memorandum

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Project: Charlotte Douglas International Airport (CLT) Part 150 Study Update
Subject: Forecast Verification
From: Landrum & Brown, Inc.
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This CLT Part 150 Study Update used aircraft activity levels for the forecast year of 2028 based on the approved *Forecast Technical Memorandum, Technical Memorandum – Final* prepared for CLT.[1] Based on AC 150/5070, *Airport Master Plans*, a forecast is considered to be consistent with the Federal Aviation Administration's (FAA) Terminal Area Forecast if the Airport's forecast and the FAA's TAF differ by less than 10 percent in the 5-year forecast. The FAA TAF issued January 2024 projected a total of 594,664 operations for CLT in 2028 and the CLT forecast projected a total of 639,783 operations for 2028. The difference in operations is 45,119, or 7.6 percent (less than 10 percent). As such, the CLT forecast is consistent with the FAA's TAF.

[1] Forecast Technical Memorandum, Technical Memorandum – Final, Charlotte Douglas International Airport Environmental Impact Statement, VHB in association with InterVISTAS, April 18, 2018.

Forecast Technical Memorandum

Charlotte Douglas International Airport Environmental Impact Statement

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1

Introduction

In accordance with FAA Order 1050.1F "Environmental Impacts: Policies and Procedures, an EIS requires a Purpose and Need section. In order to demonstrate part of the need for capacity-related components of the Project, a passenger and operations forecast ("EIS forecast") has been completed for Charlotte Douglas International Airport ("the Airport" or "CLT"). This technical memorandum covers analysis of the historical traffic at CLT as well as the methodology and results of the long-term traffic forecast. This long-term annual forecast was used as the basis of derivative forecasts (busy day, peak hour, design day schedules), which served as inputs into the simulation modeling. Summary forecast results are shown below in **Table 1-1**. The most recent calendar year of data available as of the writing of this memorandum is 2016; therefore, 2016 was selected as the base year for this EIS.

In addition to showing the results of the EIS forecast, this memorandum also compares the EIS forecast to the Federal Aviation Administration's (FAA) 2016 Terminal Area Forecast (TAF) and the forecast completed by the Charlotte Aviation Department (the Department) in 2014 for the CLT Master Plan (known as the Airport Capacity Enhancement Plan or ACEP).[1] The service and outlook for CLT is now updated to reflect changing conditions since completion of the ACEP.

1 The ACEP was released in February 2016; however, the latest full year of data shown in the report and used in the forecast is 2013.

Table 1-1 Summary of Charlotte Douglas International Airport Forecast

	Forecast				Compound Annual Growth Rates		
	Base Year 2016	Base Year+1 2017	Build Year 2028	Build Year +5 2033	Base Year+1 2017	Build Year 2028	Build Year +5 2033
Passenger Enplanements							
Air Carrier	15,640,736	15,850,803	19,824,450	21,720,151	1.3%	2.0%	2.0%
Commuter	6,533,011	6,895,699	8,068,898	8,578,173	5.6%	1.8%	1.6%
Total	**22,173,747**	**22,746,502**	**27,893,348**	**30,298,324**	**2.6%**	**1.9%**	**1.9%**
Aircraft Operations							
Air Carrier	400,819	409,357	482,269	513,764	2.1%	1.6%	1.5%
Air Taxi	117,378	118,994	129,351	133,460	1.4%	0.8%	0.8%
Subtotal	*518,197*	*528,351*	*611,620*	*647,224*	*2.0%*	*1.4%*	*1.3%*
General Aviation	24,869	24,935	25,487	25,742	0.3%	0.2%	0.2%
Military	2,676	2,676	2,676	2,676	0.0%	0.0%	0.0%
Total Operations	**545,742**	**555,962**	**639,783**	**675,643**	**1.9%**	**1.3%**	**1.3%**
Peak Hour Operations	114	116	134	146	1.8%	1.4%	1.5%
Cargo/Mail							
Enplaned and Deplaned Tons	154,477	169,152	235,242	261,000	9.5%	3.6%	3.1%
Operational Factors							
Average Aircraft Size (seats)							
Air Carrier	144	144	148	150	0.0%	0.2%	0.2%
Air Taxi	59	59	62	63	0.0%	0.4%	0.4%
Average Enplaning Load Factor							
Air Carrier	83.6%	83.7%	84.3%	84.6%			
Air Taxi	80.2%	80.3%	81.4%	81.4%			

Source: FAA Operations Network (OPSNET); InterVISTAS analysis for forecast.

Note: This summary table shows is based on a Build Year of 2028. A similar version of this table reflecting Base Year + 5, 10 and 15 years is shown in the Appendix.

Note: The forecast does not reallocate air taxi operations to air carrier as the seating capacity increases; therefore, the average aircraft size (seats) for air taxi goes above 60 seats.

2

Historical Traffic Analysis

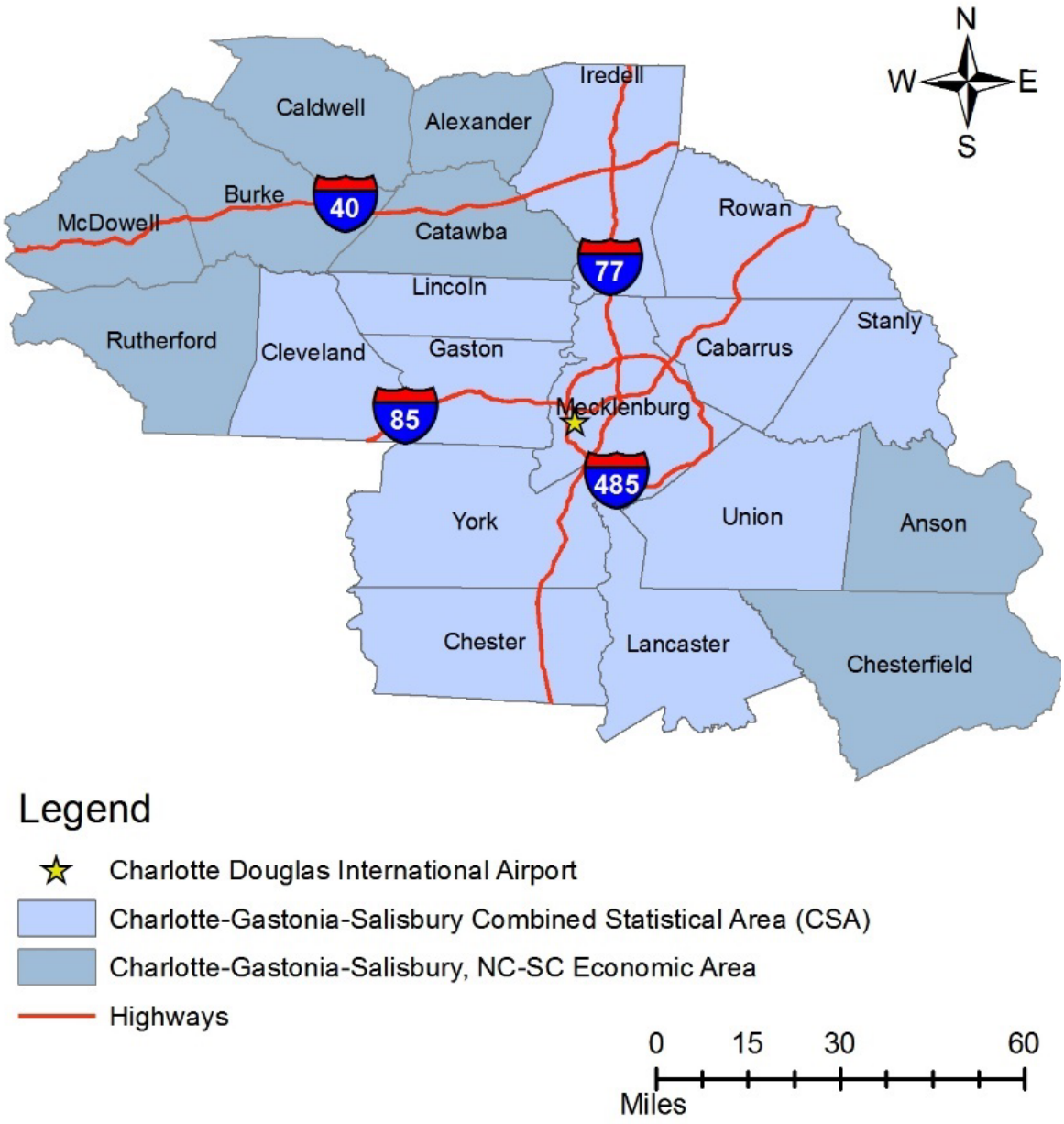
This chapter presents background information on the Charlotte Douglas International Airport ("the Airport" or "CLT"), the economics of the surrounding catchment area, historical traffic growth, the relationship between local economics and airport traffic, as well as the Airport's role as a hub in the network of the dominant air carrier American Airlines.

2.1 Catchment Area

The Airport serves the 20-county Charlotte-Gastonia-Salisbury economic area, which includes portions of both North Carolina and South Carolina (**Figure 2-1**).[2] Included in this economic area is the Charlotte-Concord Combined Statistical Area (CSA), which in turn covers the 10-county Charlotte-Concord-Gastonia Metropolitan Statistical Area (MSA) and two micropolitan areas (Albemarle and Shelby). The largest county, Mecklenburg County in North Carolina, includes the City of Charlotte and the Airport itself.

2 City of Charlotte, Official Statement, Bond Series 2017 A-C, May 19, 2017.

Figure 2-1 CLT Catchment Area



Source: County data from U.S. Census Bureau

Within the United States, Charlotte was the 17th largest city and the 21st largest CSA (**Table 2-1**) in 2016.

Table 2-1 Top 20 U.S. Cities Ranked by Population, CY 2016

Rank	City	State	Population
1	New York City	New York	8,537,673
2	Los Angeles	California	3,976,322
3	Chicago	Illinois	2,704,958
4	Houston	Texas	2,303,482
5	Phoenix	Arizona	1,615,017
6	Philadelphia	Pennsylvania	1,567,872
7	San Antonio	Texas	1,492,510
8	San Diego	California	1,406,630
9	Dallas	Texas	1,317,929
10	San Jose	California	1,025,350
11	Austin	Texas	947,890
12	Jacksonville	Florida	880,619
13	San Francisco	California	870,887
14	Columbus	Ohio	860,090
15	Indianapolis	Indiana	855,164
16	Fort Worth	Texas	854,113
17	**Charlotte**	**North Carolina**	**842,051**
18	Seattle	Washington	704,352
19	Denver	Colorado	693,060
20	El Paso	Texas	683,080

Source: United States Census Bureau, 2017.

While the Airport's entire catchment area represents approximately a two-hour drive time, the core of the Airport's catchment is the Charlotte-Concord CSA with a population of 2.6 million (**Table 2-2**).

Table 2-2 Population Comparison, CY 2016

Area	Counties	Population
City of Charlotte	n/a	842,051
Charlotte-Concord-Gastonia MSA	10	2,474,314
Charlotte-Concord CSA	**12**	**2,632,249**
Charlotte-Gastonia-Salisbury	20	3,179,393

Source: United States Census Bureau, 2017.

Historically, the population of the Charlotte-Concord CSA has grown at a rate higher than that of the United States (**Table 2-3)**. In addition, the CSA population is estimated to grow at an average annual rate of almost double that of the United States through 2050.

Table 2-3 Select Historical and Forecast Populations (in thousands)

Year	United States	10-Yr CAGR	North Carolina	10-Yr CAGR	South Carolina	10-Yr CAGR	Charlotte-Concord CSA	10-Yr CAGR
Historical								
2000	282,162		8,082		4,024		1,883	
2010	309,347	0.9%	9,559	1.7%	4,636	1.4%	2,382	2.4%
2016	324,161		10,169		4,951		2,626	
Forecast								
2020	336,383	0.8%	10,723	1.2%	5,192	1.1%	2,807	1.7%
2030	368,644	0.9%	12,215	1.3%	5,836	1.2%	3,3007	1.7%
2040	399,419	0.8%	13,732	1.2%	6,475	1.0%	3,839	1.5%
2050	428,119	0.7%	15,246	1.1%	7,096	0.9%	4,393	1.4%
CAGRs								
2000-2016	0.9%		1.4%		1.3%		2.1%	
2016-2020	0.9%		1.3%		1.2%		1.7%	
2016-2050	0.8%		1.2%		1.1%		1.5%	

Source: Complete Economic and Demographic Data Source (CEDDS), Woods & Poole Economics, Inc., 2017.
CAGR - Compound Annual Growth Rate

Real per capita income in the Charlotte-Concord CSA is expected to grow at 1.1 percent annually over the period of 2016-2050 (**Table 2-4**). Comparatively, the United States anticipates similar annual real growth in per capital income over the same period (1.2 percent).

Table 2-4 Select Historical and Projected Per Capita Income (in 2009 USD)

Year	United States	10-Yr CAGR	North Carolina	10-Yr CAGR	South Carolina	10-Yr CAGR	Charlotte-Concord CSA	10-Yr CAGR
Historical								
1990	29,082		25,370		23,376		26,531	
2000	36,833	2.4%	32,719	2.6%	29,840	2.5%	34,205	2.6%
2010	39,622	0.7%	34,757	0.6%	31,638	0.6%	36,846	0.7%
2016	44,637		37,884		35,477		41,295	
Forecast								
2020	47,378	1.8%	40,272	1.5%	37,757	1.8%	43,677	1.7%
2030	54,339	1.4%	46,262	1.4%	43,450	1.4%	49,564	1.3%
2040	60,336	1.1%	51,212	1.0%	48,040	1.0%	54,367	0.9%
2050	66,890	1.0%	56,621	1.0%	53,055	1.0%	59,481	0.9%
CAGRs								
2000-2016	1.2%		0.9%		1.1%		1.2%	
2016-2020	1.5%		1.5%		1.6%		1.4%	
2016-2050	1.2%		1.2%		1.2%		1.1%	

Source: Complete Economic and Demographic Data Source (CEDDS), Woods & Poole Economics, Inc., 2017.

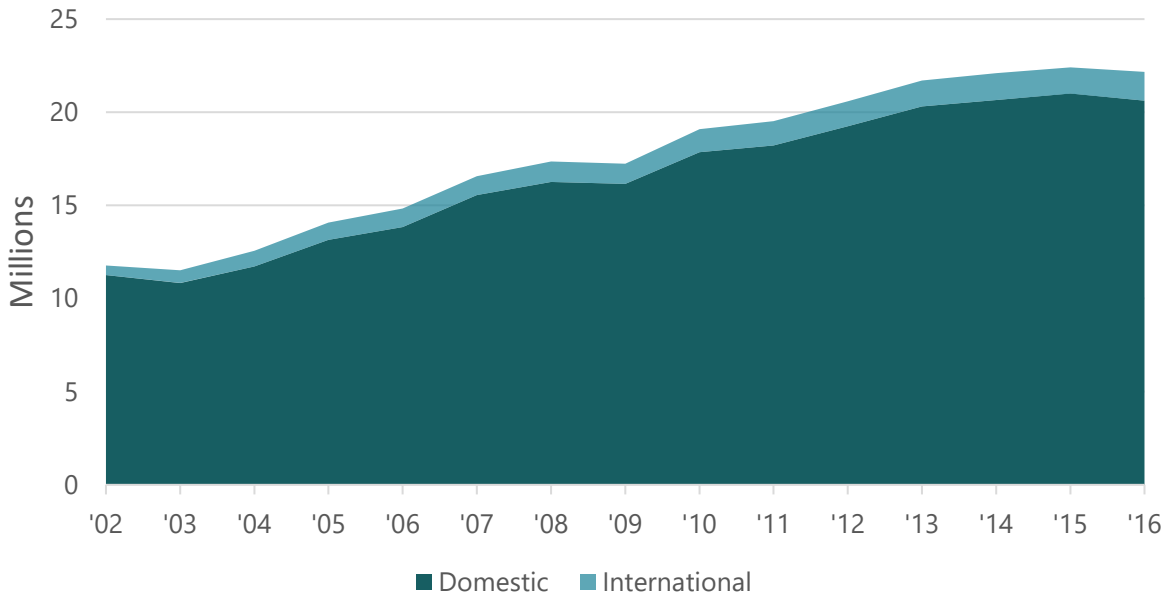
2.2 Background and Historical Passenger Traffic

One of the most important inputs into a traffic forecast is the historical traffic. This section shows historical data for enplaned passengers (including both Origin and Destination (O&D) passengers and connecting passengers) as well as discusses CLT's role as a hub for American Airlines.

2.2.1 Enplaned Passengers

Since 2002, the Airport has grown 4.6 percent annually on average in terms of enplaned passengers, reaching 22.2 million in 2016. During this period, average international growth (8.1 percent) almost doubled that of domestic growth (4.4 percent). As shown in **Figure 2-2** below, enplanements only dipped by 0.6 percent in 2009 following the 2008-2009 economic crisis – compared to a 7.2 percent drop in the United States as a whole.[3] Traffic rebounded in 2010 with a rate of 10.7 percent. In 2016, traffic declined by 1.1 percent, driven by a decrease in domestic connecting passengers (O&D passengers increased). However, in the first half of 2017, enplaned passenger traffic was three percent higher than the first six months of 2016; international enplaned passengers are 20 percent higher than the same period in 2016.

Figure 2-2 Historical Enplaned Passengers at CLT, 2002-2016



Source: CLT Monthly Activity Reports

3 FAA Aerospace Forecast, FY 2011-2031

Since 2002, domestic traffic has increased by an average of 4.4 percent annually and international traffic has increased by an average of 8.1 percent annually (**Table 2-5**).

Table 2-5 Compound Annual Growth Rates for Historical Enplaned Passengers at CLT

CAGRs	2002-06	2006-11	2011-16	2002-16
Domestic	5.3%	5.6%	2.5%	4.4%
International	17.7%	5.7%	3.5%	8.1%
Total	**5.9%**	**5.6%**	**2.6%**	**4.6%**

Source: CLT Monthly Activity Reports
CAGR - Compound Annual Growth Rate

Among the 30 large hub airports in the United States, CLT accounts for the 10th most enplaned passengers (see **Table 2-6** below).

Table 2-6 Enplaned Passengers at Top 30 U.S. Airports, CY 2016

Rank	Airport	Enplaned Passengers (millions)
1	Atlanta Hartsfield – Jackson International	50.5
2	Los Angeles International	39.6
3	Chicago O'Hare International	37.6
4	Dallas-Fort Worth International	31.3
5	NYC John F. Kennedy International	29.2
6	Denver International	28.3
7	San Francisco International	25.7
8	Las Vegas McCarran International	22.8
9	Seattle-Tacoma International	21.9
10	**Charlotte/Douglas International**	**21.5**
11	Phoenix Sky Harbor International	20.9
12	Miami International	20.9
13	Orlando International	20.3
14	Houston George Bush Intercontinental	20.1
15	Newark Liberty International	19.9
16	Minneapolis-St Paul International	18.1
17	Boston Logan International	17.8
18	Detroit Metropolitan Wayne County	16.8
19	NYC LaGuardia	14.8
20	Philadelphia International	14.6
21	Fort Lauderdale/Hollywood International	14.3
22	Baltimore/Washington International Thurgood Marshall	12.3
23	Ronald Reagan Washington National	11.5
24	Salt Lake City International	11.1
25	Chicago Midway International	11.0
26	Washington Dulles International	10.6
27	San Diego International	10.3
28	Honolulu Daniel K Inouye International	9.7
29	Tampa International	9.2
30	Portland International	9.1

Source: FAA, Enplanements at All Commercial Service Airports (by Rank), October 10, 2017.

The ACEP was released in February 2016; however, the latest full year of data shown in the report is from 2013. In 2013, CLT accounted for the 8th most enplaned passengers in the U.S. airport;[4] it has since been surpassed in the rankings by Las Vegas McCarran International Airport and Seattle-Tacoma International Airport.

4 ACI, 2012 World Annual Traffic Report as shown in the ACEP

2.2.2 Current Service and Role as Hub

Passenger traffic at CLT comprises of O&D traffic (travel to and from Charlotte) and connecting traffic (passengers making connections at CLT) as illustrated below. As can be seen in **Table 2-7**, connecting traffic comprises 71 percent of passenger movements and consists mostly of domestic connections.

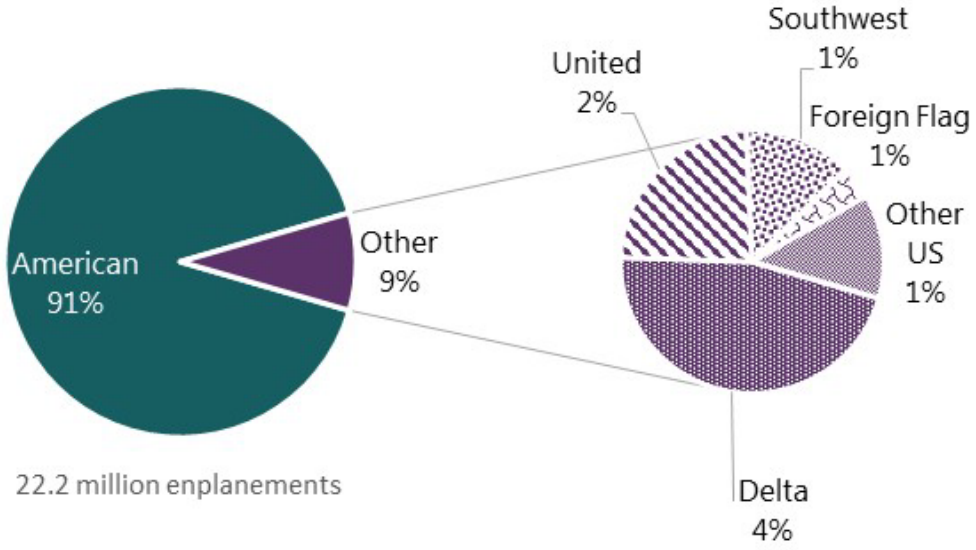
Table 2-7 Charlotte Passenger Traffic CY 2016

Traffic Type	Share
Domestic O&D	25.6%
International O&D	3.2%
Domestic Connecting	67.5%
International Connecting	3.7%
Total	**100.0%**

Source: U.S. DOT O&D and T100 data, via Flight Global's Diio Mi database.

The high rate of connections at CLT reflects its role as a hub for American Airlines which accounted for 91 percent of seat capacity and passengers in CY 2016 (**Figure 2-3**).[5] Of the remaining nine percent of passengers, Delta Air Lines serves the largest share at four percent, followed by United Airlines at two percent.

Figure 2-3 Airline Share of CLT Enplanements, CY 2016



Source: U.S. DOT T100 via Airline Data, Inc.; CLT Monthly Traffic Reports.

Before the merger of American Airlines and US Airways in 2013,[6] Charlotte was the largest of US Airways' four hubs. Now, Charlotte is American Airlines' second largest hub after Dallas/Fort Worth, as illustrated in (**Table 2-8**) below. After carriers merge, it is typical for changes to be made

5 Innovata schedule data via Flight Global's Diio Mi database.

6 Although the merger was announced in 2013, the two airlines did not begin operating under one Air Operator's Certificate (AOC) until 2015.

to the hub structure in order to optimize operations. As an example, the largest international connect flow was the U.S. Northeast-Caribbean market. Some of this traffic has since shifted to American Airlines' largest Caribbean gateway, Miami (**Figure 2-4**).

Table 2-8 Overview of Capacity at American Airlines Hubs, CY 2016

Seat Rank	Airport	Markets Served	Daily Departures	Daily Seats
1	Dallas/Fort Worth	202	749	95,927
2	**Charlotte**	**158**	**660**	**71,170**
3	Chicago O'Hare	133	481	49,938
4	Miami	129	333	48,061
5	Philadelphia	114	379	37,549
6	Phoenix	86	253	33,557
7	Los Angeles	70	202	27,723
8	Washington DCA	72	239	20,654
9	New York JFK	46	93	13,225

Source: Airport Records, U.S. DOT, O&D Survey, via Flight Global's Diio Mi database.

Figure 2-4 American Airlines Hub Locations

Source: Innovata schedule data via Flight Global's Diio Mi database, August 2017.

Flights from CLT reach 169 destinations; 135 of those in the United States (**Table 2-9**). These 135 destinations account for 95 percent of weekly departing flights. International service connects Charlotte to 34 airports with the 50 percent of those located in the Caribbean. American Airlines' focus at Charlotte is on domestic connections as it connects the United States to Latin American via its hub at Miami; Europe via its hub at New York JFK; and Asia from Los Angeles.

Table 2-9 Weekly Frequencies from CLT by Region, August 2017

Region	Weekly Departures	Weekly Departing Seats	Number of Destinations
Domestic	4,893	509,388	135
Europe	63	16,926	8
Caribbean	112	16,876	17
Mexico	30	5,048	4
Canada	46	2,984	2
Central America	7	882	3
Total	**5,150**	**552,104**	**169**

Source: Innovata Schedule Data via Flight Global's Diio Mi database, August 2017.

As noted above, the air service offerings at CLT has changed since the ACEP. In 2013, international flights accounted for 6.5 percent of total scheduled flights[7] whereas in August 2017 they accounted for 5 percent. Of these international flights, 65 percent were to Latin America in 2013;[8] this share has dropped to 57.8 percent in 2017.

Of the 5,150 weekly nonstop departures at CLT in August 2017, 67.8 percent are operated with narrowbody equipment **(Table 2-10**). Ten routes are operated with widebody aircraft.

Table 2-10 Weekly Frequency from CLT by Aircraft Type, August 2017

Aircraft Group	Weekly Departures	Weekly Departing Seats	Number of Destinations
Narrowbody	3,493	442,823	124
Regional Jet/Turboprop	1,584	89,985	90
Widebody	73	19,296	10
Total	**5,150**	**552,104**	**N/A**

Source: Innovata Schedule Data via Flight Global's Diio Mi database, August 2017

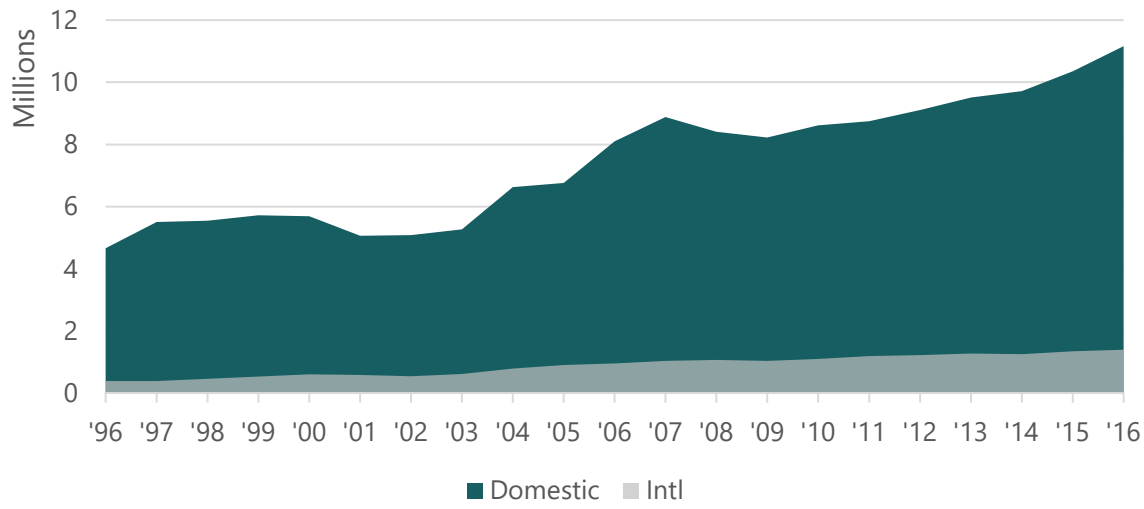
2.2.3 Origin and Destination (O&D) Passengers

While connections account for 71.2 percent of passengers at CLT, O&D passengers play an increasing role at the Airport. Over the last 20 years, O&D passengers have increased by 4.7 percent annually on average (**Table 2-11**), with slightly larger growth in the international segment (see **Figure 2-5)**. In 1996, international passengers accounted for 7.6 percent of total passengers; this share has increased to 11.1 percent in 2016. In 2016, both international and domestic O&D passengers grew, by 7.8 percent and 3.8 percent, respectively compared to 2015.

7 OAG schedules as shown in the ACEP

8 Ibid.

Figure 2-5 Historical O&D Passengers at CLT, 1996-2016



Source: U.S. DOT O&D Survey via Flight Global's Diio Mi database.

Table 2-11 Compound Annual Growth Rates for Historical O&D Passengers at CLT

CAGRs	1996-06	2006-16	1996-16
Domestic	5.7%	3.3%	4.5%
International	9.5%	3.9%	6.7%
Total	**6.0%**	**3.3%**	**4.7%**

Source: U.S. DOT O&D Survey via Flight Global's Diio Mi database.

New York City (as represented by JFK, LaGuardia and Newark airports) is the largest O&D destination from CLT, followed by Chicago (O'Hare and Midway) (see **Table 2-12**).

Table 2-12 Top 10 O&D Destinations from CLT, CY 2016

Rank	City	O&D Passengers
1	New York City	1,514,506
2	Chicago	594,468
3	Boston	474,979
4	Dallas	422,592
5	Philadelphia	339,573
6	Orlando	281,049
7	Baltimore	274,187
8	Los Angeles	272,809
9	Washington D.C.	244,093
10	San Francisco	240,379

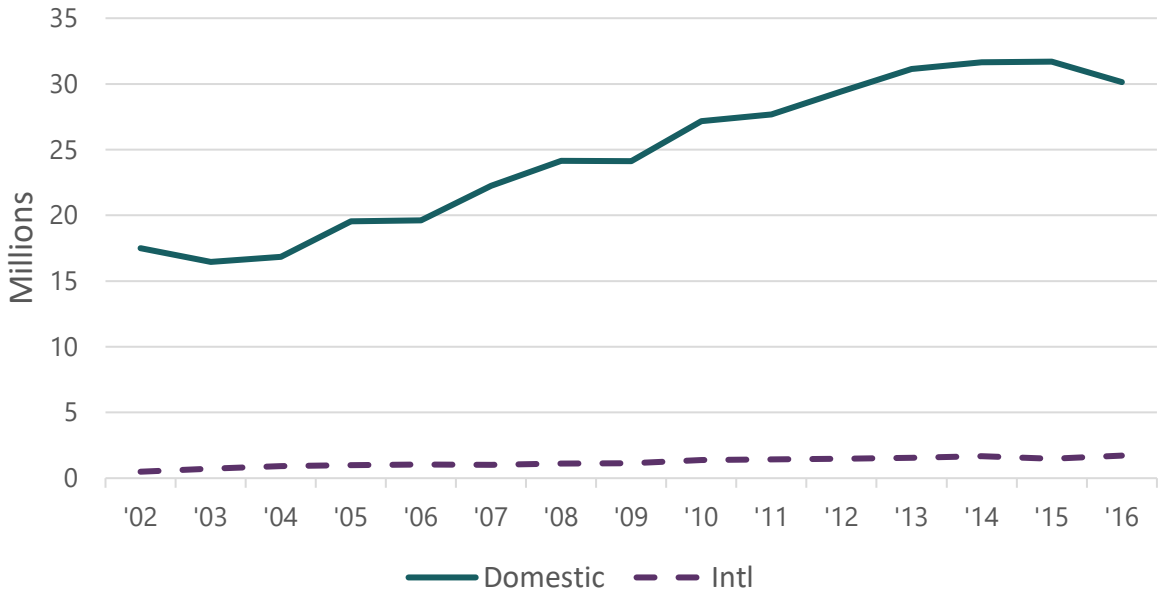
Source: U.S. DOT O&D Survey via Airline Data, Inc.
CAGR - Compound Annual Growth Rate

2.2.4 Connecting Passengers at CLT

Since 2002, the number of connecting passengers at CLT has increased by 4.2 percent annually on average (**Figure 2-6** and **Table 2-13**), reaching 31.9 million passengers in 2016. International connections, which include connections between domestic and international flights have increased at a faster rate than domestic-to-domestic connections, likely due to the increase in the number of international flights.

Connecting traffic is a function of air carrier hubbing and network decisions (primarily American Airlines at CLT). While underlying demand can grow connecting traffic, it is American Airlines decision to flow traffic through specific hubs that will ultimately affect traffic volumes at CLT.

Figure 2-6 Historical Connecting Passengers at CLT, 2002-2016



Source: U.S. DOT O&D Survey via Flight Global's Diio Mi database

Table 2-13 Compound Annual Growth Rates for Historical Connecting Passengers at CLT

CAGRs	2002-06	2006-11	2011-16	2002-16
Domestic	2.9%	7.1%	1.7%	4.0%
International	20.5%	6.6%	3.8%	9.3%
Total	**3.5%**	**7.1%**	**1.8%**	**4.2%**

Source: U.S. DOT O&D Survey via Flight Global's Diio Mi database

Table 2-14 below shows the major domestic connecting flows (domestic-to-domestic) and **Table 2-15** shows international connecting flows (domestic-to-international and international-to-international) at CLT in 2016. The major domestic-domestic flows tend to be north-to-south in nature, particularly on the eastern side of the country. CLT is geographically well-positioned to continue to handle these flows within America Airlines' network, compared with the Airline's other major hubs.

Table 2-14 Charlotte Domestic Connecting Flows, CY 2016

Domestic Connecting Flows	
Northeast-to-Southeast	16.7%
Florida-to-Northeast	14.1%
Northeast-to-Southwest	7.5%
Florida-to-Southeast	6.9%
Great Lakes-to-Southeast	6.8%
Florida-to-Great Lakes	6.0%
Northeast-to-Pacific	5.3%
Southeast-to-Southwest	5.0%
Other	31.7%
Total	**100.0%**

Source: U.S. DOT, O&D Database via Airline Data, Inc.

As shown in **Table 2-15**, for international, nearly two thirds of the flows are to the Caribbean and Mexico, which overlaps with American Airlines' Miami hub. Similarly, the flows to Europe overlap with Dallas and American Airlines' hubs in the Northeast.

Table 2-15 Charlotte International Connecting Flows, CY 2016

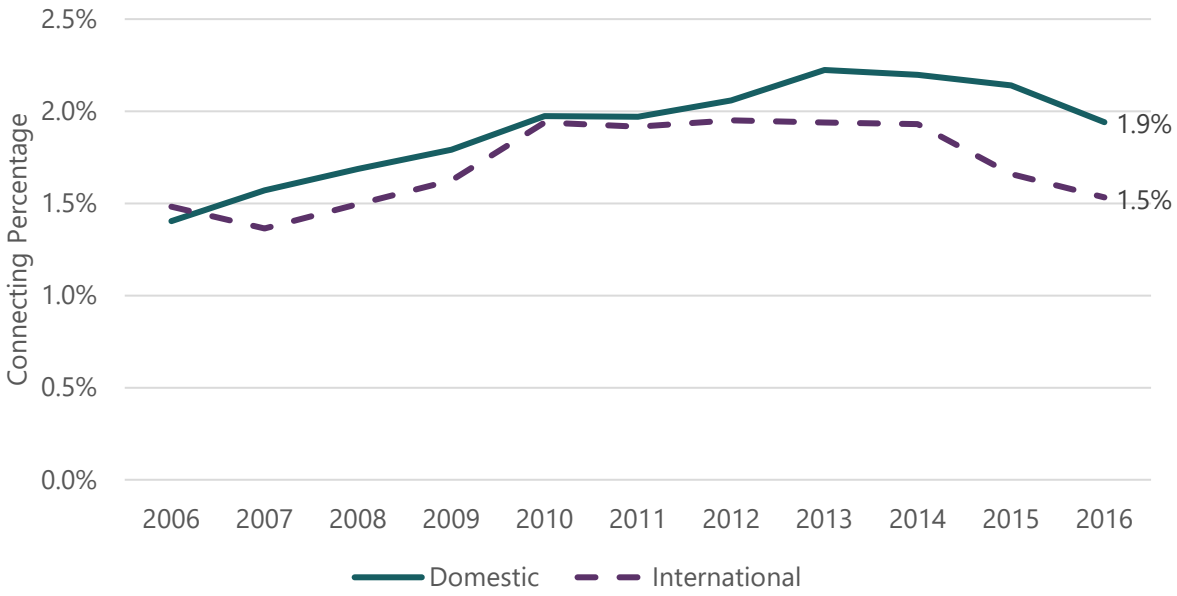
International Connecting Flows	
Domestic-to-Caribbean	50.8%
Domestic-to-Europe	23.6%
Domestic-to-Mexico	15.7%
Domestic-to-Canada	5.3%
Domestic-to-Other	2.9%
International-to-International	1.7%
Total	**100.0%**

Source: U.S. DOT, O&D Database via Airline Data, Inc.

In 2016, domestic connecting traffic at CLT accounted for 1.9 percent of total U.S. domestic passenger traffic, while international connecting traffic accounted for 1.5 percent of total U.S. international passenger traffic (see **Figure 2-7**).[9] Both the international and domestic connecting share of CLT compared to the national aviation market have been declining since 2013. This decline is due to an industry-wide trend towards more direct services as well as a consolidation of American Airlines' connecting traffic at other hubs such as Miami and Dallas. As discussed in the next chapter, this is a trend that is expected to continue, and it serves as one of the inputs into the long-term passenger forecast prepared for this EIS.

9 "International" here includes U.S.-Transatlantic, U.S.-Latin American, and U.S.-Canadian markets

Figure 2-7 CLT Connecting Share of Total U.S. Traffic, 2006-2016



Source: U.S. DOT O&D Survey via Flight Global's Diio Mi database, FAA

2.3 Aircraft Operations

2.3.1 Types of Aircraft Operations

Aircraft operations can be divided into categories based on aircraft size or operation purpose. The following definitions are used in the FAA's annual TAF forecast and in this technical memorandum.

1. **Commercial operations** (those operated as a business) can be defined based on the size of the aircraft involved:
    a. **Air carrier** – "takeoffs or landings of commercial aircraft with seating capacity of more than 60 seats"[10]
    b. **Air taxi** includes**:**
        i. Commuter – itinerant operations performed by commercial aircraft with seating capacity of 60 seats or less on scheduled flights
        ii. On-demand – itinerant operations performed by commercial aircraft with seating capacity of 60 seats or less on non-scheduled or for-hire flights

10 FAA TAF, Appendix A: Description of Activity Measures, page 26.

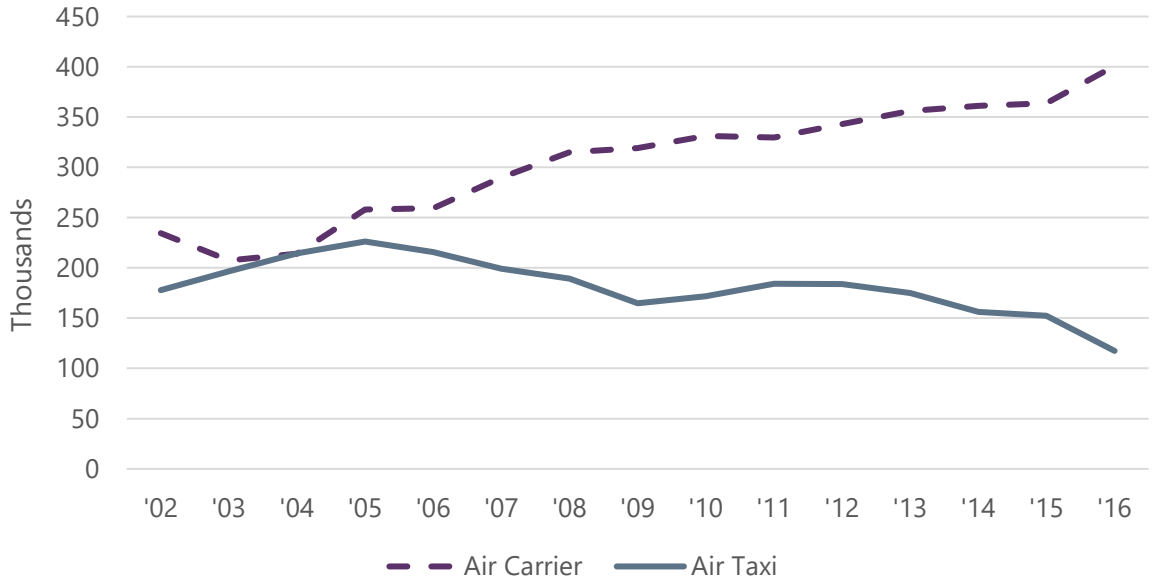
2. **Non-commercial operations**

   a. **General Aviation (GA) – "**all civil aviation aircraft takeoffs and landings not classified as commercial or military"[11]
   b. **Military – "**takeoffs and landings by military aircraft"[12]

2.3.2 Historical Aircraft Operations at CLT

Overall commercial operations at CLT have increased by 1.7 percent on average annually since 2002, reaching 518,197 in 2016 (**Figure 2-8**).

Figure 2-8 Historical Commercial Operations at CLT, 2002-2016



Source: FAA OPSNET

This growth has been driven by increases in air carrier operations as air taxi operations have declined over this period by 2.9 percent per annum on average (**Table 2-16**). The number of both international and domestic air carrier operations have increased by 6.1 percent and 4.1 percent, respectively.[13]

Table 2-16 Compound Annual Growth Rates for Historical Commercial Operations at CLT

CAGRs	2002-06	2006-11	2011-16	2002-16
Air Carrier	2.6%	4.9%	4.0%	3.9%
Air Taxi	4.9%	-3.1%	-8.6%	-2.9%
Total Commercial	**3.6%**	**1.6%**	**0.2%**	**1.7%**

Source: CLT Monthly Activity Reports
CAGR - Compound Annual Growth Rates

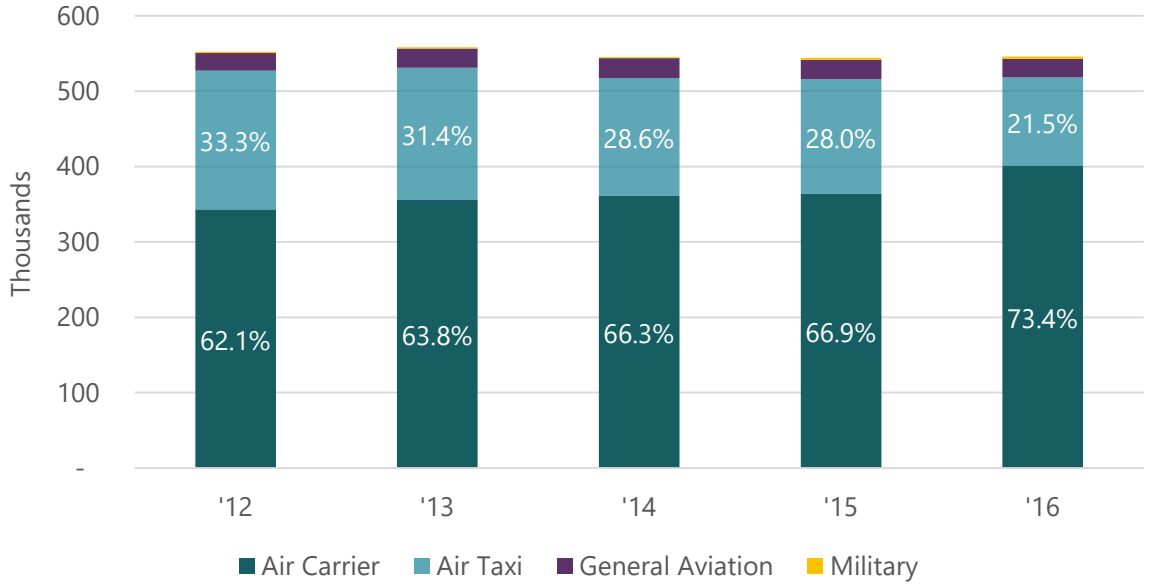
11 FAA TAF, Appendix A: Description of Activity Measures, page 26.

12 Ibid.

13 U.S. DOT T100 via Airline Data, Inc.

In 2016, 73.4 percent of total aircraft operations were air carrier. Almost 22 percent of operations were air taxis; 4.6 percent were General Aviation (GA); and 0.5 percent were military (**Figure 2-9**). General Aviation operations have been steadily falling and represent 60 percent of the level in 2002. Military operations have typically remained within a band of 1,700-2,500 per year, increasing slightly to 2,676 in 2016.

Figure 2-9 Operations by Category, 2012-2016

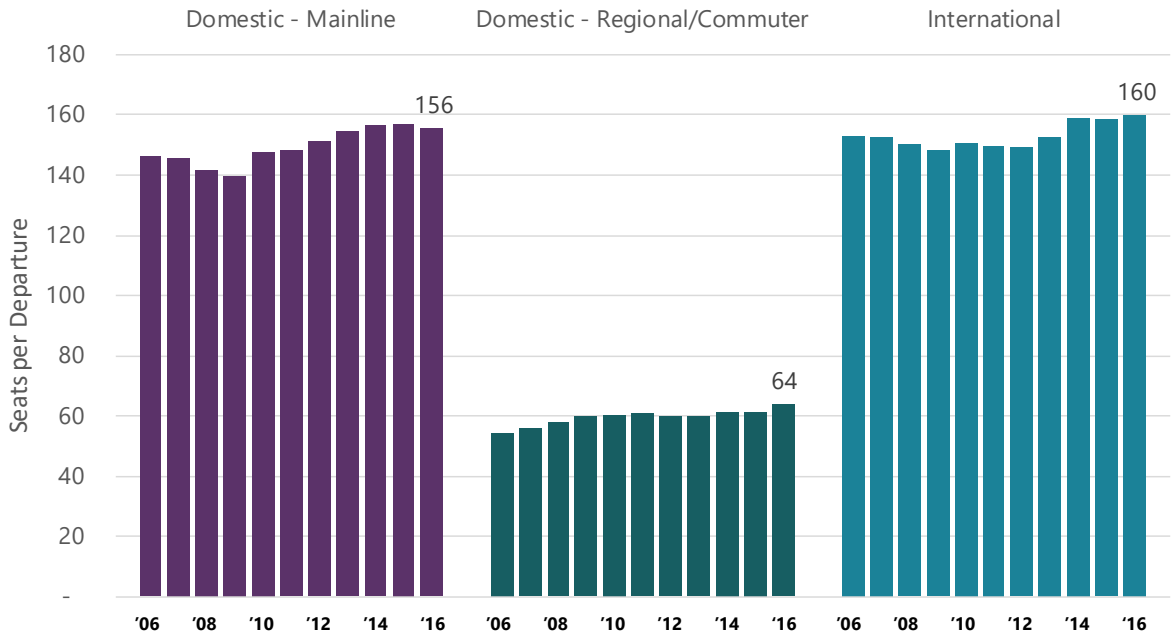


Source: FAA OPSNET

2.4 Aircraft Fleet Mix

As is the case nationwide, average aircraft size at CLT has been increasing (**Figure 2-10**). However, the growth rate of these larger aircraft in the CLT fleet has been faster than the national rate over the last 10 years. Since 2006, the average number of scheduled seats per departure at CLT has increased from 91 to 107, an average annual growth rate of 1.6 percent or 1.6 seats per year. For comparison, among U.S. commercial carriers over the same period, average annual growth was 1.1 percent. The reason for faster growth at Charlotte is the historically large share of CLT departures operated by smaller, regional/commuter aircraft. In 2006, over 60 percent of CLT's departures were operated on regional/commuter aircraft; in 2016, this share has dropped to 53.2 percent; at the same time, the regional carriers have started operating larger regional jets, such as the CRJ 700 and Embraer 170, which typically have a capacity between 65 and 90 seats. Both these factors have contributed to an increasing aircraft size at CLT.

Figure 2-10 Average Seats per Departure at CLT (Scheduled), 2006-2016

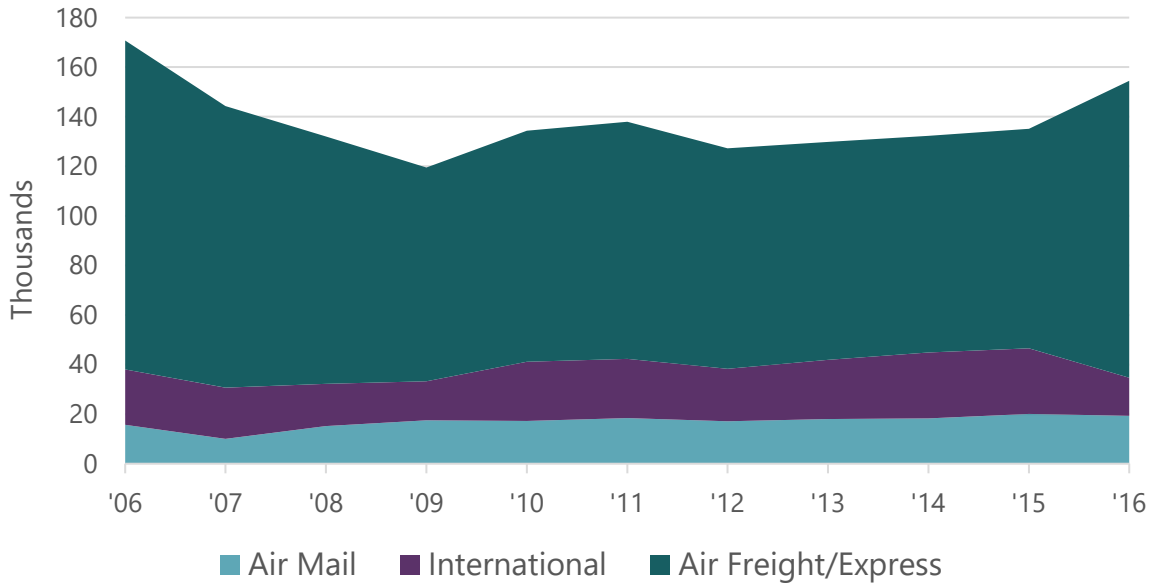


Source: Airline Schedules, via Airline Data, Inc.

2.5 Air Cargo

Air cargo tonnage has averaged 2.1 percent growth since the financial crisis (2009-15 growth). Domestic cargo accounts for 81 percent of total cargo enplaned and deplaned at CLT, while international makes up the remaining 19 percent. Historically, Charlotte has been served primarily by FedEx and UPS (which serve the air freight/express mail market), which together carried nearly 100 percent of cargo on scheduled cargo flights between 2012 and 2015. Belly cargo (cargo carried in the hold of commercial passenger aircraft) accounts for 33 percent of total cargo at CLT. Cargo volumes increased by 14.4 percent in 2016 to 154,000 tons (**Figure 2-11** and **Table 2-17**) much of which can be attributed to Amazon, which contracted services with both ABX Air and Air Transport for cargo operations in and out of Charlotte. In 2016, 77.5 percent of cargo served at CLT was air freight/express mail.[14]

Figure 2-11 Historical Cargo at CLT (tons), 2006-2016



Source: CLT Monthly Activity Reports

Table 2-17 Compound Annual Growth Rates for Historical Cargo at CLT

CAGRs	2006-11	2011-16	2006-16
Air Freight/Express	-6.3%	4.6%	-1.0%
Air Mail	3.1%	1.0%	2.1%
International	1.4%	-8.5%	-3.6%
Total	**-4.2%**	**2.3%**	**-1.0%**

Source: CLT Monthly Activity Reports

14 Air freight/express mail includes all cargo that is not international or regular mail.

3

Traffic Forecast

3.1 Introduction

In the process of conducting this EIS, it is necessary to update the long-term traffic forecast for the Charlotte Douglas International Airport ("the Airport" or "CLT"). This updated forecast will be used as an input into several subsequent analyses completed for the Environmental Impact Statement (EIS) including (among others): aircraft delay modeling, noise modeling, establishment of the design aircraft type, and determination of the optimal runway length. This chapter first presents the methodology and results for projecting passengers, operations and cargo. The most recent calendar year of data available as of the writing of this memorandum is 2016; therefore, 2016 was selected as the base year for this EIS forecast. The two benchmark years chosen for this study are 2028 (the "Build Year," when the Project is expected to open) and the Build Year plus five years (2033). Both the passenger and operations forecasts are compared to both the Airport Capacity Enhancement Plan (ACEP) and the FAA's Terminal Area Forecast (TAF) to determine consistency. Where the EIS forecast differs from either the ACEP or TAF forecasts, explanations are discussed. The forecasts presented in this chapter for CLT have been submitted to the FAA's Airport District Office (ADO) for approval for use in the EIS study.

3.2 Passenger Forecast Methodology

This section presents the separate approaches used to forecast Origin and Destination (O&D) and connecting traffic.

3.2.1 Origin-Destination Traffic Forecast Methodology

The long-term passenger forecasts prepared for this EIS are based on an econometric model for domestic, Canada, the Caribbean (including Mexico and Central America), South America, trans-Atlantic, and trans-Pacific origin-destination passengers. Separate outbound (Charlotte residents) and inbound (overseas residents) models were developed using data sourced from the U.S. DOT. Various models were tested to explain traffic volumes in terms of: relevant GDP measures, population, air fares and fuel prices. The most robust models, in terms of statistical fit (adjusted r-squared and parameter t-statistics), were found to be those based on measures of real GDP (as well as dummy variables in 2001 and 2002 to capture the impacts of the events of September 11, 2001). For the domestic and outbound international models, Charlotte Combined Statistical Area (CSA) gross domestic product (GDP) was found to be the most effective explanatory variable, while the real GDP of the international regions were used for the inbound markets. The dependent variables used in the econometric analysis were in natural log terms. The key results from the econometric analysis are summarized in Appendix 1.

As the markets mature, the responsiveness of demand to economic growth is expected to decline. To capture this, the GDP elasticities were gradually declined by 25 percent by 2035 - this of level decline is based on expert judgement and reflects the expected maturing of the market. To generate forecasts of O&D traffic, the parameters were applied to projections of real GDP sourced from Woods & Poole[15] for Charlotte GDP and the U.S. Department of Agriculture Economic Research Service.[16]

3.2.2 Connecting Traffic

Connecting traffic at CLT is primarily a function of air carrier decisions (primarily American Airlines). While underlying demand can grow connecting traffic, it is carriers' decisions regarding flow traffic through specific hubs that will ultimately affect traffic volumes.

Connecting traffic was modelled as a function of national demand for travel and CLT's share of that demand. In 2016, domestic connecting traffic at CLT accounted for 1.9 percent of total domestic passenger traffic. The FAA forecasts that in the U.S., domestic traffic will increase by 1.7 percent per annum up to 2035. It is assumed that CLT's share of this traffic will decline by 10 percent over the forecast period as new direct services reduce the need for connecting itineraries (CLT's share will decline to 1.7 percent). As noted in Section 2.2.4, CLT's share of domestic connecting traffic has been declining in recent years, and this trend is expected to continue. This trend of declining connecting share was broadly confirmed by interviews with American Airlines. As a result, domestic connecting traffic is forecast to increase by 1.2 percent per annum (forecast values are shown in the Appendix).

The forecasts of international connecting traffic were based on the FAA forecasts of traffic to/from Canada, Latin America and Trans-Atlantic. CLT's share of these total traffic flows is assumed to decline by 25 percent, due to the development of direct services and the increased concentration of connecting flows at other hubs. As with domestic connecting traffic, CLT's share of international connecting traffic has been declining and this trend is expected to continue. This results in average growth of 2.1 percent per annum over the forecast period (compared with 3.6 percent per annum growth in total demand). Forecast connecting passenger values are shown in the Appendix.

3.3 Passengers

The EIS passenger forecast projects passengers by route group (domestic and international) as well as type of passenger. The two types of passengers projected are O&D and connecting.

- **O&D passengers** at CLT are those beginning or ending their trip at CLT. An example of an O&D passenger would be someone traveling between Charlotte and New York City.
- **Connecting passengers** at CLT are those changing planes in the Airport on their way to another destination. An example of a connecting passenger would be someone flying from New York City to Charlotte and then to Dallas.

15 Complete Economic and Demographic Data Source (CEDDS), Woods & Poole Economics, Inc., 2017.

16 U.S. Department of Agriculture Economic Research Service, https://www.ers.usda.gov/

3.3.1 Passenger Forecast Assumptions

The next three sections describe the different assumptions used to create the Base, High, and Low forecasts. Although the Base Case is that used for the majority of EIS analyses, it is important to have High and Low cases in order to test the range of possible outcomes.

3.3.1.1 Base Case

The following assumptions were made in creating the passenger forecast:

- The United States economy as well as Charlotte's local economy will experience moderate and steady growth between 2016 and 2035 in line with current forecasts;
- No large demand shock, such as terrorism or war, will significantly affect demand for air travel in the U.S.;
- No significant change in airfares from Charlotte will dramatically affect demand for air travel;
- No large change in jet fuel prices will dramatically affect the airlines' ability to serve Charlotte's from their respective bases;
- The U.S. air traffic control system will be able to absorb incremental capacity throughout the forecast period;
- The airport's facilities will not constrain demand; and,
- CLT's share of the U.S. industry domestic connects is forecast to decline from 1.9 percent to 1.7 percent while the share of international connections declines from 1.5 percent to 1.1 percent. This is an industry trend that reflects greater passenger volumes flying on a nonstop itinerary to reach their destination. Even though the CLT share of connecting passengers is declining, the actual volume of connecting passengers will increase.

3.3.1.2 High Case

In order to test the outer limit of the passenger forecast, a High Case was created. The following assumptions were made regarding the high forecast scenario for CLT:

- In an iterative process, O&D adjustments upward were made to the underlying independent variables in the regression analysis, i.e., economic growth rates forecast by Woods & Poole[17] and the U.S. Department of Agriculture Economic Research Service. The revised economic growth rates will drive changes to O&D passengers. In the High Case, the GDP growth rate increased by 0.1 percentage points.
- Connecting adjustments upward were made on the share of U.S. passenger growth that CLT connecting traffic represents. In the High Case, connecting shares of 1.9 percent for domestic, and 1.5 percent for international are held constant through the forecast period.

17 Complete Economic and Demographic Data Source (CEDDS), Woods & Poole Economics, Inc., 2017.

However, after review of the output, it was determined that a larger adjustment to the O&D forecast was necessary to reflect a more meaningful change in the underlying conditions. The GDP growth rate was then increased by +0.5 percentage points per annum throughout the forecast period. No change was made to initial assumptions for the connecting passenger forecast.

3.3.1.3 Low Case

In order to test the lower limit of the passenger forecast, a Low Case was created. The following assumptions were made regarding the Low Case for CLT:

- In the Low Case, the GDP growth rated was decreased by -0.1 percentage points per annum.
- Connecting shares were decreased from 1.9 percent to 1.6 percent for domestic, and 1.5 percent to 1.0 percent for international over the forecast period.

Similar to the high forecast, the results of the low forecast scenario were further analyzed and it was determined that an additional adjustment to the O&D passenger forecast was required. The GDP growth rate was adjusted to reflect a -0.5 percentage point change per year throughout the forecast period.

A high/low variance range of 20-25 percent was assumed when reviewing the outputs of the scenarios above.

3.3.2 Annual Passenger Forecasts

For 2017, the number of enplaned/deplaned passengers is expected to increase 2.4 percent from 2016, which reflects anticipated seat capacity growth shown in the 2017 schedule data and the year-to-date passenger figures as of April 2017. Based on the methodology and assumptions described above, the average growth rate is forecast to average 2.4 percent per annum between 2016 and 2020 (figures below **Table 3-1**). In the longer run, between 2016 and 2035, total enplanements will increase at 1.8 percent per annum. Yearly passengers at Charlotte will reach approximately 62.6 million by 2035, compared to 44.4 million in 2016. The resulting passenger forecasts are presented in **Table 3-1**, **Table 3-2**, and **Table 3-3** below.

Table 3-1 Passenger Forecast – Base Case

Year	Domestic O&D	Int'l O&D	Connecting	Total
2005	6,762,157	899,855	20,544,040	28,206,052
2010	8,613,655	1,091,525	28,549,027	38,254,207
2011	8,752,758	1,193,081	29,097,869	39,043,708
2012	9,107,012	1,217,000	30,904,360	41,228,372
2013	9,513,203	1,266,955	32,676,733	43,456,891
2014	9,718,241	1,248,403	33,309,205	44,275,849
2015	10,353,573	1,343,355	33,173,903	44,870,831
2016	11,162,763	1,393,853	31,865,406	44,422,022
2017	11,547,629	1,491,064	32,454,311	45,493,004
2020	12,686,885	1,761,671	34,343,300	48,791,856
2025	14,615,653	2,285,876	36,120,282	53,021,811
2030	16,524,455	2,903,787	38,265,291	57,693,533
2035	18,378,400	3,621,209	40,604,915	62,604,524
Compound Annual Growth Rates (CAGRs)				
2005 – 2010	5.0%	3.9%	6.8%	6.3%
2010 – 2015	3.7%	4.2%	3.0%	3.2%
2016 – 2020	3.3%	6.0%	1.9%	2.4%
2020 – 2025	2.9%	5.3%	1.0%	1.7%
2025 – 2030	2.5%	4.9%	1.2%	1.7%
2030 – 2035	2.1%	4.5%	1.2%	1.6%
2016 – 2035	2.7%	5.2%	1.3%	1.8%

Source: Airport Statistics data for historical; U.S. DOT T100; InterVISTAS analysis for forecasts.
Note: Data is reflected in calendar years

Table 3-2 Passenger Forecast – High Case

Year	Domestic O&D	Int'l O&D	Connecting	Total
2005	6,762,157	899,855	20,544,040	28,206,052
2010	8,613,655	1,091,525	28,549,027	38,254,207
2011	8,752,758	1,193,081	29,097,869	39,043,708
2012	9,107,012	1,217,000	30,904,360	41,228,372
2013	9,513,203	1,266,955	32,676,733	43,456,891
2014	9,718,241	1,248,403	33,309,205	44,275,849
2015	10,353,573	1,343,355	33,173,903	44,870,831
2016	11,162,763	1,393,853	31,865,406	44,422,022
2017	11,612,917	1,506,527	32,616,771	45,736,215
2020	12,970,619	1,836,321	35,048,853	49,855,794
2025	15,335,467	2,508,638	37,877,975	55,722,080
2030	17,760,411	3,351,055	41,311,086	62,422,552
2035	20,196,602	4,387,422	45,223,392	69,807,416
Compound Annual Growth Rates (CAGRs)				
2005 – 2010	5.0%	3.9%	6.8%	6.3%
2010 – 2015	3.7%	4.2%	3.0%	3.2%
2016 – 2020	3.8%	7.1%	2.4%	2.9%
2020 – 2025	3.4%	6.4%	1.6%	2.2%
2025 – 2030	3.0%	6.0%	1.8%	2.3%
2030 – 2035	2.6%	5.5%	1.8%	2.3%
2016 – 2035	3.2%	6.2%	1.9%	2.4%

Source: Airport Statistics data for historical; U.S. DOT T100; InterVISTAS analysis for forecasts.
Note: Data is reflected in calendar years

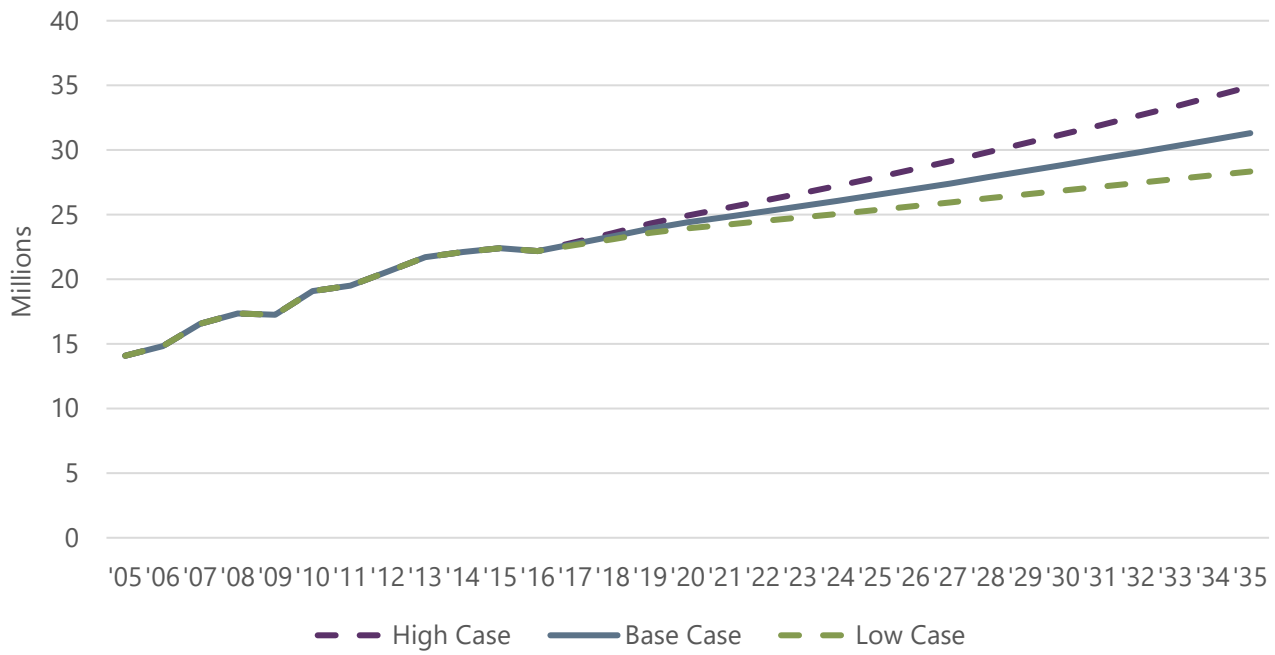
Table 3-3 Passenger Forecast – Low Case

Year	Domestic O&D	Int'l O&D	Connecting	Total
2005	6,762,157	899,855	20,544,040	28,206,052
2010	8,613,655	1,091,525	28,549,027	38,254,207
2011	8,752,758	1,193,081	29,097,869	39,043,708
2012	9,107,012	1,217,000	30,904,360	41,228,372
2013	9,513,203	1,266,955	32,676,733	43,456,891
2014	9,718,241	1,248,403	33,309,205	44,275,849
2015	10,353,573	1,343,355	33,173,903	44,870,831
2016	11,162,763	1,393,853	31,865,406	44,422,022
2017	11,482,340	1,475,601	32,319,802	45,277,743
2020	12,407,831	1,689,593	33,762,591	47,860,015
2025	13,926,024	2,082,707	34,695,996	50,704,728
2030	15,368,749	2,517,566	35,829,682	53,715,997
2035	16,715,958	2,993,229	36,958,319	56,667,506
Compound Annual Growth Rates (CAGRs)				
2005 – 2010	5.0%	3.9%	6.8%	6.3%
2010 – 2015	3.7%	4.2%	3.0%	3.2%
2016 – 2020	2.7%	4.9%	1.5%	1.9%
2020 – 2025	2.3%	4.3%	0.5%	1.2%
2025 – 2030	2.0%	3.9%	0.6%	1.2%
2030 – 2035	1.7%	3.5%	0.6%	1.1%
2016 – 2035	2.1%	4.1%	0.8%	1.3%

Source: Airport Statistics data for historical; U.S. DOT T100; InterVISTAS analysis for forecasts.
Note: Data is reflected in calendar years

The figure below (**Figure 3-1**) reflects the high and low growth scenarios compared to the base case. Forecasted enplanements for the high case are 12 percent above the base case, reaching 33.8 million enplanements in 2035. As for the low scenario, enplanements are projected to be 28.3 million, nine percent below the base case scenario. The variance for the revised high/low forecast is 23 percent.

Figure 3-1 Enplanements Forecast – Base, High, Low Cases



Source: CLT statistics data for historical; U.S. DOT T100; InterVISTAS analysis for forecasts.

3.3.3 Comparative Enplaned Passenger Forecasts

Forecasts that are part of an EIS are required to be approved by the FAA. The FAA "must ensure that the forecast is based on reasonable planning assumptions, uses current data, and is developed using appropriate forecast methods."[18] In addition, forecasts must be deemed to be consistent with the FAA's Terminal Area Forecast (TAF). The TAF is an annual forecast of passengers and aircraft operations produced by the FAA for all existing airports in the National Plan of Integrated Airport Systems[19]. The comparison shown below (**Figure 3-2**) shows the most recent version of the TAF, which uses FY 2016 as the base year and provides forecasts for FY 2017-2045. In addition to its baseline forecast, the TAF also shows optimistic and pessimistic scenarios. In order to be approved, this EIS forecast must fall within a defined, acceptable range of the baseline TAF forecast: ±10 percent in the five-year forecast period and ±15 percent in the 10-year forecast period.

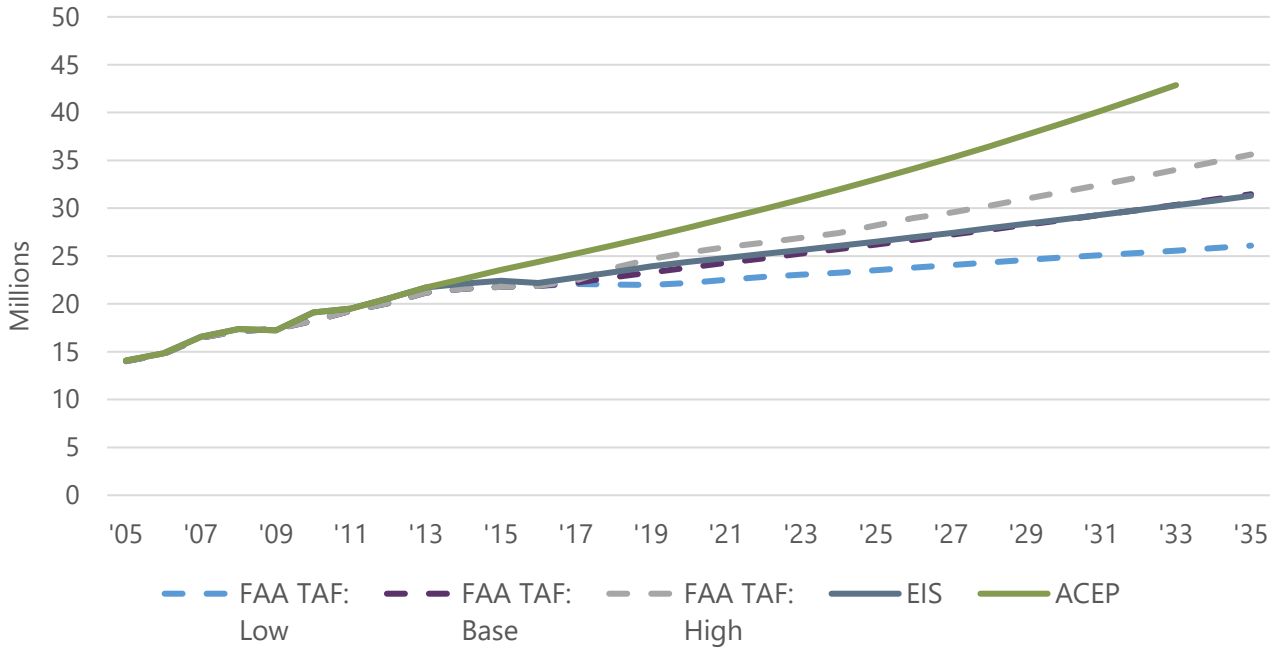
As shown in the table below **(Table 3-4**), the EIS passenger forecast matches closely with the FAA TAF for the future forecast years.[20] The EIS forecast is 0.5 percent below the TAF base forecast by 2035, which is within the TAF consistency requirements required by the FAA. This forecast technical memorandum is accompanied by a letter to the FAA requesting approval for its use in this EIS process.

18 FAA, Approval of Local Forecasts, 2008, page 1.

19 CLT is a large hub airport.

20 The TAF forecast has been converted into calendar years for comparison purposes. Calendar year figures were determined by assuming 75 percent of operations in the base fiscal year and 25 percent of operations in the following fiscal year (i.e., for CY 2016: 75 percent of FY 2016 and 25 percent of FY 2017).

Figure 3-2 Historical and Forecast Enplaned Passengers – EIS, TAF and ACEP



Source: Airport statistics data for historical; U.S. DOT T100 data; InterVISTAS analysis for forecasts.
FAA TAF: https://www.faa.gov/data_research/aviation/taf/
CLT Master Plan Update: Phase 1, Airport Capacity Enhancement Plan
Note: The forecast in the ACEP ends in 2033

Table 3-4 Historical and Forecast Enplaned Passengers Compound Average Growth Rates – EIS, TAF, and ACEP

Period	EIS	TAF	ACEP
2010 – 2016	2.5%	3.1%	4.2%
2016 – 2020	2.4%	2.1%	3.5%
2020 – 2025	1.7%	2.0%	3.4%
2025 – 2030	1.7%	1.9%	3.3%
2030 – 2035	1.6%	1.8%	3.3%
2016 – 2035	1.8%	1.9%	3.5%

Source: Airport statistics data for historical; U.S. DOT T100; InterVISTAS analysis for forecasts.
FAA TAF: https://www.faa.gov/data_research/aviation/taf/
CLT Master Plan Update: Phase 1, Airport Capacity Enhancement Plan
Note: ACEP Growth Rates are for 2030-2033, and 2013-2033
Note: Comparison is made between the baseline EIS and TAF forecasts.

The graph (**Figure 3-2**) and table (**Table 3-4**) above, also show a comparison of the EIS forecast to that in the ACEP. When compared to the enplanement forecast in the ACEP, both the EIS and TAF forecasts are 29.3 percent and 29.2 percent below the ACEP in 2033, respectively. The ACEP forecast used 2013 as a base year, while 2016 is the base year in the EIS forecast, and has overestimated enplanements in 2016 by over 2 million passengers.

Since the ACEP forecast was completed, several of the assumptions used in the forecast have changed.

- At the time the ACEP forecast was created, the merger of American Airlines and US Airways had only recently been announced. The ACEP forecast assumed that the merger "is not expected to negatively affect passenger growth at CLT."[21] While the merger has not negatively affected passenger traffic at CLT as of yet, American Airlines has altered the role of CLT in its network, specifically in international routes.
- The ACEP assumed that "Growth in the Latin American economies will be the primary driver of continued growth in international air travel at CLT."[22] While Charlotte maintained service to the Caribbean, American Airlines shifted international service among its hub and withdrew its service from Charlotte to Sao Paulo and Rio de Janeiro in Brazil, instead relying on its flights from Miami to connect the U.S. to South America. In 2016, Charlotte had no flights to South America and American Airlines is not expected to add any in the near future according to the carrier's network planners.
- In addition, the ACEP report states that "Domestic enplanements at CLT increased 4.8 percent annually between 1990 and 2013…This was primarily driven by domestic connections…"[23] However, since the ACEP forecast was completed, domestic O&D passengers continued to grow, while domestic connections have grown more slowly or even decline (-1.1 percent on average per annum from 2013-2016).
- The ACEP "assumed that connecting domestic enplanements would account for 75.0 percent of the total domestic enplanements throughout the forecast period."[24] Instead, the connecting share of passengers has declined to 71.7 percent in 2016.
- The ACEP assumed continued high fuel prices; however, fuel prices have plummeted in recent years, changing the economics of airline operations.

All of these factors/assumptions explain why the ACEP forecast is higher than that of the more recent TAF and EIS forecasts.

3.4 Operations

This section presents the methodology and results for projected aircraft operations at CLT for the 2017-2035 period.

3.4.1 Operations Forecast Assumptions

Forecasts of annual commercial passenger aircraft operations are based on forecast passenger traffic demand. Passenger aircraft landings depend on the average aircraft size and average load factor (i.e., average passenger per flight), as represented by the formula below:

$$\boldsymbol{Passenger\ Aircraft\ Operations} = (Passenger\ Forecasts)/(Avg.Aircraft\ Size\ x\ Avg.Load\ Factor)$$

where Avg. Aircraft Size x Avg. Load Factor = Avg. Passengers per Aircraft Movement

21 CLT Master Plan Update: Phase 1, Airport Capacity Enhancement Plan

22 Ibid.

23 Ibid.

24 Ibid.

Forecasts of average load factors were prepared (including marginal growth) and applied to the passenger figures (**Table 3-5**).

Table 3-5 Load Factor Assumptions

Region	2016	2035
Commuter – Domestic	80.2%	81.4%
Air Carrier – Domestic	84.0%	85.0%
Air Carrier – Canada	77.4%	82.0%
Air Carrier – Caribbean, Mexico, Central America	83.8%	85.0%
Air Carrier – South America	80.0%	82.0%
Air Carrier – Trans-Atlantic	75.1%	80.0%
Air Carrier – Trans-Pacific	80.0%	85.0%

Source: InterVISTAS assumptions.

Projections of passenger operations for Base, High and Low Cases were created by applying these load factor assumptions and assumptions regarding aircraft size (discussed in Section 3.4.5 below). Forecasts of annual general aviation and military operations were increased in line with the FAA TAF forecast.

3.4.2 Cargo Operations Forecasts

In 2016, there were 2,696 air cargo operations at CLT, 0.5 percent of total aircraft operations. The forecast of cargo aircraft operations was based on historical operations and forecast air cargo tonnage. It was assumed that the proportion of air cargo that would be transported by cargo aircraft (as opposed to passenger aircraft bellyhold), would remain at 2016 levels throughout the forecast period. Furthermore, it was assumed that the tonnage per cargo aircraft would remain constant over the forecast period.

3.4.3 Annual Operations Forecasts

The resulting base case operations forecasts are presented in **Table 3-6** below. Air carrier aircraft movements are forecast to increase by an average of 1.4 percent per annum, compared with passenger growth of 1.8 percent per annum (the lower growth due to rising load factors and the number of passengers per aircraft). Total operations for the base case forecasted are projected to grow at an average annual rate of 1.2 percent.

Table 3-6 Operations Forecast – Base Case – Charlotte Douglas International Airport

Year	Air Carrier	Air Taxi	GA	Military	Total
2010	331,110	171,836	24,414	1,741	529,101
2011	329,680	184,122	24,131	1,909	539,842
2012	343,121	183,870	23,400	1,702	552,093
2013	356,079	175,051	25,426	1,392	557,948
2014	361,273	156,188	26,321	1,396	545,178
2015	363,667	152,215	25,639	2,423	543,944
2016	400,819	117,378	24,869	2,676	545,742
2017	409,357	118,994	24,935	2,676	555,962
2020	431,503	122,231	25,083	2,676	581,494
2025	464,250	127,137	25,335	2,676	619,399
2030	494,758	130,959	25,588	2,676	653,981
2035	526,759	135,135	25,845	2,676	690,415
Compound Annual Growth Rates					
2010 – 2015	1.9%	-2.4%	1.0%	6.8%	0.6%
2016 – 2020	1.9%	1.0%	0.2%	0.0%	1.6%
2020 – 2025	1.5%	0.8%	0.2%	0.0%	1.3%
2025 – 2030	1.3%	0.6%	0.2%	0.0%	1.1%
2030 – 2035	1.3%	0.6%	0.2%	0.0%	1.1%
2016 – 2035	1.4%	0.7%	0.2%	0.0%	1.2%

Source: Airport Statistics data for historical; U.S. DOT T100; InterVISTAS analysis for forecasts.
Note: Data is reflected in calendar years.
Note: The forecast does not reallocate air taxi operations to air carrier as the seating capacity increases; therefore, the average aircraft size (seats) for air taxi goes above 60 seats.

Table 3-7 Operations Forecast – High Case – Charlotte Douglas International Airport

Year	Air Carrier	Air Taxi	GA	Military	Total
2010	331,110	171,836	24,414	1,741	529,101
2011	329,680	184,122	24,131	1,909	539,842
2012	343,121	183,870	23,400	1,702	552,093
2013	356,079	175,051	25,426	1,392	557,948
2014	361,273	156,188	26,321	1,396	545,178
2015	363,667	152,215	25,639	2,423	543,944
2016	400,819	117,378	24,869	2,676	545,742
2017	411,504	119,523	24,935	2,676	558,638
2020	440,726	124,439	25,083	2,676	592,925
2025	483,014	129,731	25,335	2,676	640,757
2030	531,968	138,249	25,588	2,676	698,481
2035	585,654	147,635	25,845	2,676	761,810
Compound Annual Growth Rates					
2010 – 2015	1.9%	-2.4%	1.0%	6.8%	0.6%
2016 – 2020	2.4%	1.5%	0.2%	0.0%	2.1%
2020 – 2025	1.8%	0.8%	0.2%	0.0%	1.6%
2025 – 2030	1.9%	1.3%	0.2%	0.0%	1.7%
2030 – 2035	1.9%	1.3%	0.2%	0.0%	1.8%
2016 – 2035	2.0%	1.2%	0.2%	0.0%	1.8%

Source: Airport Statistics data for historical; U.S. DOT T100; InterVISTAS analysis for forecasts.
Note: Data is reflected in calendar years
Note: The forecast does not reallocate air taxi operations to air carrier as the seating capacity increases; therefore, the average aircraft size (seats) for air taxi goes above 60 seats.

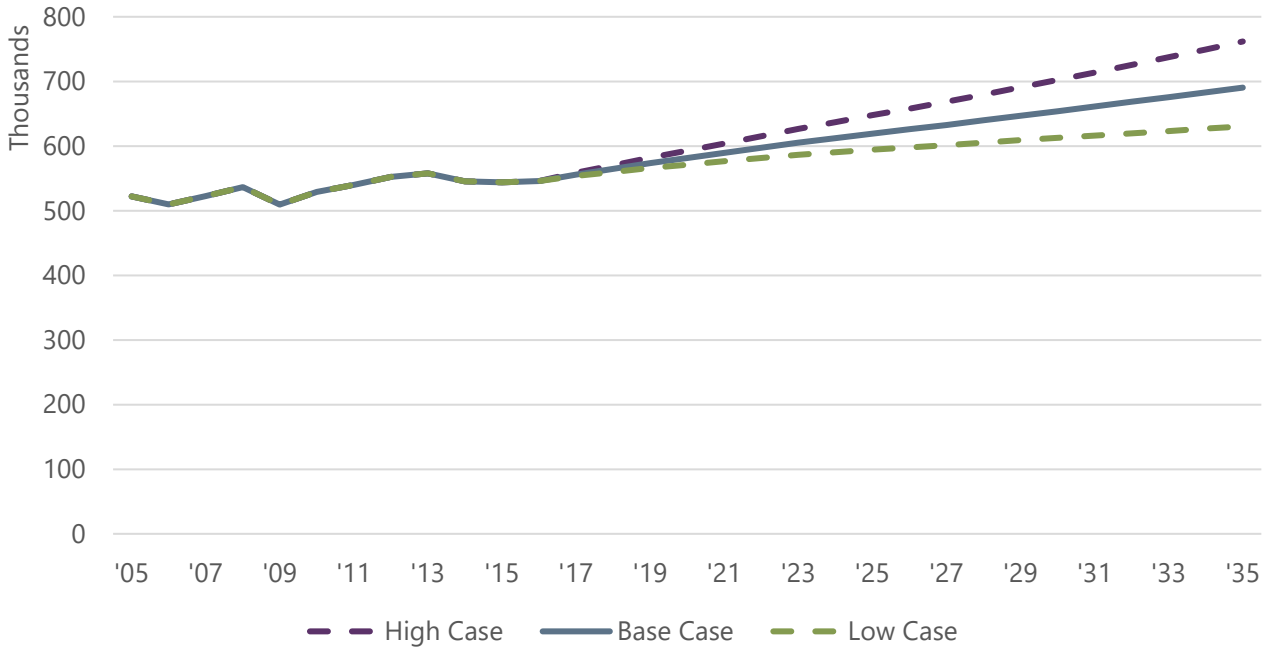
Table 3-8 Operations Forecast – Low Case – Charlotte Douglas International Airport

Year	Air Carrier	Air Taxi	GA	Military	Total
2010	331,110	171,836	24,414	1,741	529,101
2011	329,680	184,122	24,131	1,909	539,842
2012	343,121	183,870	23,400	1,702	552,093
2013	356,079	175,051	25,426	1,392	557,948
2014	361,273	156,188	26,321	1,396	545,178
2015	363,667	152,215	25,639	2,423	543,944
2016	400,819	117,378	24,869	2,676	545,742
2017	407,441	118,506	24,935	2,676	553,557
2020	423,357	120,210	25,083	2,676	571,326
2025	440,261	119,856	25,335	2,676	588,129
2030	459,150	121,963	25,588	2,676	609,377
2035	477,630	124,175	25,845	2,676	630,326
Compound Annual Growth Rates					
2010 – 2015	1.9%	-2.4%	1.0%	6.8%	0.6%
2016 – 2020	1.4%	0.6%	0.2%	0.0%	1.2%
2020 – 2025	0.8%	-0.1%	0.2%	0.0%	0.6%
2025 – 2030	0.8%	0.3%	0.2%	0.0%	0.7%
2030 – 2035	0.8%	0.4%	0.2%	0.0%	0.7%
2016 – 2035	0.9%	0.3%	0.2%	0.0%	0.8%

Source: Airport Statistics data for historical; U.S. DOT T100; InterVISTAS analysis for forecasts.
Note: Data is reflected in calendar years
Note: The forecast does not reallocate air taxi operations to air carrier as the seating capacity increases; therefore, the average aircraft size (seats) for air taxi goes above 60 seats.

In the high growth scenario, total aircraft operations at Charlotte Douglas International will reach over 761,800 operations, with an average annual growth rate of 1.8 percent through 2035 (**Figure 3-3** and **Table 3-7**). While a period of low growth is projected to reach 630,300 operations in 2035 with an average annual growth rate of 0.8 percent (**Table 3-8**).

Figure 3-3 Operations Forecast – Base, High, Low Cases – Charlotte Douglas International Airport



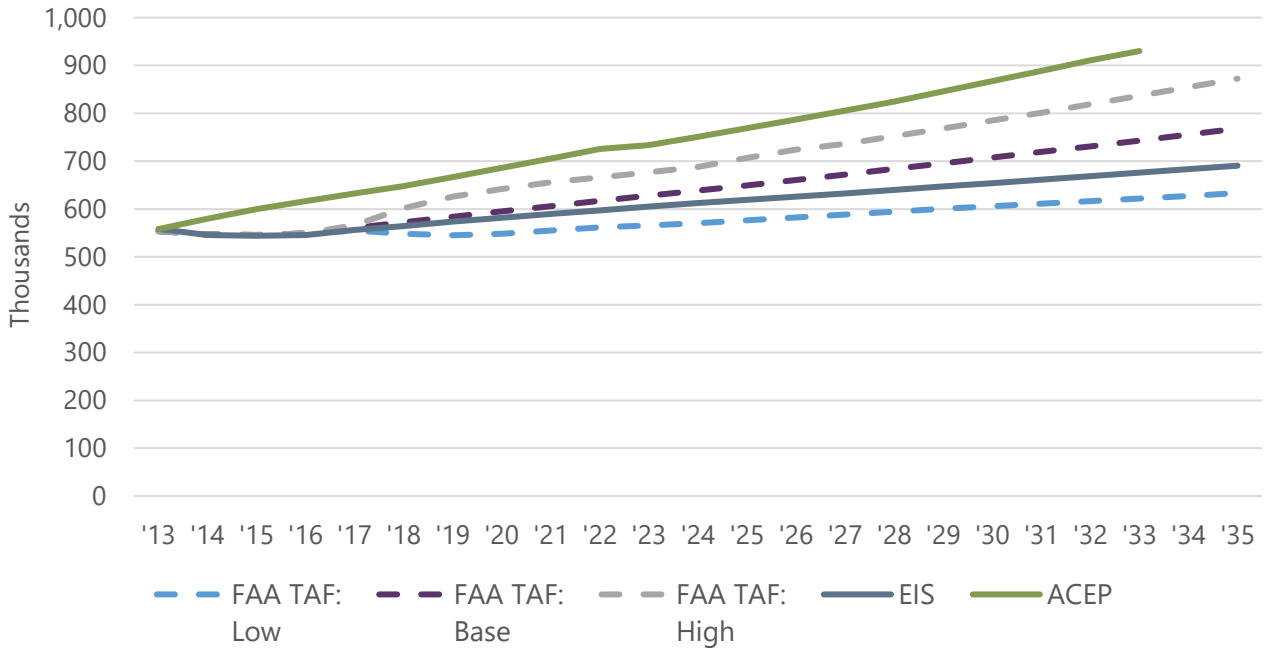
Source: Airport Statistics data for historical; U.S. DOT T100; InterVISTAS analysis for forecasts.

3.4.4 Comparative Operations Forecasts

The chart (**Figure 3-4)** and table (**Table 3-9**) below provide a comparison with the FAA TAF forecasts and the ACEP forecasts. The EIS forecast is lower than the baseline FAA forecast, with forecast volumes in 2033 being 9.1 percent below that of the TAF, and 27.4 percent below the ACEP forecast in 2033.[25]

25 The ACEP forecast extended to 2033 only.

Figure 3-4 Historical and Forecast Aircraft Operations – EIS, TAF and ACEP



Source: Airport statistics data for historical; U.S. DOT T100 data; InterVISTAS analysis for forecasts.
FAA TAF: https://www.faa.gov/data_research/aviation/taf/
CLT Master Plan Update: Phase 1, Airport Capacity Enhancement Plan

Table 3-9 Historical and Forecast Operations– EIS, TAF and ACEP

	Year	EIS	FAA TAF	ACEP	EIS vs. TAF	EIS vs. ACEP
Passenger Enplanements						
Base Year	2016	22,173,747	21,900,456	24,408,300	1.2%	-9.2%
Base Year + 1	2017	22,746,502	22,231,446	25,266,400	2.3%	-10.0%
Build Year	2028	27,893,348	27,735,137	36,449,000	0.6%	-23.5%
Build Year + 5	2033	30,298,324	30,353,627	42,865,500	-0.2%	-29.3%
Commercial Operations						
Base Year	2016	518,197	521,304	579,260	-0.6%	-10.5%
Base Year + 1	2017	528,351	532,647	594,800	-0.8%	-11.2%
Build Year	2028	611,620	655,739	783,220	-6.7%	-21.9%
Build Year + 5	2033	647,224	714,678	886,260	-9.4%	-27.0%
Total Operations						
Base Year	2016	545,742	548,653	616,400	-0.5%	-11.5%
Base Year + 1	2017	555,962	560,057	632,300	-0.7%	-12.1%
Build Year	2028	639,783	683,696	824,740	-6.4%	-22.4%
Build Year + 5	2033	675,643	742,889	930,080	-9.1%	-27.4%

Source: Airport statistics data for historical; U.S. DOT T100 data; InterVISTAS analysis for forecasts.
FAA TAF: https://www.faa.gov/data_research/aviation/taf/
CLT Master Plan Update: Phase 1, Airport Capacity Enhancement Plan
Note: A version of this table with Base Year +5,10,15 years is shown in the Appendix.
Note: Comparison is made between the baseline EIS and TAF forecasts.

3.4.5 Aircraft Fleet Mix

One of the other major assumptions required to convert the passenger forecast into aircraft operations is the average aircraft size, which includes assumptions regarding how the fleet of aircraft using CLT will change in the future. Forecasts of average aircraft size were prepared and applied, pointing to a trend of larger aircraft. In particular, the fleet orders of American Airlines which include large orders for the Airbus A321neo (starting in 2019) and the Boeing B737Max8 (starting in 2021), were included. The addition of these aircraft are expected to increase the average aircraft size at CLT (confirmed in interviews with American Airlines).

Average Aircraft Size (Seats per Departure) Assumptions:

- **Commuter** – commuter aircraft, including large and small regional jets, are assumed to increase from 59 seats in 2016 to 62 seats in 2022 and 64 seats by 2035. This increase assumes network carriers will continue retiring smaller regional jets and replace them with more efficient larger regional jets.
- **Domestic** – seats per aircraft increase from 142 in 2016 to 145 in 2022 and 148 by 2035, as airlines upgauge; e.g., moving some operations from A319 to A320, and from A320 to A321Neo, etc.
- **Canada** – seats per departure to Canada decreased following the 2008-2010 financial crisis. However, seats per departure have stabilized since 2013. Average seats are forecast to increase gradually from 62 seats in 2016 to 64 in 2022 and 67 in 2035.

- **Caribbean, Mexico, South America** – seats per departures has stayed relatively flat for this region at 159 seats - assumed to be 162 seats by 2022 and 166 seats by 2035.
- **South America** – US Airways previously serviced Brazil from 2009-2015, with average seats per departure of 204 in 2015. Service is assumed to resume by 2020, operating with 209 seats.
- **Trans-Atlantic** – seats per departures are projected to increase from 261 seats in 2016 to 265 in 2035.
- **Trans-Pacific** – does not currently have service, assumed this would remain the case through 2035

3.5 Cargo

This section presents the methodology and forecast results for cargo tonnage at CLT for the 2017-2035 period.

3.5.1 Cargo Forecast Assumptions

Cargo forecasts were prepared for Base, High and Low Cases, with differing assumptions for each case. The cargo growth forecast is based on expert judgement.

3.5.1.1 Base Case

The continuation of activity is expected to spur growth in the short term, averaging 6 percent per annum up to 2019. After that, cargo activity growth at the airport is expected to taper off in the long term as Amazon plans to build a centralized air hub at Cincinnati/Northern Kentucky Airport to support its growing fleet of Prime Air cargo planes. Cargo growth after 2020 is projected to range from 2-3 percent per annum in line with historical levels. While the Department does not currently have plans to expand its cargo facilities, the Department recently completed an expansion of the cargo ramp, providing 12,000 square yards of additional space. Airport facilities are assumed to accommodate future cargo activity levels.

The following assumptions were made concerning the cargo forecast at Charlotte:

- The U.S. economy as well as Charlotte's local economy will experience moderate and steady growth between 2016 and 2041;
- Rapid growth due to Amazon will slow by 2019;
- Key integrated carriers (e.g., FedEx, UPS, etc.) will maintain their services at Charlotte airport;
- Passenger air carriers would continue to provide cargo services through their belly capacity; regional jets would provide limited cargo capacity
- Long-term (2020-2035) growth is forecast to average 2.4 percent per annum, close to the average between 2011 and 2016 (2.3 percent per annum – see Section 2.5).

3.5.1.2 High Case

To reflect a high growth scenario, an adjustment of +0.5 percentage points was made to the annual cargo growth rate.

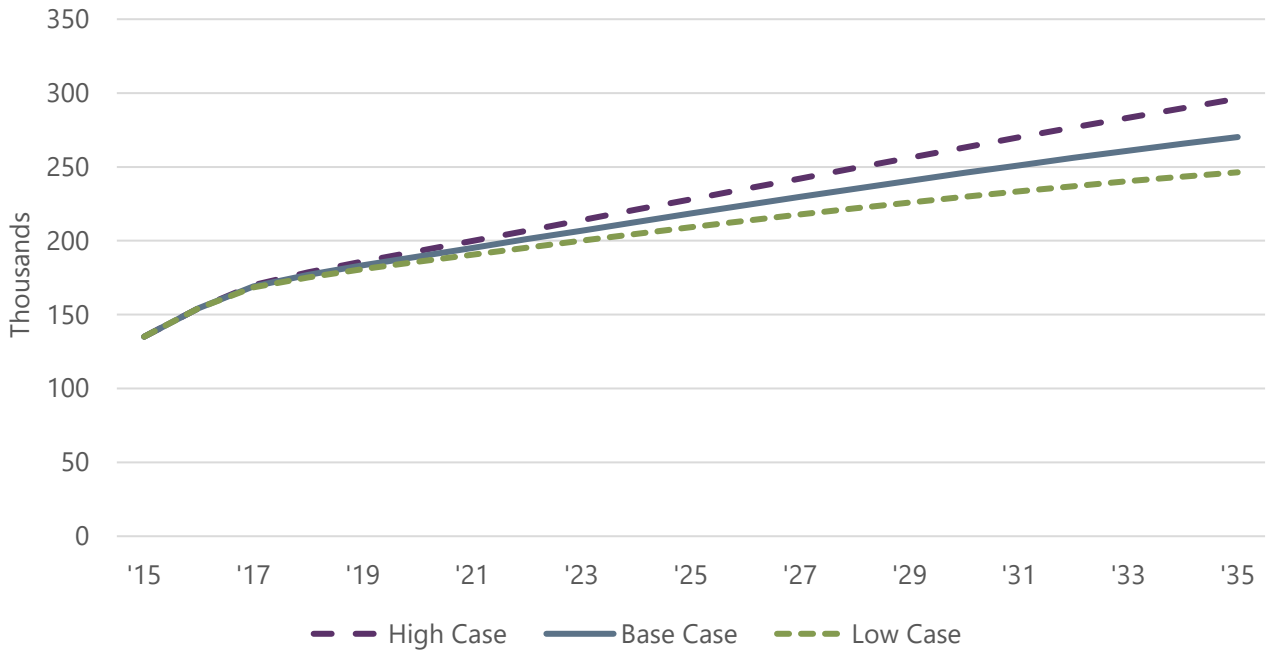
3.5.1.3 Low Case

For the low growth scenario, it was assumed Amazon growth in the early part of the forecast is curtailed, and an adjustment of -0.5 percentage points was made to the annual cargo growth rate.

3.5.2 Annual Cargo Forecasts

In the Base Case forecast, cargo tonnage is expected to grow an average of 3.0 percent per year reaching 270,215 tons in 2035, compared to 154,477 tons in 2016 (**Figure 3-5**). In the High Case forecast average annual growth increases to 3.5 percent per year, reaching 296,264 tons in 2035. While in the Low Case, cargo is projected to reach 246,346 tons by 2035, with an average annual growth rate of 2.5 percent.

Figure 3-5 Historical and Forecast Cargo Tonnage – Base, High, Low Cases – Charlotte Douglas International Airport



Source: Airport Statistics data for historical; U.S. DOT T100; InterVISTAS analysis for forecasts.

3.6 Conclusion

The forecasts presented in this technical memorandum will be used as an input into several subsequent analyses in the EIS. The Base Case forecast serves as the most likely future demand scenario given no constraints on traffic growth at the Airport; the High and Low Cases serve as indicators of how actual demand could vary above/below the Base Case depending on changes in the economic environment or changes in strategic decisions made by American Airlines. The annual forecasts for 2028 (Build Year) and 2033 (Build Year + 5) will be converted into Design Day Schedules including details of individual flights. Such schedules are required to conduct the capacity delay analysis and evaluate delays in airspace, runway usage, taxi-in/out times, and gate

usage. Simulation of a Design Day Schedule for 2016 (based on current OAG schedules) will determine the presence and location of existing delays; the schedules for 2028 and 2033 will be used as inputs to model future delays in the absence of the Project (No Action).

Appendix 1: Additional Data

Domestic O&D Traffic Parameter Estimates (1998-2016)

Variable	Parameter Estimate	T-Statistic
Constant	-22.53	-5.92
Ln (Charlotte GDP)	1.19	10.10
Ln (2001 Dummy)	-0.13	-1.41
Ln (2002 Dummy)	-0.17	-1.83
Adjusted-R^2	0.89	

Canada O&D Traffic Parameter Estimates – Outbound (1998-2016)

Variable	Parameter Estimate	T-Statistic
Constant	-20.19	-5.09
Ln (Charlotte GDP)	0.97	7.91
Ln (2001 Dummy)	-0.05	-0.48
Ln (2002 Dummy)	0.17	1.72
Adjusted-R^2	0.79	

Canada O&D Traffic Parameter Estimates – Inbound (1998-2016)

Variable	Parameter Estimate	T-Statistic
Constant	-43.24	-10.38
Ln (Canadian GDP)	1.93	13.00
Ln (2001 Dummy)	-0.07	-0.92
Ln (2002 Dummy)	0.01	0.10
Adjusted-R^2	0.91	

Caribbean (including Mexico and the Caribbean) O&D Traffic Parameter Estimates – Outbound (1998-2016)

Variable	Parameter Estimate	T-Statistic
Constant	-73.08	-12.37
Ln (Charlotte GDP)	2.64	14.48
Ln (2001 Dummy)	-0.11	-0.78
Ln (2002 Dummy)	-0.03	-0.23
Adjusted-R^2	0.93	

Caribbean (including Mexico and the Caribbean) O&D Traffic Parameter Estimates – Inbound (1998-2016)

Variable	Parameter Estimate	T-Statistic
Constant	-87.26	-11.52
Ln (Regional GDP)	3.50	12.93
Ln (2001 Dummy)	-0.27	-1.74
Ln (2002 Dummy)	-0.22	-1.41
Adjusted-R^2	0.92	

South America O&D Traffic Parameter Estimates – Outbound (1998-2016)

Variable	Parameter Estimate	T-Statistic
Constant	-88.11	-8.93
Ln (Charlotte GDP)	3.03	9.94
Ln (Dummy 2001)	-0.01	-0.04
Ln (Dummy 2002)	-0.13	-0.55
Adjusted-R^2	0.87	

South America O&D Traffic Parameter Estimates – Inbound (1998-2016)

Variable	Parameter Estimate	T-Statistic
Constant	-97.56	-12.83
Ln (SAM GDP)	3.67	14.06
Ln (Dummy 2001)	0.10	0.48
Ln (Dummy 2002)	0.01	0.06
Adjusted-R^2	0.93	

Trans-Atlantic O&D Traffic Parameter Estimates – Outbound (1998-2016)

Variable	Parameter Estimate	T-Statistic
Constant	-27.81	-3.97
Ln (Charlotte GDP)	1.24	5.74
Ln (Dummy 2001)	0.08	0.47
Ln (Dummy 2002)	-0.36	-2.11
Adjusted-R^2	0.72	

Trans-Atlantic O&D Traffic Parameter Estimates – Inbound (1998-2016)

Variable	Parameter Estimate	T-Statistic
Constant	-87.76	-7.27
Ln (EU-28 GDP)	3.27	8.26
Ln (Dummy 2001)	-0.06	-0.44
Ln (Dummy 2002)	-0.40	-2.93
Adjusted-R^2	0.84	

Trans-Pacific O&D Traffic Parameter Estimates – Outbound (1998-2016)

Variable	Parameter Estimate	T-Statistic
Constant	-69.67	-10.26
Ln (Charlotte GDP)	2.49	11.85
Ln (Dummy 2001)	0.06	0.34
Ln (Dummy 2002)	0.00	0.02
Adjusted-R^2	0.90	

Trans-Pacific O&D Traffic Parameter Estimates – Inbound (1998-2016)

Variable	Parameter Estimate	T-Statistic
Constant	-37.41	-16.85
Ln (Asia GDP)	1.57	21.47
Ln (2001 Dummy)	0.04	0.51
Ln (2002 Dummy)	0.00	-0.04
Adjusted-R^2	0.97	

Historical Values of the Independent Variables

Year	CLT GRP Real 2009 ($mns)	Canada GDP Real 2010 ($bns)	Caribbean GDP Real 2010 ($bns)	South America GDP Real 2010 ($bns)	Trans-Atlantic GDP Real 2010 ($bns)	Trans-Pacific GDP Real 2010 ($bns)	2001 Dummy	2002 Dummy
1998	79,625	1,211	297	3,742	14,627	9,932	0	0
1999	84,943	1,271	308	3,743	15,050	10,262	0	0
2000	86,498	1,337	318	3,887	15,634	10,741	0	0
2001	89,212	1,359	332	3,920	15,973	11,052	1	0
2002	92,383	1,397	341	3,933	16,178	11,465	0	1
2003	96,233	1,424	351	3,998	16,405	12,012	0	0
2004	102,951	1,469	362	4,245	16,834	12,685	0	0
2005	111,670	1,515	379	4,437	17,191	13,382	0	0
2006	122,351	1,555	399	4,675	17,785	14,223	0	0
2007	128,762	1,586	415	4,937	18,346	15,251	0	0
2008	137,250	1,605	423	5,127	18,456	15,808	0	0
2009	128,097	1,561	419	5,062	17,669	16,128	0	0
2010	116,819	1,614	427	5,354	18,038	17,399	0	0
2011	120,718	1,662	437	5,599	18,350	18,250	0	0
2012	129,882	1,694	446	5,760	18,278	19,140	0	0
2013	126,752	1,728	457	5,918	18,308	20,096	0	0
2014	131,396	1,771	470	5,975	18,547	20,986	0	0
2015	140,388	1,789	483	5,959	18,882	21,922	0	0
2016	144,331	1,829	499	6,013	19,264	22,867	0	0

Source: US Department of Agriculture Economics Research Centre; Woods & Poole 2017

Summary of Domestic Connecting Traffic Forecast (millions)

Year	U.S. Domestic Traffic	CLT Share	CLT Domestic Connections
2016	718.7	1.9%	14.0
2017	738.0	1.9%	14.2
2020	791.4	1.9%	15.0
2025	847.6	1.8%	15.7
2030	917.9	1.8%	16.5
2035	998.0	1.7%	17.4
CAGR			
2016 – 2020	**2.4%**		**1.9%**
2020 – 2025	**1.4%**		**0.8%**
2025 – 2030	**1.6%**		**1.0%**
2030 – 2035	**1.7%**		**1.1%**
2016 – 2035	1.7%		1.2%
Total Change in CLT Share		-10.0%	

Summary of International Connecting Traffic Forecast (millions)

Year	U.S. International Traffic	CLT Share	CLT International Connections
2016	102.3	1.5%	1.6
2017	105.2	1.5%	1.6
2020	118.3	1.5%	1.7
2025	142.7	1.4%	1.9
2030	169.9	1.2%	2.1
2035	201.3	1.1%	2.3
CAGR			
2016 – 2020	**3.7%**		**2.3%**
2020 – 2025	**3.8%**		**2.4%**
2025 – 2030	**3.5%**		**1.9%**
2030 – 2035	**3.4%**		**1.7%**
2016 – 2035	3.6		2.1%
Total Change in CLT Share		-25.0%	

Summary of Charlotte Douglas International Airport Forecast – FAA Template

	Forecast					Compound Annual Growth Rates			
	Base Year 2016	Base Year+1 2017	Base Year+5 2021	Base Year+10 2026	Base Year+15 2031	Base Year+1 2017	Base Year+5 2021	Base Year+10 2026	Base Year+15 2031
Passenger Enplanements									
Air Carrier	15,640,736	15,850,803	17,411,598	19,089,474	20,951,150	1.3%	2.2%	2.0%	2.0%
Commuter	6,533,011	6,895,699	7,398,772	7,864,182	8,374,605	5.6%	2.5%	1.9%	1.7%
Total	**22,173,747**	**22,746,502**	**24,810,370**	**26,953,656**	**29,325,755**	**2.6%**	**2.3%**	**2.0%**	**1.9%**
Aircraft Operations									
Air Carrier	400,819	409,357	438,230	469,999	501,066	2.1%	1.8%	1.6%	1.5%
Air Taxi	117,378	118,994	123,291	127,823	131,798	1.4%	1.0%	0.9%	0.8%
Subtotal	*518,197*	*528,351*	*561,520*	*597,822*	*632,864*	*2.0%*	*1.6%*	*1.4%*	*1.3%*
General Aviation	24,869	24,935	25,134	25,386	25,639	0.3%	0.2%	0.2%	0.2%
Military	2,676	2,676	2,676	2,676	2,676	0.0%	0.0%	0.0%	0.0%
Total Operations	**545,742**	**555,962**	**589,330**	**625,884**	**661,180**	**1.9%**	**1.5%**	**1.4%**	**1.3%**
Peak Hour Operations	114	116	*	*	*	1.8%			
Cargo/Mail									
Enplaned and Deplaned Tons	154,477	169,152	195,221	224,125	251,111	9.5%	4.8%	3.8%	3.3%
Operational Factors									
Average Aircraft Size (seats)									
Air Carrier	144	144	146	147	149	0.0%	0.3%	0.2%	0.2%
Air Taxi	59	59	61	62	63	0.0%	0.7%	0.5%	0.4%
Average Enplaning Load Factor									
Air Carrier	83.6%	83.7%	83.9%	84.2%	84.5%				
Air Taxi	80.2%	80.3%	80.7%	81.2%	81.4%				

Source: Airport Statistics data for 2016; InterVISTAS analysis for forecast

* Forecast peak hour was only estimated for 2028 (Build Year) and 2033 (Build Year +5). See Table 1-1.

Comparison of EIS and TAF Forecasts – FAA Template

	Year	EIS	FAA TAF	EIS vs TAF
Passenger Enplanements				
Base Year	2016	22,173,747	21,900,456	1.2%
Base Year + 1	2017	22,746,502	22,231,446	2.3%
Base Year + 5	2021	24,810,370	24,283,346	2.2%
Base Year + 10	2026	26,953,656	26,714,161	0.9%
Base Year + 15	2031	29,325,755	29,301,711	0.1%
Commercial Operations				
Base Year	2016	518,197	521,304	-0.6%
Base Year + 1	2017	528,351	532,647	-0.8%
Base Year + 5	2021	561,520	578,313	-2.9%
Base Year + 10	2026	597,822	632,765	-5.5%
Base Year + 15	2031	632,864	691,018	-8.4%
Total Operations				
Base Year	2016	545,742	548,653	-0.5%
Base Year + 1	2017	555,962	560,057	-0.7%
Base Year + 5	2021	589,330	605,921	-2.7%
Base Year + 10	2026	625,884	660,623	-5.3%
Base Year + 15	2031	661,180	719,127	-8.1%

Source: Airport statistics data for historical; U.S. DOT T100 data; InterVISTAS analysis for forecasts.
FAA TAF: https://www.faa.gov/data_research/aviation/taf/
Note: TAF has been converted to Calendar Years for comparison.