York and Philadelphia metro areas, the LVIA catchment area includes counties within a two-hour drive of the Airport (generally to the northwest of the Airport) as well as the Allentown Metropolitan Statistical Area (MSA)[1] where LVIA has a dominant geographical advantage over the large hub airports in New York and Philadelphia which limits the extent of the catchment area to the east and southeast. In **Figure 4.1.1**, the seven-county core area identified accounts for over 96% of the Airport's current passenger traffic.

Figure 4.1.1: LVIA Passenger Catchment and Core Areas



Source: Lehigh Northampton Airport Authority, True Market/Leakage Study (February 2016).

The seven-county core area's population of 1.6 million people accounts for 67% of LVIA's 13-county catchment area's total population of 2.3 million in 2015[2]. The catchment area accounted for $97 billion of

[1] Allentown MSA = Lehigh County (PA), Northampton County (PA), Carbon County (PA), and Warren County (NJ).
[2] Unless otherwise specified, all economic and demographic statistics are based on Woods & Poole 2016 CEDDS data and may differ from the data used in other reports. All dollar values are stated in current dollars while all growth rates are stated in real

household income for 2015 (in current dollars) with the core area accounting for over two-thirds of that total, or $67 billion. The average household income of $107,376 in the core area was below the national average of $118,206 and also below the Mid-Atlantic region and state averages ($137,204 and $115,898 respectively).

Average annual population growth of 0.7% in the core area between 2000 and 2015 was below the national average of 0.9% but well above the Mid-Atlantic regional average of 0.4% and state growth of 0.3%. Total household income growth of 1.7% per year in the core area from 2000 to 2015 (in real terms) was below the national average of 1.9%, while real average income growth was 0.7% per year compared to 0.8% per year nationally.

In terms of general economic measures, the core area produced $66 billion of gross regional product (68% of the catchment area's $97 billion total) with 2000-2015 real growth of 1.5% per year below the national average of 1.9% per year but equal to the state's growth rate (1.5% per year). Key sectors driving air cargo growth are the manufacturing and transportation/warehousing sectors. Personal earnings in the core area's manufacturing sector were $6.3 billion in 2015 while the transportation/warehousing sector contributed $2.1 billion. A net decline in core area manufacturing earnings of 21% from 2000 to 2015 in real terms exceeded the national decline of 17% but was less than the state and regional averages (down 25% and 27% respectively). Increased concentration of transportation/warehousing activities in the area is demonstrated by the net increase of 61% in real personal earnings from 2000 to 2010 compared to the national growth of 19% and 14% for the state.

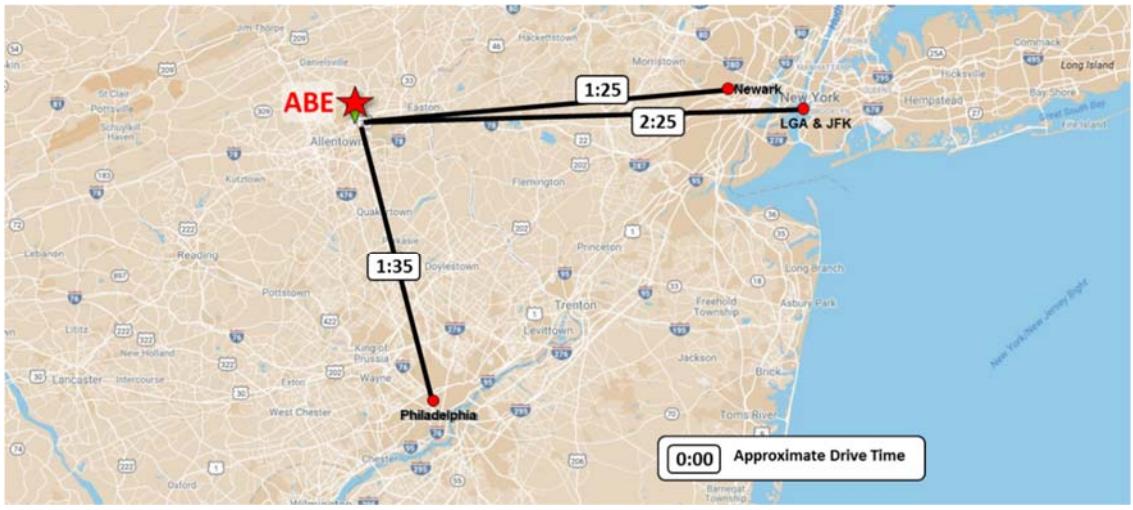
Forecasted growth in the core area's population base through 2040 (0.6% per year) is projected to be less than the national average (0.9% per year) but double the projection for the state (0.3% per year). In real terms, real average household income growth is projected to slightly exceed national growth (1.5% vs. 1.4% per year), with total household income growth of 1.9% below the national average of 2.2% per year but exceeding the state level of 1.6% per year. The core area's gross regional product growth is projected at 1.8% per year (in real terms) which is equal to the state and regional growth projections but below the national projection of 2.1% per year. Manufacturing earnings for the core area are projected to remain relatively level at 0.1% annual growth while growth in transportation/warehousing earnings is forecast at 1.9% per year, exceeding national, regional and state projections of 1.4%, 1.2%, and 1.2% respectively

Nearby Large Hub Airports

As shown in **Figure 4.1.2**, there are four major airports located within 120 miles and a 2 ½-hour drive from the Allentown area.

(constant dollar) terms.

Figure 4.1.2: Drive Time to Nearby Major Airports



Source: Campbell-Hill

As shown in **Table 4.1.1**, these four airports, Philadelphia International Airport (PHL), Newark Liberty International Airport (EWR), LaGuardia Airport (LGA) and John F. Kennedy International Airport (JFK) are major hub airports with nonstop flights, both domestic and international, to significantly more markets than from LVIA. The convenience of nonstop service at these airports draws travelers[3] from throughout the area.

Table 4.1.1: Regional Airport Comparison

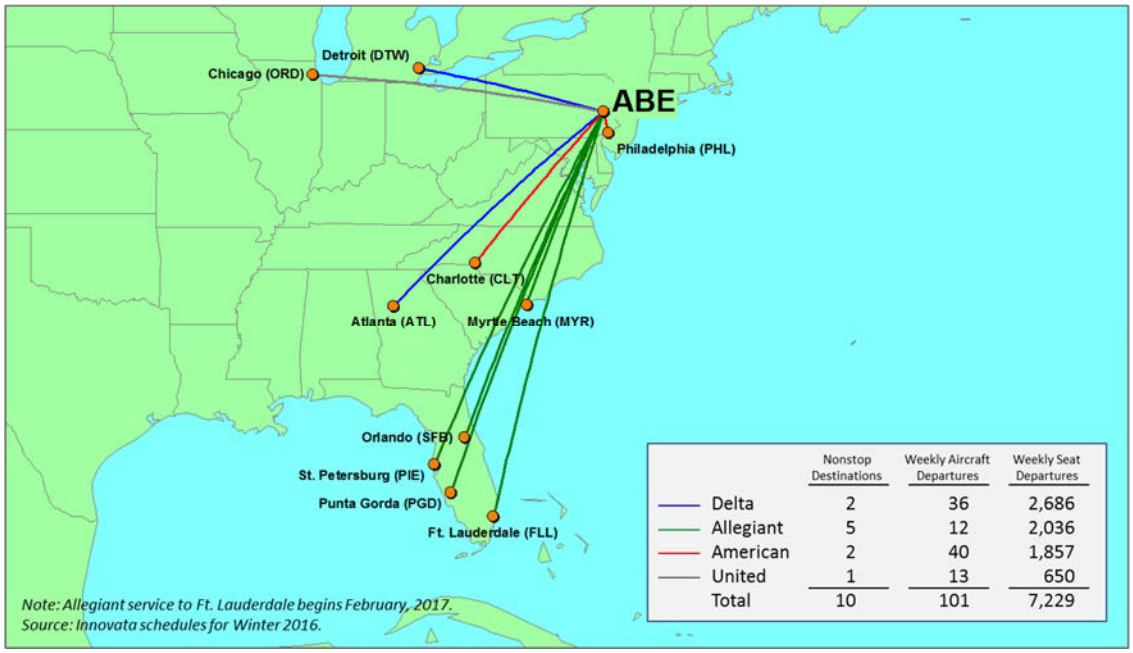
	ABE	PHL	EWR	JFK	LGA
Nonstop Destinations	9*	113	162	174	68
Avg. Daily Flights	14	458	555	577	518

Note: Does not include Myrtle Beach service which is seasonal
Source: Innovata Schedule, March 2017.

As shown in **Figure 4.1.3**, LVIA has year-round nonstop service to nine destinations from four carriers, plus seasonal service to Myrtle Beach (MYR) on Allegiant Air for a total of 10 nonstop destinations. Delta Air Lines, Allegiant Air and American Airlines account for 90% of the available departing seats at the Airport.

[3] Passengers using an airport other than the airport closest to them are defined as leakage.

Figure 4.1.3: LVIA Nonstop Route Map



	Nonstop Destinations	Weekly Aircraft Departures	Weekly Seat Departures
Delta	2	36	2,686
Allegiant	5	12	2,036
American	2	40	1,857
United	1	13	650
Total	10	101	7,229

Source: Innovata Schedule.

Beginning in 2017, new services commenced at the Airport including new twice-weekly nonstop service to Fort Lauderdale (FLL) by Allegiant Air which started on February 15, also starting on February 15, a year-over-year increase from 6 weekly nonstop flights to 9 weekly flights to Orlando-Sanford (SFB) during the peak months on Allegiant Air and American Airlines replaced Dash-8-100 aircraft with larger 50-seat regional jets on two of its three daily nonstop flights to Philadelphia starting February 16[4]. These air service changes show that capacity and traffic will continue to grow at the Airport.

4.2 Methodologies

In addition to the FAA Terminal Area Forecast (TAF), several different analytical methodologies were used in the development of the aviation forecasts. The following definitions apply to terminology used in the forecasts.

Market Share Analysis

LVIA's enplanement share of the National system was historically trended, and a future enplanement share[5] trend of the National system developed. Future LVIA enplanements were estimated by multiplying the estimated future market share by the FAA TAF National enplanement numbers.

Regression Analysis

A Regression Analysis is a statistical process for estimating the relationship between a dependent variable

[4] It is expected that American will replace the third Dash-8 aircraft to Philadelphia by the end of the summer based on interviews with the network planners.
[5] Hence referred to as Market Share.

and an independent variable. A time series regression analysis compares the variables over a period of time, while a cross-sectional analysis compares variables for a group of markets or geographical areas for a single period. Demographic projections for the catchment area were used to estimate passenger and cargo growth at LVIA on a time series basis. Relationships between cargo service levels and traffic and between passenger travel propensity and income levels within the catchment area were based on cross-sectional analysis.

Trend Analysis

A method to predict the future based on past results. Three- and five-year annual growth rates were calculated and used to estimate growth at LVIA.

Air Service Analysis

LVIA enplanements and operations were estimated based on 2017 schedules filed by the air carriers and includes expected service changes for 2017 through 2021. Interviews were conducted with the Airport, Network Planners and previous experience working with the Airport doing air service development. Key forecast assumptions include expected schedule changes, average seats per departure and percentage of seats filled (seat factor). Beyond 2021, the FAA TAF's year-over-year growth rates were used.

Re-cast Analysis

For the 12 months ending September 2016, LVIA enplanements were 6.8% higher[6] than the **FAA TAF** was for the same period. For this analysis, the FAA TAF was re-cast by substituting LVIA's actual enplanements for the 12 months ending September 2016 for the FAA's estimate of enplanements, then using the FAA TAF's year-over-year growth rates to estimate enplanements 2017 through 2040. This analysis was done to reflect recent changes in service and traffic at the Airport.

4.3 Commercial Forecast

LVIA has had considerable variability in its commercial passenger volumes, operations and seat-capacity since 2005. This section provides a quick overview of recent commercial aviation trends at the Airport, then lays out the five different methodologies analyzed (alternative forecasts to the TAF) for developing the commercial forecast, and makes the final recommendation for commercial passengers and operations through 2040. Cargo and general aviation trends will be covered in Sections 4.4 and 4.5, respectively. The peak activity forecast will be covered in Section 4.6.

Historical Trends

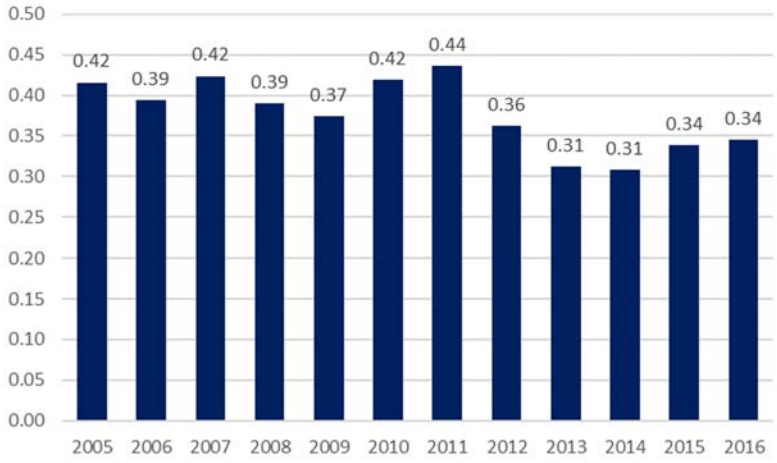
Enplanements

While LVIA enplanements have varied year-to-year, they continue to remain below where they were 10 years ago. As shown in **Figure 4.3.1**, the spike in fuel prices in 2008 drove airline fares up and airline capacity down resulting in the decline in enplanements between 2007 and 2009. AirTran started service in 2009 and this led to an increase in enplanements to the recent high of 0.44 million in 2011. The loss of AirTran service in 2012 and the losses of American Chicago O'Hare (ORD) and United Washington Dulles (IAD) nonstop service drove enplanement volumes down to a low of 0.31 million in 2014. Passenger traffic has since

[6] 346,814 actual enplanements compared to 324,802 in the FAA TAF.

increased to 0.34 million in 2016 largely as a result of capacity growth by Delta to Atlanta and Allegiant. Over the last three years, enplanements have grown 3.4% annually.

Figure 4.3.1: Passenger Enplanements at LVIA (in Millions)



CAGR Change in Enplanements		
3-year	5-year	10-year
3.4%	-4.6%	-1.3%

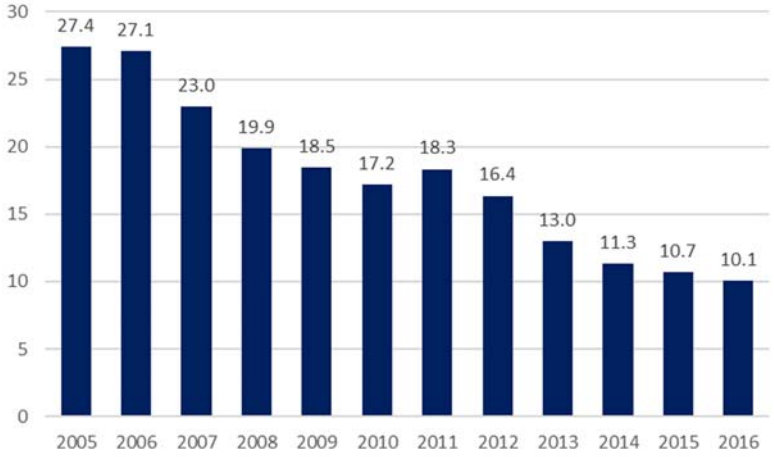
Source: Lehigh Northampton Airport Authority Airport Statistics.

Commercial Operations

Commercial operations[7] include those of the scheduled air carriers including their regional partners. **Figure 4.3.2** below shows the large decline in scheduled operations at the Airport starting in 2007. Airline bankruptcies, carrier consolidation, high fuel prices, and the Great Recession decreased operations over 35% by 2010. The loss of AirTran service, American (ORD) and United (IAD) nonstop service further impacted commercial operations since 2012. Since 2006, commercial operations have fallen by 63%. Based on current public airline schedules, commercial operations will not decline in 2017 compared to 2016.

[7] Commercial operations include arriving and departing flights.

Figure 4.3.2: Commercial Operations at LVIA (in Thousands)



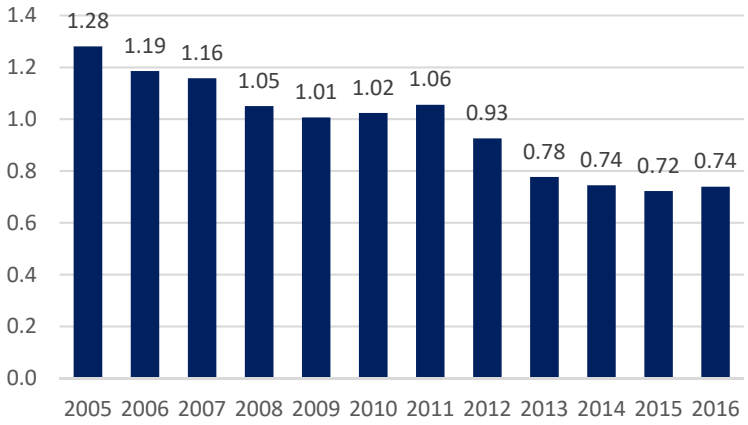
CAGR Change in Operations		
3-year	5-year	10-year
-8.2%	-11.3%	-9.4%

Source: U.S. DOT T-100 Report.

Commercial Seats and Average Aircraft Size

As shown in **Figures 4.3.3 and 4.3.4**, total commercial seats have not fallen as much as operations as the average aircraft size has grown, particularly over the last three years driven by Allegiant Air's large jets. Since 2006, total seats have declined 37% while average aircraft size has grown 68%. Over the last four years, LVIA total seats have held relatively constant.

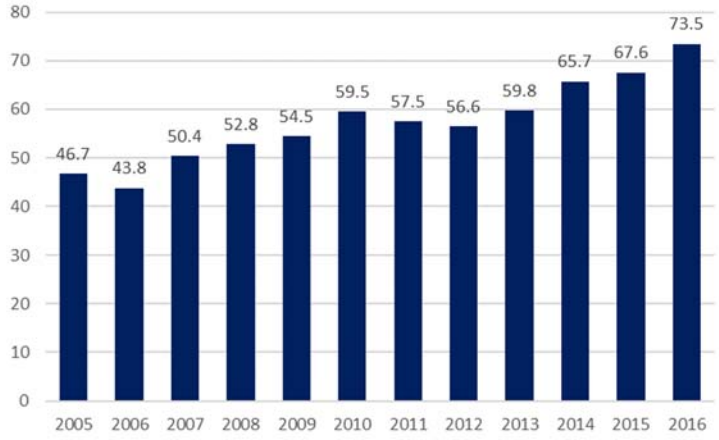
Figure 4.3.3: Total Commercial Seats at LVIA (in Millions)



CAGR Change in Seats		
3-year	5-year	10-year
-1.6%	-6.9%	-4.6%

Source: U.S. DOT T-100 Report.

Figure 4.3.4: Average Seats per Departure



Source: U.S. DOT T-100 Report.

The types of commercial aircraft serving LVIA in a typical week in July 2006, 2011 and 2016 are shown in **Table 4.3.1** on the following page. A July schedule is shown for seasonal continuity. July has been the peak travel month for three of the last four years. The large decline in operations and the associated changes in fleet mix are due to the loss of hub and large market flying as a result of the reasons mentioned earlier (carrier bankruptcy, consolidation, etc.). LVIA lost hub service to Atlanta (FL), Chicago O'Hare (AA), Cleveland (CO), Cincinnati (DL), Pittsburgh (US), Toronto (AC) and Washington Dulles (UA). LVIA also lost service to other large markets including Boston (CO and DL), Fort Lauderdale (FL) and Orlando (F9 and FL).

Table 4.3.1: Aircraft Serving LVIA

July 2006				July 2011			
Aircraft	Weekly Operations	% of Operations	Seats / Departure	Aircraft	Weekly Operations	% of Operations	Seats / Departure
CRJ	262	48%	50	CRJ	146	33%	50
Saab 340	98	18%	32	ERJ-145	108	25%	50
ERJ-135	44	8%	37	Saab 340	56	13%	30
Beech 1900D	38	7%	18	MD-80	28	6%	150
Beechcraft	30	6%	19	B717	28	6%	117
DHC-8-300	24	4%	50	DHC-8-300	24	5%	50
DHC-8	16	3%	37	DHC-8	20	5%	37
MD-80	16	3%	150	Beech 1900D	16	4%	18
A319	14	3%	120	A319	12	3%	124
Total	542		46	Total	438		58

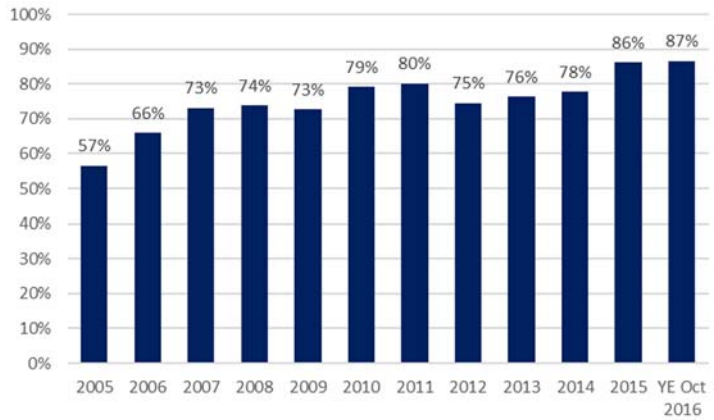
July 2016			
Aircraft	Weekly Operations	% of Operations	Seats / Departure
DHC-8	42	19%	35
CRJ	38	17%	50
ERJ	36	16%	50
CRJ-700	28	13%	65
CRJ-900	24	11%	76
MD-80	22	10%	166
B717	14	6%	110
A320	12	5%	177
CRJ-200	2	1%	50
ERJ-145	2	1%	50
Total	220		74

Source: Innovata Schedule.

Seat Factor

As shown in **Figure 4.3.5**, seat factor (the percentage of seats occupied) has grown at LVIA from 57% in 2005 to 87% for the 12 months ending October 2016.

Figure 4.3.5: Seat Factor - % of Seats Filled at LVIA



Source: U.S. DOT T-100 Report.

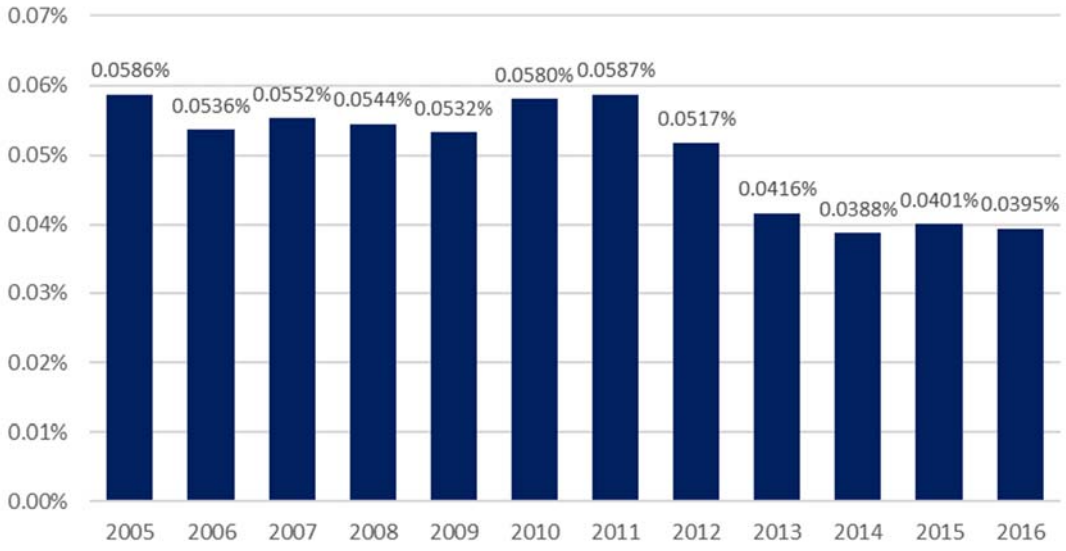
Commercial Enplanement Forecast Approaches

Five alternative methodologies for estimating LVIA enplanements were considered and developed. Each of the methodologies with accompanying enplanement forecasts are shown below and then compared to each other and the FAA TAF.

Market Share Analysis

LVIA enplanements are forecast based on LVIA's share of the national enplanement total. **Figure 4.3.6** shows that between 2005 and 2011, LVIA's share of the national enplanement total ranged between 0.0532% (2009) and 0.0587% (2011), averaging 0.0555% over the seven-year period. Between 2011 and 2013, LVIA's share of the national enplanement total fell as the Airport's traffic did not keep pace with national trends (See section above for explanation of decline in enplanements). Since 2013, LVIA's share of the national total has stabilized and has averaged 0.0400%[8].

Figure 4.3.6: LVIA's Enplanements as a % of National Enplanements

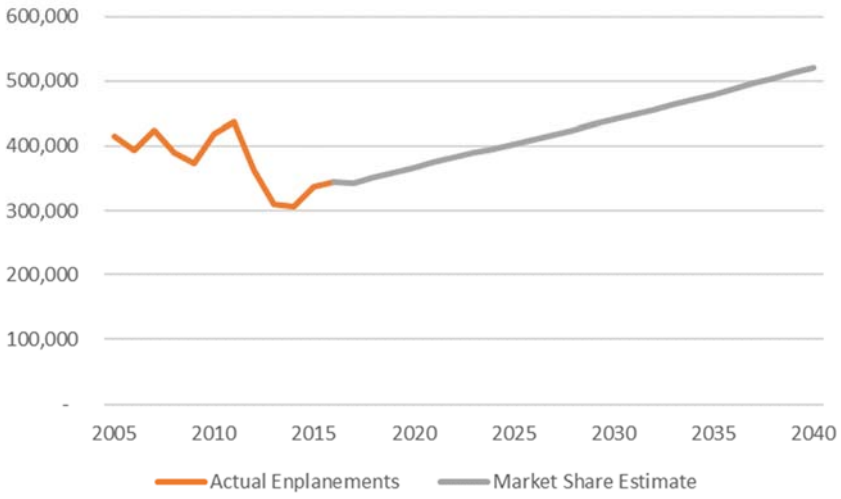


Source: FAA TAF and Campbell-Hill Analysis.

Assuming LVIA's share of the national total continues to average 0.00400% in future years, applying this percentage to the FAA TAF results in the enplanement estimate in **Figure 4.3.7** through 2040.

[8] Until 2012, the FAA classified ABE as a Small Hub airport, now it is a Nonhub Primary airport.

Figure 4.3.7: LVIA's Enplanement Estimate - Market Share Analysis



Year	ABE Actual	Market Share Estimate ABE Enplanements
2015	336,549	
2016	344,895	
2017		342,864
2022		382,179
2027		417,651
2032		455,556
2037		495,899
2040		520,800

Source: Derived from FAA TAF and Campbell-Hill Analysis.

Regression Analysis

Several different economic-, income- and population-based regression analyses were performed. The regression with the strongest correlation was one that used income data and Airlines Reporting Corporation (ARC) ticketing data.

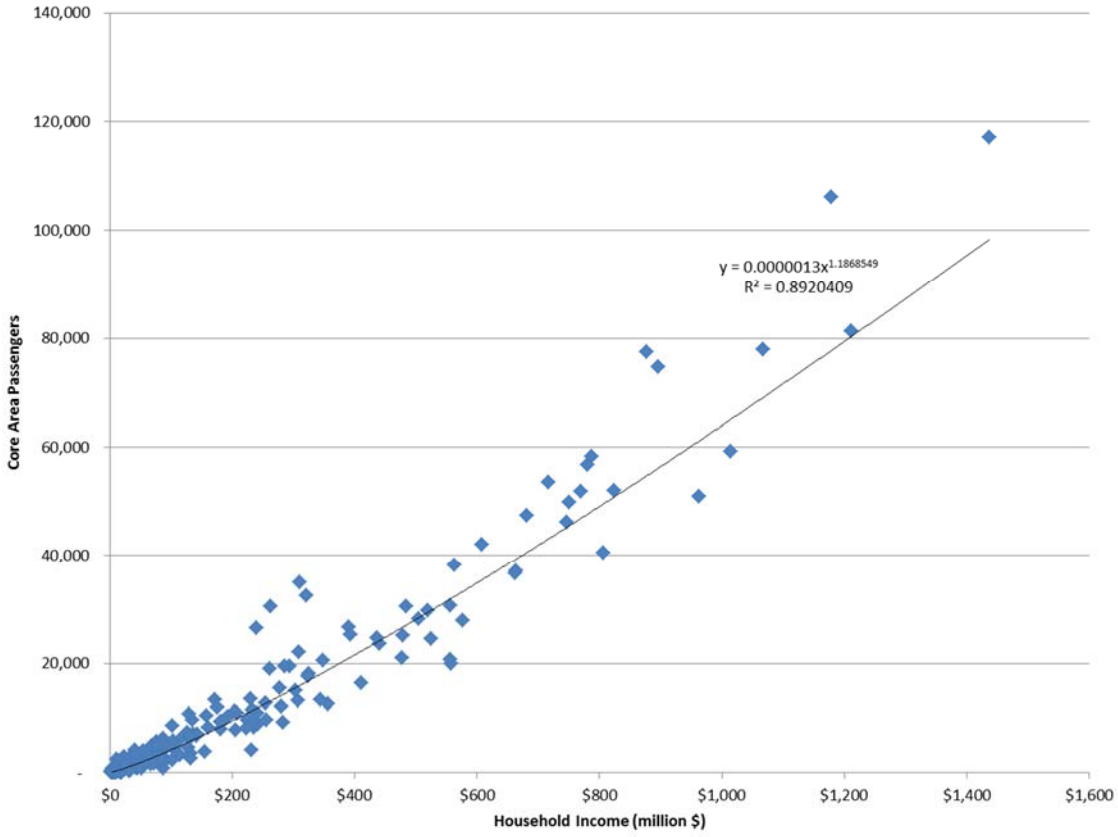
Zip code-level passenger counts from the core area were compared to total and average household income (from the U.S. Bureau of the Census) for CY 2014. The advantage of using ARC data showing total passengers for the local area (not just those using LVIA) is that the impact of service and leakage shifts can be minimized.

The analysis was based on cross-sectional patterns for all zip codes within the core area. Passenger traffic levels (domestic and international combined) were compared to total household income for all zip codes located within the LVIA core area. As shown in **Figure 4.3.8** below, passenger traffic levels for individual zip codes correlate closely with the total household income. Using the derived regression equation, year-to-year growth in traffic levels were estimated using the projected growth in aggregate income for the core area.[9] Over the forecast period from 2016 to 2040, year-over-year traffic growth ranged from 1.4% to 2.4%

[9] All economic and demographic forecasts are based on 7-county data from Woods & Poole.

per year and averaged 1.9% per year.

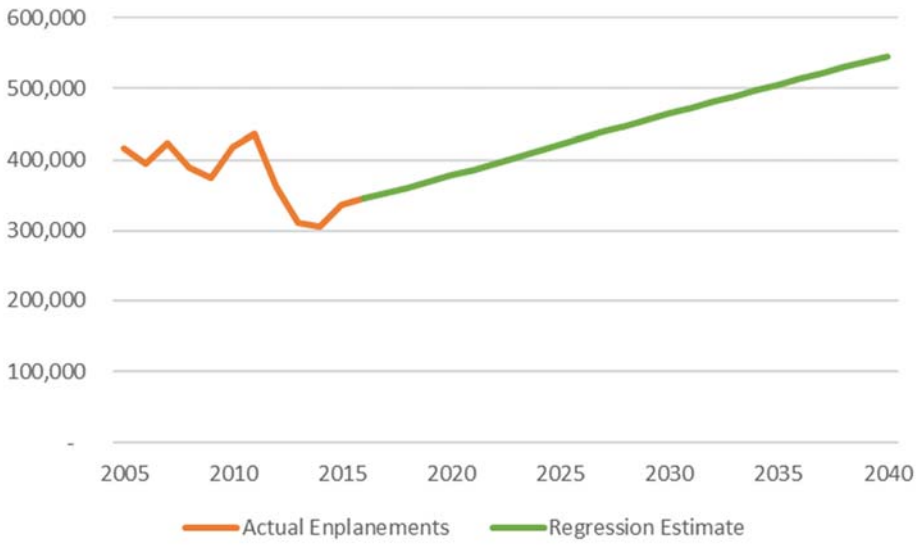
Figure 4.3.8: LVIA Core Area Passenger Traffic versus Total Household Income (2014)



Source: U.S. Bureau of the Census and ARC zip-level data for 2014 and Campbell-Hill Analysis.

The enplanement estimate through 2040 using the Regression analysis is shown in **Figure 4.3.9**.

Figure 4.3.9: LVIA's Enplanement Estimate - Regression Analysis



Year	ABE Actual	Regression Estimate ABE Enplanements
2015	336,549	
2016	344,895	
2017		352,743
2022		394,096
2027		437,461
2032		478,890
2037		518,941
2040		541,653

Source: Derived from Income and ARC data and Campbell-Hill Analysis.

Regression analysis using other demographic/economic variables did not have strong correlations and were discarded.

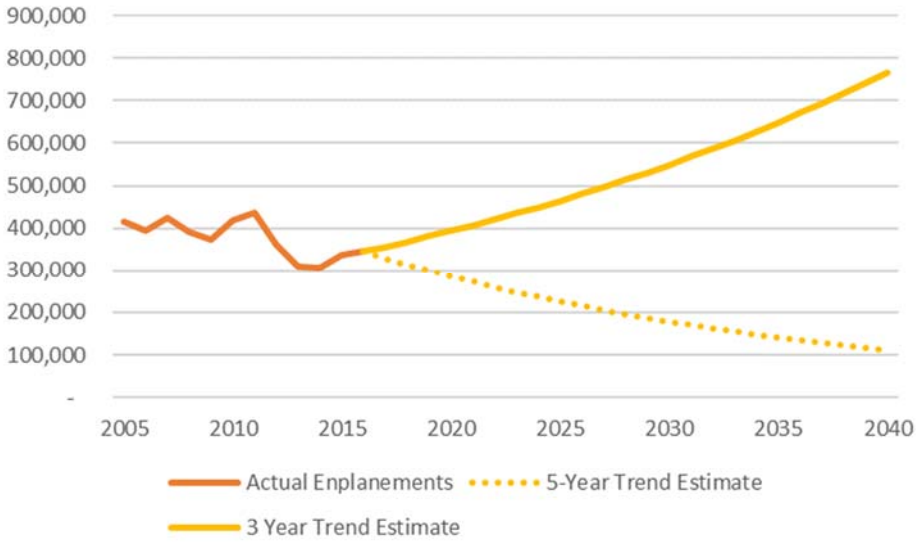
Trend Analysis

The 3- and 5-year growth rates for LVIA enplanements (Figure 4.3.1) were used to estimate LVIA enplanements. **Figure 4.3.10** below shows the wide range that these trends have on LVIA's enplanement estimate.

The base year of the 5-year trend, 2011, was when LVIA was at a recent high in terms of enplanements while the base year of the 3-year trend, 2013, was when LVIA was near its recent low in terms of enplanements. Both estimates for 2040 (5-year of 111,128 down 76.5%, 3-year of 766,691 up 62.3%) are outside of the range of reasonableness and will not be considered further.

The wide fluctuation in estimates highlights how unreliable trend analysis can be when using historical data for predicting future results. Basing an analysis on cyclical trends, such as the recent enplanement high in the 5-year trend, or the recent enplanement low in the 3-year trend provides misleading and inaccurate forecasts.

Figure 4.3.10: LVIA's Enplanement Estimate - Trend Analysis



Year	ABE Actual	5-Year Trend Estimate ABE Enplanements	3-Year Trend Estimate ABE Enplanements
2015	336,549		
2016	344,895		
2017		328,997	356,568
2022		259,849	421,134
2027		205,234	497,391
2032		162,098	587,457
2037		128,028	693,831
2040		111,128	766,691

Source: Derived from Airport reported traffic and Campbell-Hill Analysis.

Air Service Analysis

Analysis is based on 2017 schedules filed by the air carriers at LVIA with expected service changes for 2017 through 2021. Key forecast assumptions include:

- Expected schedule changes
- Average seats per departure
- Percentage of seats filled (seat factor)

Four different air service scenarios were analyzed ranging from a "Low" scenario to a "High" scenario.

Low Scenario

For the "Low" scenario, one new nonstop service and three increases in existing services are modeled. The new nonstop service is Allegiant Air's two weekly nonstop roundtrip flights to Fort Lauderdale which started on February 15. Allegiant Air also increased year-over-year weekly frequency to Orlando from 6 weekly nonstop flights (peak season) to 9 weekly nonstop flights (weekly frequency growth in the off-peak months is not as much, but is higher). These flights started on February 15. In late 2017, it is expected that American Airlines will replace all Dash-8's flying to Philadelphia (PHL) with 50-seat regional jets flying with two daily

departures in off-peak months (September through February) and three daily departures in peak months (March through August). For flights starting February 16, American replaced two of the three daily departures with 50-seat regional aircraft. Additionally, in early 2018 it is expected that American Airlines will add one daily nonstop flight to Charlotte (CLT) from January through August (daily frequency increasing from two to three during these months). Over the last 12 months, American's Charlotte load factor has exceeded 90% and LVIA-CLT is the third highest LVIA load factor market.

Medium-Low Scenario

For the "Medium-Low" scenario, the "Low" scenario is used as a baseline and several more additional market opportunities are added through 2021. In early 2018, it is anticipated that Southern Airways Express will begin nonstop service to Pittsburgh (PIT) with 19 weekly roundtrip flights. Southern Airways has been considering new PIT services to historically high-volume, unserved short-haul markets. In addition, it is considered that American Airlines in the summer of 2018 will begin twice-daily ORD service with 70-seat regional jets. Also in 2018, it is considered that Allegiant Air will begin seasonal service to Savannah with two weekly roundtrips April through September. Allegiant started service at SAV in 2015, and has quickly grown to service from 9 U.S. markets to Savannah and continues to grow.

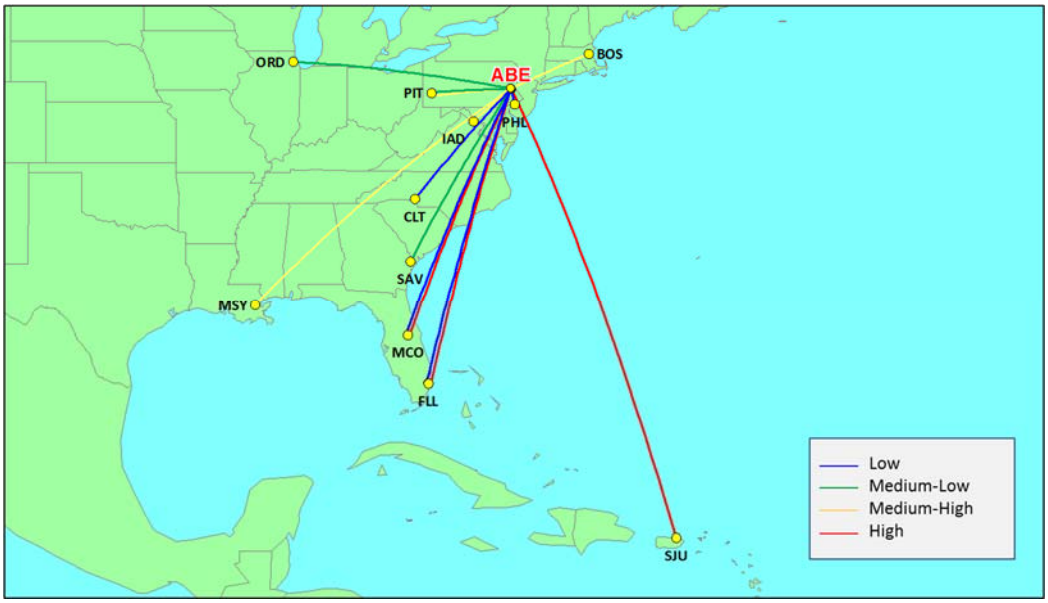
Medium-High Scenario

For the "Medium-High" scenario, the "Medium-Low" scenario is used as a baseline and to this it is considered that Allegiant Airlines will begin seasonal service to New Orleans (MSY) in 2019 with two weekly roundtrips March through May, then they will operate these flights full-year starting in 2020. Allegiant started MSY service in 2015, and now serves it from 9 U.S. markets. Also, OneJet is considered to begin five weekly roundtrips to PIT, and ten weekly roundtrips to Boston (BOS) in 2019. In the summer of 2019, it is expected that United Express will begin 19 weekly roundtrips to IAD.

High Scenario

For the "High" scenario, the "Medium-High" scenario is used as the baseline and it is expected that a LCC/ULCC carrier will begin nonstop service to FLL with daily service beginning in mid-February 2020. Nonstop service by the same carrier to Orlando (MCO) is expected to begin in mid-February 2021. In late 2020, nonstop service to San Juan (SJU) is also expected.

Figure 4.3.11: Scenarios – Air Service Analysis



Source: Campbell-Hill Analysis.

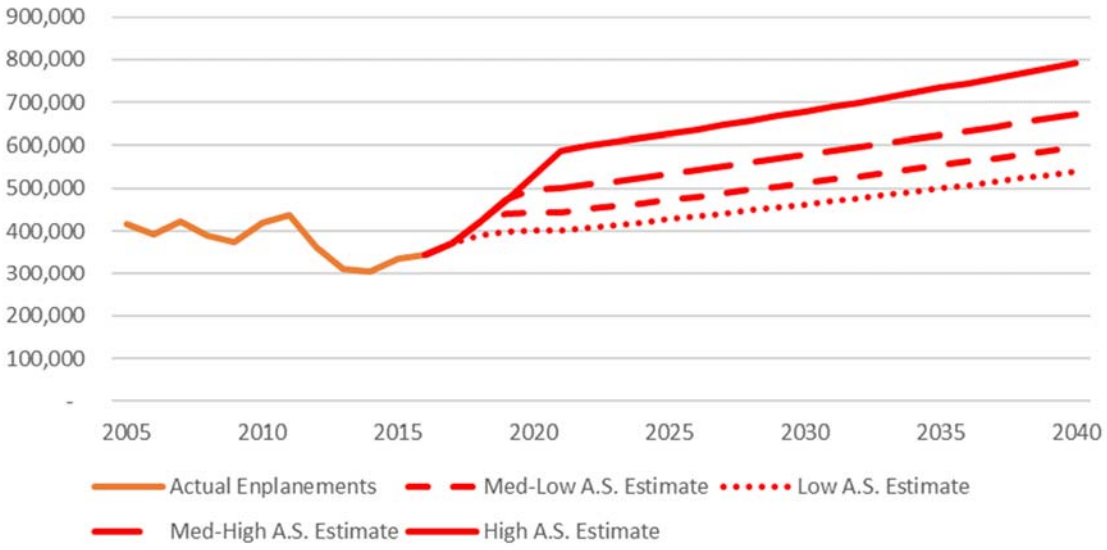
The short-term air service scenarios (2017 – 2021) are a supply driven model. Once the schedule, aircraft and frequency are established, passenger demand is forecasted. Passenger demand is forecasted by projecting the number of seats filled on each of the flights.

For existing nonstop flights, it is expected that the percentage of seats filled continues to increase over time. Between 2005 and 2016, the percentage of seats filled at LVIA grew from 57% to 87%. We do not forecast the growth to continue at this rate, but expect it to grow at a much more modest rate (overall approximately 0.5 load factor points per year, with individual route load factors capping out at 92.5% and the overall airport load factor to cap at 90% in the long term).

For new expected services, seat factors on similar services offered by each carrier were incorporated in to the forecast. For example, for Allegiant service LVIA-SAV, the seat factors of other Allegiant SAV services are analyzed, applying the average of first-year SAV load factors for the first year of LVIA-SAV service, then Allegiant's overall SAV load factors for the second year of service, then apply the same growth rates used by existing nonstop flights after that.

Multiplying seat-departures by expected percentage of seats filled yields the number of enplaned passengers by month and ultimately by year. For 2022 and beyond, FAA TAF year-over-year growth rates were applied to the 2021 Air Service estimate of enplanements to derive enplanement estimates through 2040. **Figure 4.3.12** on the following page graphically shows the results of the four Air Service scenarios. The Medium-Low, Medium-High and High Scenarios are outside the range of reasonableness and will not be considered further. The Low Scenario provided the most reasonable enplanement estimates, and will be compared with the other forecasts presented in this section.

Figure 4.3.12: LVIA's Enplanement Estimate – Air Service Analysis



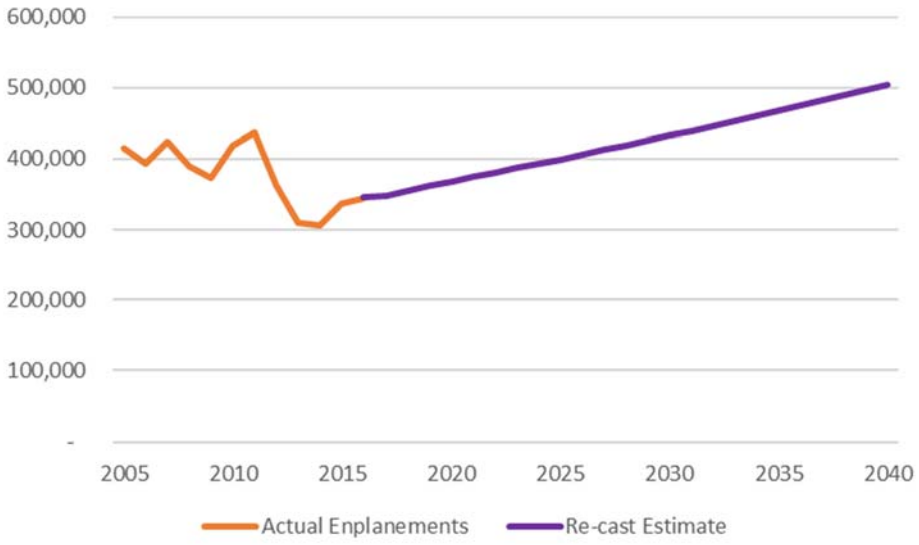
Year	ABE Actual	Low A.S. Estimate ABE Enplanements	Med-Low A.S. Estimate ABE Enplanements	Med-High A.S. Estimate ABE Enplanements	High A.S. Estimate ABE Enplanements
2015	336,549				
2016	344,895				
2017		370,629	370,629	370,629	370,368
2022		408,195	451,941	509,186	598,643
2027		441,524	488,842	550,762	647,523
2032		477,464	528,633	595,593	700,231
2037		515,708	570,975	643,299	756,317
2040		539,554	597,377	673,044	791,289

Source: Campbell-Hill Analysis.

Re-cast Analysis

For the 12 months ending September 2016, LVIA enplanements were 6.8% higher than the FAA TAF. In this analysis, FAA TAF enplanements for 2016 was replaced with actual LVIA enplanements for 12 months ending September 2016. The FAA TAF year-over-year growth rates for 2017 and beyond were used to re-estimate enplanements for 2017 through 2040. **Figure 4.3.13** shows the enplanement forecast using this methodology.

Figure 4.3.13: LVIA's Enplanement Estimate – Re-cast Analysis



Year	ABE Actual	Re-cast Estimate ABE Enplanements
2015	336,549	
2016	344,895	
2017		348,251
2022		381,662
2027		412,825
2032		446,428
2037		482,186
2040		504,482

Source: Derived from Airport reported traffic and FAA TAF and Campbell-Hill Analysis.

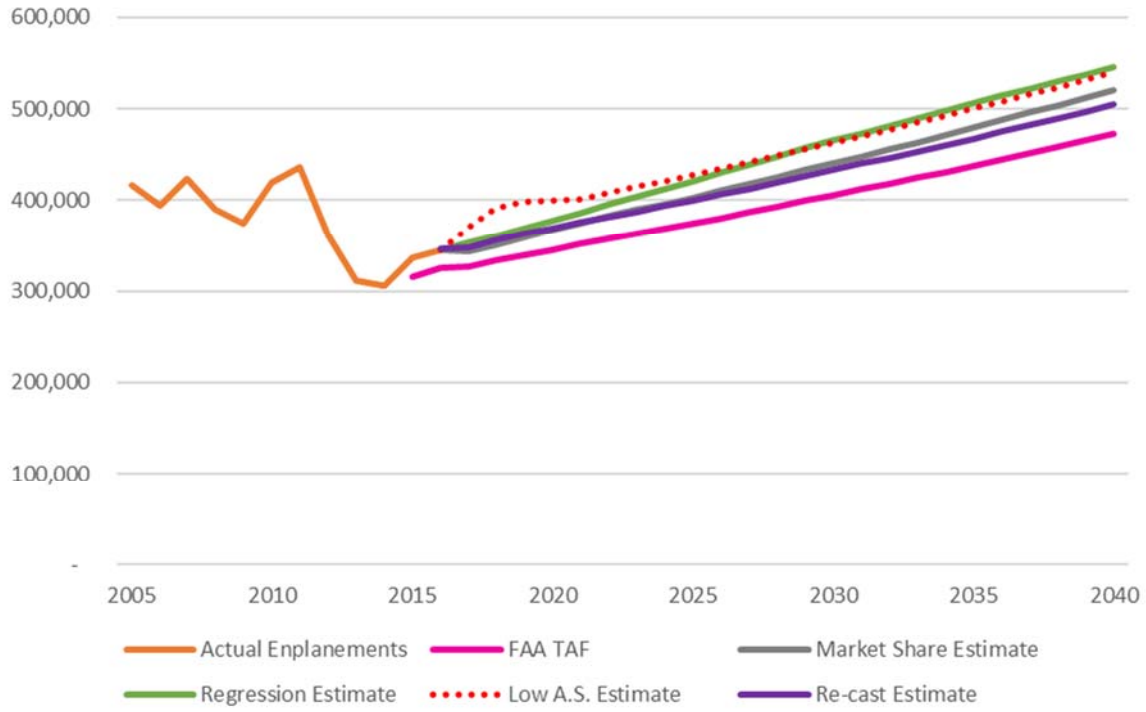
The service changes already announced at LVIA for 2017 suggest that the Re-cast enplanement estimate could be much higher than 6.8% above the FAA TAF. Assuming that the new and additional Allegiant Air services to FLL and MCO achieve a conservative 80% load factor, LVIA year ending September 2017 enplanements could be well over 15,000 higher[10] than they were in 2016. This suggests that LVIA's enplanements for year ended September 2017 would be 10.9% higher than the FAA TAF.

Recommended Enplanement Forecast

Figure 4.3.14 compares the FAA TAF enplanement forecast with the enplanement estimates of the Market Share analysis, Regression analysis, Low Air Service analysis and the Re-cast analysis.

[10] FLL - 65 departures through September 2017 with 177 seats, assumed 80% load factor = 9,204 enplanements
MCO – Through September 2017 year-over-year incremental 13,126 seat-departures, assumed 80% load factor = 10,501 enplanements

Figure 4.3.14: LVIA Enplanement Estimate Comparison



Year	ABE Actual	FAA TAF	Market Share Estimate ABE Enplanements	% Diff from TAF	Regression Estimate ABE Enplanements	% Diff from TAF	Low A.S. Estimate ABE Enplanements	% Diff from TAF	Re-cast Estimate ABE Enplanements	% Diff from TAF
2015	336,549									
2016	344,895									
2017		326,148	342,864	5.1%	352,743	8.2%	370,629	13.6%	348,251	6.8%
2022		357,438	382,179	6.9%	394,096	10.3%	408,195	14.2%	381,662	6.8%
2027		386,623	417,651	8.0%	437,461	13.1%	441,524	14.2%	412,825	6.8%
2032		418,094	455,556	9.0%	478,890	14.5%	477,464	14.2%	446,428	6.8%
2037		451,582	495,899	9.8%	518,941	14.9%	515,708	14.2%	482,186	6.8%
2040		472,463	520,800	10.2%	541,653	14.6%	539,554	14.2%	504,482	6.8%

Source: FAA TAF and Campbell-Hill Analysis.

The recommended enplanement forecast for the Master Plan is the Market Share Analysis. Relative to the FAA TAF, the Re-cast Analysis estimates in the near-term (2017 to 2022) fall well short of where enplanements should be given the new nonstop air service that has already started in 2017. Likewise, the Low Air Service Analysis over the next five years (through 2022) results in estimated enplanements much greater than 10% higher than the FAA TAF, so this estimate is also discarded. The Market Share Analysis provided a more conservative enplanement forecast, particularly over the next five years compared to the Regression Analysis, and is used as the recommended forecast.

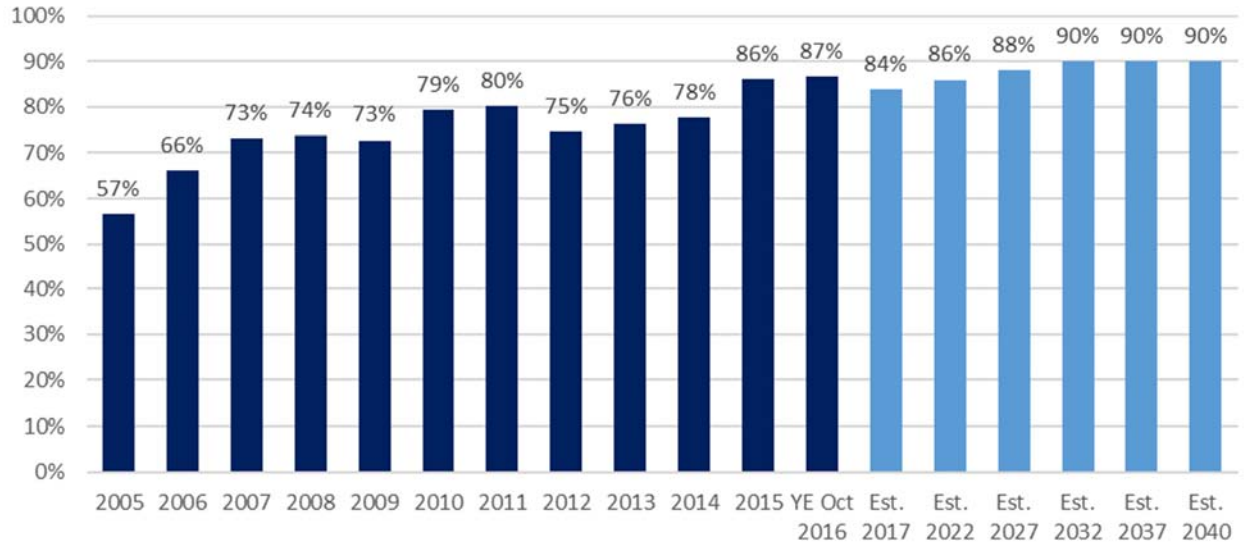
Operations Forecast

The operations forecast for 2017 comes from the published schedules filed by LVIA's air carriers. Beyond 2017, the recommended enplanement forecast from the previous section, growth trends in percentage of seats filled and trends in average seats per departure are used to forecast operations.

Estimated Seats

First, the forecast for LVIA seats for 2018 through 2040 is calculated by dividing the forecasted enplaned passengers by the forecasted percentage of seats that are filled by year. The percentage of seats filled is estimated by taking the estimated 2017 percentage of seats filled and growing the seat factor very modestly each year through 2040. Once the percentage of seats filled reaches 90% it is capped at this value for all future years. The FAA TAF has the national load factor continuing to grow each year through the end of the TAF period, capping between 86 and 87%. The resulting estimate for percentage of seats filled for all scenarios are shown in **Figure 4.3.15**.

Figure 4.3.15: LVIA Percentage of Seats Filled



Source: U.S. DOT T-100 Report and Campbell-Hill Analysis.

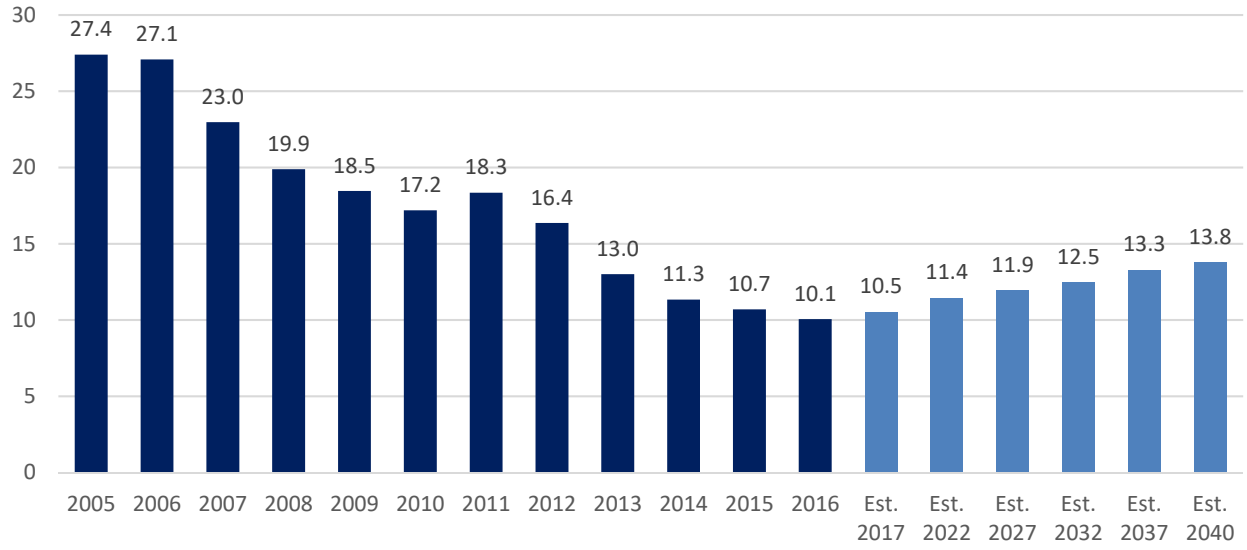
Dividing forecast enplaned passengers by year by the estimated percentage of seats by filled by year results in the estimate for total seat-departures. Total operations are forecast by multiplying total seat-departures by 2 (to get to total seats) and then dividing by the forecast of seats per departure by year.

The forecast for average seats per departure is assumed to grow by 0.43% per year after 2017. Assumed within the forecast is Delta retiring the CRJ after 2022 (replacing the CRJ with the CR7 at LVIA), American retiring the CR2 starting in 2030 (replacing it with the CR7) and United retiring the ERJ starting in 2030 (replacing it with the CR7). The growth rate of 0.43% is a proxy from the 2015 National Forecast[11] for domestic average aircraft seats per mile.

[11] As of early March 2016, the 2016 National Forecast has not been released yet (The 2016 TAF has been released).

The forecast for total operations, as shown in **Figure 4.3.16**, is determined by dividing the forecasted total seats by year by the estimated average seats per departure.

Figure 4.3.16: LVIA Total Operations (Thousands)



Source: U.S. DOT T-100 Report and Campbell-Hill Analysis.

Table 4.3.2 below shows the fleet mix and operations for selected years.

Table 4.3.2: Fleet Mix by Year Select Years

Aircraft Type	2017	2022	2027	2032	2037	2040
Commercial						
CRJ-700	1,028	765	2,650	6,482	6,906	7,160
CRJ-900	2,418	3,757	3,920	4,099	4,367	4,528
A320	671	1,748	1,824	1,907	2,032	2,106
CRJ-200	1,006	1,751	1,827	-	-	-
ERJ-135	1,564	1,651	1,722	-	-	-
CRJ	1,668	1,775	-	-	-	-
DHC-8	936	-	-	-	-	-
MD-80	922	-	-	-	-	-
B717	300	-	-	-	-	-
ERJ-145	34	-	-	-	-	-
Commercial Tot	10,547	11,447	11,942	12,488	13,305	13,795

Source: Campbell-Hill Analysis.

A summary of the recommended commercial enplanement and operation forecast is as follows in **Table 4.3.3** on the following page.

Table 4.3.3: Recommended Commercial Forecast

	Commercial Forecast			
Year	Enplanements	Operations	Average Aircraft Size	Percentage Seats Filled
2017	342,864	10,547	76.0	83.9%
2018	351,109	10,914	76.3	84.3%
2019	359,204	11,063	76.7	84.7%
2020	367,108	11,202	77.0	85.1%
2021	374,950	11,335	77.3	85.6%
2022	382,179	11,447	77.7	86.0%
2023	389,213	11,550	78.0	86.4%
2024	395,995	11,643	78.3	86.8%
2025	402,902	11,736	78.7	87.3%
2026	410,266	11,841	79.0	87.7%
2027	417,651	11,942	79.3	88.2%
2028	425,059	12,042	79.7	88.6%
2029	432,660	12,144	80.0	89.0%
2030	440,259	12,243	80.4	89.5%
2031	447,888	12,340	80.7	89.9%
2032	455,556	12,488	81.1	90.0%
2033	463,275	12,645	81.4	90.0%
2034	471,218	12,807	81.8	90.0%
2035	479,442	12,974	82.1	90.0%
2036	487,726	13,142	82.5	90.0%
2037	495,899	13,305	82.8	90.0%
2038	504,142	13,468	83.2	90.0%
2039	512,453	13,632	83.5	90.0%
2040	520,800	13,795	83.9	90.0%

Source: Campbell-Hill Analysis.

4.4 All-Cargo Forecast Methodology and Results

Historical Cargo Activity

LVIA's air cargo traffic ranks 87th among U.S. airports in 2015 (in terms of total enplaned and deplaned weight) and 82nd in terms of domestic cargo traffic.[12] By comparison, other regional airports ranked higher in total air cargo traffic for 2015 including Newark (10th), Philadelphia (18th) and Harrisburg (62nd). LVIA was ranked 95th in terms of landed weight for all-cargo aircraft in 2015 (combining aircraft and cargo weight), also below Newark (12th), Philadelphia (16th), and Harrisburg (68th).[13]

As shown in **Table 4.4.1**, total enplaned and deplaned traffic weight (including minor traffic on passenger flights) more than tripled over the last four years (from 2012 to 2016) to over 57,000 metric tonnes.[14][15]

Table 4.4.1: LVIA Total Cargo Traffic (2012-2016)

Fiscal Year	ABE Cargo Traffic (MT)		
	Enplaned	Deplaned	Total
2012	7,767	7,181	14,948
2013	7,827	7,033	14,860
2014	7,493	6,144	13,638
2015	11,434	10,068	21,502
2016	28,887	28,244	57,131

Source: Lehigh Northampton Airport Authority.

Until 2015, the primary source of LVIA's all-cargo activity (i.e., excluding passenger flight traffic) was express traffic on scheduled flights by the U.S. integrated carrier, FedEx, which accounted for over 99% of the Airport's all-cargo traffic from 2012 through 2014 (see **Table 4.4.2**).[16] In September 2015, Amazon started a domestic air network moving its traffic on dedicated flights moving between a national hub in Wilmington, OH (ILN) and several regional hubs including LVIA.[17] For the latest year, LVIA's cargo activity was dominated by FedEx and flights dedicated to handling Amazon traffic; combined those carriers were responsible for over 99% of total traffic in 2016. A minor amount of all-cargo traffic (50 tonnes in 2016) moved on ad-hoc charter flights.

[12] Source: Airports Council International – North America, 2015 North American Airport Traffic Summary (combining freight and mail traffic for reporting airports).
[13] Source: FAA, CY 2015 ACAIS data.
[14] 1 metric tonne (MT) = 2,204.6 pounds
[15] Note that the small amount of traffic handled on passenger flights is excluded from the all-cargo analysis.
[16] Annual all-cargo traffic levels were assigned by carrier type by subtracting passenger flight traffic and then using patterns in the T-100 data and airport flight data to project FY 2016 totals by carrier with airport-level totals for FY 2012-2015 adjusted based on distribution patterns in the T-100 data.
[17] While flights are also operated to non-hub airports, the regional hubs include Dallas-Fort Worth (DFW), Phoenix (PHX), Oakland (OAK), Sacramento (SCK), Ontario, CA (ONT), Tampa (TPA), Charlotte (CLT) and Orlando (MCO).

Table 4.4.2: LVIA All-Cargo Traffic by Carrier Type (2012-2016)

Fiscal Year	ABE All-Cargo Traffic (MT)			
	FedEx	Amazon	Other	Total
2012	14,922	0	13	14,935
2013	14,828	0	16	14,844
2014	13,598	0	20	13,618
2015	13,301	8,163	19	21,483
2016	15,072	42,044	7	57,124

Note: Excludes traffic carried on passenger flights.
Source: Lehigh Northampton Airport Authority, T-100 and Campbell-Hill.

Table 4.4.3: LVIA All-Cargo Operations by Carrier Type (2012-2016)

Fiscal Year	ABE All-Cargo Operations			
	FedEx	Amazon	Other	Total
2012	1,397	0	14	1,411
2013	1,451	0	0	1,451
2014	1,441	0	48	1,489
2015	1,454	480	18	1,952
2016	1,485	1,902	16	3,403

Source: Lehigh Northampton Airport Authority, T-100 and Campbell-Hill Analysis.

FedEx's operations at LVIA connect the local market with FedEx's domestic express network via flights to its national hubs in Memphis (MEM) and Indianapolis.[18] LVIA also acts as a transfer point between the inbound hub flights and outbound turboprop flights to Wilkes Barre (AVP). In 2016, FedEx's traffic totaled over 15,000 tonnes moving on a total of 972 operations. Since 2012, FedEx's traffic has increased by 1% while flight operations increased 6%.

As of February 2017, FedEx operated two daily weekday inbound Boeing 757 flights from MEM and IND that arrive in the early morning.[19] For the next 3-4 hours, traffic is sorted to containers that are then trucked to sort centers located in Bethlehem (handling local Allentown traffic), Reading and Wilkes-Barre and the AVP flight. The morning aircraft remain at the Airport until their evening departure with outbound traffic to the sort hubs. During peak traffic periods in November and December, FedEx will operate an additional inbound flight as well as a Saturday flight. While mostly operated with Boeing 757's, FedEx plans to shift the hub flights to Airbus 300's in 2017.

The LVIA hub flights handle inbound and outbound express traffic for a geographical area that is roughly within 1 ½ hours of the Airport (including AVP to north). This service area is defined by the location of surrounding airports that also have hub flights, which include Newark (EWR), Philadelphia (PHL), and Harrisburg (MDT).

Normal traffic levels average 2,000 inbound boxes in the morning and 5,000-6,000 outbound boxes in the

[18] International traffic can also be routed via these flights but is not specifically identified in any data source.
[19] Some of this information was gathered from a discussion with a local manager for FedEx.

evening. In peak season, traffic levels can double requiring extra flights and/or larger aircraft. The imbalance in the outbound direction is due to the high concentration of e-commerce distribution centers in the area.[20]

The daily flights to AVP use Cessna turboprop aircraft operated by a contract carrier, Wiggins Airways. These flights handle morning express traffic for the Wilkes-Barre markets that cannot meet delivery deadlines via the truck routing. This flight does not return until the next morning and handles no inbound traffic at LVIA. The airport facility also handles international traffic trucked to/from FedEx's European gateway at Newark (EWR).

Starting in 2015, all-cargo flights operated by various contract airlines (including ABX Air (ABX), Air Transport International L.L.C. (ATI), and Atlas at LVIA) were used as part of a developing domestic all-cargo network for Amazon-based traffic. The network currently operates with a national hub at Wilmington, OH (ILN) linked to regional distribution airports some of which are secondary airports such as LVIA selected to avoid congestion at major cargo gateways.

For 2016, Amazon operated 1,900 operations at LVIA including 911 operations to/from ILN, which operated on a round-trip basis. Some flights connecting with other "regional" hubs were only operated one-way or operated round-trip on an inconsistent basis. In 2016, the top regional airports were ONT (191 outbound flights and 52 inbound), DFW (192 outbound flights), PHX (122 inbound flights), TPA (122 outbound flights), SCK (94 inbound flights and 1 outbound), and CLT (94 outbound flights). All of the flights utilized Boeing 767 aircraft of which three-quarters were 767-200's with remainder being 767-300's.

As the service levels (and national network) have been developing rapidly since the September 2015 start, the pattern for the most recent quarter is probably more indicative of service levels going forward. For the 4th quarter of 2016, Amazon averaged one flight per day to and from ILN with daily inbound flights from DFW and daily outbound flights to ONT. Flights inbound from PHX and then outbound to TPA operated daily except for a three-week period at the end of November. Other flights that operated slightly more than half of the period were flights inbound from STK and outbound to CLT and flights inbound from ONT and outbound to RFD. This pattern suggests that Amazon is shifting its limited fleet to meet peak demand, but may also reflect imbalances in traffic flows.

For the 12 months ending October 2016, the Amazon flights handled 36,751 tonnes of air cargo at LVIA on 1,736 flights at an average of 21 tonnes per flight. The ILN flights accounted for over half of this traffic (19,770 tonnes) with traffic that was equally balanced by direction. Flights to the OAK hub accounted for 3,881 tonnes (also equally balanced) with significant outbound traffic to ONT (3,571 tonnes), TPA (1,888 tonnes) and CLT (1,369 tonnes). The hubs generating inbound traffic include DFW (2,737 tonnes), PHX (1,983 tonnes), and SCK (1,509 tonnes). The average cargo load for these markets ranged from 19 tonnes to 26 tonnes per flight.

[20] This imbalance in package volumes is larger than the weight imbalance that is slightly higher in the outbound direction (22% in 2013 based on airport statistics). This difference may be explained by smaller package weights for the outbound e-commerce traffic than for consolidated inbound loads.

All-Cargo Flight Forecasts

The future growth of cargo activity at LVIA will depend on several key factors:

- Growth in the demand for integrated cargo services by FedEx[21] as affected by local consumer and business demand for inbound services and the continued expansion of e-commerce-based traffic both locally and in general.
- The continued development of Amazon's domestic air cargo network and LVIA's continued prominent role in that network, as well as possible expansion into international services.
- The extent to which air trade traffic that is produced overseas (in particular the high share of e-commerce) is affected by international trade policies. These policies could affect (1) access to particular low-cost markets producing consumer products and (2) the costs of transporting and delivering those products to U.S. destinations. Any reduction in international air trade volumes would affect the domestic traffic of both FedEx and Amazon.
- The level of demand for international air cargo services in LVIA's catchment area and the possibility to attract direct air services diverted from traditional international gateway airports such as JFK.

Each of these factors will be discussed separately below and represented in the forecasts.

Domestic Integrated Cargo Traffic Levels

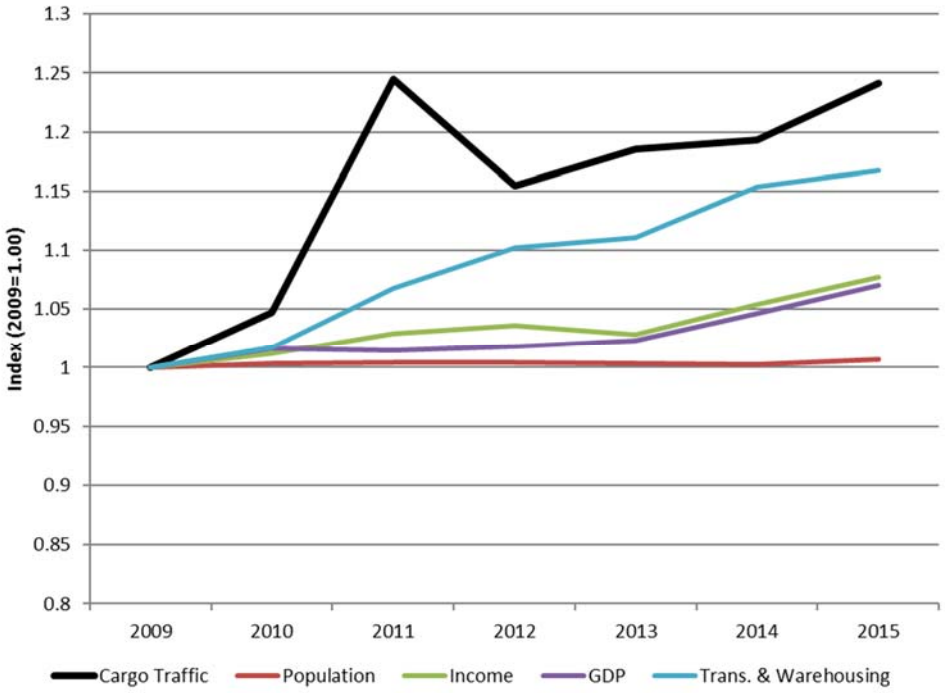
As noted previously, FedEx serves a relatively large service area via LVIA including connecting turboprop flights to AVP, which does not have direct hub flights to MEM or IND. The current and historical traffic levels at LVIA are therefore representative of the demand for FedEx services and can be used as a basis for forecasting future demand.[22] Various techniques for forecasting traffic levels include: (1) economic and demographic growth for the local service area; (2) predicted patterns of growth for FedEx's national traffic; and (3) general air cargo forecasts by FAA and Boeing. The issue of whether UPS is likely to serve the same local market using direct flights as opposed to trucking services is also addressed.

As the FedEx traffic growth and its service patterns have been stable for some time, it is reasonable to base its future growth on the local economy. As shown in **Figure 4.4.1**, the pattern of growth for FedEx traffic since 2009 has been steady (other than a spike in 2011) and the growth is most closely matched to the growth in the transportation and warehousing sector for the LVIA catchment area (as measured by real personal income).

[21] UPS does not currently fly to ABE based on the proximity of its hub operation at PHL and, while there have been discussions with the carrier in the past, direct flights are not likely to occur as described in Section 4.2.2.

[22] There are no known constraints on the level of services provided by FedEx to the local market and FedEx controls the air and ground routing of local traffic. Therefore, the "demand" for FedEx's services at ABE can be measured in terms of actual traffic.

Figure 4.4.1: LVIA Cargo Statistics (2009-2015)



Source: U.S. DOT, T-100 statistics and Woods & Poole.

Regression analysis was used to compare growth patterns in FedEx's traffic at LVIA from 2003 to 2015 with economic and demographic factors for the LVIA service area (defined as the passenger catchment area, which is very similar to the service area described by FedEx). Direct correlations with population, gross domestic product, household income, and income for the transportation and warehousing sector (all expressed in real terms) produced low R-squared values and/or coefficients that were illogical (e.g., increased income negatively affecting traffic levels). Alternative regressions including growth patterns in domestic traffic for FedEx's MEM and IND hubs (as representative of the national integrated carrier market) produced similar results. The conclusion was that while the local economy influences traffic demand levels, macro-levels factors (e.g., the shift from air to surface delivery and changing patterns for e-commerce activity) have dominated past growth. A "Local Economy" traffic forecast was therefore based on an average of the projected Woods & Poole growth rates for catchment area real household income (to represent inbound traffic) and real income for the transportation and warehousing sector (to represent outbound traffic).[23]

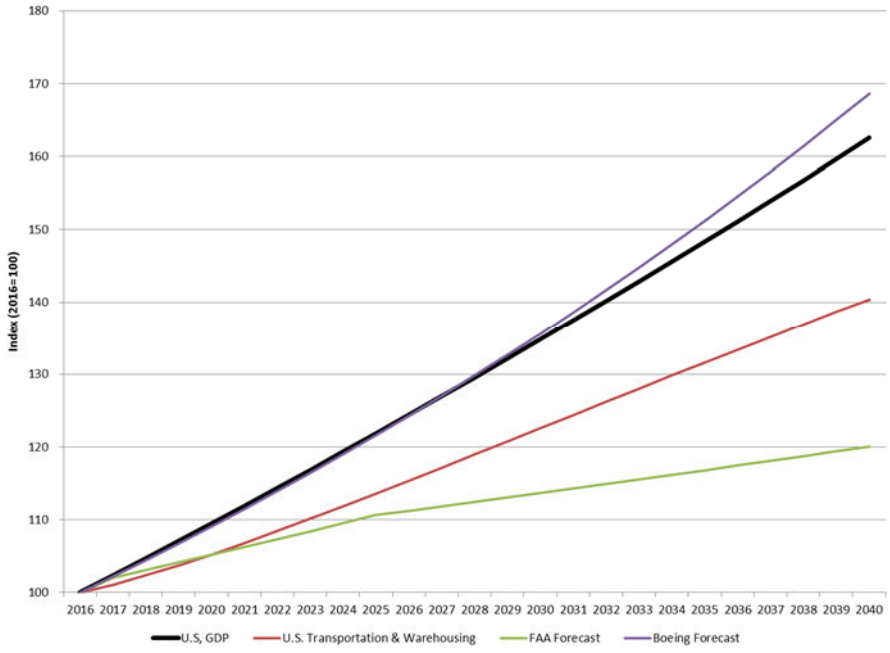
An alternative economy-based forecast was applied using traffic at the FedEx hubs served via LVIA. Various regression analyses compared traffic at the two hubs combined with combinations of economic and demographic factors at a national level. The best results compared traffic levels to national population and income for the transportation and warehousing sector yielding an R-squared value of 0.90, rational

[23] While traffic in both directions contain a mixture of shipments to/from households, businesses and distribution centers, it is assumed that the growth in wealth for the local market (as measured by household income as affected by both population and business growth) would be a good factor to use for inbound traffic. Based on discussions with FedEx, shipments from various distribution centers account for a high share of their outbound traffic, so the growth in the local transportation and distribution sector (as measured by personal income) should be a good determinant for outbound traffic growth.

coefficients and reasonable correlation factors. The resulting "FedEx Hub" traffic forecast projected growth in total hub traffic based on the national forecasts of population and transportation and warehousing income (from Woods & Poole) assumed that LVIA's 2016 share of that traffic would remain constant during the forecast period.[24]

A final traffic forecast was based on national-level air cargo forecasts as produced by the Boeing Company[25] and the FAA[26]. Boeing projects North American domestic cargo traffic (which is dominated by the integrated carriers) to average 2.2% annual growth between 2016 and 2035. In contrast, the FAA projects relatively low growth (1.0% per year from 2016 to 2025 and 0.1% annual growth from 2025 to 2026). As shown below, the Boeing "high" forecast exceeds projected national growth in GDP and the transportation and warehousing sector while the FAA "low" forecast growth is well below both indices. The "National Cargo" forecast is based on an average between the Boeing and FAA growth rates.

Figure 4.4.2: Comparison of Forecasts (2016-2040)



Source: Woods & Poole, FAA and Boeing Company.

The resulting traffic level for each of the three traffic forecasts is shown below. The recommended forecast is an average of the three forecasts.

[24] This is a conservative estimate based on the relatively high growth projected for ABE's local transportation and warehousing sector (1.9% per year from 2015 to 2040) compared to the national growth (1.4% per year).
[25] The Boeing Company, The Boeing World Air Cargo Forecast 2016/2017
[26] FAA, FAA Aerospace Forecast, Fiscal Years 2016-2036

Table 4.4.4: LVIA Integrated Cargo Traffic Forecasts (2016-2040)
(metric tonnes)

Fiscal Year	Local Economy	FedEx Hub	National Cargo	Average
2016	15,072	15,072	15,072	15,072
2017	15,328	15,177	15,315	15,273
2022	16,777	15,927	16,587	16,431
2027	18,378	16,818	17,806	17,668
2032	20,059	17,738	18,861	18,886
2037	21,778	18,632	19,979	20,130
2040	22,825	19,147	20,681	20,884

Source: Campbell-Hill Analysis.

The operations forecast for FedEx operations was developed using a cross-sectional analysis comparing the average cargo tons per operation for all airports directly served to/from MEM or IND (using T-100 data for 12 months ending October 2016 for airports with at least 250 operations for the year). The resulting operations forecast are shown below. The distribution by aircraft type is based on the following:

- Turboprop operations will continue using the same type of aircraft (or a similar replacement aircraft).
- FedEx has indicated that they will replace their narrow-body B-757 operations with wide-body Airbus A-300 aircraft in the first quarter of 2017 so a 25/75 split was assumed.
- FedEx is in the process of replacing its Airbus fleet with new more efficient Boeing B-767 wide-body aircraft of which they currently operate 39 and have 70 on order and options for 24 more. It is assumed that all operations would use these aircraft by 2022.

Table 4.4.5: Integrated Cargo Operations Forecasts (2016-2040)

Fiscal Year	Turboprop	Boeing B-757	Airbus A-300	Boeing B-767	Total
2016	513	872	100	0	1,485
2017	517	244	733	0	1,494
2022	538	0	0	1,008	1,546
2027	561	0	0	1,039	1,600
2032	582	0	0	1,068	1,651
2037	604	0	0	1,097	1,701
2040	616	0	0	1,114	1,731

Source: Campbell-Hill Analysis.

Other Integrated Carrier Traffic

Since DHL ceased operation of its domestic express network in 2008-2009[27], the two U.S integrated carriers, FedEx and UPS, have dominated the U.S. domestic all-cargo market. In 2014 (before the start of the Amazon operations), the two carriers accounted for 94% of all-cargo traffic moving between airports in the Continental U.S.[28] While it is possible that other e-commerce shippers may follow Amazon in operating some dedicated air services, it is highly unlikely that another integrated carrier will enter the U.S. domestic market. Therefore, the possibility for expanded service by an integrated carrier at LVIA would be limited to UPS which currently serves the LVIA area with connecting truck services to and from its regional hub in

[27] DHL continues to operate domestic all-cargo flights that only handle traffic connecting to or from its international flights.
[28] Based on T-100 statistics and adjusted for foreign carriers carrying onboard traffic between domestic airports on international flights, but including traffic on flights moving international cargo to/from DHL's gateway airports.

Philadelphia.

The basic structure of UPS's domestic network is based on its national sort hub in Louisville (SDF), regional sort hubs in ONT, PHL and DFW, international gateways in Anchorage (ANC), Oakland (OAK) and PHL, and origin/destination airports serving individual metropolitan markets. Flight patterns are determined by the ability to deliver nightly shipments from a particular origin airport to a sort hub where transferred to an outbound flight that allows for morning delivery the next day.[29] Airports that are within a reasonable drive time of a sort hub are served with trucks rather than flights, and the addition of the regional sort hubs expanded the geographical regions that could be so served.

LVIA is within 55 air miles of the regional sort hub at PHL and 1 ½ hours by road, well within the coverage range for truck services. For comparison purposes, the nearest airport with regular UPS air service from PHL is Hartford, CT (BDL) which is 196 miles by air. Similar patterns exist for the other sort hubs with the closest air service airport for ONT being Fresno (FAT), which is 222 miles away, and for SDF with Rickenbacker (LCK) 188 miles away. Unless UPS were to move its sort hub from PHL, it is highly unlikely that LVIA would ever be directly served via air.

Amazon-Based Traffic

The future growth for cargo activity based on the Amazon flights will depend on a number of factors including:

- The extent to which Amazon can successfully establish and expand the first shipper-dedicated air cargo network in the world.
- The size and scope of the network designed to handle Amazon (and possibly other) air cargo traffic.
- The timeframe necessary to fully build up the network and the growth potential after full build-up.
- The extent to which LVIA's role and share of the network increases, decreases or changes as the network develops and grows.

Information on the current and future plans for the Amazon air network is very limited (and they declined to comment for this study). While their current flight and traffic patterns can be measured using the T-100 data, the limited history for this operation makes it difficult to determine the current stage of development for the network or what the final build-out may be. The forecast below is built on assumptions based on Amazon's stated plans and an analysis of LVIA's current role relative to the overall network structure.

On January 31, 2017, it was announced that Amazon would shift its national hub operations from ILN to Cincinnati/Northern Kentucky Airport (CVG) where they will develop the capability to handle over 200 daily operations with a fleet of 40 aircraft. No schedule for completing this expansion has been released. For comparison purposes, departures at ILN totaled 312 in October 2016 (10 per day) using a fleet of 20 leased Boeing 767 aircraft. The key questions regarding future operations at LVIA are whether this expansion will apply proportionally or used to expand the number of airports in the network, and whether new airports might be served directly at LVIA.

[29] These flights also carry traffic for afternoon or second-day delivery, but the flight patterns are mostly directed by the ability to provide next morning delivery of express shipments with a high degree of certainty.

While not explicitly stated by Amazon, the pattern of flight and traffic operations suggest that the network is being used to transfer products between major distribution centers using a combination of hub-transfer flights routed via ILN and direct point-to-point flights that "bypass" the hub. Some of the bypass routings are operated in just one direction, which may be dictated by an imbalanced flow of traffic or may just indicate limited fleet resources and hub transfer capability for the current network. These types of routings could also be dictated by service requirements for each airport's mix of facility types (e.g., sortation vs. final delivery).

Based on the latest operating and traffic data[30], LVIA is served with a daily round-trip flight to/from ILN and 3 bypass flights arriving from DFW, PHX and SCK and departing for ONT, CLT and TPA. Compared to other non-ILN points, LVIA has the most flights, slightly exceeding ONT and SCK with about twice as many as TPA, RFD, and CLT. LVIA has just one round-trip to/from ILN while DFW and SCK each have two. LVIA is the only airport with bypass flights connecting to 6 of the non-ILN airports. It should be noted that LVIA's flight data indicates that the October 2016 schedule was reduced for November and December which may indicate fleet limitations or changes in the shipping patterns.

Unlike passenger forecasts, it is difficult to measure the "demand" for the Amazon air network as it is internally determined and controlled. Therefore, any reasonable forecast must be based on their likely network plan.

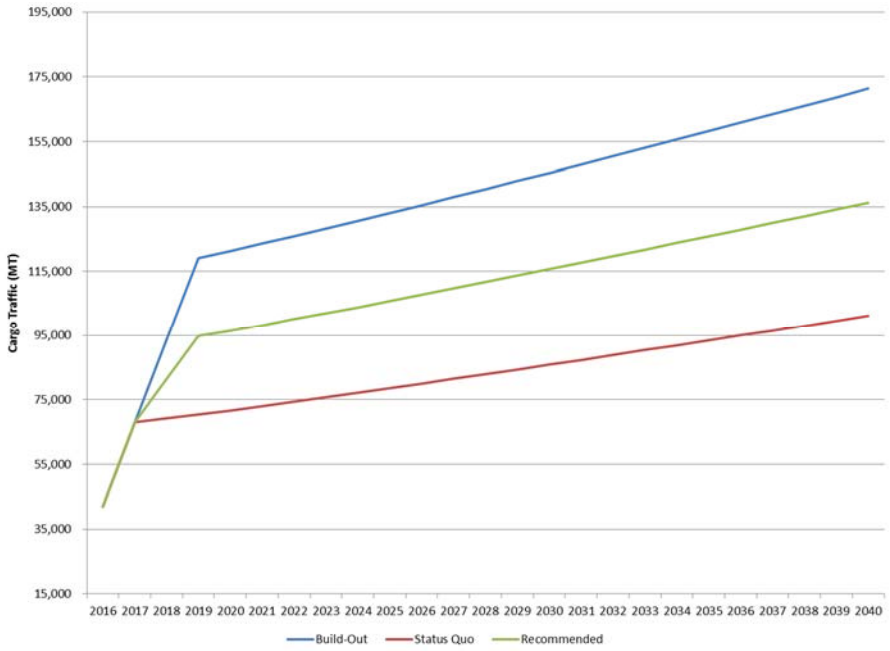
The forecast for the Amazon operations is based on two scenarios characterized by assumptions on the short-term expansion plan for LVIA as follows:

- Baseline traffic and operations in 2016 were estimated using year-to-date October 2016 T-100 statistics adjusted to match the airport traffic totals.
- A "Status Quo" forecast assumes that the traffic levels and operating patterns that applied in October 2016 represents the desired long-term role for LVIA and is used for the 12-month 2017 traffic levels. Thereafter, traffic growth is based on the forecasted growth of the local transportation and warehousing sector (as measured by real income growth from Woods & Poole).
- A "build-out" forecast assumes the same traffic and operations for 2017 as the "Status Quo" forecast, but adds a second flight to/from ILN in 2019 and expands to the number of airports served with bypass flights from 3 to 5 airports in both directions (i.e., a 40% increase). The 2018 estimate is the midpoint of the 2017 and 2019 estimates with post-2019 growth based on the growth in the local transportation and warehousing sector.

The recommended forecast is the average of the two forecasts from **Figure 4.4.3** and is shown in **Table 4.4.6**.

[30] Based on October 2016 T-100 data which should be limited to flights that handle O&D traffic and exclude repositioning flights.

Figure 4.4.3: Amazon Traffic Forecasts



Source: Campbell-Hill Analysis.

Based on current operations and the stated fleet plan, it is assumed that all future operations will be conducted using wide-body Boeing B-767 aircraft as shown below (most likely the -300 variant as the older -200 models are being phased out of service).

Table 4.4.6: Amazon Operation Forecast

Fiscal Year	Boeing B-767
2016	1,902
2017	3,074
2022	4,530
2027	4,962
2032	5,416
2037	5,881
2040	6,163

Source: Campbell-Hill Analysis.

Other All-Cargo Traffic

All other all-cargo traffic and operations is minimal and inconsistent so the 2017 levels were assumed as the average for 2012-2016 from the T-100 statistics and grown through 2040 using the FAA cargo forecast growth rates. Over this time period, the distribution of flights has been 98% narrow-body jets and 2% turboprops with no turboprop flights since 2014. It is assumed that all future operations will be conducted using narrow-body jet aircraft.

Combined All-Cargo Forecast

The combined traffic and operations forecasts are shown in **Table 4.4.7**. The projected average annual

growth in traffic from 2016 to 2040 of 4.3% per year is primarily based on the high growth forecast for the Amazon operations (5.0% per year). A study published in 2015 projected 2.4% annual growth in Lehigh Valley airfreight traffic from 2011 to 2014 but was produced prior to the initiation of Amazon's air operations.[31]

Table 4.4.7: Combined Traffic and Operations Forecasts

Fiscal Year	Traffic (MT)	Operations			
		Wide-body Jets	Narrow-body Jets	Turbo-Props	Total
2016	57,131	2,002	888	513	3,403
2017	83,240	3,807	260	517	4,584
2022	116,585	5,538	17	538	6,093
2027	127,378	6,001	18	561	6,580
2032	138,628	6,485	18	582	7,085
2037	150,136	6,978	18	604	7,599
2040	157,141	7,278	18	616	7,912

Source: Campbell-Hill Analysis.

The projected levels of traffic and operations growth will significantly impact the requirements for all-cargo aircraft parking and terminal handling capacity. Total operations are projected to grow 133% from 2016 to 2040 with jet activity up 150%. The elimination of most narrow-body flights (from 31% of jet operations in 2016 to almost 100% in 2040) will also affect ramp and parking capacity needs. Based on the operating patterns of FedEx and Amazon, the weekday demand for jet aircraft capacity is likely to be the primary constraint.[32] Currently, non-peak weekdays have 2 FedEx jet flights (one wide-body and one narrow-body) while Amazon averages 3 jet flights (with both arriving and departing the same day). During peak periods, FedEx may add a third flight for a total of 5-6 jet flights per weekday.[33] Based on projected flight growth, weekday jet operations will double to 12-13 wide-body flights per day with the potential for 9-10 wide-body flights by 2022 (with the elimination of FedEx's narrow-body flights). It is unlikely that the ad hoc jet flights or FedEx turboprop operation would require any additional aircraft space.

In terms of cargo terminal and handling capacity, the near tripling of cargo traffic (from 157 tonnes per day in 2016 to 431 tonnes per day in 2040) will also require some expansion and new development although more knowledge of the specific requirements for FedEx and Amazon is required. Key factors affecting cargo terminal needs include whether cargo is sorted on-airport or transferred to an off-site location, the storage time in the terminal (if any), the balance of traffic, and any special handling requirements (e.g., refrigeration). Future terminal needs should consider these factors.

International Air Cargo

LVIA does not currently have direct international all-cargo service or any services projected during the forecast period. International O&D traffic is handled on the FedEx flights to MEM and is also trucked to

[31] Lehigh Valley Planning Commission, Lehigh Valley Regional Freight Plan (October 13, 2015)

[32] While Amazon currently operates daily flights, FedEx's current operation has two weekday flights during non-peak periods with additional flights during the November/December peak. This analysis assumes a proportional growth in the number of these jet flights.

[33] Based on the limited operating period, it is unknown whether the Amazon operation will also have seasonal peaks that would change their flight patterns at ABE.

and from nearby European gateways (EWR for FedEx and PHL for UPS), but since that traffic is not specifically identified in the traffic data it is covered in the domestic all-cargo forecasts. The LVIA local market does generate a significant amount of air exports and imports that are flown or trucked to other international airports as described below.

While international air trade does not affect these forecasts, **Appendix D – Forecast Information** provides a profile of air trade patterns for an area that could be served with international flights at LVIA. Some of patterns identified in the trade analysis:

- Based on LVIA's location within 2 1/2 hours of 3 airports with international all-cargo services (JFK, PHL and EWR), LVIA's potential international cargo catchment area was defined as counties within 3-4 hours of LVIA where LVIA is the closest airport relative to the 3 other airports (based on drive time). A primary area was further defined within the total area as the counties within 90 minutes of LVIA (allowing same day pickup or delivery for local businesses).[34]
- The 31-county international catchment area produced $3.6 billion of air exports and $8.5 billion of air imports in 2015 accounting for 1.2% of total U.S. air trade. The region's air trade value increased 5% from 2013 to 2015 with export value up 11% and import value up 3%. The region produced nearly 55,000 tonnes of import trade and 43,000 tonnes of export trade with the combined weight up 7% from 2013 to 2015 (with imports up 17% and exports down 4%).
- The 7-county primary area produced $1.9 billion of air exports and $3.3 billion of air imports in 2015 with export value increasing 29% from 2013 to 2015 and import value up 4%. Trade weight was nearly 40,000 tonnes including over 18,000 tonnes of exports and 21,000 tonnes of imports. Export trade declined 4% from 2013 to 2015 while import weight increased 17%.
- Asia/Pacific markets dominate the air trade for the primary region with nearly half of the total weight in 2015. Europe accounted for 39% of the trade followed by Latin America with 6%, All Other (Africa and Middle East) with 5% and North America (Canada and Mexico) with 3%. Export trade is more heavily dependent on Europe with 43% of the total weight while Asia/Pacific accounts for 57% of the import trade.
- China is the top country market for the LVIA primary market region by a wide margin based on having more than one-third of the total air import weight while also being the top export market in 2015. Germany is the second largest trade partner being second in import trade and third in export trade. United Kingdom, France, Japan and India are also large sources of trade, with France being the fastest growing export market (up 25% from 2013 to 2015) and Vietnam as the fastest growing import market (up 64%).
- The top export commodities for the primary region were a combination of industrial materials (led by organic chemicals and steel products) and high tech products (medical equipment, semiconductor machinery and biological products). The top import commodities were primarily apparel and consumer electronics, although there are also commodities flowing to the local pharmaceutical sector.
- Without scheduled international services, the LVIA regional air trade is mostly routed via the primary cargo gateways.[35] In terms of total international cargo, 43% of Pennsylvania's air exports are routed via JFK while the integrated carriers (FedEx's EWR gateway and MEM hub and UPS's PHL gateway and

[34] It is likely that the requirements of shippers and consignees located within this primary area would be the primary driver for any direct international flights so Appendix D focuses on the area's trade patterns.
[35] Routing patterns are not available for the local ABE primary market, but can be discerned by state-level patterns for Pennsylvania.

SDF hub) handle over 25% of export trade. JFK is even more dominant for import trade with 58% of the weight while the integrated carrier gateways (EWR and PHL) handled 24% of the trade.

- The potential of attracting direct international all-cargo flights to LVIA is currently limited by the lack of existing cargo handling capabilities and the absence of international passenger flights that could serve as a platform for building those capabilities. The dominance of the three nearby gateways at JFK, EWR and PHL, and the lack of any benchmark "secondary gateway" airport in region, make it unlikely that a general all-cargo operator (e.g. Cargolux) would schedule all-cargo services for LVIA. While it is possible that Amazon might expand its domestic air network with international routes, there has been no indication that this was a possibility (and those services are unlikely to be routed to airports without international capabilities).

It must be concluded that the current pattern of infrequent ad hoc international cargo activity would continue throughout the forecast period.

4.5 General Aviation Forecast

General aviation (GA) operations include all non-commercial and non-military flight activities including recreational flying, flight training, and business travel. Flight activity is categorized as either "local" for flights that originate and terminate at the same airport or "itinerant" for flights that originate or terminate at another airport. Activity levels at an airport are measured in terms of the number of local and itinerant flights as well as the number of aircraft that are based at the Airport and average operations per based aircraft.

As shown in **Table 4.5.1**, GA activity at LVIA has fluctuated significantly since 2000. The number of based aircraft increased from 95 in 2000 to a peak of 138 in 2010-11 before declining to the current level of 115. Local operations in 2016 were 6% below the 2000 level but 40% below the peak high in 2013. Itinerant operations in 2016 were 55% lower than the 2000 level and at the lowest level since 2010. The average operations per based aircraft has also declined significantly but has fluctuated throughout the period.

Table 4.5.1: LVIA General Aviation Statistics (2000-2016)

Fiscal Year	Based Aircraft	GA Operations			per Based Aircraft
		Local	Itinerant	Total	
2000	95	37,823	55,427	93,250	982
2005	110	35,485	53,070	88,556	805
2010	138	44,513	31,070	75,584	548
2011	138	37,273	30,211	67,484	489
2012	109	47,036	30,914	77,950	715
2013	106	59,248	30,825	90,073	850
2014	113	52,132	32,353	84,485	748
2015	113	44,930	26,926	71,856	636
2016	115	35,595	25,210	60,805	529

Source: Lehigh Northampton Airport Authority and FAA TAF.

The number of based aircraft in 2016 included 69 piston aircraft, 10 turboprop, 33 jets, and 3 helicopters.[36] The forecast of based aircraft uses the national growth rates by aircraft type in the FAA[37] forecast. The

[36] The aircraft count was provided by the airport while the helicopter count is sourced to the FAA TAF.
[37] FAA, FAA Aerospace Forecast, Fiscal Years 2016-2036

average growth is applied to the 2016 fleet and is shown in **Table 4.5.2**. The average annual growth of 0.7% for the total fleet compares to 0.2% per year for the U.S. GA fleet (in the national FAA forecasts).

Table 4.5.2: LVIA Based Aircraft Forecast (2016-2040)

Fiscal Year	ABE Based Aircraft				
	Piston	Turboprop	Jet	Rotorcraft	Total
2016	69	10	33	3	115
2017	69	10	34	3	116
2022	66	11	38	3	119
2027	64	12	43	4	122
2032	62	12	49	4	127
2037	59	13	55	5	132
2040	58	14	59	5	136
Average Annual Growth					
FAA (2015-36)	-0.7%	1.3%	2.5%	2.2%	0.7%

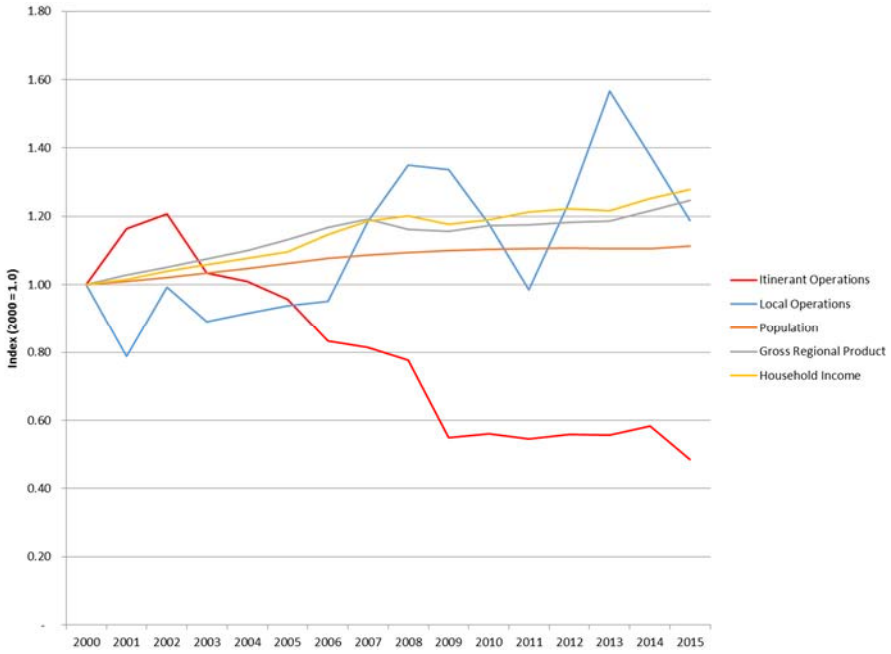
Source: FAA TAF and Campbell Hill Analysis.

The factors driving the Airport's GA activity include demand factors such as the local interest in recreational flying and pilot training and the desirability of corporate travel by private versus commercial aircraft. Demand for GA flights is affected by the local economy, which determines the ability to fund both personal and business travel. The primary supply factor driving GA activities in general is the cost of aircraft operations particularly fuel costs, but local factors include the availability and cost of space to park aircraft, and airspace congestion. Safety and security issues have also increased in the post-9/11 environment.

The historical pattern of general aviation operations at LVIA does not directly correlate with local demographic growth patterns. As shown in **Figure 4.5.1**, local operations have increased over the last 15 years along with the local economy, but year-to-year growth has varied significantly relative to the relatively stable growth for the local economy. It is likely that the positive impact of population and household income growth on "local" leisure and training activities has been offset by other factors (most probably diversion to other airports or local interest in recreational flying). The influence of aviation gasoline prices on local operations is also not evident. As shown in **Figure 4.5.2**, local operations at LVIA increased over the last 15 years while fuel prices more than doubled through 2012 before declining through 2015. Over that period, the growth patterns for local operations do not appear to be greatly affected by fuel prices[38].

[38] Statistics for 2016 supports this conclusion, as local operations at ABE declined 20% while national aviation gasoline prices (unadjusted for inflation) also declined 17%.

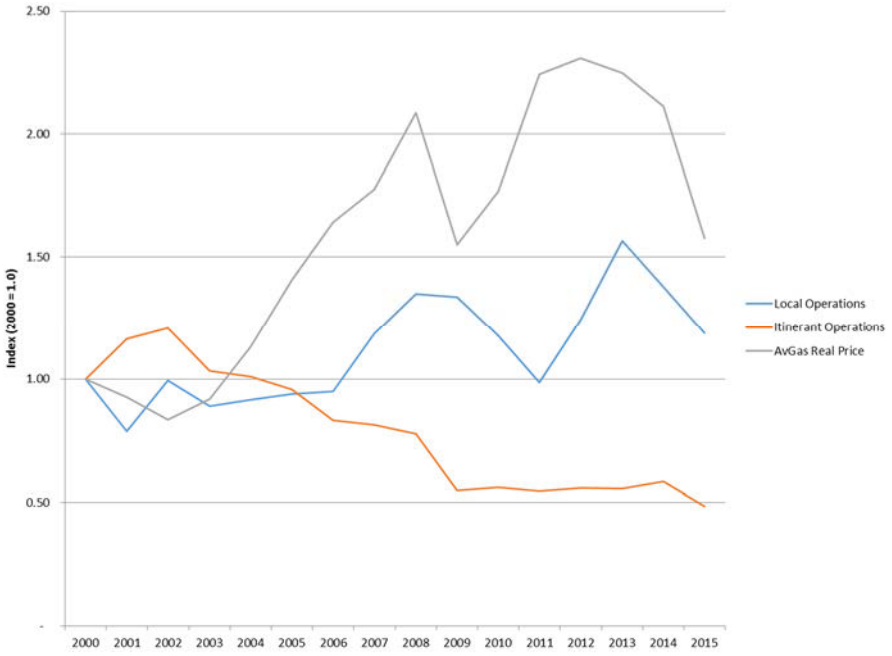
**Figure 4.5.1: General Aviation Operations vs.
LVIA Core Area Demographic Growth (2000-2015)**



Source: Woods & Poole 2016 CEDDS, Lehigh Northampton Airport Authority and FAA 2015 TAF.

Recent growth patterns for itinerant GA operations also do not correlate well with local economic conditions. While the local economy (as measured by household income, population and gross regional product) grew over the last 15 years, itinerant operations, after a 20% increase from 2000 to 2002, declined to half of the Airport's 2000 activity by 2015. While the 2007-2009 recession accelerated this decline, there was no rebound as the economy recovered and there was a further decline of 17% in 2015. While fuel prices no doubt contributed to this decline, there is not a close correlation (as shown by declining operations in 2015 and 2016 (down 8%) while fuel prices also declined.

Figure 4.5.2: General Aviation Operations vs. Aviation Gasoline Prices (2000-2015)



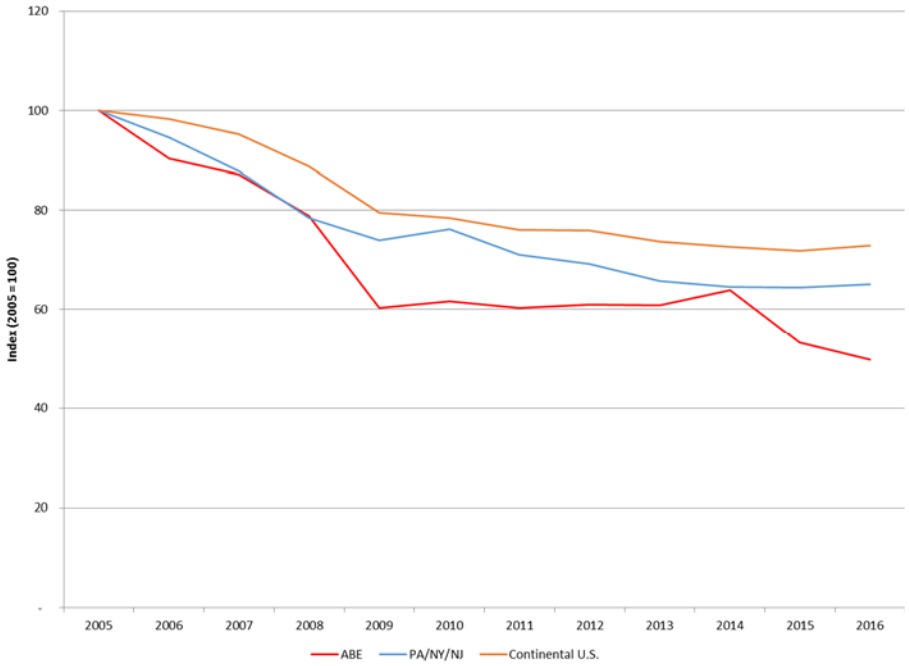
Source: Lehigh Northampton Airport Authority, FAA 2015 TAF and Energy Information Administration.

Regression analysis was applied in order to correlate both local and itinerant operations to various economic measures and fuel prices. While there was some minor correlation between local operations and household income and itinerant operations and fuel prices, the results were not usable for predicting future growth based on low correlation values and illogical coefficient estimates.

The growth patterns for GA operations at LVIA were compared to patterns for the three states of Pennsylvania, New York and New Jersey as well as those for the continental U.S.[39] As shown below, the national trend of decline in local operations has been relatively steady from 2005 to 2016 with the regional pattern following the same general trend but at higher level of decline. The LVIA levels of local operations closely tracked the regional pattern from 2005 to 2008 before experiencing a significant decline in 2009, relative stability through 2014, and a drop through 2016 that was not matched at the national or regional level.

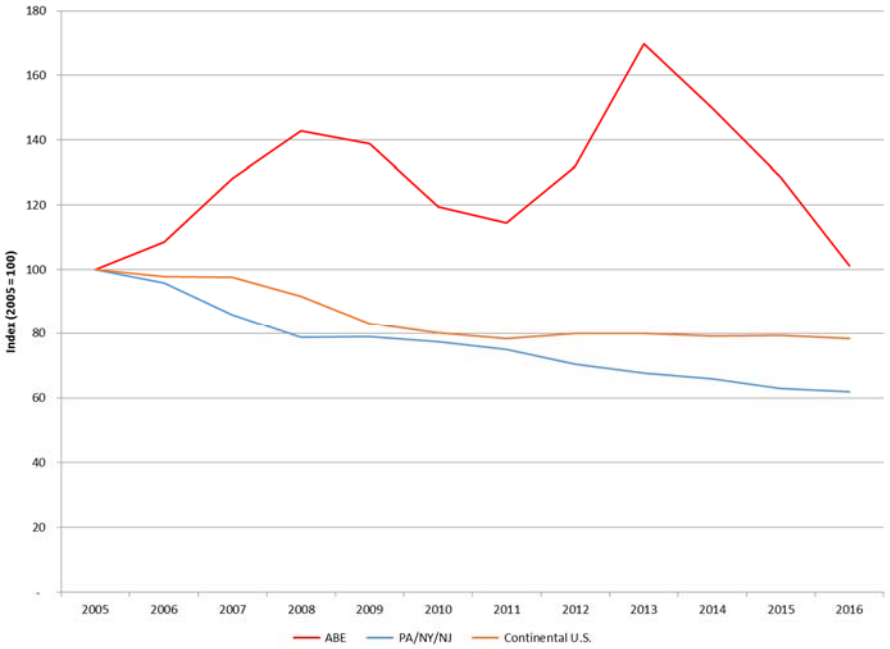
[39] Operations for Alaska and Hawaii were excluded based on the significantly different pattern of GA use for those states.

Figure 4.5.3: Local GA Operations LVIA vs. 3-State Region and U.S.



Source: FAA OPSNET data.

Figure 4.5.4: Itinerant GA Operations LVIA vs. 3-State Region and U.S.



Source: FAA OPSNET data.

The growth pattern for itinerant operations at LVIA was also not consistent with either national or regional trends. Operations in 2005 increased significantly through 2008 before declining through 2011, spiking in 2013 and returning to the about the same level by 2015. The national trend was a decline from 2007 to 2011 and stability through 2016. The regional pattern saw decline from 2005 to 2008 (while LVIA's operations were increasing), relative stability through 2011 and slow decline through 2016.

As with the based aircraft forecast, the forecast of GA operations uses the national growth rates for flown hours by aircraft type in the FAA[40] forecast. It is assumed that 2017 levels will equal 2016 operations and the distribution by aircraft type was developed from the Final Part 150 Update[41]. The average of the two growth rates was applied post-2017 and the resulting forecasts are shown in **Table 4.5.3**. The average annual growth of 1.8% for all operations compares to 1.2% per year growth in flown hours for the U.S. GA fleet (in the national FAA forecasts) and 0.9% growth in the FAA TAF operations for LVIA.

Table 4.5.3: LVIA GA Operations

Fiscal Year	ABE Operations				
	Piston	Turboprop	Jet	Rotorcraft	Total
2016	20,274	9,061	31,175	295	60,805
2017	20,274	9,061	31,175	295	60,805
2022	19,747	9,791	36,307	334	66,179
2027	19,233	10,579	42,285	378	72,475
2032	18,733	11,431	49,247	427	79,838
2037	18,245	12,352	57,355	483	88,436
2040	17,959	12,940	62,847	520	94,266
Average Annual Growth					
FAA (2015-36)	-0.5%	1.6%	3.1%	2.5%	1.8%

Source: Campbell-Hill Analysis.

The distribution of GA operations by aircraft type and corresponding time split was developed from the latest Part 150 Study showing daytime (0700-2200) and nighttime operations (2200-0700) for 2015. The distribution by aircraft type was: jets (51%), turboprop (15%), piston prop (33%), and helo (0.5%). The daytime shares of operations by type were: jets (90%), turboprop (92%), piston prop (97%) and helo (91%).

The same distribution by aircraft type was applied to the 2016 traffic levels to derive the fleet mix shown in **Table 4.5.4**.

[40] FAA, FAA Aerospace Forecast, Fiscal Years 2016-2036

[41] Wyle Laboratories, Inc., Lehigh Valley International Airport Part 150 Update – 2015/2020 Noise Exposure Maps (October 2016)

Table 4.5.4: LVIA GA Operations by Aircraft Type (2016)

	GA Operations		
	Day	Night	Total
Jet	27,932	3,243	31,175
Turboprop	8,358	703	9,061
Piston Prop	19,567	707	20,274
Helo	269	26	295
	56,126	4,679	60,805

Source: Campbell-Hill Analysis Final Part 150 Update for LVIA – NEMs.

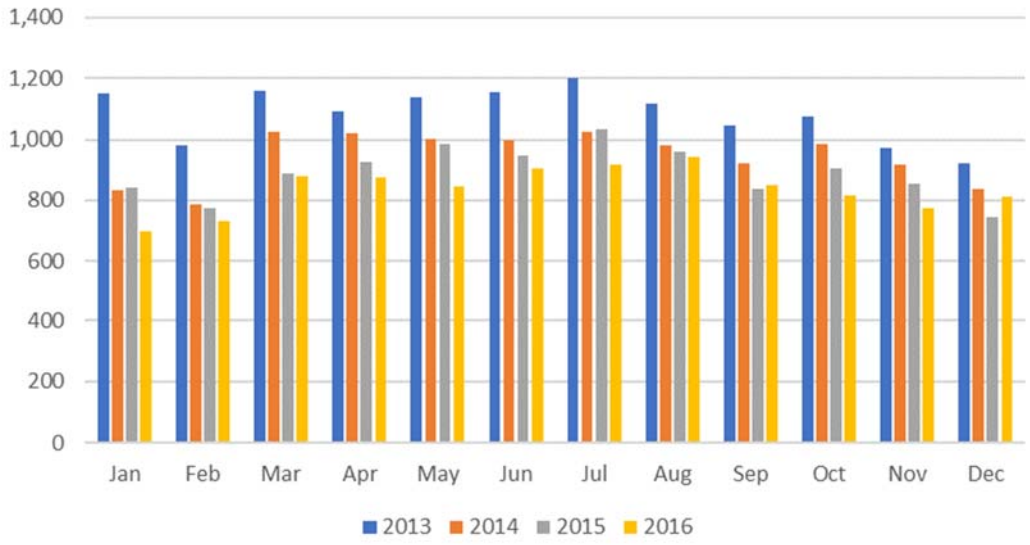
4.6 Peak Activity Forecast

Since many of the Airport's facility needs are related to the levels of activity during peak periods, forecasts were developed for peak month, day and hour operations.

Commercial Peak Activity

As shown in **Figure 4.6.1**, over the last four years, peak month activity occurs during the month of July. Operations exceed 10% of the average calendar month, and over the last four years have exceeded the average calendar month by 11.1%. For the purpose of the forecast, peak month commercial operation activity is defined as 10 percent busier than the average month.

Figure 4.6.1: Peak Month Commercial Operations



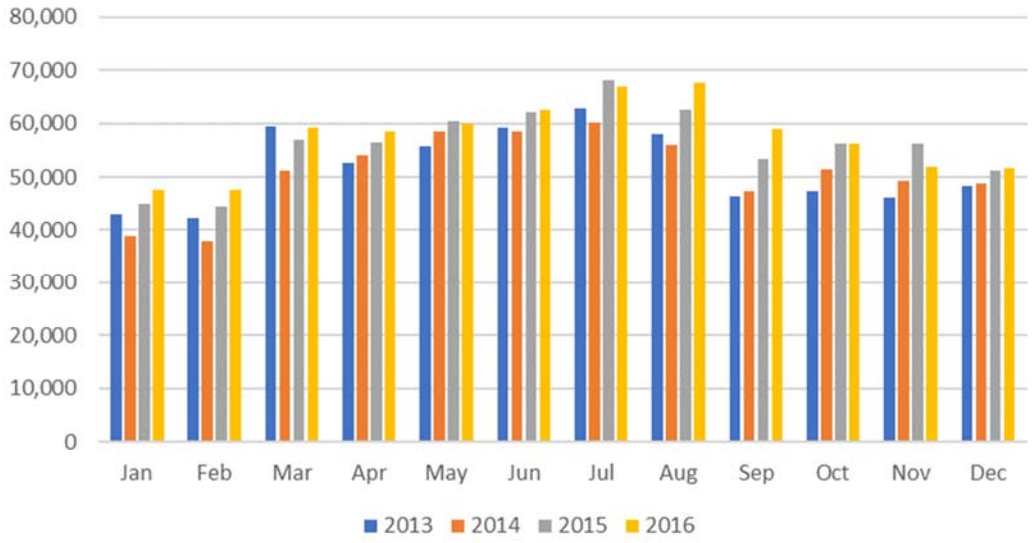
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Distribution by Month	7.8%	7.3%	8.8%	8.7%	8.8%	8.9%	9.3%	8.9%	8.1%	8.4%	7.8%	7.4%
Percent Busier than Average	-6.1%	-12.9%	5.1%	4.1%	5.7%	6.7%	11.1%	6.5%	-2.8%	0.7%	-6.3%	-11.8%

Source: U.S. DOT T-100 Report, Innovata Schedule for Nov/Dec 2016.

The peak commercial passenger month over the last four years has been consistent with peak operations in July. **Figure 4.6.2** on the following page shows July passengers are 19.3% higher than the average month. For the purpose of the forecast, peak month commercial passengers will be defined as 19% busier than the

average month.

Figure 4.6.2: Peak Month Commercial Passengers

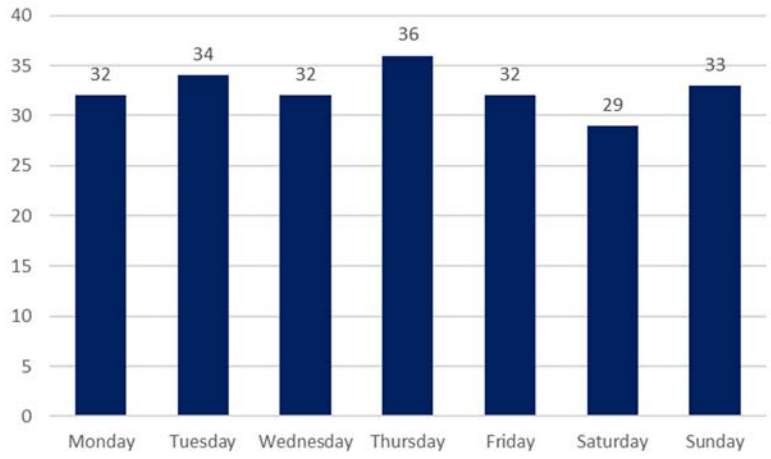


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Distribution by Month	6.7%	6.6%	8.7%	8.5%	9.0%	9.3%	9.9%	9.4%	7.9%	8.1%	7.9%	7.7%
Percent Busier than Average	-19.3%	-20.4%	4.8%	2.6%	8.4%	12.0%	19.3%	12.8%	-4.6%	-2.3%	-5.8%	-7.5%

Source: Airport reports.

Based on a schedule for a typical (non-holiday) week in July 2017[42], the peak day for operations is a Thursday as shown in **Figure 4.6.3**. Thursday has 36 commercial operations, 10.5% higher than the average day, which has 32.6 commercial operations. For the purpose of the forecast, peak day commercial operation activity will be defined as 10% busier than the average day.

Figure 4.6.3: Peak Day Commercial Operations for July

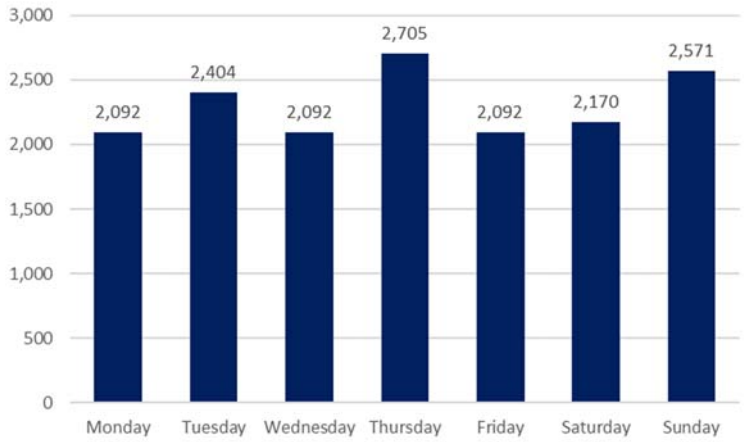


Source: Innovata Schedule for July 2017.

[42] Typical week is July 10-July 16, 2017.

Applying July 2016 load factors by airline and route and conservatively assuming an 80% load factor for the new Allegiant Air Fort Lauderdale route indicates that Thursday is also the peak day for commercial passengers. Thursday has over 2,700 passengers, 17.4% higher than the average day, which has 2,300 passengers. For the purpose of the forecast, peak day commercial passenger activity will be defined as 17% busier than the average day.

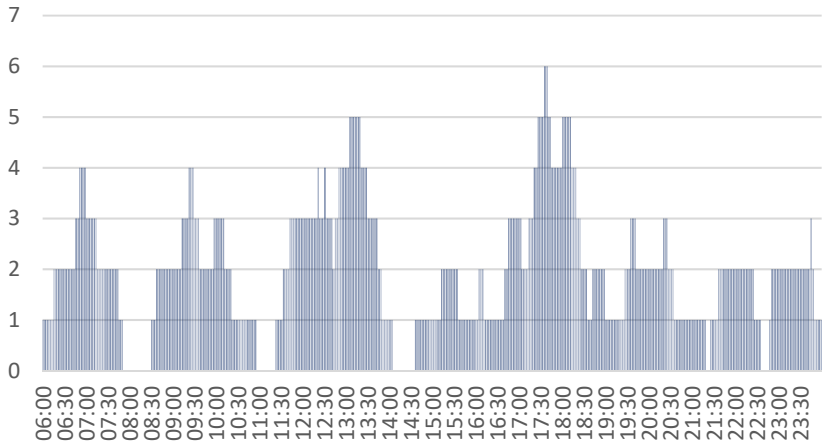
Figure 4.6.4: Peak Day Passengers for July



Source: Innovata Schedule for July 2017, T-100 Report for July 2016.

Based on a schedule for a typical Thursday in July (July 13, 2017), on a 60-minute rolling basis the peak hour for operations is between 5:35pm and 5:45pm, with 6 operations as shown in **Figure 4.6.5**.

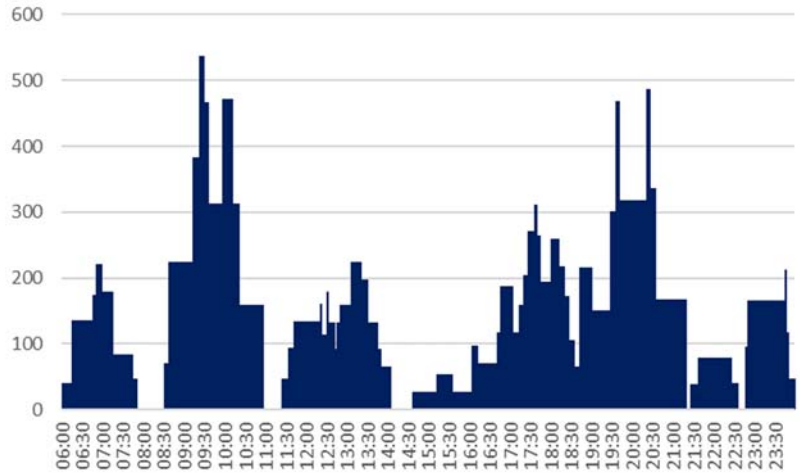
Figure 4.6.5: Peak Hour Commercial Operations on a Thursday



Source: Innovata Schedule for July 13, 2017.

Peak passenger demand differs from the operation demand, driven by larger Allegiant Air flights in the morning (two arrivals and two departures). On a 60-minute rolling basis, the peak hour passenger demand period is between 9:20am and 9:30am. There is also a slightly lower peak in the evening, also when Allegiant Air has two arrivals and two departures.

Figure 4.6.6: Peak Hour Passengers on a Thursday



Source: Innovata Schedule for July 2017, T-100 Report for July 2016.

Table 4.6.1 below presents the forecast of peaking characteristics for commercial operations and passengers at LVIA.

Table 4.6.1: Peak Forecast of Commercial Operations and Passengers

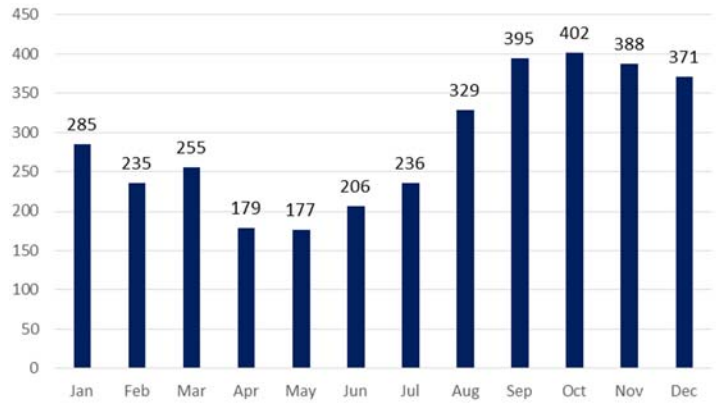
Year	Annual Operations	Peak Month Operations	Peak Day Operations	Average Day Operations	Peak Hour Operations	Average Hour Operations
2017	10,547	967	36	33	6	2
2022	11,447	1,049	39	35	7	2
2027	11,942	1,095	41	37	7	2
2032	12,488	1,145	43	39	7	2
2037	13,305	1,220	45	41	8	2
2040	13,795	1,264	47	43	8	3
Year	Annual Passengers	Peak Month Passengers	Peak Day Passengers	Average Day Passengers	Peak Hour Passengers	Average Hour Passengers
2017	685,729	68,001	2,705	2,304	537	148
2022	764,357	75,799	3,015	2,568	599	165
2027	835,302	82,834	3,295	2,807	655	181
2032	911,113	90,352	3,594	3,061	714	197
2037	991,798	98,353	3,912	3,332	777	215
2040	1,041,599	103,292	4,109	3,500	816	225

Source: Campbell-Hill Analysis.

Cargo Peak Activity

As shown in **Figure 4.6.7**, peak month activity in 2016 occurred during October, which accounted for 11.6 percent of annual operations.[43]

Figure 4.6.7: Peak Month Cargo Operations



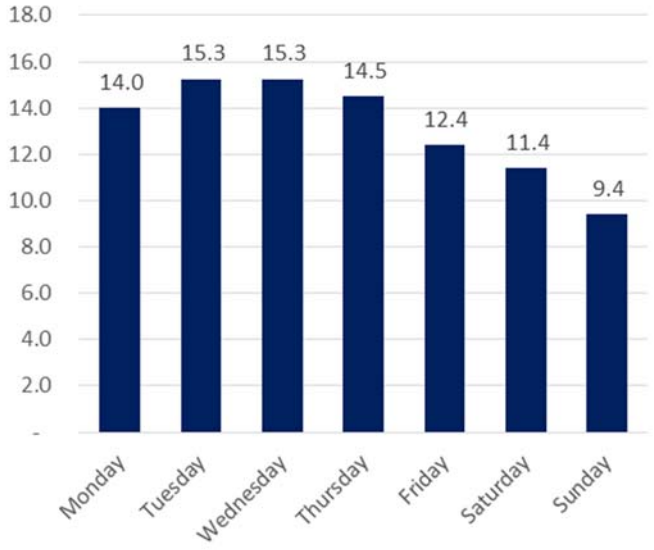
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Distribution by Month	8.2%	6.8%	7.4%	5.2%	5.1%	6.0%	6.8%	9.5%	11.4%	11.6%	11.2%	10.7%
Percent Busier than Average	-1.1%	-18.4%	-11.5%	-37.9%	-38.6%	-28.5%	-18.1%	14.2%	37.1%	39.5%	34.6%	28.7%

Source: Lehigh Northampton Airport Authority, flight data for 2016.

Based on flight operations for the peak month of October 2016, the peak days for operations as shown in **Figure 4.6.8** were Tuesday and Wednesday, which has 18% higher operations than the average day for that month. For the purpose of the forecast, peak day activity will be defined as 18% busier than the average daily operations.

[43] This analysis is limited to the latest 12 months based on the large impact of the Amazon operations started in September 2015.

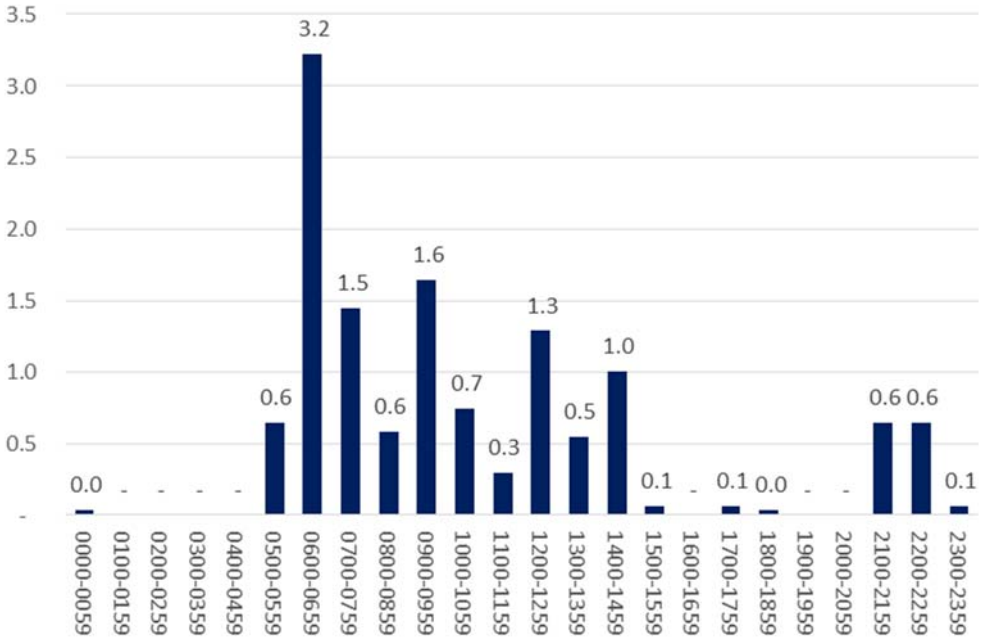
Figure 4.6.8: Peak Day All-Cargo Operations for September 2016



Source: Lehigh Northampton Airport Authority, flight data for September 2016.

Based on a schedule for the average day in the peak month of October 2016, peak hour operations are between 6:00am and 7:00am with an average of 3.2 operations (see **Figure 4.6.8**).

Figure 4.6.8: Peak Hour All-Cargo Operations for September 2016



Source: Lehigh Northampton Airport Authority, flight data.

Table 4.6.2 on the following page presents the forecast of peaking characteristics for all-cargo operations at LVIA.

Table 4.6.2: Peak Forecast of Cargo Operations

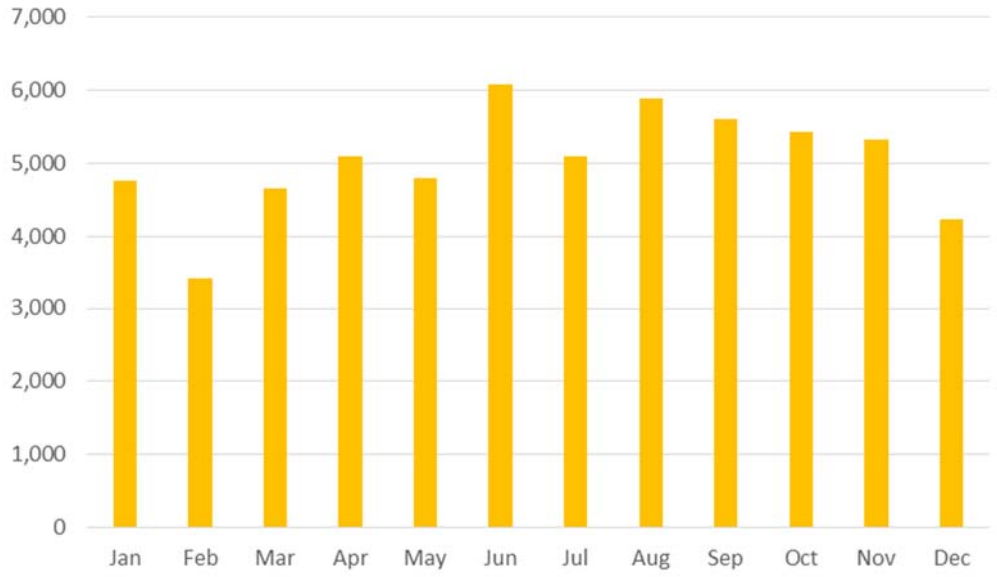
Fiscal Year	Annual Operations	Peak Month Operations	Peak Day Operations	Average Day Operations	Peak Hour Operations	Average Hour Operations
2016	3,403	396	15	13	4	1
2017	4,584	533	20	17	5	1
2022	6,093	708	27	23	7	1
2027	6,580	765	29	25	7	1
2032	7,085	824	31	27	8	1
2037	7,599	883	34	28	8	1
2040	7,912	920	35	30	9	1

Source: Campbell-Hill Analysis.

General Aviation Peak Activity

As shown in **Figure 4.6.9**, peak month activity in 2016 occurred during the month of June when GA operations accounted for 10% of the year's activity. June's average day activity level exceeded the annual average day operations by 23%.

Figure 4.6.9: Peak Month GA Operations

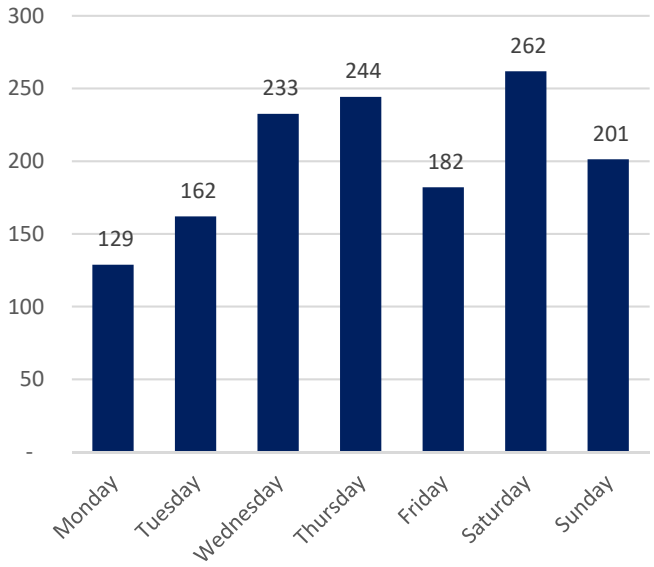


	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Distribution by Month	7.9%	5.7%	7.7%	8.4%	8.0%	10.1%	8.4%	9.8%	9.3%	9.0%	8.8%	7.0%
Percent Busier than Average	-7.1%	-28.4%	-8.8%	2.9%	-6.0%	22.7%	-0.5%	15.2%	13.4%	6.2%	7.7%	-17.2%

Source: FAA OPSNET data.

Based on the peak month of June 2016, the peak day for operations as shown in **Figure 4.6.10** is Saturday which had 30% more operations than the average day for that month. For the purpose of the forecast, peak day activity will be defined as 30% busier than the average day.

Figure 4.6.10: Peak Day GA Operations for June 2016



Source: FAA OPSNET data.

Table 4.6.3 below presents the forecast of peaking characteristics for GA operations at LVIA. Time-of-day data is not available from the FAA but the Part 150 study showed a 92/8 split between daytime (0700-2200) and nighttime (2200-0700) operations.

Table 4.6.3: Peak GA Operations Forecast

Fiscal Year	Annual Operations	Peak Month Operations	Peak Day Operations	Average Day Operations
2016	60,805	6,116	264	204
2017	60,805	6,116	264	204
2022	66,179	6,657	288	222
2027	72,475	7,290	315	243
2032	79,838	8,030	347	268
2037	88,436	8,895	385	297
2040	94,266	9,482	410	316

Source: Campbell-Hill Analysis.

4.7 Forecast Summary

Table 4.7.1 below presents a summary of the preferred aviation activity forecasts for commercial air carrier operations and enplanements, air cargo carrier operations and traffic, and GA based aircraft and operations as detailed in the previous sections. These forecasts serve as the basis for establishing facility requirements for the analyses necessary for Master Planning.

Table 4.7.1: Recommended Forecast

	Commercial Forecast		Cargo Forecast		GA and Local		Total
Year	Enplanements	Operations	Traffic (MT)	Operations	Aircraft	Operations	Operations
2017	342,864	10,547	83,240	4,584	116	60,805	75,936
2018	351,109	10,914	96,858	5,201	116	61,844	77,958
2019	359,204	11,063	110,512	5,818	117	62,900	79,781
2020	367,108	11,202	112,484	5,908	117	63,974	81,084
2021	374,950	11,335	114,511	5,999	118	65,067	82,402
2022	382,179	11,447	116,585	6,093	119	66,179	83,719
2023	389,213	11,550	118,695	6,188	119	67,393	85,131
2024	395,995	11,643	120,838	6,285	120	68,629	86,557
2025	402,902	11,736	123,011	6,383	121	69,888	88,007
2026	410,266	11,841	125,183	6,481	122	71,170	89,491
2027	417,651	11,942	127,378	6,580	122	72,475	90,997
2028	425,059	12,042	129,594	6,679	123	73,891	92,613
2029	432,660	12,144	131,830	6,780	124	75,335	94,259
2030	440,259	12,243	134,083	6,881	125	76,807	95,931
2031	447,888	12,340	136,350	6,983	126	78,308	97,631
2032	455,556	12,488	138,628	7,085	127	79,838	99,410
2033	463,275	12,645	140,913	7,187	128	81,488	101,320
2034	471,218	12,807	143,207	7,290	129	83,172	103,268
2035	479,442	12,974	145,508	7,392	130	84,891	105,258
2036	487,726	13,142	147,818	7,496	131	86,645	107,283
2037	495,899	13,305	150,136	7,599	132	88,436	109,340
2038	504,142	13,468	152,463	7,703	134	90,338	111,509
2039	512,453	13,632	154,797	7,807	135	92,281	113,720
2040	520,800	13,795	157,141	7,912	136	94,266	115,973

Source: Campbell-Hill Analysis.

Table 4.7.2 compares the preferred air carrier enplanements and total operations forecasts of all activity types to the FAA TAF forecast. At the end of the planning period, the preferred forecast predicts a level of enplanements 10.2 percent above the TAF and total Airport operations 10.5 percent above the TAF.

Table 4.7.2: Recommended Forecast

	Enplanements			Operations		
Year	ABE TAF	Preferred Forecast	Preferred Forecast versus TAF	ABE TAF	Preferred Forecast	Preferred Forecast versus TAF
2017	326,148	342,864	5.1%	78,614	75,936	-3.4%
2018	333,153	351,109	5.4%	80,040	77,958	-2.6%
2019	339,494	359,204	5.8%	81,507	79,781	-2.1%
2020	345,573	367,108	6.2%	82,958	81,084	-2.3%
2021	351,610	374,950	6.6%	84,376	82,402	-2.3%
2022	357,438	382,179	6.9%	85,633	83,719	-2.2%
2023	363,071	389,213	7.2%	86,652	85,131	-1.8%
2024	368,610	395,995	7.4%	87,608	86,557	-1.2%
2025	374,295	402,902	7.6%	88,576	88,007	-0.6%
2026	380,396	410,266	7.9%	89,572	89,491	-0.1%
2027	386,623	417,651	8.0%	90,582	90,997	0.5%
2028	392,757	425,059	8.2%	91,600	92,613	1.1%
2029	399,134	432,660	8.4%	92,639	94,259	1.7%
2030	405,436	440,259	8.6%	93,685	95,931	2.4%
2031	411,741	447,888	8.8%	94,742	97,631	3.0%
2032	418,094	455,556	9.0%	95,811	99,410	3.8%
2033	424,507	463,275	9.1%	96,896	101,320	4.6%
2034	431,108	471,218	9.3%	98,000	103,268	5.4%
2035	437,973	479,442	9.5%	99,127	105,258	6.2%
2036	444,869	487,726	9.6%	100,266	107,283	7.0%
2037	451,582	495,899	9.8%	101,411	109,340	7.8%
2038	458,421	504,142	10.0%	102,573	111,509	8.7%
2039	465,421	512,453	10.1%	103,754	113,720	9.6%
2040	472,463	520,800	10.2%	104,948	115,973	10.5%

Source: Campbell-Hill Analysis.

Table 4.7.3 details operations for the Airport by aircraft type for select years.

Table 4.7.3: Forecast Operations by Aircraft Type

Aircraft Type	2017	2022	2027	2032	2037	2040
Commercial						
CRJ-700	1,028	765	2,650	6,482	6,906	7,160
CRJ-900	2,418	3,757	3,920	4,099	4,367	4,528
A320	671	1,748	1,824	1,907	2,032	2,106
CRJ-200	1,006	1,751	1,827	-	-	-
ERJ-135	1,564	1,651	1,722	-	-	-
CRJ	1,668	1,775	-	-	-	-
DHC-8	936	-	-	-	-	-
MD-80	922	-	-	-	-	-
B717	300	-	-	-	-	-
ERJ-145	34	-	-	-	-	-
Commercial Tot	10,547	11,447	11,942	12,488	13,305	13,795
Cargo						
Wide-body	3,807	5,538	6,001	6,485	6,978	7,278
Narrow-body	260	17	18	18	18	18
Turbo-Prop	517	538	561	582	604	616
Cargo Total	4,584	6,093	6,580	7,085	7,599	7,912
GA						
Jet	31,175	36,307	42,285	49,247	57,355	62,847
Turbo-Prop	9,061	9,791	10,579	11,431	12,352	12,940
Piston-Prop	20,274	19,747	19,233	18,733	18,245	17,959
Helo	295	334	378	427	483	520
GA Total	60,805	66,179	72,475	79,838	88,436	94,266
Total	75,936	83,719	90,997	99,411	109,340	115,973

Source: Campbell-Hill Analysis.

Based on the recommended forecasts, the Airport Reference Code (ARC), now referred to by the FAA as the Runway Design Code (RDC), of D-IV is expected to stay the same, while the design aircraft will change from a DC-8F-63 to a B767-300ER. A new design group for taxiways has been established by the FAA since the last master plan and the Taxiway Design Group (TDG) will be a 5. These codes will be further described and incorporated into the facility requirements phase of the Master Plan.