Chapter 2
Aviation Forecast

2.1 Introduction

This chapter contains aviation activity forecasts for the Airport over a 20-year planning period. Aviation demand forecasts are an important step in the master planning process as they form the basis for future demand-driven improvements at the Airport and provide data that is incorporated into other studies and policy decisions. This chapter presents aviation activity forecasts through 2037, using 2017 as a base year, and is organized as follows:

- Airport Classification
- General Aviation Trends
- User Survey
- Forecasting Approach
- Based Aircraft Forecast
- Based Aircraft Fleet Mix
- General Aviation Operations Forecast
- Military Operations Forecast
- Commercial Operations Forecast
- Instrument Operations Forecast
- Jet Operations
- Peak Operations Forecast
- Critical Aircraft
- Forecast Summary and TAF Comparison

The Federal Aviation Administration (FAA) projects future aviation activity within the Terminal Area Forecast (TAF), which are then compared to the forecasts in this chapter. Forecasts that are developed for airport master plans and/or federal grants must be approved by the FAA. It is the FAA's policy, listed in Advisory Circular (AC) 150/5070-6B, Airport Master Plans, that FAA approval of forecasts should be consistent with the TAF. Master plan forecasts for operations and based aircraft inventories are considered consistent with the TAF if they differ by less than ten percent in the five-year forecast period and less than fifteen percent in the ten-year forecast period. If the forecast is not consistent with the TAF, differences must be resolved or approved if the forecast data is to be used in FAA decision making. This chapter examines information that pertains to aviation activities and examines the projection of aviation demand. The forecasts contained in this chapter include industry-standard methodologies such as local and national trends, socioeconomic analysis, and federal and state projections.

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2.2 Airport Classification

The Airport has been owned and operated by the City since 1998 and serves a vital role in the regional transportation infrastructure while providing a buffer between the agricultural land to the north and west as well as the developed commercial and residential areas to the south and east. The 2017 - 2021 National Plan of Integrated Airport Systems (NPIAS) identifies 3,340 public use airports (3,332 existing and eight proposed) that contribute to the national air transportation system. This equals approximately 65% of the 5,136 public use airports and 17% of the 19,536 total U.S. airport facilities. The NPIAS is a report submitted to Congress by the FAA on a biannual basis that identifies airports included in the National Airspace System (NAS), discusses the various roles they serve, and determines development projects eligible for federal funding under the Airport Improvement Program (AIP).

Airports are grouped into two major categories under the NPIAS: primary and nonprimary. Primary airports have scheduled air carrier service and at least 10,000 annual enplaned passengers. General aviation (GA) aircraft typically use nonprimary airports, which are grouped into five categories: national, regional, local, basic, and unclassified. C29 is considered a regional GA airport. Of the 87 NPIAS airports in Wisconsin, 13 are classified as regional airports. Regional airports are located in or near metropolitan areas serving sizable populations and the FAA anticipates that these airports support regional economies with long distance flying and prominent levels of activity, including jet and multiengine aircraft. The 2017 FAA Terminal Area Forecast (TAF) records 87 based aircraft and 40,966 annual operations at C29.

In addition to federal planning, the Airport is also considered at a state level. The Wisconsin Department of Transportation recently updated the role of airport classifications in Wisconsin as part of their Wisconsin State Airport System Plan 2030. The updated classifications are based on a combination of both aviation and non-aviation factors, which consist of the following four primary performance categories:

- **Activity –** This evaluated such factors as the number and type of based aircraft, the number of annual operations, and the number of registered pilots within a 30-minute drive time.
- **Economics –** This category evaluated the percentage of itinerant operations, the gross regional product (GRP) within a 30-minute drive time, and the total retail sales within a 30-minute drive time.
- **Accessibility –** This category considered the population, the number of jobs, and the overall number of square miles that fell within a 30-minute drive time of the airport.
- **Facilities –** This category rated the airports based on their physical facilities such as runway length and precision approach capabilities.

Based on equal consideration of these categories, the Wisconsin State Airport System Plan 2030 categorizes C29 as a Large General Aviation Airport. Airports of this category support all GA aircraft and include daily operations of all types of business jets.

2.3 General Aviation Trends

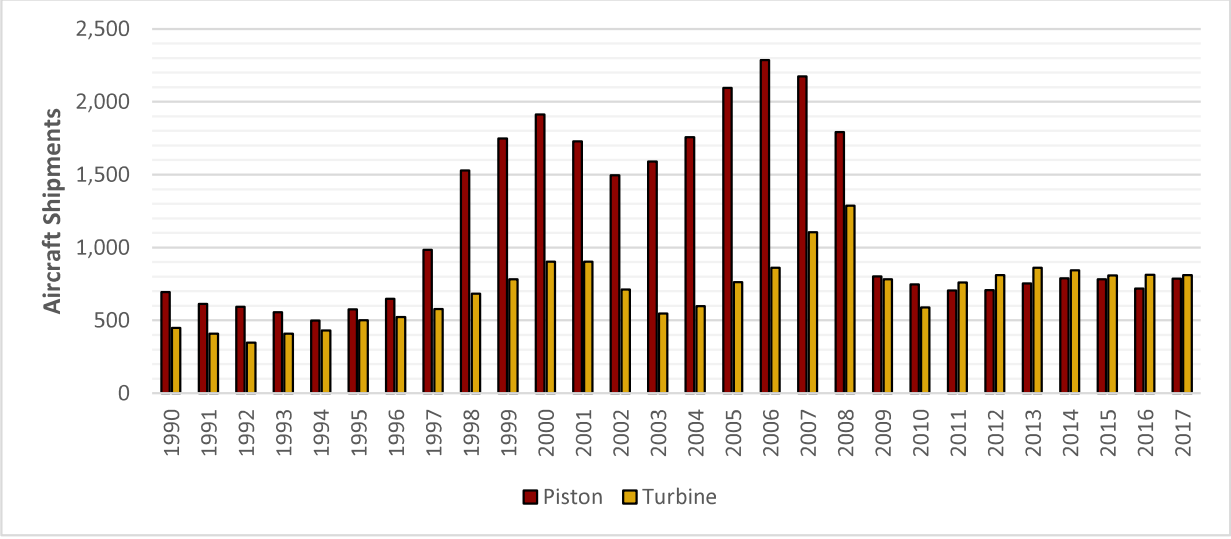
Projections of aviation demand presented in this chapter are informed by existing and historical industry wide trends. However, it is also important to understand current local changes. Local, regional, and national trends all have significant effects on the use of the Middleton Municipal Airport and economic impacts play

a considerable role in aviation forecast trends, due to the amount of business related travel that occurs at the Airport.

Operations at C29 have remained relatively stable over the past several decades. The Airport saw a notable increase from 41,610 operations in 2004 to 47,768 in 2009, before a decrease to 40,510 operations in 2010 following the 2008 recession, where annual operations remained until 2016. The following year saw the first year of operations growth as the 2017 TAF recorded 40,955 annual operations in 2017. However, hangars are currently at capacity and the Airport is unable to house additional aircraft. Interest has been expressed by local pilots and businesses in basing additional aircraft at C29 but the hangar area is completely built out and additional construction in this area is not feasible. Although national trends have seen a decline in recreational activity over the past several decades it is important to separate the economic impacts to the Airport from a lack of growth due to hangar capacity. There have been at least sixteen inquires from October 2017 to June 2018 and it is likely that existing built up demand would create at least a short term rapid increase in based aircraft as hangar space becomes available.

National trends and the changing industry may also impact the Airport over the long-term. There has been a national decrease in piston aircraft and active pilots over the past several decades. Between 1980 and 2009 pilot certification experienced a decrease of 28 percent. The rising cost of aircraft ownership and operation is a leading factor in declining pilot numbers and student pilots are not replacing retiring pilots at an effective rate. This is supported by decreasing instructional hours, the increasing average age of pilots, and a downward trend in student pilots. However, there are two primary areas of forecasted growth that may impact C29. The first is the increase in turbine aircraft. The FAA 2017 FAA Aerospace Forecast reports that in 2016, single-engine piston deliveries decreased by 7.4 percent while jet deliveries increased 1.8 percent. This reflects the post-recession trend of an increase in new turbine aircraft shipments surpassing piston aircraft shipments. This trend is illustrated in **Chart 2-1**, as reported by the General Aviation Manufactures Association (GAMA). Although turbine aircraft are becoming more prominent, the current runway length at C29 limits the size of aircraft able to utilize the Airport.

Chart 2-1: Aircraft Shipments by Type



Source: GAMA 2017 Annual Report

2.4 User Survey

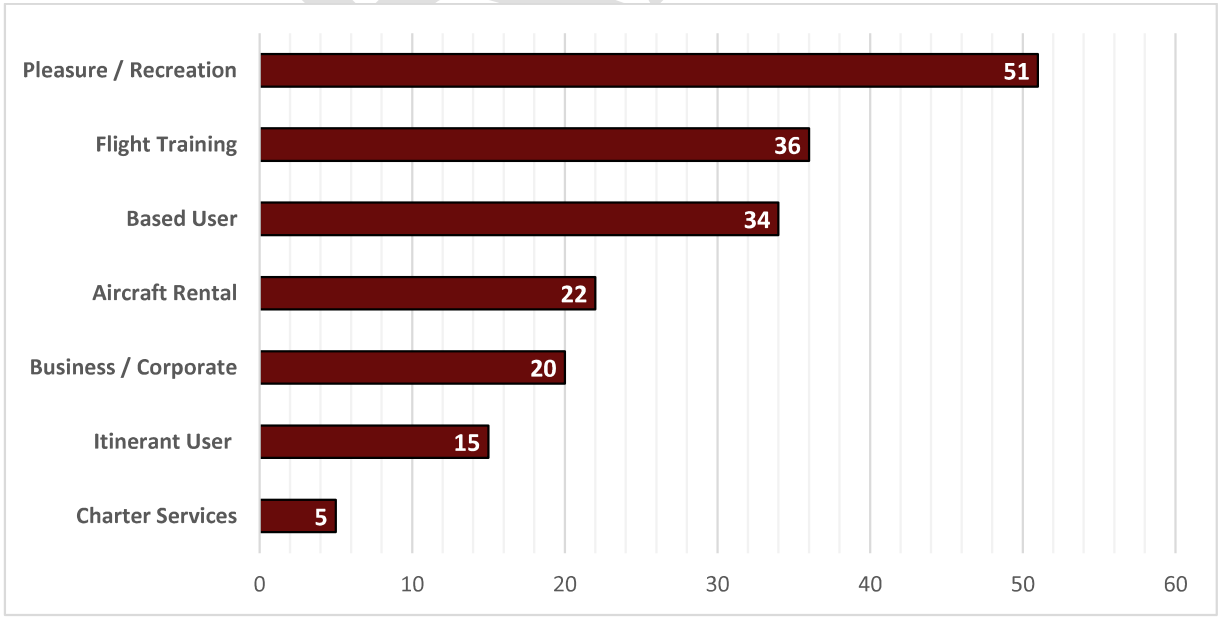
In May of 2018 an online survey was made available to local pilots to gather information about the frequency and types of use at C29. As of July 2018, a total of 91 responses have been gathered and this section summaries those relevant to this chapter. Responses related to runway length and other facility needs will be discussed in the following chapter.

2.4.1 Airport Use

Of those that responded, 61 stated that they use the Airport. This includes based, local and itinerant users and **Chart 2-2** shows the variety of activities the Airport supports. Please note that users could select all use types relevant to them, so totals are greater than 61. Recreation is the most prominent use while the Airport also supports activity by based users and for flight training. It is worth noting that as based aircraft users make up a sizable portion of activity at the Airport it is logical to assume that the Airport could see a significant increase in operations if additional hangars are constructed. Business aviation makes up a smaller portion of activity but still maintains a strong presence on the Airport. Users were then asked to further define any other uses and to describe any importance of the Airport for their business use.

Several users stated that they visit the Airport to attend various community events, such as Young Eagles and for the local chapter of the Experimental Aircraft Association (EAA). Pilots also make use of the Airport for mechanical assistance, fueling or other maintenance services. In addition to supporting recreation, flight training and community events, the users also made it clear that the Airport bolsters local business. Twenty-six respondents emphasized that it was very important to their business. The Airport reportedly saves time when arriving in the area for business and users will also use their hangar as a meeting area upon arrival. Due to the time savings of flying directly into the area it creates a more cost effective manner to visit the area. The Airport's proximity to the City of Madison provides a convenient but uncongested method of accessing the area.

Chart 2-2: Airport Use



2.4.2 Fleet Mix

The Airport master record indicates that as of June 2018 the majority of aircraft based at the Airport are single engine aircraft, although two jets and eight multiengine aircraft are present. Survey responses closely aligned with this trend as the vast majority of aircraft used at C29 were single engine piston aircraft. However, some larger aircraft operating at the Airport include the Cessna 340, 310, Caravan, Citation Mustang and the Learjet 45. Pilots with larger aircraft stated that they may base these aircraft at other airports with larger runways and only use them at C29 when conditions allow.

2.4.3 Operations and Trip Length

Users estimate that they conduct between 3,150 - 3,781 annual operations. A total of 68 percent of respondents stated they anticipate their operations to increase in the future and 40 percent expect to purchase another aircraft. Existing respondents' aircraft are generally similar, normally single engine piston aircraft and all of which are less than 12,500 pounds. However, trip length varies considerably, as shown in **Table 2-1**. A large portion of users conduct trips less than 250 miles although trips lengths as great as 1,000 miles are not uncommon. For reference, the maximum range of a C172 in still air is approximately 730 miles. This would indicate that pilots are using their aircraft to their maximum range or stopping to refuel while operating out of C29.

Table 2-1: Percentage of Operation by Trip Length (by % of respondents)

Trip Length	0%	> 0% - 25%	25% - 50%	50% - 75%	75%
< 100	4%	19%	21%	14%	39%
100 - 250	7%	42%	21%	4%	7%
250 - 500	14%	42%	16%	0%	2%
500- 750	25%	32%	5%	0%	0%
750 - 1,000	28%	26%	0%	0%	0%
> 1,000	30%	21%	2%	0%	0%

2.4.4 Conclusion

Airport users indicate that the Airport is generally meeting their needs in relation to their current operations, as the fleet mix of respondents tends to be single engine piston aircraft. The few turbine users that operate at the Airport state that their operations are limited due to runway length, but it is often more than adequate for piston users. Operations are expected to increase as pilots continue to utilize the Airport and additional aircraft are added based on hangar availability. The following chapter will provide a more focused examination of hangar, runway and other facility needs.

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2.5 Forecasting Approach

Several forecasting techniques may be used to project aviation activity that ranges from subjective judgment to sophisticated mathematical modeling. These forecasts incorporate local and national industry trends in assessing current and future demand. Socioeconomic factors such as local population, retail sales, and employment have also been analyzed for their relationship with the levels of aviation activity. FAA forecasts, market share methodologies, and socioeconomic methodologies are used to develop forecasts for C29 and are described in the following sections.

2.5.1 FAA Forecast Analysis

Historical and projected aviation activity is reported by the FAA in the TAF. Typical forecasting approaches may be deemed less valid due to recent fluctuations in aviation related activity at both a local and national level or if the TAF is deemed to not reflect current trends. In some instances, the TAF is reviewed and may be used for purposes of long-range planning.

2.5.2 Growth Rate

This methodology uses the growth rates projected by relevant planning documents and applies these growth rates to activity at C29. These growth rates are often gleaned from state or federal planning documents such as the FAA TAF, FAA Aerospace Forecast, or the State Aviation System Plan (SASP). Once the growth rates relevant to C29 are determined they are applied to various types of aviation activity at the Airport.

2.5.3 Market Share Methodology

Market share, ratio, or top-down methodologies compare local levels of activity with a larger entity. Such methodologies imply that the proportion of activity that can be assigned to the local level is a regular and predictable quantity. This method has been used extensively in the aviation industry to develop forecasts at the local level. Historical data is most commonly used to determine the share of total national traffic activity that will be captured by a particular region or airport.

2.5.4 Regression Analysis

Regression analyses examine the direct relationship between two or more sets of historical data. Local socioeconomic conditions examined in this chapter include population, total employment, and total retail sales for Dane County. Historical and forecasted socioeconomic statistics for Dane County were obtained from the economic forecasting firm Woods & Poole Economics, Inc. and are shown in **Table 2-2**. The relationship between aviation activity at the Airport and socioeconomic data is measured by determining how changes to one variable impact the other. This is measured with the R^2 value where a result of 1 implies a perfect relationship, with each variable perfectly influencing and driving the other, while 0 means no relationship. Future aviation activity projections were developed based on the observed and projected relationship between historical aviation activity and the socioeconomic data sets.

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Table 2-2: Local Socioeconomic Factors - Dane County, WI

Year	Population	Employment	Total Personal Income ($2009)	Income Per Capita ($2009)
Historical				
2007	471,644	386,540	$21,703,897,000	$46,018
2008	471,644	387,067	$21,615,560,000	$45,241
2009	477,791	378,960	$21,189,464,000	$43,692
2010	484,979	378,961	$21,257,913,000	$43,455
2011	489,190	388,220	$22,317,488,000	$44,953
2012	496,460	395,794	$23,047,582,000	$45,780
2013	503,438	401,163	$23,673,109,000	$46,417
2014	510,007	410,783	$24,349,239,000	$47,143
2015	516,494	420,074	$25,859,633,000	$49,456
2016	522,878	432,105	$26,485,955,000	$49,854
2017	531,273	445,940	$27,158,552,000	$50,577
Projected				
2022	536,975	484,537	$30,623,737,000	$53,890
2027	568,267	520,686	$34,149,177,000	$56,849
2032	600,701	554,700	$37,612,234,000	$59,388
2037	633,330	584,248	$40,945,814,000	$61,630
CAGR	***0.60%***	***0.72%***	***1.13%***	***0.47%***

Source: Woods & Poole Inc.

2.6 Based Aircraft Forecast

Based aircraft determine many facility requirements. As local aircraft will usually desire hangars due to the Wisconsin winters and other weather hazards, based aircraft are often the driving factor in determining hangars, the dimensions and layout of supporting taxiway and taxilanes, as well as other facilities. This section utilizes the aforementioned methodologies to examine historical and future based aircraft counts.

2.6.1 FAA TAF

The FAA defines a based aircraft at an airport as an aircraft that is "operational & air worthy" and typically based at the airport for a majority of the year. The current FAA 5010 Airport Master Record notes an inspection date of May 24, 2018 and notes the following based aircraft: 81 single-engine aircraft, 2 jets, 8 multi-engine aircraft, and 3 helicopters, for a total of 94 aircraft. Data in the FAA's TAF differs from the FAA 5010 Airport Master Record. The FAA TAF notes the following 2017 based aircraft: 76 single-engine aircraft, 2 jets, 7 multi-engine aircraft, and 2 helicopters, for a total of 87. No growth is projected by the TAF in any category and forecasts 87 total aircraft for the duration of the planning period.

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Methods for reporting based aircraft at airports have changed in recent years, and this is reflected in the wide fluctuations in the historical TAF data for based aircraft at C29. Historical TAF records show an increase from 39 to 63 aircraft from 2004 to 2005, 60 to 74 from 2011 to 2012, and 72 to 86 from 2014 to 2015. Although the TAF is the source for historical based aircraft numbers, the Airport Master Record is used in this chapter for the current aircraft count due to its more frequent updates and local focus. It is recommended that the Airport work with the Wisconsin Bureau of Aeronautics and the FAA to bring the 5010 Master Records and the TAF into conformity with the latest aircraft inventories completed.

2.6.2 Growth Rate

The growth rates from the FAA 2017 TAF and 2017 Aerospace Forecast were determined and then applied to the based aircraft counts at C29. Each of these forecast documents have individual advantages. The 2017 FAA TAF forecasts total based aircraft by region and is therefore more relevant to activity at C29 than a national forecast. The TAF projects total based aircraft within the Great Lakes region while the 2017 Aerospace Forecast projects active aircraft by specific aircraft type. Each of the respective growth rates in these planning documents are applied to aircraft at C29 and can be seen in **Table 2-3**.

Table 2-3: Based Aircraft Forecast – Growth Rate

Year	National Growth	Regional Growth
2017	94	94
2022	91	97
2027	88	100
2032	85	103
2037	83	106
CAGR	***-0.65%***	***0.61%***

Source: 2017 FAA TAF, 2017 FAA Aerospace Forecast, Mead & Hunt.
Notes: Regional growth derived from TAF and national growth derived from Aerospace Forecast

2.6.3 Market Share

The market share methodology compares local based aircraft at the Airport to a greater whole, such as regional or statewide based aircraft. A review of aircraft based in the Great Lakes FAA regional district from 2010 to 2017 indicates the market share of C29 has grown from 0.22 percent in 2010 to 0.33 percent in 2017. The 2017 market share is applied to the forecasted total aircraft for the duration of the planning period and shown in **Table 2-4**.

Table 2-4: Based Aircraft Forecast – Market Share

Year	C29 Aircraft	Great Lakes	Market Share
2017	94	28,538	0.33%
2022	97	29,486	0.33%
2027	100	30,391	0.33%
2032	103	31,299	0.33%
2037	106	32,219	0.33%
CAGR	***0.62%***	***0.61%***	***N/A***

Source: 2017 FAA TAF, 2017 FAA Aerospace Forecast, Mead & Hunt.

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2.6.4 Regression Analysis

As described above, this section compares socioeconomic data to historical based aircraft to determine their relationship. The population, total employment, and total retail sales for Dane County are compared to historical based aircraft since 1980. The relationship with each of the socioeconomic conditions are shown by the R^2 value in **Table 2-5**. Although R^2 values vary, none exceed the 0.9 value desired before using these values to project future aviation activity. Currently, 94 aircraft are based at the Airport, which is greater than socioeconomic data would currently indicate. Therefore, each of the regression analysis used in this section forecast fewer number of aircraft initially than currently exist at the Airport. To correct for this and produce a more stable trend, the compound annual growth rates (CAGR) of each of the regression analysis forecasts have instead been applied to the existing aircraft to result in more realistic growth over the planning period. These modified forecasts are shown below in **Table 2-6**.

Table 2-5: Based Aircraft Forecast – Regression Analysis R^2 Values

Socioeconomic Value	R^2 Value
Population	0.27
Total Personal Income	0.20
Employment	0.28
Income per Capita	0.17
Multivariate – Population and Employment	0.56

Source: Woods & Poole Inc.
Notes: Income uses 2009 dollars

Table 2-6: Based Aircraft Forecast – Modified Regression Analysis

Year	Population	Employment	Total Personal	Income Per Capita
2017	94	94	94	94
2022	99	98	100	97
2027	105	103	106	100
2032	111	108	113	103
2037	118	113	121	106
CAGR	***1.14%***	***0.91%***	***1.25%***	***0.62%***

Source: 2017 FAA TAF, 2017 FAA Aerospace Forecast, Mead & Hunt.

2.6.5 Demand Based Forecast

One of the shared limitations of many industry standard methodologies is that they usually seek to establish a growth rate or steady relationship with local socioeconomic conditions in order to project future operations. Due to this approach, they are unable to account for changes in the market or existing airport limitations. Since hangar space at C29 is limited aircraft are unable to be based at the Airport despite existing demand. The user survey, discussed in **Section 2.4**, records that 18 respondents stated they would consider basing their aircraft at C29 if hangar space was available. This, in conjunction with the 16 inquires regarding hangar space over the past year, indicate that if hangar space was suddenly available the based aircraft would likely increase in manner previous methodologies are unable to capture.

Therefore, this forecast uses the user survey and hangar inquires as the basis for establishing demand in the short term before returning future growth to expected regional trends. To establish an uninhibited forecast based on demand, instead of existing constraints, this forecast also assumes jet aircraft would be

uninhibited by future runway length. As stated in the user survey, jet aircraft occasionally operate at C29 but are based elsewhere as weather or a contaminated runway may inhibit their operations at C29.

This forecast projects growth in three ways. The first is that it follows the baseline of organic regional growth established by the TAF, as discussed in **Section 2.6.2**. This forecast provides a growth rate independent from the particular conditions at C29 and is reflective of the larger aviation industry. Second, the existing known demand is phased into the Airport over time. A total of 18 user survey respondents stated they would be interested in basing their aircraft at C29 but it assumed not every one of them would make an immediate transition. As at least sixteen inquiries have been made over the past year for hangar space it is expected that demand would be high in the first five years before slowly declining. Future aircraft transitioning from another airport to C29 in the long term would likely come from the Dane County Regional Airport (MSN), as C29 is able to act as reliever for business growth in the metropolitan area. The final type of growth would be based on jet aircraft which are expected to be one of the most rapidly growing aircraft types during the planning period. The 2017 FAA TAF projects an increase from 14,100 based jet aircraft in 2017 to 22,040 in 2037, a CAGR of 2.26%. Therefore, the final type of increase applies this growth rate to the existing two jets at C29, which is shown with a single decimal place to better depict incremental growth. Note that some of the demand based increase would also include jets. Finally, as based jet growth is forecasted separately, the existing two jet aircraft have been removed from the current TAF count. These combined types of growth can be seen below in **Table 2-7**.

Table 2-7: Based Aircraft Forecast – Demand Based Forecast

Year	TAF Based Growth Rate (excludes jets)	Demand Based Increase	TAF Based Jet Growth	Demand Based Forecast
2017	92	-	2.0 (2)	**94**
2022	95	16	2.2 (2)	**115**
2027	98	3	2.5 (3)	**124**
2032	101	2	2.8 (3)	**131**
2037	104	1	3.1 (3)	**139**
CAGR	***0.61%***	**-**	***2.26%***	***1.96%***

Source: 2017 FAA TAF, 2017 FAA Aerospace Forecast, Mead & Hunt.

2.6.6 Based Aircraft Preferred Forecast

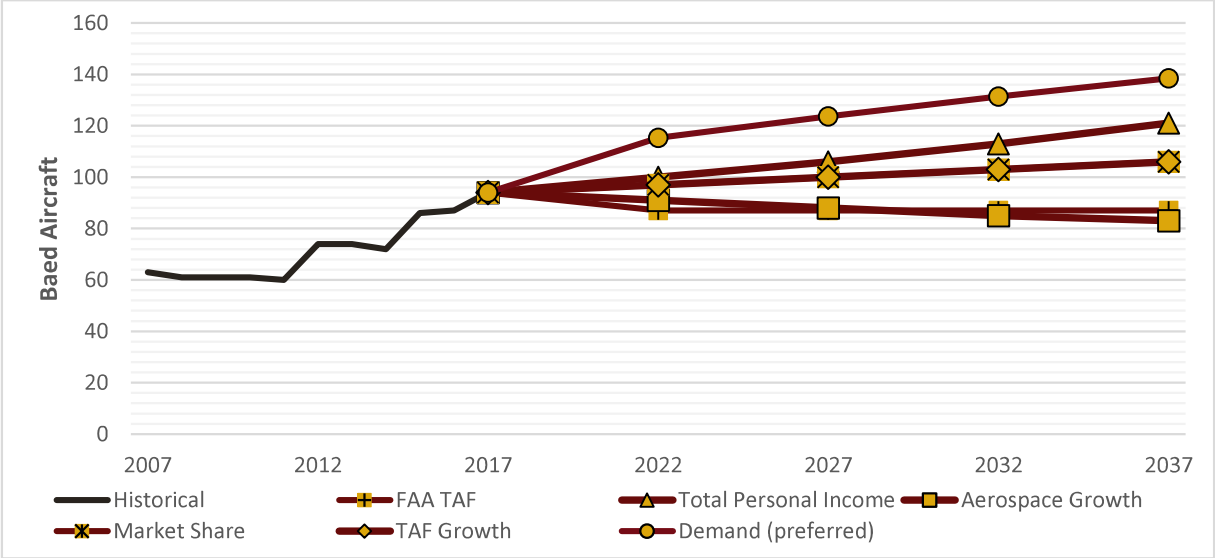
Although several of the regression analysis forecast project reasonable results, the strength of the relationship between socioeconomic data and historical based aircraft is not sufficient to use this as a method to project future activity. This may be partially due to variation between actual based aircraft counts and the number recorded by the annual FAA TAF. However, for this reason the regression analysis forecasts were dismissed from consideration. This also means the FAA TAF, which projects 87 aircraft for the duration of the planning period, does not reflect current conditions and it is unlikely it projects future activity. Recent trends show steady growth for the previous decade. Therefore, as the TAF is not thought to accurately reflect historic trends, this forecast was dismissed from consideration. While the market share forecast projects reasonable growth, this alone is not a reason to select a forecast. Market share forecasts are preferred when conditions remain the same and the market share at C29 has grown steadily over the past decade. Therefore, this forecast was dismissed from consideration.

Finally, the two growth rate forecasts each depict a different direction of growth. The 2017 FAA Aerospace forecast depicts a reduction in aircraft based on growth rates applied to individual aircraft types. However, this does not account for changes in the GA community, such as the introduction of light sport aircraft , which are expected to become a larger portion of the fleet in the future. In addition, this forecast does not reflect historical trends. For these reasons it was dismissed from consideration. Finally, the FAA TAF forecast derived from the growth rate of the total based aircraft within the Great Lakes region is used to project future growth at C29. Although this is reflective of the region as a whole it does not account for the particular conditions at C29. As stated in Section 2.6.5, these methodologies are unable to account for the existing demand and limitation due to hangars and runway length. As the demand based forecast is able to account for the current demand at C29 while also considering regional growth reflected in the TAF it is selected as the preferred forecast. Each of the forecasts from this section are presented below in **Table 2-8,** and **Chart 2-3** shows selected forecasts. Please note that the table has been reoriented for space.

Table 2-8: Based Aircraft Forecast Summary

Year		2017	2022	2027	2032	2037	*CAGR*
FAA TAF		94	87	87	87	87	***-0.39%***
Market Share		94	97	100	103	106	***0.60%***
Regression Analysis	**Population**	94	99	105	111	118	***1.14%***
	Employment	94	98	103	108	113	***0.92%***
	Total Personal Income	94	100	106	113	121	***1.27%***
	Income Per Capita	94	97	100	103	106	***0.60%***
Growth Rate	**FAA Aerospace**	94	91	88	85	83	***-0.62%***
	FAA TAF	94	97	100	103	106	***0.60%***
Demand Based (preferred)		**94**	**115**	**124**	**131**	**139**	***1.96%***

Chart 2-3: Based Aircraft Forecast



Source: 2017 FAA TAF, 2017 FAA Aerospace Forecast, Mead & Hunt.
Note: The market share and TAF based growth forecast are collocated and are only partially visible.

2.7 Based Aircraft Fleet Mix

As the type of aircraft based at the Airport will impact the type and location of hangars and other facilities, it is important to consider the specific types of aircraft anticipated at the Airport. It is worth noting that although only two jets are currently based at the Airport, the length of the runway limits the potential for jet aircraft. Although runway length needs will be discussed in greater detail in Chapter 3, *Facility Requirements*, a potential runway extension would increase the likelihood of jet aircraft based at the Airport. Aviation supports regional business, and nearby Dane County Regional Airport (MSN) shows 18 based jets. The Airport could likely play a reliever role to MSN while also supporting nearby business. Finally, as discussed above, piston aircraft are becoming less common due to their comparative cost to operate. These trends are reflected in the anticipated fleet mix shown below in **Table 2-9**.

Table 2-9: Projected Fleet Mix

Year	Single		Jet		Multiengine		Helicopter		Total
	#	%	#	%	#	%	#	%	
2017	81	86.2%	2	2.1%	8	8.5%	3	3.2%	94
2022	97	84.0%	5	4.5%	9	7.5%	5	4.5%	115
2027	102	82.0%	6	5.0%	10	8.0%	6	5.0%	124
2032	106	80.7%	7	5.3%	11	8.5%	7	5.5%	131
2037	111	79.5%	8	5.5%	13	9.0%	7	6.0%	139

2.8 General Aviation Operations Forecast

GA operations at the Airport have rebounded since the 2008 recession. In 2007 the FAA TAF recorded 46,308 operations, which later decreased to 40,500 in 2010. However, GA operations have recently began to increase and 2017 saw the first year of recorded growth with 40,945 annual GA operations, which includes both itinerant and local GA operations. This section uses various methodologies to project future GA operations.

2.8.1 FAA TAF

The FAA TAF divides operations into air taxi, local, and itinerant GA operations. Air taxi operations can include operations such as unscheduled passenger service on small aircraft and are included in the itinerant operations. The TAF anticipates both of these GA categories to grow steadily during the planning period, as shown in **Table 2-10**.

Table 2-10: GA Operations – FAA TAF

Year	Itinerant	Local	Total
2017	15,673	25,272	40,945
2022	16,578	26,680	43,258
2027	17,529	28,171	45,700
2032	18,541	29,740	48,281
2037	19,626	31,380	51,006
CAGR	***1.13%***	***1.09%***	***1.10%***

Source: 2017 FAA TAF

2.8.2 Regression Analysis

Similar to based aircraft, the relationship between socioeconomic conditions and operations were examined. Likewise, the R^2 values, shown in **Table 2-11**, are not sufficient to determine future operations and this methodology was no longer considered.

Table 2-11: GA Operations – Regression Analysis

Socioeconomic Value	R^2 Value
Population	0.13
Total Personal Income*	0.18
Employment	0.18
Income per Capita*	0.12
Multivariate – Population and Employment	0.10

Source: Woods & Poole Inc.

2.8.3 Growth Rate

The 2017 FAA Aerospace projects operations based on the specific type of operation and this methodology applies these growth rates to the itinerant and local operations. This results in modest growth for the duration of the planning period, as seen in **Table 2-12**.

Table 2-12: GA Operations – Growth Rate

Year	Itinerant	Local	Total
2017	15,673	25,272	40,945
2022	15,887	25,738	41,625
2027	16,104	26,213	42,317
2032	16,324	26,697	43,021
2037	16,547	27,190	43,736
CAGR	***0.27%***	***0.37%***	***0.33%***

Source: 2017 FAA Aerospace Forecast

2.8.4 Operations Per Based Aircraft

An Operations Per Based Aircraft (OPBA) forecast uses the current number of aircraft at the airport as a benchmark to project the total number of operations at the Airport. FAA Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems (NPIAS)*, states that "a general guideline is 250 operations per based aircraft for rural GA airports, 350 operations per based aircraft for busier GA airports, and 450 operations per based aircraft for busy reliever airports." Due to the location of C29 near MSN and the City of Madison, the Airport would fall in the final category. A review of the TAF for the past five years also indicates than an average of 503 annual operations has occurred per based aircraft. In order to provide a more conservative number in agreement with the guidance, 450 operations have been applied to the preferred based aircraft forecast below in **Table 2-13**.

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Table 2-13: GA Operations Forecasts – OPBA

Year	Based Aircraft	GA Operations
2017	94	40,945
2022	115	51,750
2027	124	55,800
2032	131	58,950
2037	139	62,550
CAGR	***1.96%***	***2.14%***

Source: 2017 FAA TAF, basedaircraft.com, Mead & Hunt

2.8.5 GA Operations Preferred Forecast

This section selects a preferred GA operations forecast and the forecasts presented in this section can be seen in **Table 2-14** and **Chart 2-4**. While the growth rate methodology results in a reasonable, if modest, growth for the duration of the planning period, it relies on national trends that may not reflect local conditions. The regression forecasts account for local conditions but a meaningful relationship between socioeconomic activity and GA operations was not established, although the regression analysis employment-based forecast is shown as an example. The TAF projects future operations growing by 1.10 percent for the duration of the planning period. However, similar to the based aircraft forecast, these methodologies are unable to account for existing constraints on the Airport. As the number of based aircraft increase it is reasonable that the number of operations would also increase. For this reason, the OPBA forecast is selected as the preferred forecast.

Table 2-14: GA Operations Forecasts

Year	FAA TAF	Growth Rate	Regression - Employment	OPBA (preferred)
2017	40,945	40,945	40,945	**40,945**
2022	43,258	41,625	44,558	**51,750**
2027	45,700	42,317	45,117	**55,800**
2032	48,281	43,021	45,643	**58,950**
2037	51,006	43,736	46,099	**62,550**
CAGR	***1.10%***	***0.33%***	***0.59%***	***2.14%***

Source: 2017 FAA TAF, 2017 FAA Aerospace Forecast, basedaircraft.com, Mead & Hunt

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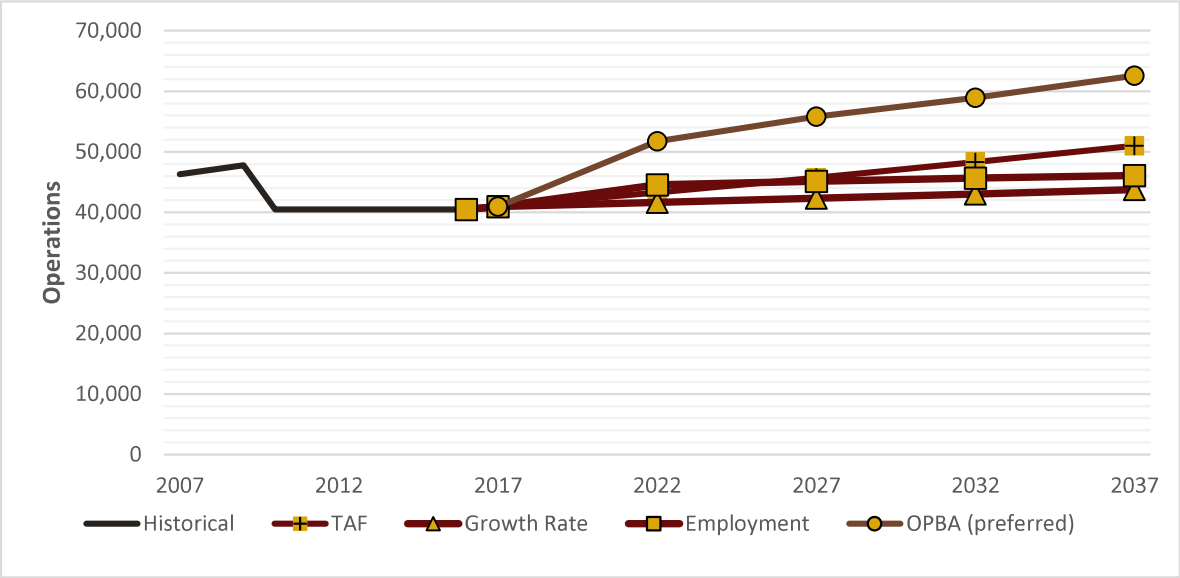
Chart 2-4: GA Operations Forecasts



Source: 2017 FAA TAF, 2017 FAA Aerospace Forecast, Mead & Hunt

2.9 Military Operations Forecast

Military operations have historically made up a small portion of total operations at C29 and have remained less than one percent of annual operations for the past decade. As military operations are driven more by national security policy decisions and the local mission requirements of nearby military units, instead of economic factors or local conditions, the TAF is the preferred forecast for military operations. The 2017 TAF projects 10 annual military operations for the duration of the planning period.

2.10 Commercial Operations Forecast

Air taxi activity has remained steady at approximately 2,500 annual operations for the past decade, or approximately 5 percent of total operations. As turbine aircraft become increasingly common, it is expected that air taxi operations will grow in the future. The 2017 FAA Aerospace Forecast projects that the total GA and air taxi fleet will increase modestly, with piston aircraft decreasing and turbine aircraft, including helicopters, compensating for this decline. Hours flown are anticipated to increase 0.94 percent over the planning period and this growth has been applied to existing air taxi operations in **Table 2-15**.

Table 2-15: Air Taxi Operations Forecast

Year	Aerospace Forecast
2017	2,500
2022	2,620
2027	2,745
2032	2,877
2037	3,014
CAGR	***0.94%***

Source: 2017 FAA TAF, 2017 FAA Aerospace Forecast, Mead & Hunt

2.11 Instrument Operations Forecast

Instrument operations provide equipped aircraft with either radio or global positioning signals to navigate and conduct approaches to runways during poor weather conditions. Most instrument operations are conducted by commercial operators as recreational pilots are less likely to fly during poor weather conditions. In order to project future instrument operations, the average annual instrument operations from the past decade was applied to total operations. This process can be seen in **Table 2-16**.

Table 2-16: Instrument Operations Forecast

Year	IFR Operations		VFR Operations		Total Operations
	#	%	#	%	
2007	2,528	5.5%	43,780	94.5%	46,308
2008	3,276	7.0%	43,751	93.0%	47,027
2009	3,196	6.7%	44,562	93.3%	47,758
2010	3,396	8.4%	37,104	91.6%	40,500
2011	3,042	7.5%	37,458	92.5%	40,500
2012	3,084	7.6%	37,416	92.4%	40,500
2013	2,878	7.1%	37,622	92.9%	40,500
2014	2,716	6.7%	37,784	93.3%	40,500
2015	3,206	7.9%	37,294	92.1%	40,500
2016	2,740	6.8%	37,760	93.2%	40,500
2017	2,624	6.4%	38,321	93.6%	40,945
Average	***2,971***	***7.0%***	***39,350***	***93.0%***	***42,322***
2022	3,623	7.0%	48,137	93.0%	51,760
2027	3,907	7.0%	51,903	93.0%	55,810
2032	4,127	7.0%	54,833	93.0%	58,960
2037	4,379	7.0%	58,181	93.0%	62,560

Source: Traffic Flow Management System Counts (TFMSC) Database
Note: Totals include military aircraft and therefore differ from Table 2-14

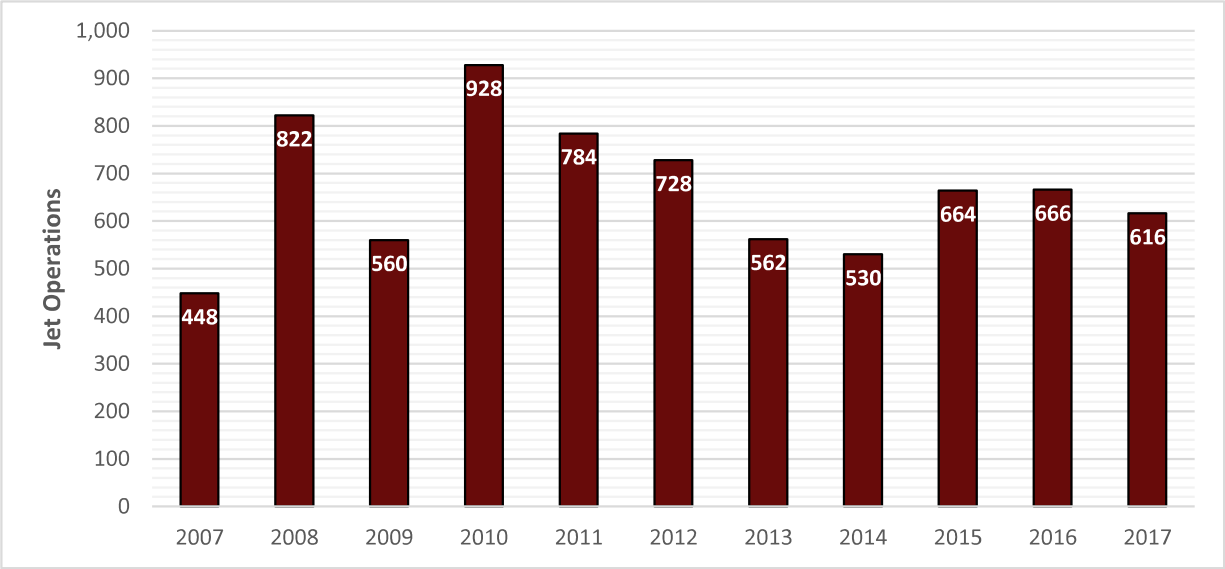
2.12 Jet Operations

Operations by business jet aircraft are often the most demanding at GA airports. These aircraft will impact runway length, taxiway and taxilane widths, and other facilities. This section discusses the existing and future jet operations before selecting a design aircraft in the following section.

2.12.1 Historic Jet Operations

Jet, or turbine, operations are surveyed through the use of the FAA Traffic Flow Management System (TFMSC) Database, which provides detailed information on operations that file a flight plan, as do the vast majority of jet operations. Jet operations over the past decade are shown in **Chart 2-5**. Although punctuated by years of high activity, such as 2008 and 2010, jet operations have otherwise remained relatively stable with a modest increase from 448 operations in 2007 to 616 to 2017.

Chart 2-5: Historical Jet Operations



Source: TFMSC Database

2.12.2 Future Jet Operations

Operations of turbine aircraft are anticipated to increase in the future as business aviation becomes more prominent. The 2017 FAA Aerospace Forecast states the following on this topic:

> *"Operations at FAA and contract towers are forecast to increase 0.8 percent a year over the forecast period with commercial activity growing at five times the rate of noncommercial activity. The growth in U.S. airline and business aviation activity is the primary driver. Large and medium hubs will see much faster increases than small and non-hub airports, largely due to the commercial nature of their operations."*

As C29 is a comparatively smaller airport, it is expected that total operations growth will remain modest, but that turbine and business aviation will increase at a more rapid rate. As turbine operations are usually closely tied to business growth in the area, the methodologies in this section use federal forecasts and local socioeconomic data, as available, that reflect potential business growth.

Growth Rate

Although the turbine fleet is expected to only grow modestly, the 2017 FAA Aerospace Forecast expects new aircraft to fly more often and conduct additional operations per year. National fixed-wing turbine hours are compared to existing operations and the growth rate from each respective period is applied to C29 jet operations. This forecast assumes that the ratio of operations to hours flown will remain constant for the planning period and is shown in **Table 2-17**.

Table 2-17: Jet Operations – Growth Rate

Year	C29 Jet Operations	National Turbine Hours Flown*
2017	616	6,983
2022	706	8,007
2027	789	8,949
2032	888	10,070
2037	966	11,296
CAGR	***2.43%***	***2.43%***

Source: 2017 FAA Aerospace Forecast, Mead & Hunt
Notes: Operations are for fixed-wing turbine aircraft only and are in thousands of hours

Operations Ratio

As the number of operations may not increase at the same rate as hours flown, this alternative methodology establishes a ratio of operations to hours flown. In the past five years there was an average of 0.0931 jet operations for every 1,000 jet hours flown nationally. This ratio is applied to future national trends in **Table 2-18** and results in 1,052 operations by 2037.

Table 2-18: Jet Operations – Growth Rate

Year	C29 Jet Operations	National Turbine Hours Flown*	Average Operations per 1,000 hours
2010	928	5700	0.1628
2011	784	5871	0.1335
2012	728	6151	0.1184
2013	562	6076	0.0925
2014	530	6494	0.0816
2015	664	6375	0.1042
2016	666	6712	0.0992
2017	616	6,983	0.0882
Average	**N/A**	**N/A**	**0.0931**
2022	746	8,007	.0931
2027	834	8,949	
2032	938	10,070	
2037	1,052	11,296	
CAGR	***2.71%***	***2.43%***	**.0931**

Source: 2017 FAA Aerospace Forecast, Mead & Hunt

Regression Analysis

Similar to previous regression analysis forecasts, this methodology compares jet operations to local socioeconomic data to establish a relationship. The relationship between each of the tested variables is shown in **Table 2-19**. Although the relationship is low for each of these variables, it should be noted that the lower number of jet operations and limited 10-year period of data used makes it more difficult to establish a reliable relationship to the surrounding community and does not necessarily depict the long-term relationship between business aviation and the community.

Table 2-19: Jet Operations – Regression Analysis

Socioeconomic Value	R^2 Value
Total Personal Income*	0.10
Employment	0.06
Income per Capita*	0.06
Total Earnings*	0.07

Source: Woods & Poole Inc.

Jet Operations Preferred Forecast

As the regression analysis does not establish reliable trends with local conditions, that methodology was not considered. While the turbine fleet is expected to increase over time, the growth rate may not perfectly mirror the hours flown by the national fleet, as hours may vary by particular aircraft and mission type. Therefore, the growth rate forecast was no longer considered. Finally, while the operations ratio forecast is not able to perfectly account for the variation in hours flown by aircraft, this problem is mitigated by taking the average from the past five years and applying it to local operations. This forecast also aligns with expected local trends and is therefore selected as the preferred forecast.

2.13 Peak Operations Forecast

Annual forecasts of aircraft operations may not adequately describe the complex needs of airport facilities. Annual metrics are only useful when activity tends to be evenly distributed over the hours, days, and months of the year. However, most airports have peak periods when demand surpasses annual averages. As a result, it is important to identify and forecast peak period activity levels. Peak forecasts are presented in the following sections so that Chapter 3, *Facility Requirements*, can determine what facilities will be required to accommodate the peak demand. However, if planning is contingent on the absolute busiest periods of activity, it can lead to overestimation, overspending, and inefficiencies. As a result, these peak activity forecasts focus on the average day during the peak months for passenger and aircraft activity, rather than the absolute peak day. Peak activity forecasts should identify the "design hour" flow of aircraft. The design hour is an estimate of the peak hour of the average day of the busiest month. This approach provides sufficient facility capacity for most days of the year. The first step in this process is to determine the peak month. During the previous decade July was most frequently the peak month, with an average of 12.0 percent of annual enplanements, as shown in **Table 2-20**.

Table 2-20: Historic Monthly Operations

Month	Year										
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Jan	6.1%	4.3%	5.3%	6.3%	5.8%	6.1%	6.8%	4.2%	5.0%	5.2%	4.6%
Feb	5.9%	4.5%	5.1%	4.6%	5.0%	6.0%	5.3%	4.8%	4.9%	6.1%	5.8%
Mar	8.5%	8.2%	6.0%	7.5%	7.0%	7.8%	7.3%	6.5%	8.2%	7.1%	6.4%
Apr	8.2%	8.3%	5.9%	9.5%	7.6%	9.0%	5.5%	7.3%	8.6%	8.2%	8.6%
May	10.6%	9.3%	11.1%	9.9%	9.3%	10.2%	10.8%	11.5%	9.6%	9.5%	10.4%
Jun	10.5%	9.2%	11.1%	11.3%	11.2%	10.3%	11.0%	11.0%	10.2%	10.5%	10.0%
Jul	**11.5%**	**11.6%**	**11.5%**	**10.4%**	**11.5%**	**13.3%**	**12.1%**	**15.2%**	**13.5%**	**11.4%**	**9.6%**
Aug	9.2%	13.5%	11.7%	13.0%	10.2%	10.2%	15.7%	12.9%	10.2%	11.9%	10.4%
Sep	10.5%	9.7%	12.6%	10.2%	10.3%	10.8%	11.4%	10.6%	9.8%	11.0%	13.2%
Oct	10.2%	14.3%	9.4%	10.8%	11.2%	8.5%	9.6%	5.7%	12.5%	11.2%	9.9%
Nov	10.2%	7.3%	9.6%	8.7%	9.9%	8.7%	7.1%	7.6%	6.7%	6.5%	9.9%
Dec	4.7%	4.1%	5.9%	4.2%	6.7%	5.2%	4.4%	6.9%	5.8%	6.4%	5.9%

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The peak month percentage share of operations is applied to the total annual operations expected at the Airport through 2037. The peak month operations are then divided by 31, as there are 31 days in July, to determine operations during the average day of the peak month. Finally, 25 percent of operations are believed to occur during the peak hour of this day. This process can be seen in **Table 2-21** and results in an increase from 40 peak hour operations in 2017 to 61 peak hour operations in 2037.

Table 2-21: Forecasted Peak Activity

Year	Annual Operations	Peak Month % of Total	Peak Month Operations	Average Day Peak Month	Peak Hour %	Peak Hour
2017	40,955	12.0%	4,915	159	25%	40
2022	51,760	12.0%	6,211	200	25%	50
2027	55,810	12.0%	6,697	216	25%	54
2032	58,960	12.0%	7,075	228	25%	57
2037	62,560	12.0%	7,507	242	25%	61

2.14 Critical Aircraft

To identify the appropriate design parameters for a runway and many associated facilities, aircraft are categorized by dimensions and performance, as well as the Runway Design Code (RDC). The RDC contains three separate parts—Aircraft Approach Category (AAC), Airplane Design Groups (ADG), and Runway Visual Range (RVR)—shown in **Table 2-22**. The first component is the AAC and is designated by a letter that corresponds to the approach speed of an aircraft. The second component is the ADG and is represented by a Roman numeral based on the aircraft tail height and wingspan. When there is a conflict between the tail height and the wingspan, the more restrictive or higher group identifier is used. Finally, runway approach visibility minimums are expressed as the RVR in feet equal to quarter mile increments; however, this last component is not descriptive of aircraft characteristics. These categories are used throughout this Master Plan when discussing existing restrictions and determining the future critical aircraft.

Table 2-22: Runway Design Code Components

Aircraft Approach Category (AAC)		Airplane Design Groups (ADG)			Runway Visual Range (RVR)	
AAC	Approach Speed	ADG	Tail Height	Wingspan	RVR	Visibility
A	< 91 knots	I	< 20 feet	< 49 feet	1600	1/4
B	≥ 91 knots, < 121 knots	II	20 – 29 feet	49 – 78 feet	2400	1/2
C	≥ 121 knots, < 141 knots	III	30 – 44 feet	79 – 117 feet	3200	5/8
D	≥ 141 knots, < 166 knots	IV	45 – 59 feet	118 – 170 feet	4000	3/4
E	≥ 166 knots	V	60 – 65 feet	171 – 213 feet	4500	7/8
		VI	66 – 79 feet	214 – 261 feet	5000	1

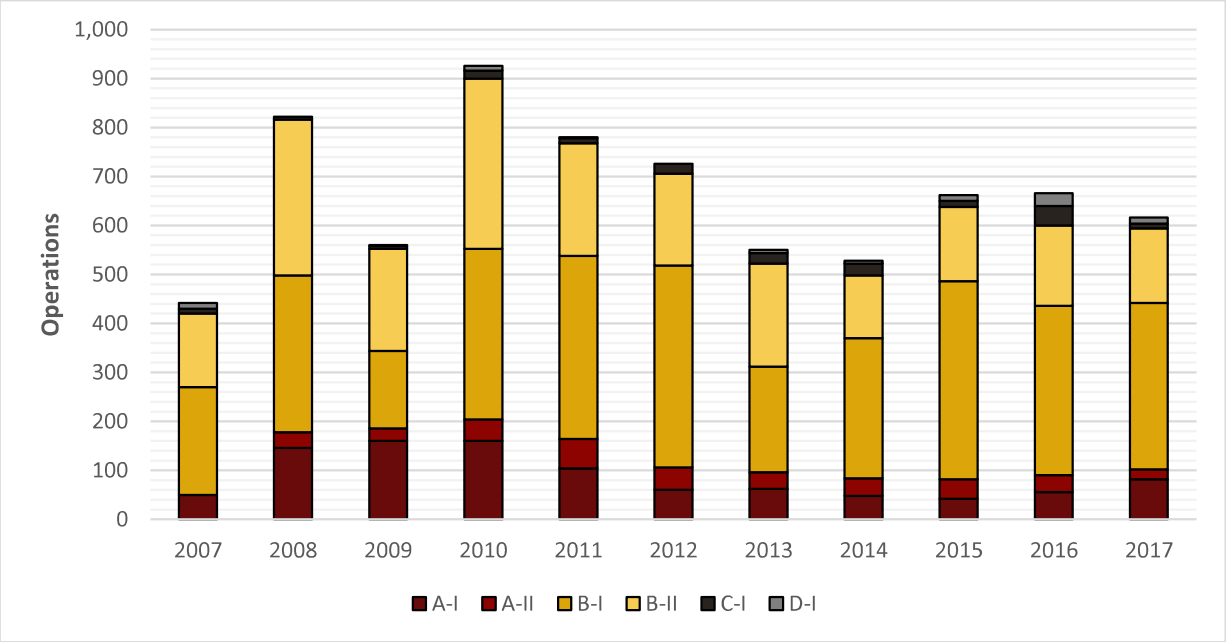
Source: FAA Advisory Circular 150/5300-13A, Airport Design

As jet operations are the most demanding at the Airport, the past 10 years of turbine operations are shown in **Chart 2-6** divided by RDC. Note that C-II and C-III operations are not shown due to scale and average

approximately two operations or less per year. The most prominent jet or turbine operations are in the B-I and B-II categories. B-I aircraft include small jets and turboprop aircraft, such as the Cessna Citation Mustang and Beech King Air 90, while the B-II category includes medium business jets, such as the Cessna Citation XLS, and larger turboprop aircraft, such as the Super King Air 350. It should be noted, however, that the existing runway length limits the ability for jet aircraft to operate at the Airport and does not necessarily reflect true demand.

The 2008 ALP shows the critical aircraft as a B-II RDC. Typically, 500 annual operations are required by an aircraft, or family of aircraft, to be designated as the critical aircraft. Although the B-II category operations do not currently meet this standard alone, when combined with other aircraft at least as demanding as B-I aircraft, this standard has been met annually since 2014. In addition, the current runway length does not allow for a high number of jet operations. Based on the anticipated jet operations forecast and national trends anticipating further growth in the turbine category, the B-II aircraft family is selected as the critical aircraft family.

Chart 2-6: Jet Operations by RDC



Source: TFMSC Database
Notes: C-II and C-III operations are not shown due to scale.

2.15 Forecast Summary and TAF Comparison

Operations at C29 have remained stable after experiencing a decline around the 2008 recession. Jet operations have increased in recent years in conjunction with national trends, and future operations will likely be comprised of a higher percentage of turbine operations as business operations continue to increase. Total operations are expected to increase at a modest 1.10 percent CAGR compared to 2.71 percent for jet operations. A summary of the forecasts presented in this chapter are shown and compared to the FAA TAF in **Tables 2-23** and **2-24**.

Table 2-23: C29 MP and TAF Comparison

Activity	Year	MP Forecast	TAF	MPF/TAF
Based Aircraft				
Base yr.	2017	94	87	8.05%
Base yr. + 5yrs.	2022	115	87	32.18%
Base yr. + 10yrs.	2027	124	87	42.53%
Base yr. + 15yrs.	2032	131	87	50.57%
Commercial Operations				
Base yr.	2017	2,500	2,500	0.00%
Base yr. + 5yrs.	2022	2,620	2,500	4.80%
Base yr. + 10yrs.	2027	2,745	2,500	9.80%
Base yr. + 15yrs.	2032	2,877	2,500	15.08%
Total Operations				
Base yr.	2017	40,955	40,955	0.00%
Base yr. + 5yrs.	2022	51,760	43,268	19.63%
Base yr. + 10yrs.	2027	55,810	45,710	22.10%
Base yr. + 15yrs.	2032	58,960	48,291	22.09%

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Table 2-24: Template for Summarizing and Documenting Airport Planning Forecasts

	2017	2022	2027	2032	2037	Base Yr. to +5	Base Yr. to +10	Base Yr. to +15	Base Yr. to +20
Operations									
Itinerant									
Air carrier	0	0	0	0	0	-	-	-	-
Commuter	0	0	0	0	0	-	-	-	-
Air Taxi	2,500	2,620	2,745	2,877	3,014	4.80%	9.80%	15.08%	20.56%
Total Commercial	2,500	2,620	2,745	2,877	3,014	4.80%	9.80%	15.08%	20.56%
General aviation	15,673	18,113	19,530	20,633	21,893	15.56%	24.61%	31.64%	39.68%
Military	10	10	10	10	10	0.00%	0.00%	0.00%	0.00%
Local						-	-	-	-
General aviation	25,272	33,638	36,270	38,318	40,658	33.10%	43.52%	51.62%	60.88%
Military						-	-	-	-
TOTAL OPERATIONS	40,955	51,760	55,810	58,960	62,560	26.38%	36.27%	43.96%	52.75%
Peak Hour									
Operations	40	50	54	57	61	25.00%	35.00%	42.50%	52.50%
Based Aircraft									
Single Engine	81	97	102	106	111	19.75%	25.93%	30.86%	37.04%
Multiengine	2	5	6	7	8	150.00%	200.00%	250.00%	300.00%
Jet Engine	8	9	10	11	13	12.50%	25.00%	37.50%	62.50%
Helicopter	3	5	6	7	7	66.67%	100.00%	133.33%	133.33%
Other	0	0	0	0	0	-	-	-	-
TOTAL	94	116	124	131	139	23.40%	31.91%	39.36%	47.87%
B. Operational Factors									
GA OPBA	450	450	450	450	450				