2.0 Aviation Activity Forecast

This aviation activity forecast serves as the basis of aeronautical demand used to guide the LTP. This forecast will inform the facility requirements, development alternatives, and financial feasibility of the LTP. The LTP forecast projects activity through calendar year 2040. To facilitate comparison with the FAA's Terminal Area Forecast (TAF), the forecasts were developed in alignment with the Federal fiscal year—October through September. Accordingly, the LTP forecast projects activity through fiscal year 2041 (October 1, 2040, through September 30, 2041) to ensure that the forecast covers the entirety of calendar year 2040. Fiscal year 2021 activity was used as the base year. Because of FCM's role as a reliever airport for the Twin Cities region, FCM does not serve any commercial airline operations (i.e., passenger or air cargo airline operations). Thus, the scope of the forecast is limited to aircraft operations, the fleet mix, and the number of aircraft based at FCM.

The FAA prepares the TAF on an annual basis for each airport in the National Plan of Integrated Airport Systems (NPIAS). The TAF is primarily used to meet the FAA's planning and budgeting needs. However, for a long-term planning effort at an airport, the airport sponsor may choose to prepare its own local forecasts as the basis of demand for facility planning rather than the TAF. Forecasts developed as part of a LTP process may differ from the TAF because they account for conditions that the TAF does not consider. They are also subject to FAA review and approval if the airport sponsor intends to seek FAA grant funding for airport development projects.

This forecast chapter is divided into six subsections. Section 2.1 reviews historical aviation activity at FCM. Section 2.2 provides an overview of common forecast methodologies and discusses which methodologies were selected for the FCM forecast. Section 2.3 presents the seven key assumptions made in developing the FCM forecasts and analyzes the economic trends and factors that influenced these assumptions. Section 2.4 describes the three forecast scenarios (Base, High, and Low) developed for FCM, provides the detailed forecasts for each scenario, and summarizes the three scenarios. Section 2.5 identifies the critical aircraft type for use in the LTP. Section 2.6 compares the proposed forecast scenario to be used in the LTP (Base Scenario) with the TAF.

2.1 Historical Aviation Activity

Generally, this section examines activity in the 20 years prior to the base year (i.e., 2001 to 2021). Unless otherwise noted, all years are fiscal years.

2.1.1 Historical Aircraft Operations

Prior to 2000, there were several fiscal years in which FCM served over 200,000 annual aircraft operations. Between 2001 and 2021, annual aircraft operations peaked at FCM in 2001 with 181,608 aircraft operations. Between 2001 and 2014, the count of annual aircraft operations fell almost every year to a low of 73,485 in 2014. This decline in aircraft operations occurred due to national economic factors—including the dot-com bubble recession in the years immediately preceding 2001, 9/11 in 2001, the Great Recession from 2007 to 2009—as well as local factors such as changes in tenant leases and the loss of FBOs at FCM. From 2001 to 2014, the average annual rate of decline in aircraft operations at FCM was 6.72%.

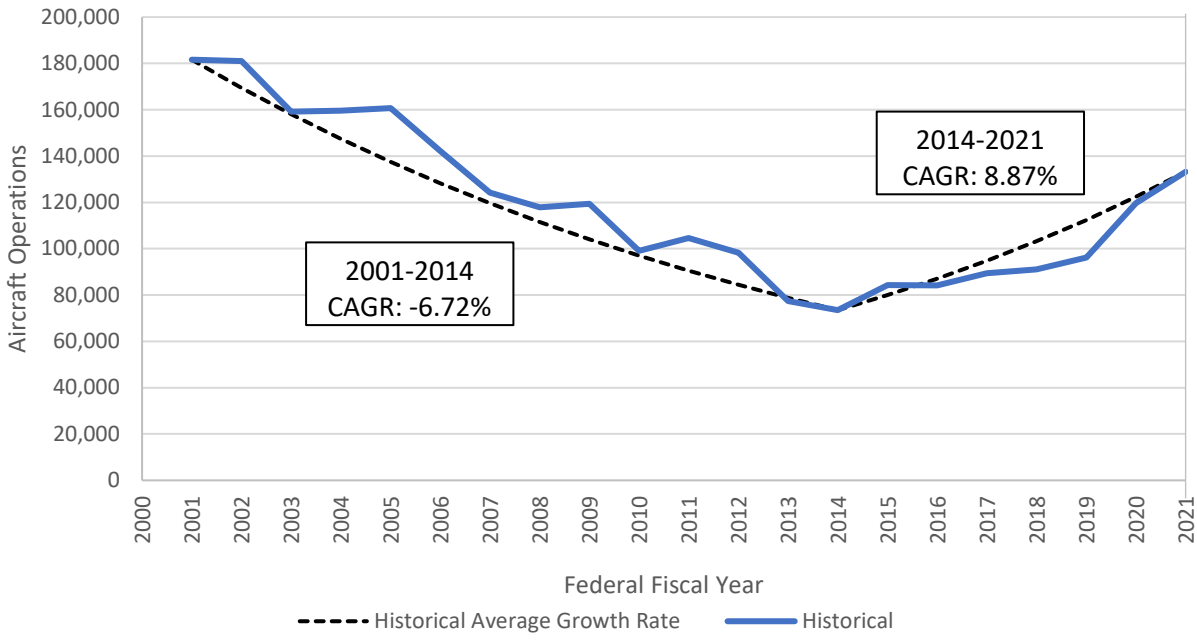
From 2014 to 2019, annual aircraft operations increased from 73,485 to 96,238, with each consecutive year experiencing an increase in activity except 2015-2016. The average annual growth rate in aircraft operations during this period was 5.54%. This growth likely occurred due to the continued economic

recovery from the Great Recession as well as faster population growth in the Twin Cities metropolitan area in the 2010s than in the previous decade[10].

Unlike many airports across the United States and globally, aircraft operations at FCM did not decline in 2020 during the COVID-19 pandemic. Rather, activity at FCM increased by 24.4% between 2019 and 2020 to 119,710 annual operations, which was its highest single-year growth in activity in the previous 20 years. Activity at FCM continued to grow in 2021 by 11.3% to 133,217 annual operations, reaching its highest level of activity since 2006. FCM's growth in 2020 and 2021 may be attributable primarily to an increase in flight school activity with the opening of ATP Flight School in 2020. Other factors explaining the recent growth include an increase in recreational flying as a pandemic lockdown activity and continued corporate hangar development on the south side of the Airport. From the low point of aircraft operations in 2014 through 2021, the average annual growth rate in aircraft operations was 8.87%.

Historical counts of aircraft operations from 2001 to 2021 at FCM are shown on **Figure 2-1**. For comparison, the compound annual growth rates (CAGRs) for 2001 to 2014 and 2014 to 2021 are also included.

Figure 2.1: FCM Historical Aircraft Operations, Fiscal Years 2001-2021



Source: 2021 FAA Terminal Area Forecast, published in 2022.

[10] The United States Census Bureau (data.census.gov) reported 2,968,806 residents in 2000, 3,279,833 residents in 2010, and 3,690,261 residents in 2020 for the Minneapolis-St. Paul-Bloomington, MN-WI Metropolitan Statistical Area (MSA). The MSA experienced 10.5% growth between 2000 and 2010 and 12.5% growth between 2010 and 2020.

2.1.2 Historical Fleet Mix

Aircraft fleet mix describes the aircraft types that comprise the aircraft operations conducted at the airport. For this FCM historical fleet mix analysis, aircraft types were grouped according to three broad classifications, rather than examined at the level of the individual aircraft make and model. The three classifications were the Airplane Design Group (ADG, defined by aircraft wingspan and tail height), the Aircraft Approach Category (AAC, defined by aircraft approach speed), and the "Operation Type" as provided by MACNOMS data. ADG and AAC are more precisely defined in Section 1.3.2.2. The subsequent paragraphs describe the MACNOMS data source and the "Operation Type" field.

The data used for the fleet mix analysis were derived from MACNOMS flight tracks provided by MAC. MACNOMS is a noise-monitoring system employed within a 40-mile radius of the Minneapolis-Saint Paul International Airport, which covers all seven MAC-owned airports, including FCM. MACNOMS records flight tracks within the region, matching the flight's registration number with the FAA database of aircraft identification. MACNOMS data were provided for calendar years 2017 through 2021. Until January 2020, the availability of aircraft type details in MACNOMS records were often limited since not all aircraft were equipped with ADS-B Out. After January 2020, the FAA's requirement for all aircraft flying in most controlled airspace to be equipped with ADS-B Out improved the accuracy of aircraft type details in MACNOMS records. MACNOMS data were used for the fleet mix analysis instead of the FAA's Traffic Flow Management System Counts (TFMSC) database because the TFMSC only accounts for Instrument Flight Rules (IFR) operations, which tend to comprise between 15% and 20% of operations at FCM. Many general aviation and flight training operations, including those at FCM, are conducted under Visual Flight Rules (VFR) and thus would not be captured in this data source.

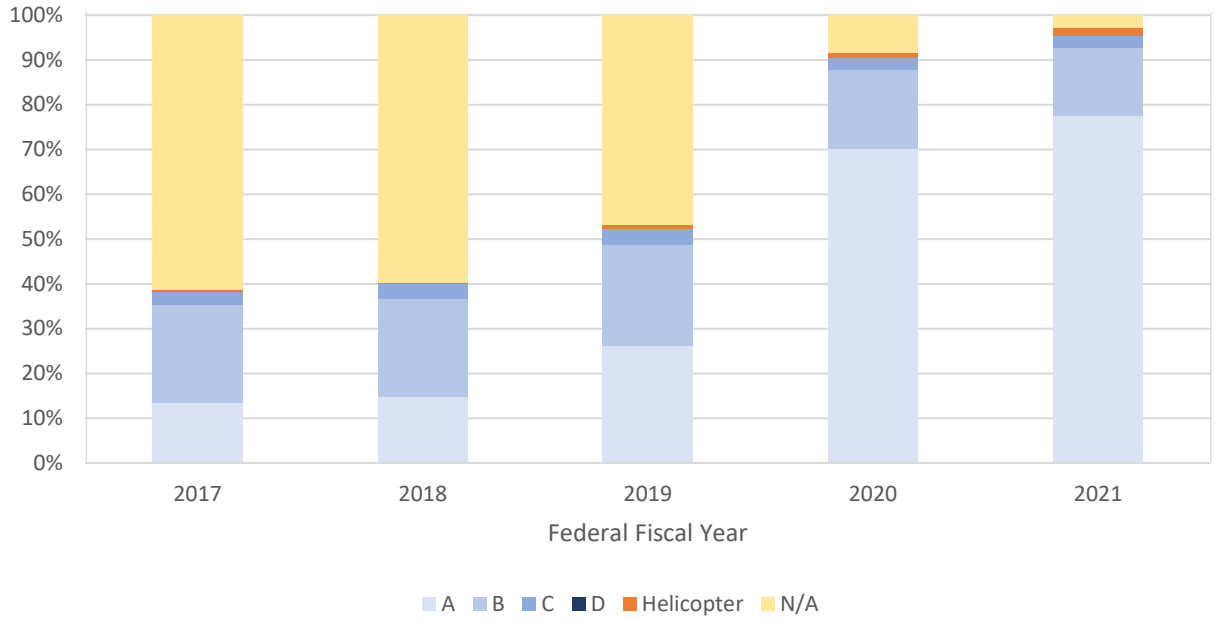
The operations data derived from MACNOMS flight tracks included an "Operation Type" field, which classified each operation as one of the following: Balloon / Blimp, Carrier Jet, Helicopter, Jet, Piston, Military, Turboprop, and Unknown[11]. The proportion of records that were classified as "Unknown" substantially decreased from 2017 to 2021, owing to the increased adoption of ADS-B Out.

The MACNOMS data set does not account for every operation at FCM. For each year from 2017 to 2021, the total operations counts as derived from MACNOMS data comprised approximately 75% of the number of annual operations as reported by the FAA's OPSNET database. Tables in this chapter that present analysis based on MACNOMS data include a line acknowledging this difference in operations counts. For the purposes of the fleet mix analysis, it was assumed that the fleet mix of the unaccounted ~25% of operations was proportional to the accounted ~75%.

Figure 2-2, **Figure 2-3**, and **Figure 2-4** present the historical composition of the fleet mix at FCM for 2017 through 2021 in terms of AAC, ADG, and Operation Type, respectively, as derived from MACNOMS data. Because the MACNOMS data analyzed began on January 1, 2017, the FY 2017 fleet mix represents the fleet mix for nine months of the fiscal year.

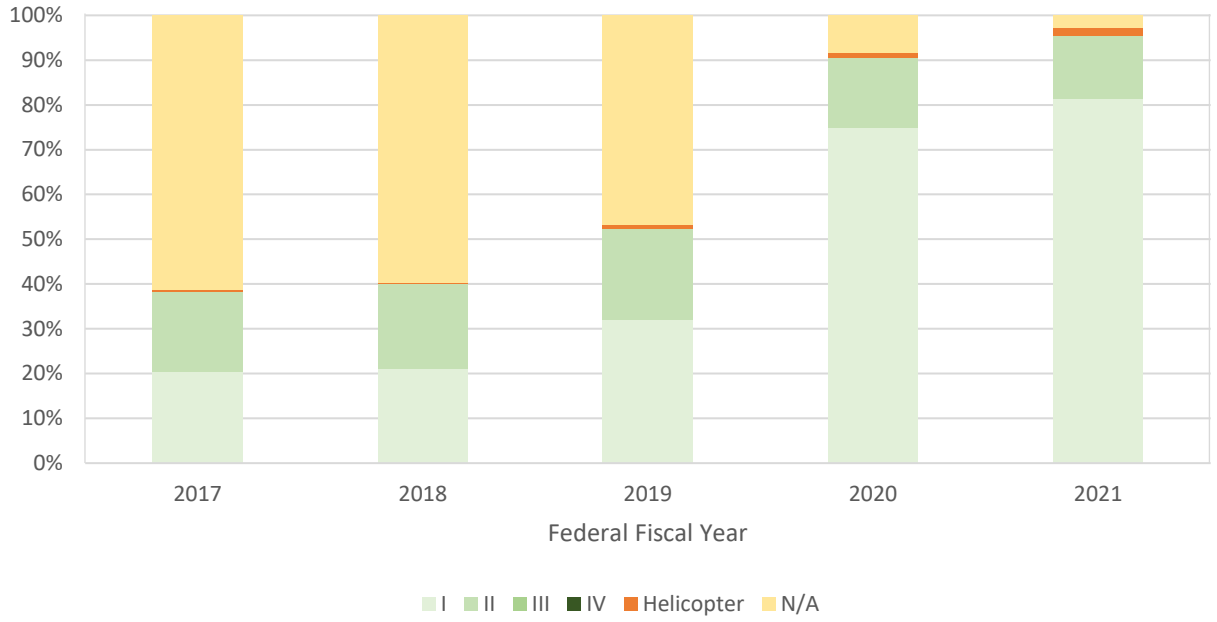
[11] "Carrier Jet" refers to jet aircraft that were operated by commercial or charter carriers. "Jet" refers to jet aircraft that were not operated by such carriers.

Figure 2.2: FCM Historical Fleet Mix by Aircraft Approach Category



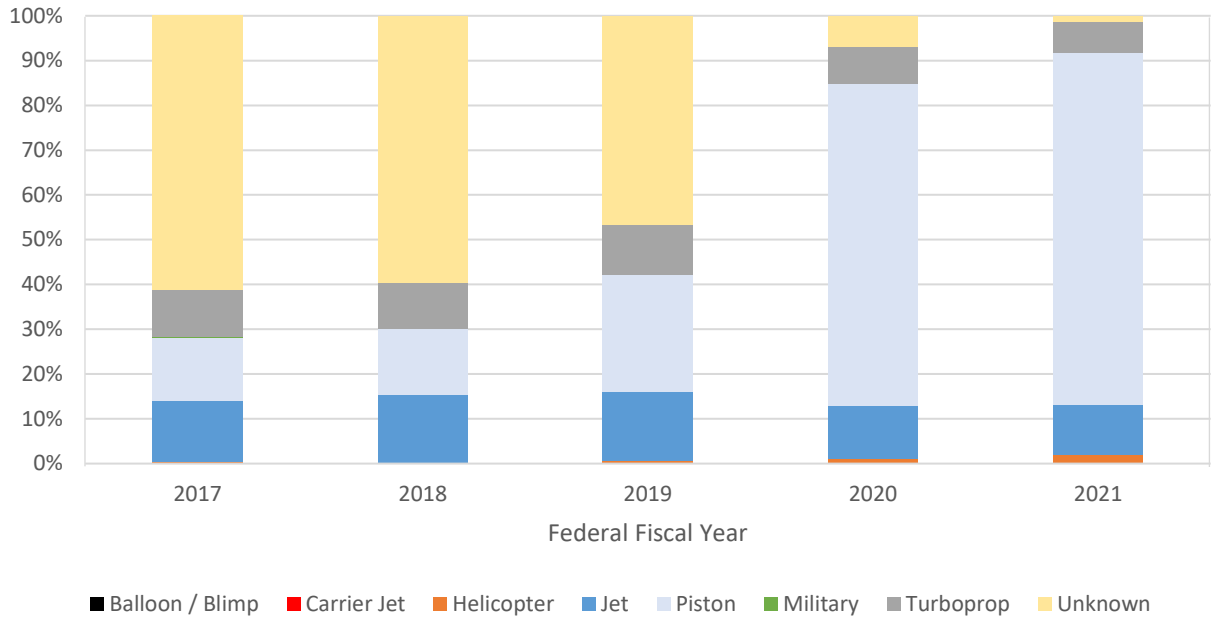
Notes:
"N/A" represents operations for which an aircraft type was not available in the MACNOMS data.
Fiscal Year 2017 fleet mix percentages only include data from January 1, 2017, through September 30, 2017.
Source: HNTB analysis of MACNOMS data.

Figure 2.3: Historical Fleet Mix by Airplane Design Group



Notes:
"N/A" represents operations for which an aircraft type was not available in the MACNOMS data.
Fiscal Year 2017 fleet mix percentages only include data from January 1, 2017, through September 30, 2017.
Source: HNTB analysis of MACNOMS data

Figure 2-4: Historical Fleet Mix by MACNOMS Operation Type



Notes:
"Unknown" represents operations for which an aircraft type was not available in the MACNOMS data.
Fiscal Year 2017 fleet mix percentages only include data from January 1, 2017, through September 30, 2017.
Source: HNTB analysis of MACNOMS data.

While the analyzed MACNOMS data may suggest a significant increase in the share of AAC A, ADG I, and piston aircraft between 2017 and 2021, this increase is due to the implementation of the ADS-B Out requirement beginning in 2020 and is not necessarily indicative of an increase in such operations. Indeed, the increase in A/I/piston aircraft coincided with the decrease in N/A or Unknown aircraft types. This swap in the fleet mix composition suggests that most of the aircraft at FCM that were not equipped with ADS-B Out prior to 2020 were A/I/piston aircraft. Due to incomplete data prior to 2020, the historical fleet mix analysis emphasized the two most recent fiscal years.

A high percentage of the historical FCM fleet was smaller, piston-powered aircraft. In 2021, more than 77% of the fleet belonged to AAC A and an additional 15% to AAC B. More than 80% of the fleet belonged to ADG I and an additional 14% to ADG II. And more than 78% of the fleet consisted of piston aircraft, with jet and turboprop aircraft comprising an additional 11% and 7%, respectively. Due to the lack of aircraft type data available prior to 2020, it is difficult to quantitatively identify emerging trends in FCM's fleet mix. Anecdotal information from MAC staff confirms that the fleet at FCM has historically been small, piston-type aircraft, and that these aircraft are expected to remain much of the fleet, even as the share of turboprop and jet aircraft are expected to increase.

Table 2-1 summarizes the historical fleet mix at FCM based on MACNOMS data in terms of the combination of AAC and ADG for every year between 2017 and 2021.

Table 2-1: Summary of FCM Historical Fleet Mix by AAC-ADG Combination

AAC ADG Combination	FY 2017 Operations (Percentage)	FY 2018 Operations (Percentage)	FY 2019 Operations (Percentage)	FY 2020 Operations (Percentage)	FY 2021 Operations (Percentage)
A-I	8,304 (12.5%)	9,300 (13.5%)	17,193 (24.9%)	47,290 (69.1%)	73,290 (76.1%)
A-II	571 (0.9%)	816 (1.2%)	888 (1.3%)	795 (1.2%)	1,345 (1.4%)
A-III	2 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)
Subtotal: AAC A	**8,877 (13.4%)**	**10,116 (14.7%)**	**18,081 (26.2%)**	**48,085 (70.2%)**	**74,635 (77.5%)**
B-I	4,461 (6.7%)	4,442 (6.4%)	4,093 (5.9%)	3,531 (5.2%)	4,419 (4.6%)
B-II	10,138 (15.3%)	10,729 (15.6%)	11,462 (16.6%)	8,564 (12.5%)	10,305 (10.7%)
B-III	5 (0.0%)	6 (0.0%)	0 (0.0%)	2 (0.0%)	0 (0.0%)
Subtotal: AAC B	**14,604 (22.0%)**	**15,177 (22.0%)**	**15,555 (22.6%)**	**12,097 (17.7%)**	**14,724 (15.3%)**
C-I	845 (1.3%)	869 (1.3%)	749 (1.1%)	565 (0.8%)	780 (0.8%)
C-II	1,035 (1.6%)	1,407 (2.0%)	1,643 (2.4%)	1,171 (1.7%)	1,753 (1.8%)
C-III	20 (0.0%)	12 (0.0%)	10 (0.0%)	0 (0.0%)	4 (0.0%)
C-IV	0 (0.0%)	0 (0.0%)	0 (0.0%)	1 (0.0%)	0 (0.0%)
Subtotal: AAC C	**1,900 (2.9%)**	**2,288 (3.3%)**	**2,402 (3.5%)**	**1,737 (2.5%)**	**2,537 (2.6%)**
D-II	34 (0.1%)	28 (0.0%)	12 (0.0%)	18 (0.0%)	23 (0.0%)
D-III	40 (0.1%)	14 (0.0%)	102 (0.1%)	49 (0.1%)	12 (0.0%)
Subtotal: AAC D	**74 (0.1%)**	**42 (0.1%)**	**114 (0.2%)**	**67 (0.1%)**	**35 (0.0%)**
Helicopter	267 (0.4%)	148 (0.2%)	488 (0.7%)	734 (1.1%)	1,819 (1.9%)
N/A	40,749 (61.3%)	41,220 (59.7%)	32,337 (46.9%)	5,750 (8.4%)	2,603 (2.7%)
TOTAL (MACNOMS)	**66,471 (100.0%)**	**68,991 (100.0%)**	**68,977 (100.0%)**	**68,470 (100.0%)**	**96,353 (100.0%)**
Difference between MACNOMS and OPSNET	**22,876**	**22,069**	**27,261**	**51,240**	**36,864**

Notes:
Totals and subtotals may not add to 100% due to rounding.
"N/A" represents operations for which an aircraft type was not available in the MACNOMS data.
MACNOMS data for Fiscal Year 2017 only include data from January 1, 2017, through September 30, 2017.
Source: HNTB analysis of MACNOMS data.

2.1.3 Historical Based Aircraft

FAA records as reported in the 2021 TAF and the National Based Aircraft Inventory Program (NBIAP) were used as the source for historical based aircraft. Airport managers use the NBIAP to track based aircraft at their airports, and the NBIAP records serve as the basis for the based aircraft portion of the TAF. At the time of the preparation of the 2021 TAF, the based aircraft records for FCM in the NBIAP had not been updated. As a result, the FY 2021 based aircraft count in the TAF was not representative of actual conditions at FCM. Instead, the validated based aircraft inventory in the NBIAP as of June 30, 2021, was used for the FY 2021 based aircraft inventory. This inventory is summarized in **Table 2-2**.

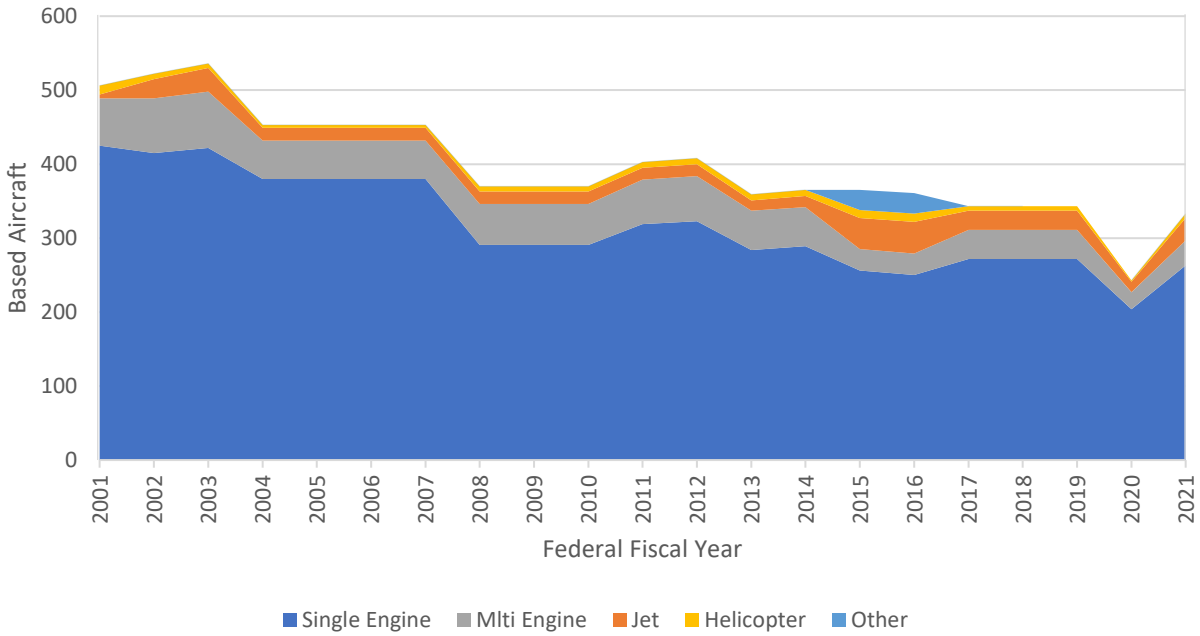
Table 2-2: FCM Based Aircraft, Fiscal Year 2021 (NBIAP Validated Inventory)

Aircraft Type	Count
Single Engine	263
Multi Engine	34
Jet	30
Helicopter	6
Other	0
TOTAL	**333**

Source: FAA National Based Aircraft Inventory Program, June 30, 2021.

According to FAA records, in 2001, there were 506 aircraft based at FCM; by 2021, there were 333. While the reported historical data suggest a decline in aircraft based at FCM, MAC staff believe that such a trend has not occurred at FCM over this period. Instead, the apparent decline in based aircraft may be more indicative of the fidelity of reporting methods for tracking based aircraft in the past. For example, historical technology and methods for tracking based aircraft easily enabled the reporting of aircraft to be based at multiple airports. MAC staff believe this phenomenon is reflected in the historical based aircraft data for FCM, commenting that it is likely a geometric impossibility for more than 500 aircraft to have been based at FCM given the current development area (2001-2003). The historical number of based aircraft at FCM by type of aircraft from 2001 through 2021 as given by FAA records is shown on **Figure 2-5**.

Figure 2-5: FCM Historical Based Aircraft, Fiscal Years 2001-2021



Sources: 2021 FAA Terminal Area Forecast, published in 2022; FAA National Based Aircraft Inventory Program, June 30, 2021.

2.2 Overview of Forecast Methodologies

The most common methodologies used in the preparation of aviation activity forecasts are regression analysis (also known as econometric modeling), trend analysis (also known as time series analysis), and market share analysis. The FCM LTP aviation activity forecasts used elements of each of these common methodologies. The following sections provide a high-level description of each of these methodologies and how they were used in the FCM forecasts. These descriptions are adapted from *ACRP Synthesis 2: Airport Aviation Activity Forecasting* (Airport Cooperative Research Program, 2007) and "Forecasting Aviation Activity by Airport" (GRA, Inc., 2001).

2.2.1 Regression Analysis

A regression analysis-based forecast uses mathematical modeling to assert a relationship between economic indicators (independent variables) and the type of activity forecast (dependent variable). It assumes that the economic indicators directly influence the forecast activity, and a change in any of the economic indicators will result in a change in the forecast activity. Because the regression is based on economic indicators, this methodology is sometimes also called econometric modeling.

The relationship between the dependent and independent variables is parameterized based on historical data and assumes that the parameters will remain consistent through the forecast period. To verify the validity of the relationship between the dependent and independent variables, the model's "goodness-of-fit" can be tested against actual historical data. In a regression model, goodness-of-fit is defined by an R^2 value, with an R^2 of 0 indicating no statistical relationship between the dependent and independent variables, and an R^2 of 1 indicating a perfect statistical relationship.

Among the three common methodologies, the regression analysis methodology is the most data-intensive, requiring multiple differing inputs. It is also the most dependent on external data, often produced by many sources, which are used for the independent variables.

2.2.2 Trend Analysis

A trend analysis-based forecast examines historical trends in aviation activity, such as average annual growth rates, and extrapolates these trends into the future to forecast activity. This methodology is sometimes also called time series analysis because of its reliance on historical activity without using independent explanatory variables. Because it does not require independent explanatory variables, this methodology is often simple to apply. The extrapolated trends may also be modified into the future if the forecaster knows of external factors that will alter the historical trend, such as a new operator commencing activity.

Among the three common methodologies, the trend analysis methodology is the least data intensive. It only requires the use of data from one source: historical activity. Consequently, it is also the least dependent on external sources of data.

2.2.3 Market Share Analysis

A market share analysis-based forecast is a top-down methodology that combines historical shares of activity in a given market with a higher-level forecast to forecast the activity in that market. For example, a local airport forecast may be developed by applying a percentage share of national activity to a national forecast. The market share may remain static over time, or it may change through the forecast period based on a trend analysis of the market share.

Among the three common methodologies, the market share analysis methodology requires more external data than the trend analysis methodology, but less than the regression analysis methodology.

2.2.4 Methodologies Used in FCM Forecast

Different elements of the FCM LTP forecast used the trend analysis, the market share analysis, or a hybrid to project activity. The regression analysis methodology was not employed for this forecast for two key reasons:

1. As a general aviation airport, activity at FCM is likely to be influenced by national general aviation activity trends—such as the long-term shift from single-engine piston aircraft to multi-engine and turbine aircraft—which are not necessarily explained by the typical economic factors used in a regression.
2. The mix of operator types at FCM has changed over the last five to seven years, with recent increases in business jet traffic and flight school activity expected to continue. A regression model based on historical data would be unlikely to capture these emerging trends.

The aircraft operations forecast used elements of the market share analysis methodology. It relied on an analysis of historical operations data at FCM to estimate the shares of operations conducted by different aircraft types. Then, the forecast employed a larger, top-down forecast contained in the FAA's Aerospace Forecast Fiscal Years 2021-2041 to assign different annual growth rates to each of these groups of operations.

Because of the strategic importance of business jet traffic at FCM to MAC, a business jet operations forecast was also prepared as a subset of the total operations forecast. The business jet forecast relied on two market share analyses: the share of national business jet traffic served in the Twin Cities region, and the share of Twin Cities business jet traffic served at FCM. The shares in these two analyses varied over time based on a trend analysis of the historical market shares.

The aircraft operations forecast was constructed in a way such that the fleet mix forecast could be easily derived from the operations forecast. Therefore, the fleet mix forecast indirectly used elements of the market share analysis methodology.

Like the aircraft operations forecast, the based aircraft forecast also used elements of top-down forecasts: the FAA's Aerospace Forecast Fiscal Years 2021-2041 as well as the TAF for FCM. Specifically, the FCM based aircraft forecast applied forecast annual growth rates in the national general aviation fleet by aircraft type to project the numbers of based single-engine, multi-engine, helicopter, and other aircraft. For based jet aircraft, the TAF for FCM forecast an increase of one based jet aircraft per year to offset the loss of one based single-engine aircraft per year. The forecast number of based jet aircraft included this baseline increase of one per year and additionally applied the national growth rate in the general aviation jet fleet.

2.3 Forecast Assumptions and Economic Trends

Seven key assumptions were made in developing the forecasts of aviation activity at FCM. These assumptions were made based on the identification of various economic trends or policies that are believed to influence future aviation activity at FCM. These assumptions are listed below, and the underlying economic trends are described in subsequent sub-sections.

1. FCM is likely to retain its recent growth in activity in 2020 and 2021. Demand is not anticipated to regress to pre-pandemic levels as the pandemic recedes.
2. Fuel price volatility is not likely to be a factor inducing additional growth, nor is it likely to cause activity to decrease.
3. Aircraft operations at FCM will grow during the forecast period at a modest rate, consistent with the nationwide modest growth of general aviation flight hours. Furthermore, fixed-wing piston aircraft operations at FCM will decline while fixed-wing turbine engine aircraft operations will grow faster, trends which are also consistent with the nationwide forecast.
4. The number of pilots operating aircraft serving FCM is not likely to be a significant factor inducing additional growth or a decrease in activity.
5. Regional economic factors—including population, labor force participation, gross domestic product, and non-agricultural employment—are unlikely to influence growth beyond a modest rate.
6. Continued economic growth within the FCM catchment area may result in growth of the number of business jet operations at FCM.
7. The existing local statutes restricting aircraft weight and runway length at FCM will not be sought to be modified or overturned.

Many of these assumptions are based on relevant elements of the FAA's Aerospace Forecast Fiscal Years 2021-2041. Where appropriate, these elements are identified in subsequent sections.

2.3.1 Recent Growth at FCM

Since 2014, annual aircraft operations have increased at FCM. This trend continued through 2021 despite the global COVID-19 pandemic from 2020 to the present and the resultant economic recession in 2020. Much of this growth in activity at FCM in 2020 and 2021 has resulted from growth in flight schools as well as an increase in business jet traffic. MAC staff believe that the new demand served in 2020 and 2021 is likely to be retained.

As noted in Section 1.4, FCM is home to multiple flight schools, including AV8 Flight School and Inflight Pilot Services. ATP Flight School also commenced operations at FCM in 2020. Activity at these flight schools is anticipated to remain strong, primarily driven by the current and looming commercial airline pilot shortage. During the COVID-19 pandemic, many commercial airlines allowed their more senior pilots to retire early, creating a vacuum in the commercial airline pilot inventory as demand for air travel has returned. Over the next few years, flight schools will play a critical role in satisfying the strong commercial airline demand for future commercial airline pilots. Flight school activity is thus expected to remain strong at FCM. The flight schools at FCM hold long-term leases with MAC, which suggests that these tenants are committed to remaining at FCM and sustaining continued growth in flight training operations.

Corporate hangar development on the south side of FCM's airfield has increased since 2020, leading to an increase in business jet traffic. Additional corporations have appealed to MAC to base their aircraft at FCM; however, demand has been metered by two factors:

1. Delays in the supply chain have slowed the delivery of steel used in the construction of additional corporate hangars.
2. Line-of-sight restrictions on the south side due to the existing Airport Traffic Control Tower cab's location limit development. If the ATCT were relocated, additional hangar development on the south side could proceed.

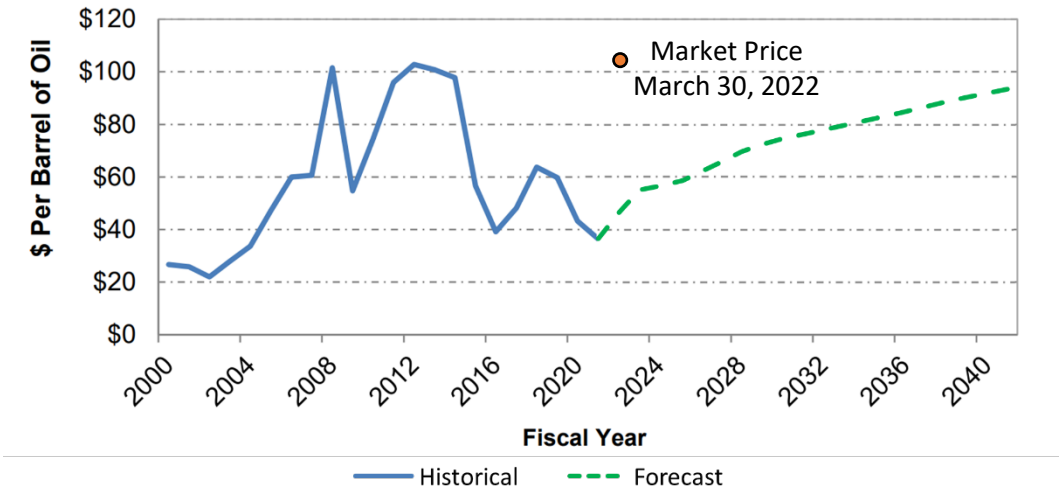
These two factors have created latent demand for south side hangar development, which will result in sustained growth in activity over the next several years as this demand is unlocked. Corporations investing in physical assets at the airport will create additional certainty of sustained growth, as it shows commitment to operating out of FCM in the future.

2.3.2 Fuel Prices

Since 2000, fuel prices for aviation operators have varied considerably, due to variability in the price per barrel of oil. Historically, the cost of oil has increased quickly due to unpredictable global events, such as the U.S.-Iraq conflict (2003-2011), Hurricane Katrina (2005), the Great Recession (2007-2009), and the Russia-Ukraine conflict (2022 to present). Oil prices can also drop sharply due to domestic policies which increase oil supply, such as the growth in the practice of fracking starting in 2013. Oil prices can also drop when a demand shock occurs, such as early in the COVID-19 pandemic shutdowns as governments encouraged residents to stay home and not to travel.

Figure 2-6 depicts the historical price per barrel of crude oil in the United States from 2000 to 2020, and it includes a forecast of oil barrel prices from 2021 through 2041. The market price of a barrel of oil on March 30, 2022 (approximately $102), has been added to the graph to highlight the significant variation from the 2022 forecast price.

Figure 2-6: Price of Crude Oil Barrels in the United States, Fiscal Years 2000-2041



Source: FAA Aerospace Forecast Fiscal Years 2021-2041; original source IHS Markit, 2020; annotation of March 30, 2022, market price and historical versus forecast curves by HNTB.

Just as economists have difficulty in forecasting oil prices due to unforeseen market conditions, so do consumers of aviation fuel. If it were certain that fuel prices could remain low and stable, then it might be reasonable to assume that aviation demand could be positively influenced by lower operational costs. Similarly, high fuel prices over a long period could lead to lower long-term demand due to the higher operational costs. Unstable fuel prices, by contrast, may dissolve or reduce the strength of a predictable relationship between fuel prices and long-term activity, as users of the Airport cannot reasonably make long-term decisions about committing to aviation activity based on fuel prices alone. That is, unstable fuel prices do not allow for a release of pent-up demand.

Since fuel prices have historically been variable, it is anticipated that fuel prices will continue to be variable and unstable. As a result, fuel prices were not assumed to be a driving factor for long-term aviation demand at FCM.

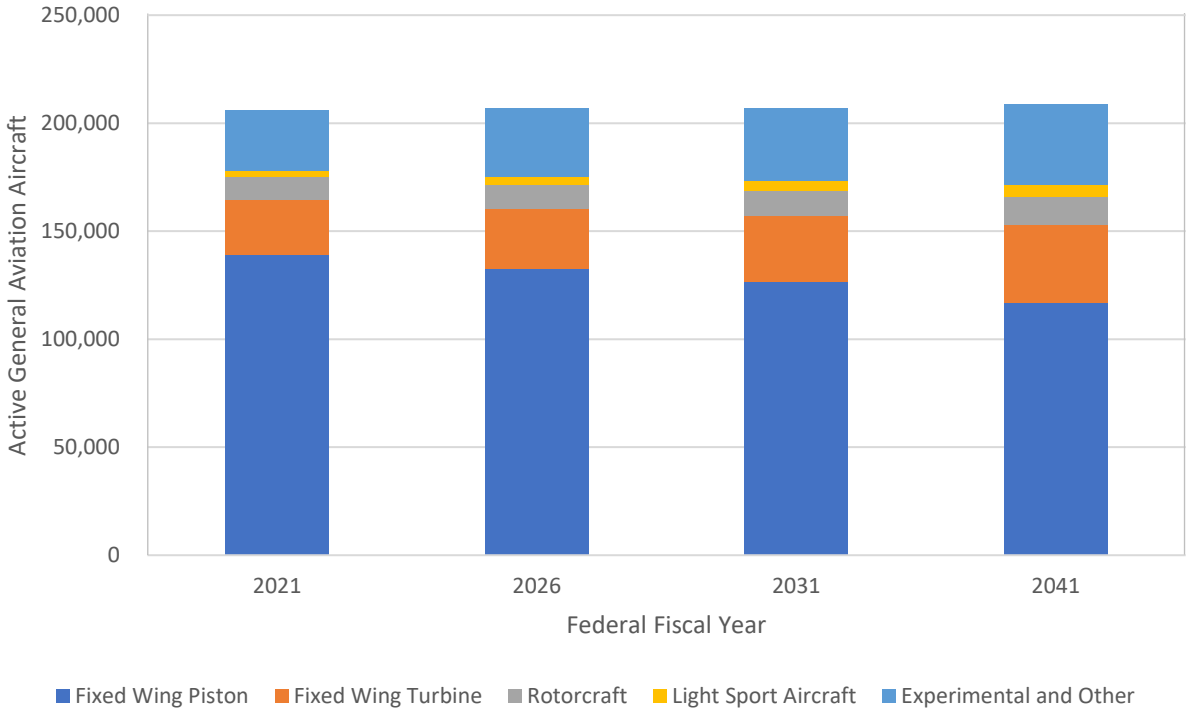
2.3.3 National General Aviation Projections and Business Jet Market Share

Nationwide trends in the general aviation market--including a decline in the operation of fixed-wing piston aircraft, growth in the operation of fixed-wing turbine aircraft, and a decline in the number of private pilot certifications—were applied to activity at FCM. These nationwide trends were considered as background data informing the long-term growth at FCM. However, specific local conditions at FCM and within the Twin Cities business jet market were analyzed for inclusion in the LTP forecast.

2.3.3.1 General Aviation Aircraft Fleet

Figure 2-7 presents the forecast number of active general aviation aircraft in the U.S. for fiscal years 2021, 2026, 2031, and 2041, as given by the FAA in the FAA Aerospace Forecast Fiscal Years 2021-2041. This forecast was prepared in 2020; thus, the counts for fiscal year 2021 are forecast. **Table 2-3** presents the estimated average annual growth rates for each class of aircraft in the national fleet between 2021 and 2041.

Figure 2-7: Nationwide Active General Aviation Aircraft Projections



Source: HNTB; data from FAA Aerospace Forecast Fiscal Years 2021-2041.

Table 2-3: Nationwide Active General Aviation Aircraft Growth Rates, Fiscal Years 2020-2041

AIRCRAFT CLASS	FORECAST ACTIVE AIRCRAFT (FY 2021)	FORECAST ACTIVE AIRCRAFT (FY 2041)	AVERAGE ANNUAL FLEET GROWTH RATE, FY 2021 2041
Fixed Wing Piston	139,065	116,905	-0.9%
Single-Engine	126,745	105,540	-0.9%
Multi-Engine	12,320	11,365	-0.4%
Fixed Wing Turbine	25,790	35,780	1.7%
Rotorcraft	10,215	13,390	1.4%
Light Sport Aircraft	2,465	5,415	4.0%
Experimental and Other	28,335	37,300	1.4%
TOTAL	**205,870**	**208,790**	**0.1%**

Source: HNTB; data from FAA Aerospace Forecast Fiscal Years 2021-2041.

Figure 2-7 and **Table 2-3** show a slight projected increase in the number of overall active general aviation aircraft between 2021 and 2041. This slight growth is the net result of the shrinking fixed-wing piston fleet

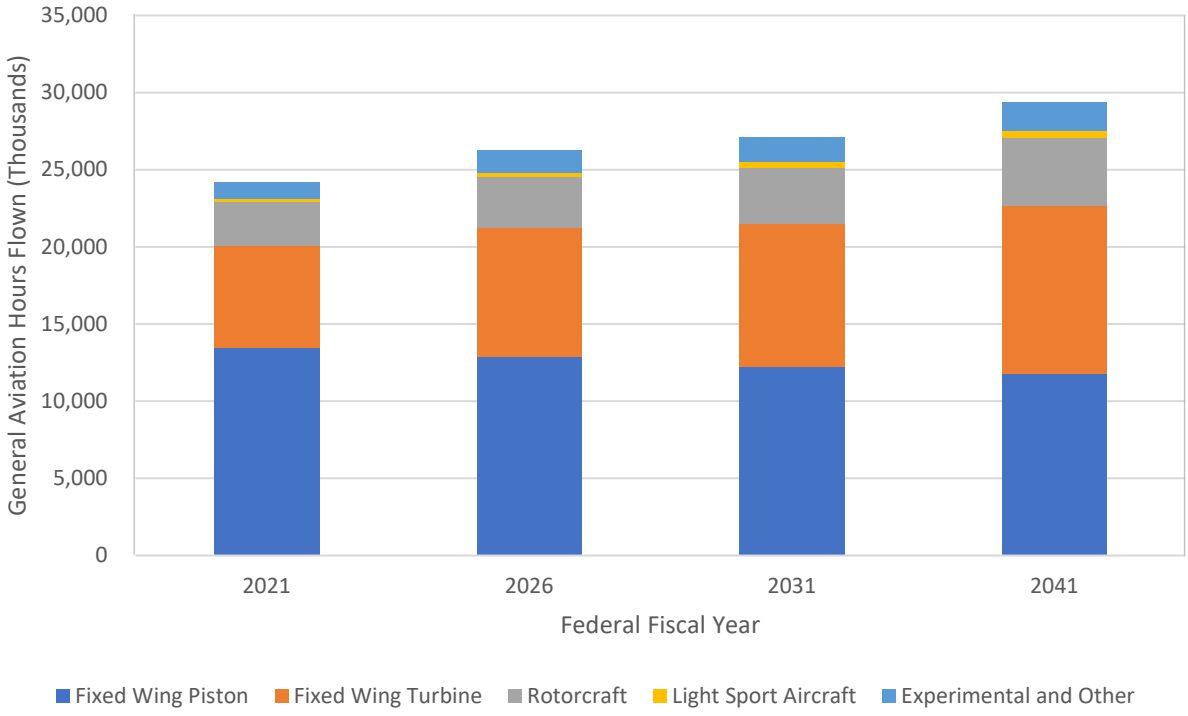
and the growing fleets of other aircraft classes (fixed-wing turbine, rotorcraft, light sport aircraft, and experimental/other). According to the FAA Aerospace Forecast Fiscal Years 2021-2041, the decline of the fixed-wing piston fleet may be attributed to a variety of factors, including: unfavorable pilot demographics, increasing cost of aircraft ownership, availability of lower-cost alternatives for recreational usage, and new aircraft deliveries not keeping pace with retirements of the aging fleet.

The projected decline in fixed-wing piston aircraft and the growth of fixed-wing turbine aircraft are reflected in the FAA's 2021 TAF for based aircraft at FCM. The TAF for FCM projects mix of aircraft to change in a manner that mirrors national trends: a decline in single-engine aircraft offset by an increase in jet and multi-engine aircraft.

2.3.3.2 General Aviation Hours Flown

Despite the slow forecast growth in the number of active general aviation aircraft at the national level, the total hours flown by general aviation aircraft across the U.S. is forecast to increase through 2041, as shown on **Figure 2-8**.

Figure 2-8: Forecast General Aviation Hours Flown



Source: HNTB; data from FAA Aerospace Forecast Fiscal Years 2021-2041.

The FAA forecasts the average long-term growth rate in nationwide general aviation hours flown from 2021 through 2041 at just under 1.0%. Like the trends projected in the nationwide general aviation fleet, the number of hours flown by fixed-wing piston aircraft is projected to decrease, while the number of hours flown by fixed-wing turbine aircraft (a category which includes business jet aircraft) is projected to drive much of the growth in total flight hours. The average annual growth rates in flight hours for these two aircraft types between 2021 and 2041 are approximately -0.7% and 2.6%, respectively.

Different aircraft types tend to fly different numbers of hours per operation. For instance, fixed-wing turbine aircraft are more likely to fly longer stage lengths than fixed-wing piston aircraft, contributing more flight hours to the total hours flown than fixed-wing piston aircraft. Consequently, if the proportion of total hours flown by each aircraft type is assumed to remain constant, then a change in total general aviation hours flown can reasonably approximate the change in aircraft operations. However, the FAA forecasts that fixed-wing turbine aircraft hours flown will comprise an increasing proportion of total hours flown. Since fixed-wing turbine aircraft tend to fly longer stage lengths, the increase in flight hours may be accomplished with fewer operations than if the increase had been forecast for fixed-wing piston aircraft. This means that the number of general aviation operations may increase at a slower rate than the average annual growth rate in total general aviation operations from 2021 to 2041 (1.0%). The growth rate of 1.0%, therefore, may be considered an upper bound for the growth rate of annual general aviation aircraft operations, with the true growth rate in operations likely being slower.

For the purposes of the LTP, it is assumed that trends in aircraft operations at FCM will follow the projected trends for national general aviation aircraft operations. This assumption was made because the types of general aviation activity that FCM serves—primarily a mix of single-engine local private pilots, flight schools, and business jets—are typical of most other general aviation airports nationwide.

2.3.3.3 FCM Business Jet Market Share

Business jets are one subset of aircraft belonging to the fixed-wing turbine category of aircraft identified in the FAA Aerospace Forecast Fiscal Years 2021-2041. MAC has identified business jets as a focus area for FCM, believing that this market shows the most promise for future growth at FCM. Therefore, the market share trends of business jets were examined in greater detail for use in the LTP forecast.

Three key factors differentiate business jet traffic from other types of non-commercial traffic. First, business jet traffic is generally oriented around the need for passengers to reach a city's central business district (CBD). Second, business jets may have more flexibility in their ability to use multiple smaller regional airports that passenger airlines cannot use. Third, business jets require longer runways than non-jet aircraft. To account for all these factors, an analysis of business jet traffic in the Twin Cities region must consider the system of airports within the region.

Among the airports owned and operated by MAC, the four closest to the Twin Cities CBDs are FCM, Minneapolis St. Paul International Airport (MSP), Saint Paul Downtown Airport (STP), and Anoka County-Blaine Airport (ANE). These airports are also the only airports in the MAC system that have at least one runway at least 5,000 feet in length. Therefore, these airports are those in the Twin Cities region that are most likely to serve business jet traffic. Based on an analysis of data from the FAA's TFMSC database for the seven airports owned and operated by MAC, these four airports served at least 99% of all business jet traffic in the region for every fiscal year between 2001 and 2021. Business jet activity at these four airports, therefore, was deemed a reasonable approximation for the business jet activity serving the entire Twin Cities region.

For every year since 2001, the Twin Cities region has served slightly less than a 1% share of all business jet operations in the United States. However, this share has generally been declining despite the stability of operations counts. **Table 2-4** compares the total business jet operations in the Twin Cities region (i.e., FCM, MSP, STP, and ANE) to the total business jet operations in the United States and computes the share of nationwide business jet operations conducted in the Twin Cities Region between 2001 and 2021.

Table 2-4: Historical Business Jet Operations

FEDERAL FISCAL YEAR	TWIN CITIES REGION	UNITED STATES	SHARE
2001	36,133	3,933,362	0.97%
2002	41,354	4,493,718	0.99%
2003	42,446	4,583,591	1.00%
2004	45,231	4,923,359	1.00%
2005	46,024	4,936,130	0.95%
2006	44,705	4,819,642	0.95%
2007	44,680	4,980,618	0.93%
2008	42,372	4,668,373	0.93%
2009	31,428	3,664,071	0.90%
2010	34,438	3,996,666	0.91%
2011	36,352	4,158,647	0.92%
2012	35,425	4,171,567	0.88%
2013	34,856	4,240,006	0.86%
2014	36,750	4,383,549	0.87%
2015	36,849	4,460,703	0.86%
2016	37,732	4,520,045	0.87%
2017	37,782	4,663,574	0.85%
2018	38,607	4,741,636	0.85%
2019	37,491	4,765,793	0.79%
2020	26,996	3,854,665	0.70%
2021	32,401	4,871,925	0.67%

Source: HNTB analysis of FAA Traffic Flow Management System Counts data.

Average annual growth in business jet traffic in the Twin Cities region has been slower than the national average annual growth rate, which has contributed to the Twin Cities' declining market share. **Table 2-5** compares average annual growth rates in business jet traffic for the Twin Cities and nationwide for four select time periods: 2001-2007 (before the Great Recession), 2001-2019 (the previous 20 years, excluding

aberrations in activity in 2020 and 2021 from the COVID-19 pandemic), 2010-2019 (the recovery after the Great Recession prior to the COVID-19 pandemic), and 2001-2021 (the previous 20 years).

Table 2-5: Historical Business Jet Operations Average Annual Growth Rate

PERIOD	TWIN CITIES REGION	UNITED STATES
2001-2007	3.6%	4.0%
2001-2019	0.2%	1.1%
2010-2019	0.9%	2.0%
2001-2021	-0.5%	1.1%

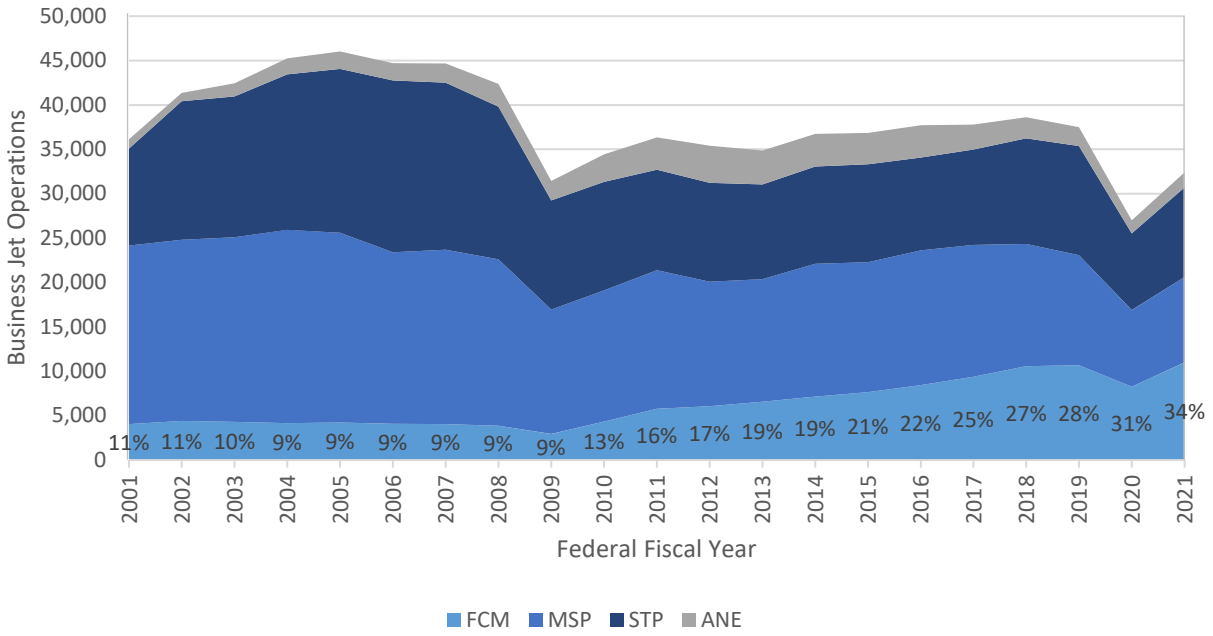
Source: HNTB analysis of FAA Traffic Flow Management System Counts data.

Within the Twin Cities region, business jet traffic has been steadily increasing at FCM since 2010. This increase has occurred for four probable reasons:

1. After MSP and STP, FCM is the next closest MAC airport to the Twin Cities CBDs in terms of physical distance and travel times, making it an attractive option for business jet traffic.
2. Among the seven counties in the Twin Cities region, job growth between 2011 and 2021 was concentrated in Hennepin County, in which FCM, MSP, and Crystal Airport [MIC] are located. Based on data from the Metropolitan Council, Hennepin County experienced a net gain of 51,484 jobs between 2011 and 2021, while the remaining six counties experienced a combined net gain of 56,636 jobs.
3. FCM has a 5,000-foot runway, which has served a variety of turbine aircraft.
4. Corporate hangar development has increased at FCM in recent years.

Figure 2-9 shows the annual number of business jet operations conducted at FCM, MSP, STP, and ANE between 2001 and 2021. The proportion of business jet operations conducted at FCM among these four airports is annotated on the Figure.

Figure 2-9: Historical Business Jet Operations at Twin Cities Airports

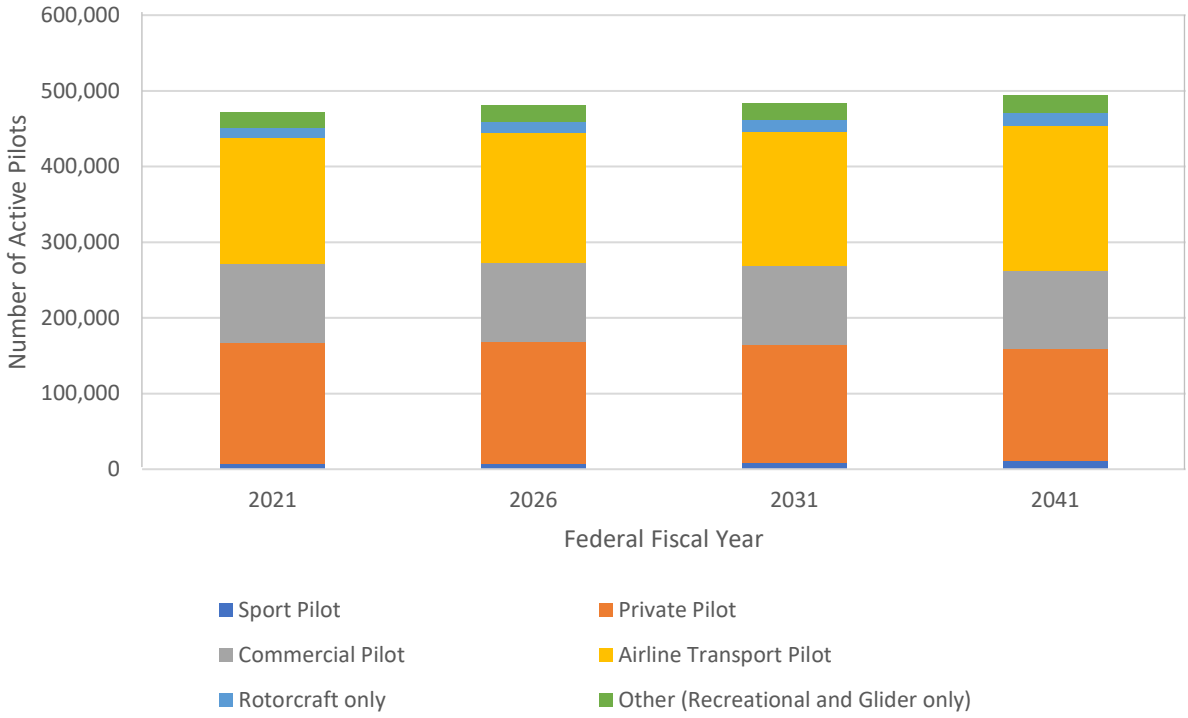


Source: HNTB analysis of FAA Traffic Flow Management System Counts data.

2.3.4 National Pilot Projections

The FAA Aerospace Forecast Fiscal Years 2021-2041 projects that the total number of active pilots in the United States will grow through 2041 by certification type. However, the bulk of this growth will be in the Airline Transport Pilot (ATP) category—that is, pilots that fly commercial passenger or cargo airline flights. **Figure 2-10** summarizes the FAA's forecast number of active pilots by certification.

Figure 2-10: Active Pilots by Type of Certificate



Source: HNTB; data from FAA Aerospace Forecast Fiscal Years 2021-2041.

Applicable national trends in pilot inventory were generally assumed to apply at FCM for the LTP forecast. As FCM does not serve airline activity, growth in the number of ATP pilots is assumed not to affect forecast activity at FCM, and thus this trend did not apply. Sport, Rotorcraft, Recreational, and Glider pilots were not assumed to have a significant influence on activity at FCM because these pilot types comprise a small proportion of pilots.

The numbers of active private pilots and commercial pilots are likely to have a more significant impact on future activity at FCM. According to the FAA, these categories are project to decrease at average annual rates of -0.4% (private) and -0.1% (commercial) between 2021 and 2041. The rate of decline in commercial pilots (-0.1%) was deemed insignificant for the forecast and unlikely to affect other factors driving business aviation demand, as described in Section 2.3.3.3. The rate of decline in the number of private pilots (-0.4%) could affect the number of general aviation operations at FCM. These pilots often fly single-engine piston aircraft, so the forecast decline in private pilots is consistent with the forecast decline in single-engine piston aircraft hours flown.

Critically, however, the FAA's forecast does not include student pilots, and FCM is home to multiple flight schools providing additional aviation demand at FCM. While an FAA forecast of student pilots has not been prepared since 2016, the forecast growth in ATP-certified pilots can provide qualitative insight into student pilot certifications as well as activity conducted at flight schools. By 2041, thousands of ATP-certified pilots will retire; these pilots must be replaced by new pilots who obtain ATP certification. The additional forecast growth in ATP-certified pilots (beyond replacement) will also require an influx of ATP-certified pilots. These new ATP-certified pilots will be student pilots at some point in the forecast period. Thus, the future growth in ATP-certified pilots would suggest near-term growth in student pilots as well as flight school activity. At FCM, ATP Flight School, which opened in 2020, is one such school that provides

certification services for pilots to obtain their ATP certifications. Consequently, it is reasonable to assume a growth in student pilots and flight school activity at FCM to meet the future growth in ATP-certified pilots.

For the purposes of the FCM forecast, it was assumed that the forecast decline in private pilots and the expected increase in student pilots at FCM would result in a negligible net effect on aircraft operations. That is, the number of pilots operating aircraft at FCM was not assumed to be a significant factor informing aviation activity.

2.3.5 Regional Economic Growth Projections

The Metropolitan Council updated its regional economic forecast in July 2021. The forecast contains projections for the region on population, labor force participants, gross domestic product (GDP), and non-agricultural employment for every fifth year (e.g., 2025, 2030, etc.) through 2050. The average annual growth rates in each of these categories are provided below in **Table 2-6**.

Table 2-6: Twin Cities Regional Growth Rate Projections

	AVERAGE ANNUAL GROWTH RATES				
ECONOMIC FACTOR	2020 2025	2025 2030	2030 2035	2035 2040	2020 2040
Population	0.91%	0.86%	0.81%	0.68%	0.82%
Labor Force	1.68%	0.77%	0.68%	0.53%	0.91%
GDP	5.07%	2.46%	2.57%	2.39%	3.11%
Non-Agricultural Employment	3.97%	0.68%	0.59%	0.50%	1.42%

Source: HNTB analysis of Metropolitan Council July 2021 forecast.

Between 2020 and 2025, the growth rates in labor force participants, GDP, and non-agricultural employment are higher than in other five-year periods because of the recovery from the economic downturn caused by the global COVID-19 pandemic. However, beyond 2025, sustained, modest growth in all categories is forecast. These metrics indicate that economy of the Twin Cities region will continue to grow at a modest rate through the forecast period. As aviation activity is often closely correlated with background regional economic growth, it is reasonable to assume that aviation activity in the Twin Cities region will grow at a modest growth rate. While the regional economic projections developed by the Metropolitan Council applied to the entire Twin Cities region and not specifically to the catchment area that FCM serves (see **Figure 2-11**), these regional economic factors were assumed to behave similarly within the FCM catchment area. Therefore, the regional economic indicators support the assumption of modest aviation activity growth at FCM throughout the forecast period.

2.3.6 Continued Catchment Area Economic Growth

In 2019, MAC conducted a Vision Study for its primary reliever airports ANE, STP, and FCM. A portion of the Vision Study included an economic benchmarking exercise of three regional airport systems deemed comparable to the MAC system. The three regional airport systems were specifically selected since they each consisted of a primary large hub airport and multiple reliever airports with varying facilities and roles. These three comparable regions included the Boston region, the Denver region, and the Phoenix region.

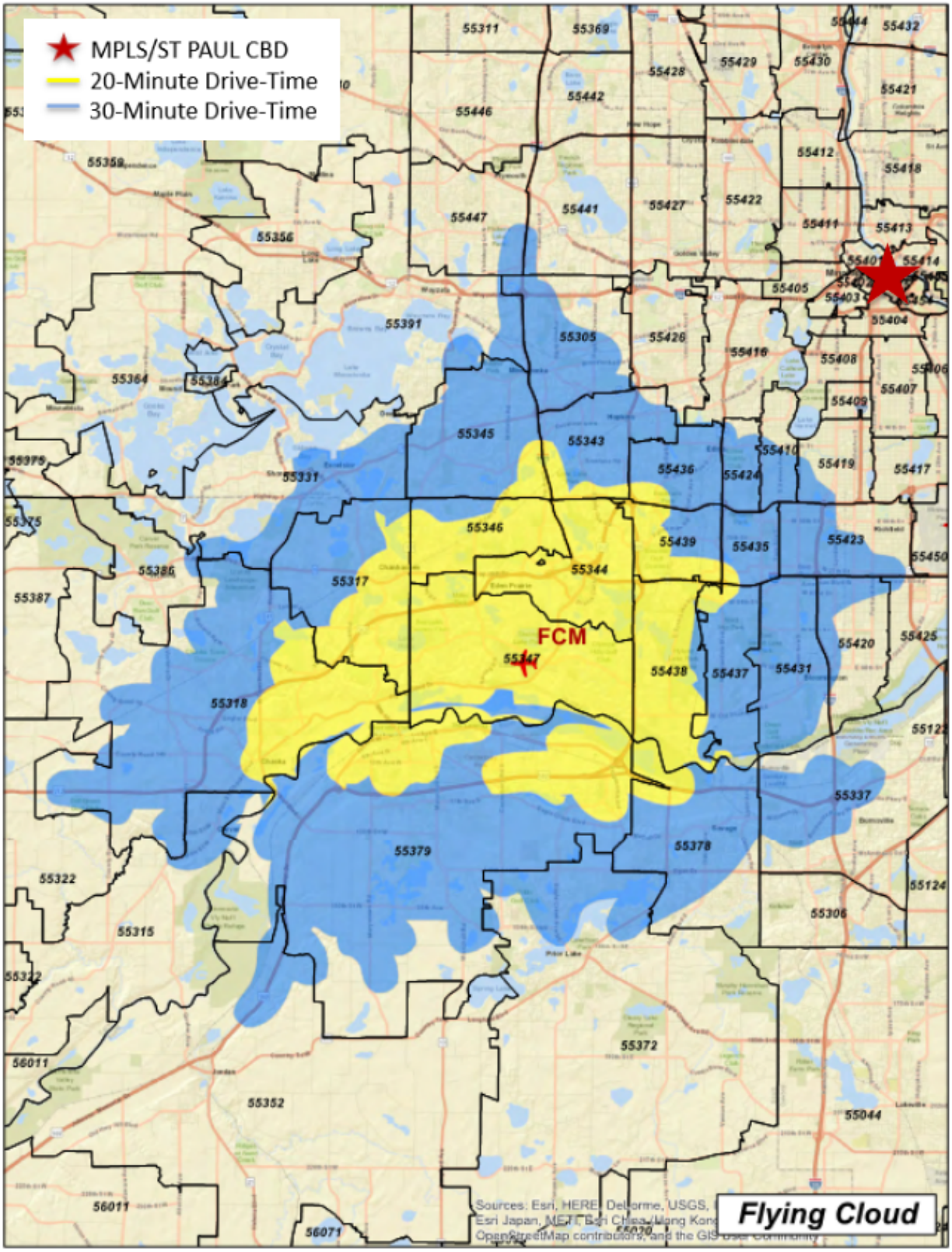
Based on the benchmarking exercise, the Vision Study team identified a group of factors that had the most significant impact on an airport's ability to attract business jet operations. Two of these factors included a high per capita income and a high average wage/salary per employee.

The benchmark economic analysis conducted in the Vision Study identified catchment areas for each of the three primary MAC reliever airports and MSP, which were defined as the locations accessible to or from the airport by a 20-minute drive. The catchment area for FCM from the Vision Study is shown on **Figure 2-11**.

Among the four MAC airports examined in the Vision Study (MSP, FCM, ANE, and STP), FCM had the smallest catchment area in terms of population, households, and employment, but it accounted for the highest number of itinerant general aviation operations, as well as the most business jet operations per capita. The Vision Study identified the probable cause for these characteristics as the comparative wealth of FCM's catchment area over the other airports', measured in terms of per capita income, average wage and salary, and percentage of households with annual incomes greater than $200,000.

For the LTP forecast, the economic metrics examined in the Vision Study were updated based on more recent data. The objective of this exercise was to confirm whether the economic indicators of each airports' catchment areas had remained stable since the Vision Study analysis was conducted, assuming that the catchment areas for each airport had not changed. Using data from the U.S. Census Bureau's American Community Survey 5-Year Estimates, income per capita was estimated for each of the four airports' catchment areas with the most recent data available (2019) in nominal dollars. Additionally, average wage per employee was estimated within each airport's catchment area using the number of employees and total payroll data from the U.S. Census Bureau's Retail Trade, Zip Code Series dataset and the Bureau's County Business Patterns dataset with the most recent data available (2019) in nominal dollars. The results of these analyses are summarized in **Table 2-7** and **Table 2-8**.

Figure 2-11: FCM Catchment Area



Source: Metropolitan Airports Commission, Primary Reliever Airports Vision Study, November 2019.

Table 2-7: Income per Capita Within 20-Minute Drive Catchment

	FCM	MSP	STP	ANE
2017 Per Capita Income (nominal)	$52,894	$39,228	$29,475	$34,674
2019 Per Capita Income (nominal)	$55,456	$42,372	$31,957	$36,875
Average Annual Growth 2017 to 2019	2.39%	3.93%	4.13%	3.13%
Absolute Change 2017 to 2019	$2,562	$3,144	$2,142	$2,201

Source: HNTB, based on data from the American Community Survey by Zip Code.

Table 2-8: Wage per Employee Within 20-Minute Drive Catchment

	FCM	MSP	STP	ANE
2016 Average Wage Per Employee (nominal)	$68,611	$49,993	$53,762	$51,785
2019 Average Wage Per Employee (nominal)	$74,765	$57,275	$58,404	$57,314
Average Annual Growth 2016 to 2019	2.90%	4.64%	2.80%	3.44%
Absolute Change 2016 to 2019	$6,154	$7,282	$4,642	$5,529

Source: HNTB, based on data from the American Community Survey by Zip Code.

The economic metrics updated with 2019 data revealed that FCM's catchment area's per capita income and wage per employee have largely kept pace with inflation. These findings suggest that aeronautical demand at FCM is likely to continue to grow, albeit modestly. Additionally, FCM's catchment area maintains the highest income per capita and wage per employee among the catchment areas for FCM, MSP, STP, and ANE. These results are strong indicators that FCM would be the most likely airport in the Twin Cities region poised to experience an increase in business jet operations and based aircraft. These results therefore suggest continued growth in business jet operations (a subset of fixed-wing turbine operations) during the forecast period.

2.3.7 Local Policies and Restrictions

Minnesota Statute 473.641, Subdivision 4 states that MAC cannot use its revenues to "expand or upgrade the use of an existing metropolitan airport from minor use to intermediate use status". In 2000, this statute was amended to define a "minor use" airport as, "an airport with a runway or runways of length no longer than 5,000 feet." In effect, the legislation prevents FCM, which is a "minor use" airport per Minnesota state law, from constructing a new runway or lengthening an existing runway beyond 5,000 feet.

In 2003, MAC issued Ordinance 97, which resulted from coordination between the city of Eden Prairie, the FAA, and MAC. This Ordinance, which superseded the historical Ordinance 51, restricts operations at FCM to aircraft with a maximum take-off weight of less than 60,000 pounds.

The net effect of these two policies is that FCM is restricted in the types of aircraft that it can serve. Ordinance 97 is an explicit limitation on aircraft types, while the 5,000-foot restriction indirectly limits the aircraft types that can operate at FCM. MAC has no intention of seeking to modify or overturn either of these policies as part of the LTP. Consequently, these policies act as upper bounds on the fleet mix forecast. While the aircraft fleet mix at FCM may change over the forecast period, it can only change to include aircraft up to a certain size. That is, the fleet mix forecast will not project any increase in activity for aircraft larger than the largest that operate at FCM today. Currently, MAC discourages operators who violate the weight restriction by sending warning letters to such operators.

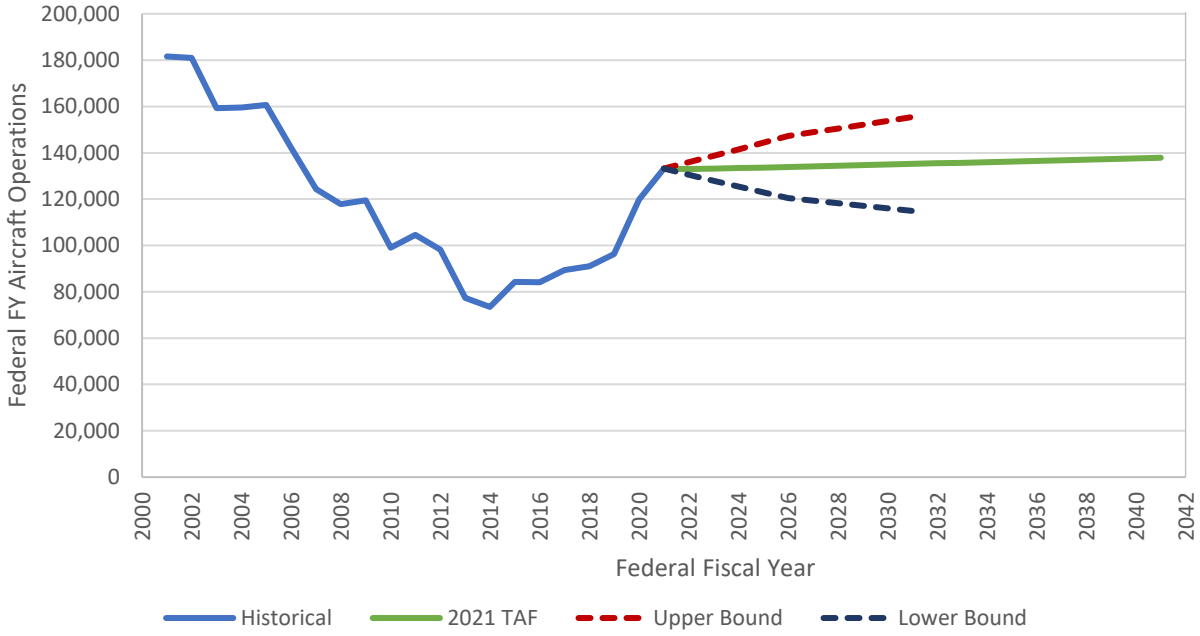
The LTP will include a stakeholder and tenant outreach process as well as an analytical runway length analysis. The results of these processes will provide insight into whether these policies constrain demand, and if so, to what degree.

2.4 Forecast Scenarios

In recognition of the uncertainty inherent in developing aviation activity forecasts, three forecast scenarios were developed for the LTP. These scenarios consisted of a Base Scenario, a High Scenario, and a Low Scenario to reflect a probable range of demand that could be realized at FCM over the forecast period. To facilitate comparison with the FAA TAF, the forecast scenarios were aligned with the federal fiscal year—October through September.

Forecasts supported by appropriate analysis and that project activity within specified variances from the TAF receive FAA approval. Advisory Circular 150/5070-6B, *Airport Master Plans* describes the specified variances as up to 10 percent in the 5-year forecast and up to 15 percent in the 10-year forecast. **Figure 2-12** depicts the 2021 FAA TAF for FCM through 2041 and the limits of these variances from the TAF.

Figure 2-12: 2021 FAA Terminal Area Forecast for FCM and Permitted Variances



Source: HNTB, based on 2021 FAA Terminal Area Forecast for FCM, published in 2022.

2.4.1 Base Scenario

The Base Scenario operations forecast was based on national growth rates of general aviation hours flown. Different national growth rates were applied to different categories of aircraft operations at FCM.

The Base Scenario fleet mix forecast was derived from the operations forecast. The categories of aircraft operations in the forecast were based on AAC, ADG, and Operation Type (see Section 2.1.2). Fleet mix percentages were derived from the forecast operations counts per category.

For the forecast number of based aircraft in the Base Scenario, a combination of growth rates was used on the number of based aircraft in 2021 per NBAIP records (see Error! Reference source not found.). The growth rates included those given for the FCM TAF as well as the national growth rates in the general aviation aircraft fleet.

2.4.1.1 Aircraft Operations

For the Base Scenario, the annual aircraft operations forecast was prepared for every combination of AAC, ADG, and Operation Type as given in the MACNOMS historical data. Operations in each of these categories were assumed either to remain constant through the forecast period or to behave consistently with nationwide growth rates in general aviation hours flown. Operations by piston aircraft groups were assumed to grow at an average annual rate of -0.7%, consistent with the FAA's forecast growth in general aviation fixed-wing piston aircraft hours flown between 2021 and 2041. Operations by turboprop and jet aircraft groups were assumed to grow at an average annual rate of 2.6%, consistent with the FAA's forecast growth in general aviation fixed-wing turbine aircraft hours flown between 2021 and 2041. Operations by military, helicopter, and balloon / blimp groups were assumed to remain constant. Operations by unknown aircraft type were assumed to grow at an average annual rate of 1.0%, consistent with the FAA's forecast growth in overall general aviation hours flown between 2021 and 2041. Similarly, the difference in operations between MACNOMS records and OPSNET records was also assumed to grow at 1.0%. **Table 2-9** summarizes the combinations of AAC, ADG, and Operation Type that were forecast, the number of operations in the base year (2021), and the average annual growth rate applied through 2041. Combinations with zero operations in the base year were not forecast and are excluded from **Table 2-9**.

Table 2-9: FCM Forecast Groups and Applied Growth Rates

AAC	ADG	OPERATION TYPE (MACNOMS)	BASE YEAR OPERATIONS (FY 2021)	APPLIED ANNUAL GROWTH RATE
A	I	Piston	71,662	-0.68%
A	I	Carrier Jet & Jet	145	2.60%
B	I	Piston	2,249	-0.68%
B	I	Carrier Jet & Jet	2,015	2.60%
B	I	Turboprop	140	2.60%
B	I	Military	15	0.00%
B	II	Piston	542	-0.68%
B	II	Carrier Jet & Jet	60,226	2.60%
C	I	Carrier Jet & Jet	780	2.60%
C	II	Carrier Jet & Jet	17,539	2.60%
D	II	Carrier Jet & Jet	23	2.60%
D	III	Carrier Jet & Jet	12	2.60%
N/A	N/A	Helicopter	1,819	0.00%
N/A	N/A	Balloon / Blimp	9	0.00%
N/A	N/A	Piston	1,341	-0.68%
N/A	N/A	Unknown		

Note: "N/A" represents operations for which an aircraft make and model was not available in the MACNOMS data for assigning to AAC and ADG categories. "Unknown" represents operations for which an aircraft type was not available in the MACNOMS data.

Source: HNTB analysis of MACNOMS data provided by Metropolitan Airports Commission.

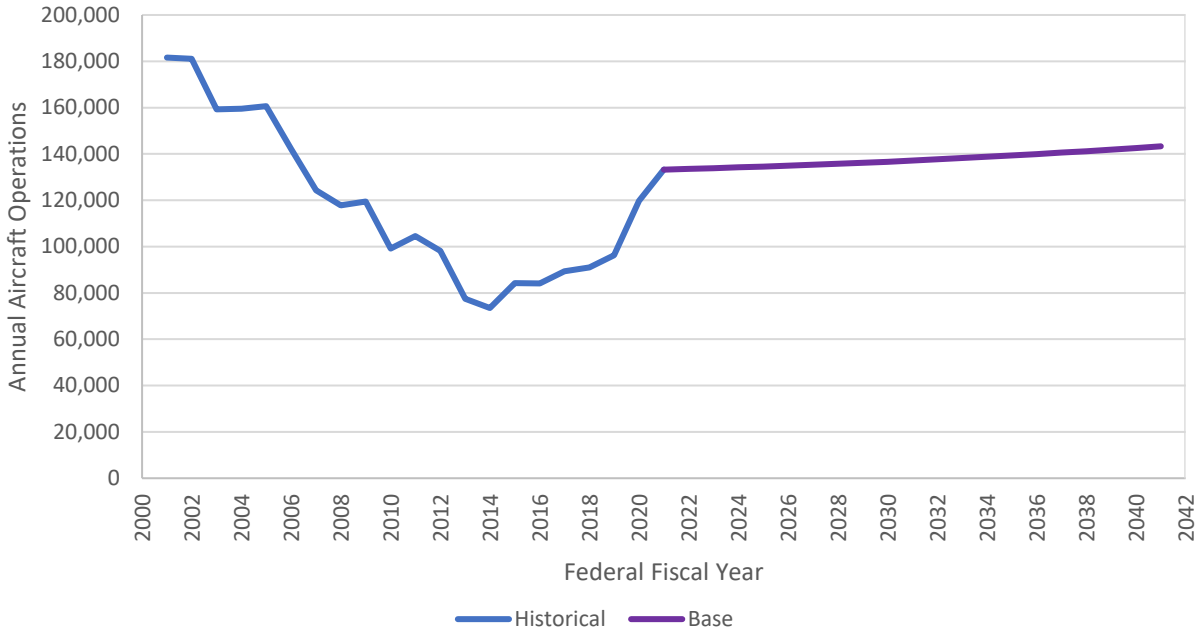
Using these assumptions, the forecast annual number of aircraft operations at FCM from 2021 to 2041 for the Base Scenario is listed in **Table 2-10**, shown on **Figure 2-13**, and summarized in **Table 2-11**.

Table 2-10: FCM Base Scenario Forecast Aircraft Operations by Fiscal Year

Federal Fiscal Year	A I Piston	A I Carrier Jet & Jet	A I Turbo prop	A II Turbo prop	B I Piston	B I Carrier Jet & Jet	B I Turbo prop	B I Military	B II Piston	B II Carrier Jet & Jet	B II Turbo prop	C I Carrier Jet & Jet	C II Carrier Jet & Jet	C III Carrier Jet & Jet	D-II Carrier Jet & Jet	D-III Carrier Jet & Jet	Helicopter & Balloon / Blimp	N/A AAC ADG Piston	N/A AAC ADG Unknown	Difference between MACNOMS and OPSNET	Total
2021	71,662	145	1,483	1,345	2,249	2,015	140	15	542	6,022	3,741	780	1,753	4	23	12	1,828	1,341	1,253	36,864	**133,217**
2022	71,171	149	1,522	1,380	2,234	2,067	144	15	538	6,179	3,838	800	1,799	4	24	12	1,828	1,332	1,265	37,220	**133,521**
2023	70,684	153	1,561	1,416	2,218	2,121	147	15	535	6,339	3,938	821	1,845	4	24	13	1,828	1,323	1,277	37,580	**133,844**
2024	70,200	157	1,602	1,453	2,203	2,176	151	15	531	6,504	4,041	842	1,893	4	25	13	1,828	1,314	1,290	37,943	**134,186**
2025	69,719	161	1,643	1,491	2,188	2,233	155	15	527	6,674	4,146	864	1,943	4	25	13	1,828	1,305	1,302	38,310	**134,547**
2026	69,242	165	1,686	1,529	2,173	2,291	159	15	524	6,847	4,254	887	1,993	5	26	14	1,828	1,296	1,315	38,680	**134,929**
2027	68,768	169	1,730	1,569	2,158	2,351	163	15	520	7,025	4,364	910	2,045	5	27	14	1,828	1,287	1,327	39,054	**135,330**
2028	68,297	174	1,775	1,610	2,143	2,412	168	15	517	7,208	4,478	934	2,098	5	28	14	1,828	1,278	1,340	39,431	**135,753**
2029	67,830	178	1,821	1,652	2,129	2,475	172	15	513	7,396	4,594	958	2,153	5	28	15	1,828	1,269	1,353	39,813	**136,196**
2030	67,365	183	1,869	1,695	2,114	2,539	176	15	510	7,588	4,714	983	2,209	5	29	15	1,828	1,261	1,366	40,197	**136,661**
2031	66,904	187	1,917	1,739	2,100	2,605	181	15	506	7,786	4,837	1,008	2,266	5	30	16	1,828	1,252	1,380	40,586	**137,147**
2032	66,446	192	1,967	1,784	2,085	2,673	186	15	503	7,988	4,962	1,035	2,325	5	31	16	1,828	1,243	1,393	40,978	**137,656**
2033	65,991	197	2,018	1,831	2,071	2,742	191	15	499	8,196	5,092	1,062	2,386	5	31	16	1,828	1,235	1,406	41,374	**138,187**
2034	65,539	202	2,071	1,878	2,057	2,814	195	15	496	8,409	5,224	1,089	2,448	6	32	17	1,828	1,226	1,420	41,774	**138,741**
2035	65,090	208	2,125	1,927	2,043	2,887	201	15	492	8,628	5,360	1,118	2,512	6	33	17	1,828	1,218	1,434	42,178	**139,318**
2036	64,645	213	2,180	1,977	2,029	2,962	206	15	489	8,852	5,499	1,147	2,577	6	34	18	1,828	1,210	1,447	42,585	**139,919**
2037	64,202	219	2,237	2,029	2,015	3,039	211	15	486	9,083	5,642	1,176	2,644	6	35	18	1,828	1,201	1,461	42,997	**140,544**
2038	63,763	224	2,295	2,081	2,001	3,118	217	15	482	9,319	5,789	1,207	2,713	6	36	19	1,828	1,193	1,476	43,413	**141,195**
2039	63,326	230	2,355	2,136	1,987	3,199	222	15	479	9,562	5,940	1,238	2,783	6	37	19	1,828	1,185	1,490	43,832	**141,870**
2040	62,893	236	2,416	2,191	1,974	3,283	228	15	476	9,810	6,094	1,271	2,856	7	37	20	1,828	1,177	1,504	44,256	**142,571**
2041	62,462	242	2,479	2,248	1,960	3,368	234	15	472	10,066	6,253	1,304	2,930	7	38	20	1,828	1,169	1,519	44,684	**143,298**
Annual Growth Rate	-0.68%	2.60%	2.60%	2.60%	-0.68%	2.60%	2.60%	0.00%	-0.68%	2.60%	2.60%	2.60%	2.60%	2.60%	2.60%	2.60%	0.00%	-0.68%	0.97%	0.97%	**0.37%**

Source: HNTB forecast.

Figure 2-13: FCM Base Scenario Forecast Aircraft Operations



Source: HNTB (forecast); 2021 FAA Terminal Area Forecast, published in 2022 (historical).

Table 2-11: Summary of FCM Base Scenario Forecast Aircraft Operations

FEDERAL FISCAL YEAR	AIRCRAFT OPERATIONS	AVERAGE ANNUAL GROWTH RATE (PERIOD)
2021	133,217	N/A
2026	134,929	0.26% (2021-2026)
2031	137,147	0.33% (2026-2031)
2041	143,298	0.44% (2031-2041)

Source: HNTB forecast.

2.4.1.2 Business Jet Operations

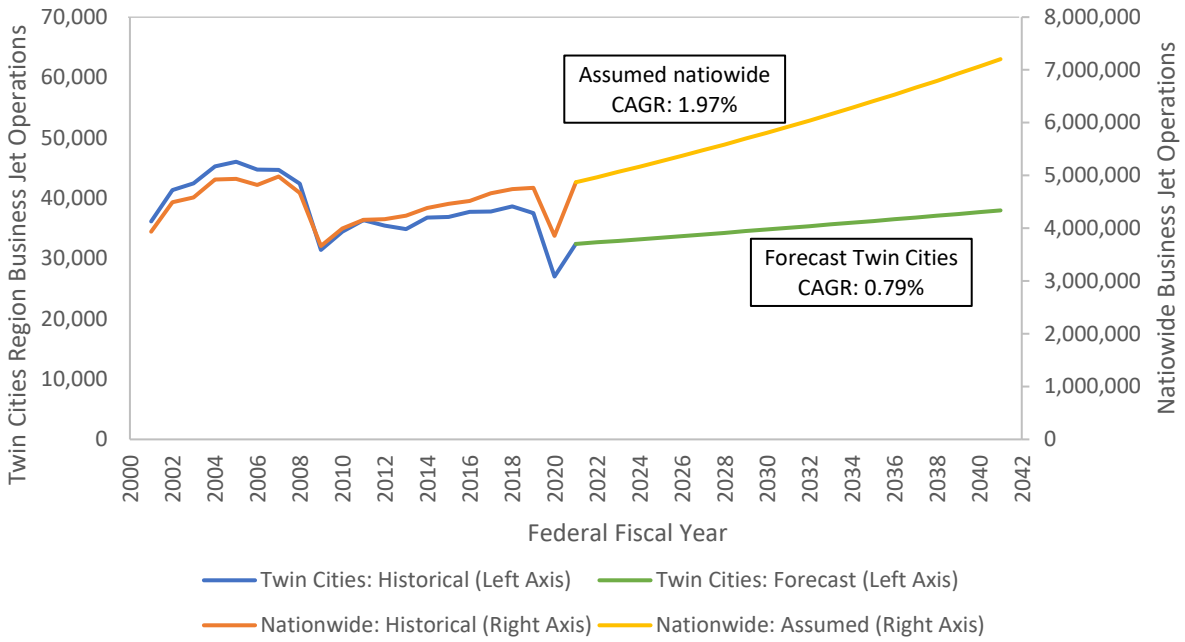
The business jet operations forecast represents a subset of the total aircraft operations forecast described in the previous section.

Business jet traffic has been growing faster nationwide than in the Twin Cities region for the previous 20 years. The LTP forecast assumes that this trend will continue, with the Twin Cities region serving a decreasing share of nationwide business jet traffic through the forecast period. From 2001 to 2019, the share of nationwide business jet traffic that was conducted in the Twin Cities region ("market share") decreased from 0.97% to 0.79%. The market share decreased at an average annual rate of -1.16% CAGR. This declining rate (-1.16% CAGR) was applied to the base year Twin Cities market share of nationwide

business jet operations (0.67%) for the LTP forecast, resulting in approximately 0.53% market share of the national business jet activity by 2041.

Although the Twin Cities' market share of business jet operations is forecast to continue declining, the total number of business jet operations in the region is forecast to increase. This phenomenon would indicate that business jet traffic within the Twin Cities is forecast to grow at a slower rate than the national rate. To estimate how this declining market share could affect business jet operations in the Twin Cities region, an average annual nationwide growth rate in business jet operations of 1.97% was assumed (i.e., the 2010-2019 average growth rate). The number of business jet operations in the Twin Cities region was consequently estimated using the forecast market shares. The application of the forecast market shares resulted in a net 0.79% CAGR in business jet operations in the Twin Cities. **Figure 2-14** presents the number of nationwide business jet operations (right axis) assuming a 1.97% annual growth rate and compares it to the forecast number of business jet operations in the Twin Cities region (left axis) based on the forecast declining market share.

Figure 2-14: Assumed Nationwide and Forecast Twin Cities Business Jet Operations by Fiscal Year



Source: HNTB forecast; historical data derived from FAA Traffic Flow Management System Counts data.

Figure 2-14 demonstrates that the forecast decline in business jet market share in the Twin Cities region results in a net growth of business jet operations, but at a slower rate (0.79% CAGR) than the assumed national growth rate (1.97% CAGR).

Table 2-12 summarizes the forecast data shown in **Figure 2-14** by providing the estimated number of business jet operations nationwide and the forecast number of business jet operations in the Twin Cities region for 2021, 2026, 2031, and 2041.

Table 2-12: Forecast Business Jet Operations: Nationwide and Twin Cities by Fiscal Year

FEDERAL FISCAL YEAR	NATIONWIDE BUSINESS JET OPERATIONS	TWIN CITIES MARKET SHARE	TWIN CITIES BUSINESS JET OPERATIONS
2021	4,871,925	0.67%	32,401
2026	5,372,368	0.63%	33,709
2031	5,924,217	0.59%	35,071
2041	7,203,794	0.53%	37,960
CAGR 2021-2041	1.97%	-1.16%	0.79%

Source: HNTB forecast.

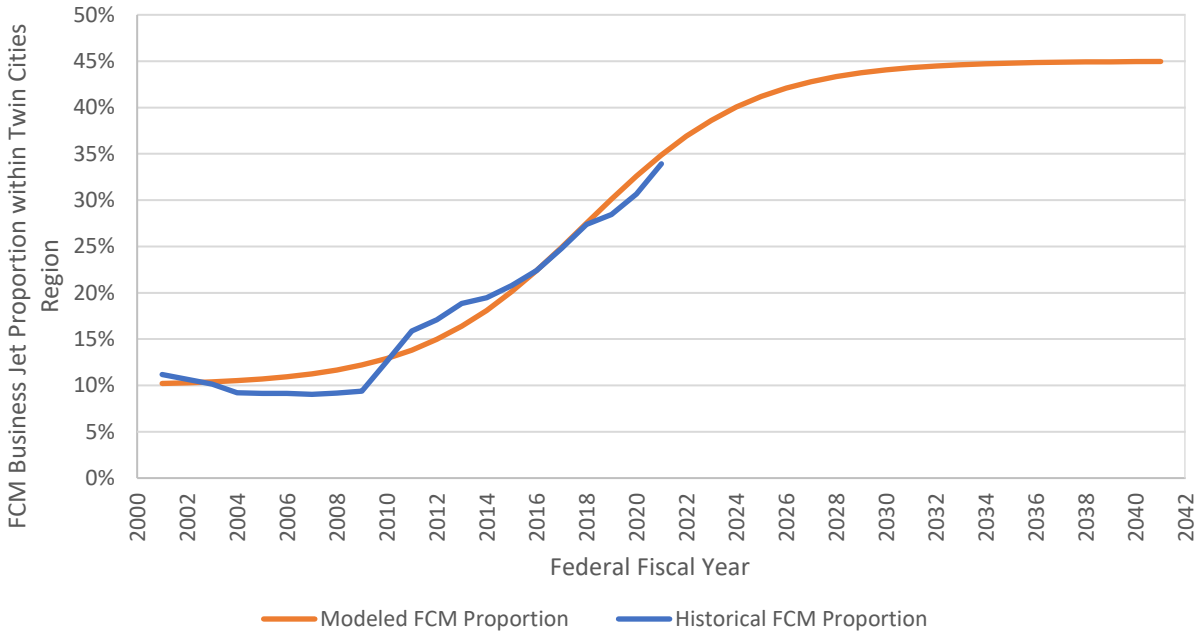
As discussed in Section 2.3.3.3, FCM has served an increasing proportion of the region's business jet traffic between 2001 and 2021. Over the forecast period, it is assumed that this trend will continue, with FCM serving slightly less than 45% of the Twin Cities' business jet traffic by 2041. This continued proportional increase is assumed primarily due to constraints on other facilities: MSP's runway capacity will be prioritized for passenger operations, STP's developable area for hangar space is limited, and no other airport in the region aside from Anoka County-Blaine Airport (ANE) has a 5,000-foot runway. Additionally, FCM's proximity to the Twin Cities CBD increases its attractiveness for business jet traffic over ANE.

The historical and future proportion of the Twin Cities' business jet traffic was modeled using a logistic function[12], with the rate of increase in the proportion of Twin Cities business jet traffic served at FCM declining through 2041. **Figure 2-15** compares the historical proportion of FCM business jet traffic with the modeled proportion based on a logistic function growth, with a correlation of 0.98 (R^2 value of 0.96) between the historical and modeled data for 2001 through 2021.

[12] The logistic function applied was defined as follows:

$$FCM\ business\ jet\ proportion = 0.1 + \frac{0.35}{(1 + e^{-0.3*(Year-2018)})}$$

Figure 2-15: Historical and Modeled Twin Cities Business Jet Proportion at FCM by Fiscal Year



Source: HNTB (modeled); HNTB analysis of FAA Traffic Flow Management System Counts data (historical).

The number of business jet operations at FCM was forecast using the proportions presented in **Figure 2-15** and the forecast number of business jet operations in the Twin Cities region (see **Table 2-12**). **Table 2-13** provides the forecast number of business jet operations in the Twin Cities region and at FCM for 2021, 2026, 2031, and 2041.

Table 2-13: Forecast Business Jet Operations: Twin Cities and FCM by Fiscal Year

FEDERAL FISCAL YEAR	TWIN CITIES BUSINESS JET OPERATIONS	FCM PROPORTION	FCM BUSINESS JET OPERATIONS
2021	32,401	33.9%	10,991
2026	33,709	42.1%	14,188
2031	35,071	44.3%	15,538
2041	37,960	45.0%	17,069
CAGR 2021-2041	0.79%	1.42%	2.23%

Source: HNTB forecast.

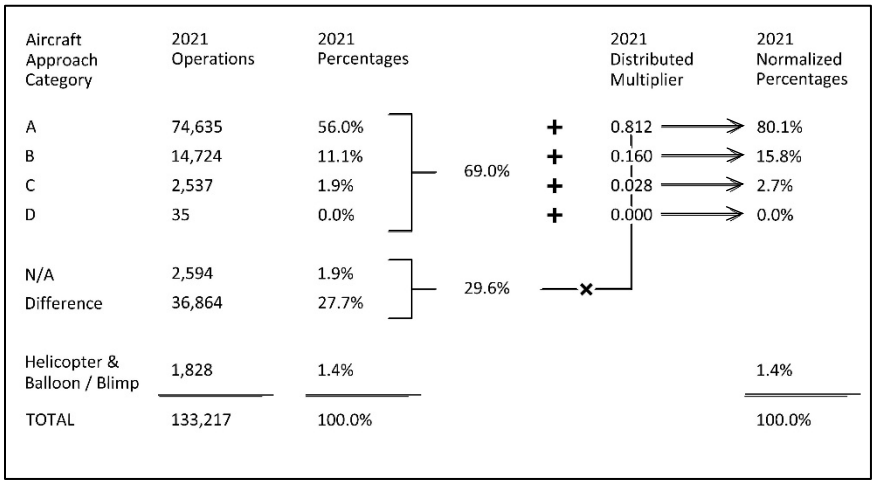
Between 2021 and 2041, the number of annual business jet operations at FCM is forecast to increase from 10,991 to 17,069. This represents an average annual growth rate in business jet operations at FCM of

2.23%. This rate exceeds the assumed average nationwide business jet traffic annual growth rate (1.97%) but is lower than the average annual growth rate in flight hours for fixed-wing turbine aircraft of 2.6% over this same period (see Section 2.3.3.2).

2.4.1.3 Fleet Mix

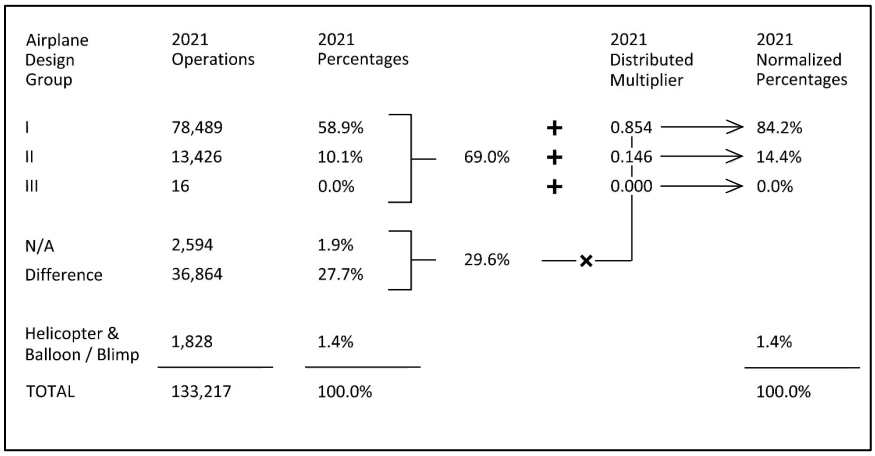
The forecast fleet mix for the Base Scenario was readily derived from the Base Scenario operations forecast, which forecast operations by combination of AAC, ADG, and Operation Type. However, the operations forecast included operations without an AAC or ADG, an "Unknown" Operation Type, and/or a difference between the MACNOMS and OPSNET historical operations counts. The fleet mix forecast further refined the operations forecast by distributing these undefined aircraft types to AACs, ADGs, and Operation Types, creating a normalized fleet mix percentage. The distribution of undefined aircraft types to AACs, ADGs, and Operation Types was proportional to the percentages of the defined aircraft types (excluding helicopters, balloons, and blimps). **Figure 2-16**, **Figure 2-17**, and **Figure 2-18** depict how this distribution was conducted for the AAC, ADG, and Operation Type fleet mix forecasts, respectively, based on the operations forecast. These figures only show the distribution for the base year for illustrative purposes, although this distribution method was used for all forecast years.

Figure 2-16: Base Year Normalized Fleet Mix Percentages by AAC



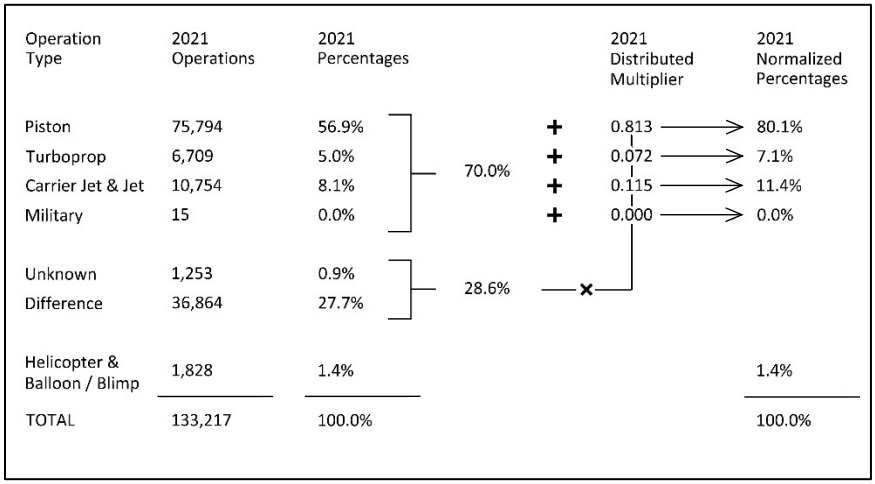
Source: HNTB analysis of MACNOMS data provided by Metropolitan Airports Commission.

Figure 2-17: Base Year Normalized Fleet Mix Percentages by ADG



Source: HNTB analysis of MACNOMS data provided by Metropolitan Airports Commission.

Figure 2-18: Base Year Normalized Fleet Mix Percentages by Operation Type



Source: HNTB analysis of MACNOMS data provided by Metropolitan Airports Commission.

The procedure illustrated in the three preceding figures was applied to the operations forecast for every fiscal year through 2041, resulting in normalized fleet mix percentages for every fiscal year. These normalized percentages were then applied to the total Base Scenario operations forecast to forecast the number of operations for each fleet mix category.

Table 2-14 summarizes the Base Scenario forecast fleet mix in terms of operations by AAC and the respective percentages for select forecast years. **Table 2-15** summarizes the forecast fleet mix by ADG. **Table 2-16** summarizes the forecast fleet mix by Operation Type. And **Table 2-17** summarizes the forecast fleet mix by AAC-ADG combination, which was developed using the same procedure described previously.

Table 2-14: Base Scenario Forecast Fleet Mix by AAC (Fiscal Year)

AAC	FY 2021 Operations (Percentage)	FY 2026 Operations (Percentage)	FY 2031 Operations (Percentage)	FY 2041 Operations (Percentage)	FY 2021 2041 Operations CAGR
A	106,669 (80.1%)	105,284 (78.0%)	103,945 (75.8%)	101,377 (70.7%)	-0.3%
B	21,044 (15.8%)	23,577 (17.5%)	26,489 (19.3%)	33,629 (23.5%)	2.4%
C	3,626 (2.7%)	4,182 (3.1%)	4,819 (3.5%)	9,984 (4.4%)	2.9%
D	50 (0.0%)	58 (0.0%)	66 (0.0%)	88 (0.1%)	2.9%
Helicopter & Balloon / Blimp	1,828 (1.4%)	1,828 (1.4%)	1,828 (1.3%)	1,828 (1.3%)	0.0%
TOTAL	**133,217 (100.0%)**	**134,929 (100.0%)**	**137,147 (100.0%)**	**143,298 (100.0%)**	**0.4%**

Notes:
Base year (2021) operations counts in this table will differ from actual base year counts due to the normalization of the percentage to exclude "N/A".
Totals and subtotals may not add to 100% due to rounding.

Source: HNTB forecast.

Table 2-15: Base Scenario Forecast Fleet Mix by ADG (Fiscal Year)

ADG	FY 2021 Operations (Percentage)	FY 2026 Operations (Percentage)	FY 2031 Operations (Percentage)	FY 2041 Operations (Percentage)	FY 2021 2041 Operations CAGR
I	112,178 (84.2%)	111,077 (82.3%)	110,072 (80.3%)	108,343 (75.6%)	-0.2%
II	19,189 (14.4%)	21,997 (16.3%)	25,217 (18.4%)	33,087 (23.1%)	2.8%
III	23 (0.0%)	26 (0.0%)	30 (0.0%)	40 (0.0%)	2.9%
Helicopter & Balloon / Blimp	1,828 (1.4%)	1,828 (1.4%)	1,828 (1.3%)	1,828 (1.3%)	0.0%
TOTAL	**133,217 (100.0%)**	**134,929 (100.0%)**	**137,147 (100.0%)**	**143,298 (100.0%)**	**0.4%**

Notes:
Base year (2021) operations counts in this table will differ from actual base year counts due to the normalization of the percentage to exclude "N/A".
Totals and subtotals may not add to 100% due to rounding.

Source: HNTB forecast.

Table 2-16: Base Scenario Forecast Fleet Mix by Operation Type (Fiscal Year)

Operation Type	FY 2021 Operations (Percentage)	FY 2026 Operations (Percentage)	FY 2031 Operations (Percentage)	FY 2041 Operations (Percentage)	FY 2021 2041 Operations CAGR
Piston	106,773 (80.1%)	104,699 (77.6%)	102,576 (74.8%)	98,108 (68.5%)	-0.4%
Turboprop	9,451 (7.1%)	10,906 (8.1%)	12,573 (9.2%)	16,653 (11.6%)	2.9%
Carrier Jet & Jet	15,149 (11.4%)	17,481 (13.0%)	20,154 (14.7%)	26,694 (18.6%)	2.9%
Military	15 (0.0%)	15 (0.0%)	15 (0.0%)	15 (0.0%)	0.0%
Helicopter & Balloon / Blimp	1,828 (1.4%)	1,828 (1.4%)	1,828 (1.3%)	1,828 (1.3%)	0.0%
TOTAL	**133,217 (100.0%)**	**134,929 (100.0%)**	**137,147 (100.0%)**	**143,298 (100.0%)**	**0.4%**

Notes:
Base year (2021) operations counts in this table will differ from actual base year counts due to the normalization of the percentage to exclude "Unknown".
Totals and subtotals may not add to 100% due to rounding.

Source: HNTB forecast.

Table 2-17: Base Scenario Forecast Fleet Mix by AAC-ADG Combination (Fiscal Year)

AAC ADG Combination	FY 2021 Operations (Percentage)	FY 2026 Operations (Percentage)	FY 2031 Operations (Percentage)	FY 2041 Operations (Percentage)	FY 2021 2041 Operations CAGR
A-I	104,747 (78.6%)	103,067 (76.4%)	101,390 (73.9%)	97,998 (68.4%)	-0.3%
A-II	1,922 (1.4%)	2,217 (1.6%)	2,555 (1.9%)	3,380 (2.4%)	2.9%
B-I	6,316 (4.7%)	6,724 (5.0%)	7,200 (5.3%)	8,385 (5.9%)	1.4%
B-II	14,728 (11.1%)	16,853 (12.5%)	19,288 (14.1%)	25,244 (17.6%)	2.7%
C-I	1,115 (0.8%)	1,286 (1.0%)	1,482 (1.1%)	1,960 (1.4%)	2.9%
C-II	2,505 (1.9%)	2,890 (2.1%)	3,330 (2.4%)	4,405 (3.1%)	2.9%
C-III	6 (0.0%)	7 (0.0%)	8 (0.0%)	10 (0.0%)	2.9%
D-II	33 (0.0%)	38 (0.0%)	44 (0.0%)	58 (0.0%)	2.9%
D-III	17 (0.0%)	20 (0.0%)	23 (0.0%)	30 (0.0%)	2.9%
Helicopter & Balloon / Blimp	1,828 (1.4%)	1,828 (1.4%)	1,828 (1.3%)	1,828 (1.3%)	0.0%
TOTAL	**133,217 (100.0%)**	**134,929 (100.0%)**	**137,147 (100.0%)**	**143,298 (100.0%)**	**0.4%**

Notes:
Base year (2021) operations counts in this table will differ from actual base year counts due to the normalization of the percentage to exclude "N/A".
Totals and subtotals may not add to 100% due to rounding.

Source: HNTB forecast.

The Base Scenario fleet mix forecast reflects trends that are forecast at the national level, as well as MAC's strategic objective to accommodate market demand for business jet operations at FCM. Specifically, operations by smaller aircraft belonging to the AAC A, ADG I, and/or piston classifications are forecast to decrease, while those conducted by AACs B and C, ADG II, and/or turboprop and jet classifications are forecast to experience the greatest increase.

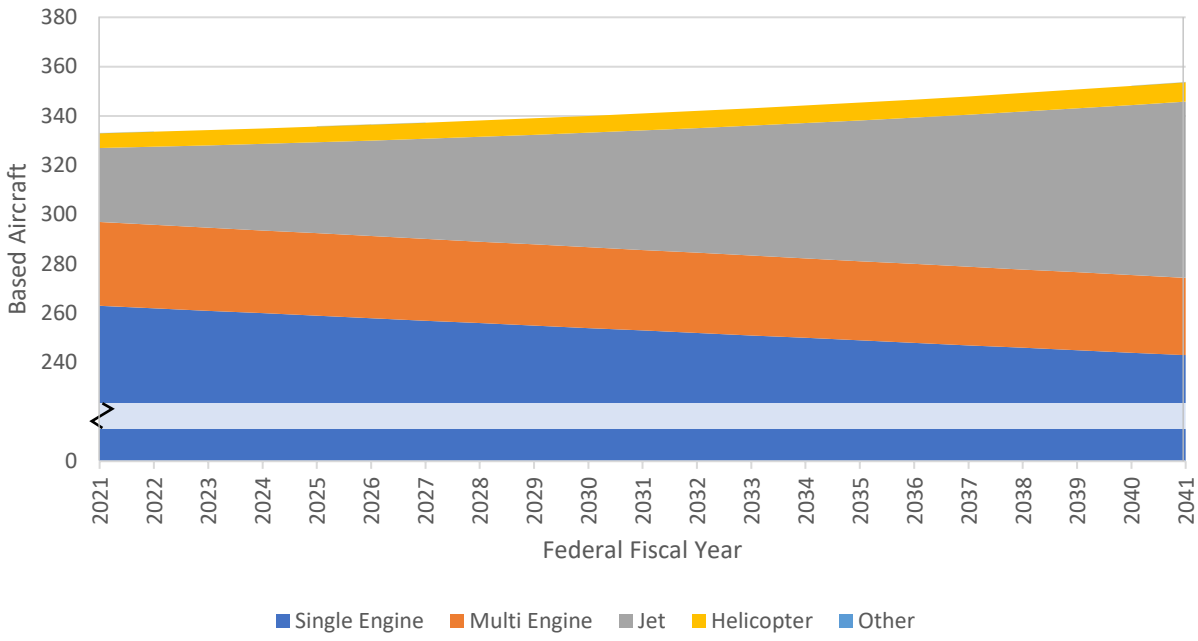
2.4.1.4 Based Aircraft

The forecast number of based aircraft in the Base Scenario combined assumptions made for the FCM TAF with the FAA's national forecast for the general aviation fleet. Specifically, the following assumptions were made:

- The Single Engine based aircraft fleet was forecast to decline by one aircraft per fiscal year, consistent with the TAF.
- The Multi Engine based aircraft fleet was forecast to decline at an average annual rate of -0.4%, consistent with the forecast national average annual decline in multi-engine general aviation aircraft (see **Table 2-3**).
- The Jet based aircraft fleet was forecast to increase by one aircraft per fiscal year to offset the loss in Single Engine aircraft, consistent with the TAF. On top of this marginal growth, the forecast national average annual growth rate in jet general aviation aircraft of 2.2% was applied (see **Table 2-3**). The compounding of these growth rates is reflective of MAC's strategic objective to accommodate market demand for business jet operations at FCM.
- The Helicopter based aircraft fleet was forecast to increase at an average annual rate of 1.4%, consistent with the forecast national average annual increase in rotorcraft (see **Table 2-3**).
- The Other based aircraft fleet was forecast to increase at an average annual rate of 1.4%, consistent with the forecast national average annual increase in experimental and other aircraft (see **Table 2-3**).

Using these assumptions, the forecast number of aircraft based at FCM from 2021 to 2041 is shown on **Figure 2-19** and summarized in **Table 2-14.**

Figure 2-19: FCM Base Scenario Forecast Based Aircraft by Fiscal Year



Source: HNTB forecast.

Table 2-14: Summary of FCM Base Scenario Forecast Based Aircraft by Fiscal Year

FEDERAL FISCAL YEAR	SINGLE ENGINE	MULTI ENGINE	JET	HELICOPTER	OTHER	TOTAL
2021	263	34	30	6	0	**333**
2026	258	33	39	6	0	**336**
2031	253	33	48	7	0	**341**
2041	243	31	71	8	0	**354**
2021-2041 CAGR	-0.4%	-0.4%	4.4%	1.4%	0.0%	**0.3%**

Source: HNTB forecast.

2.4.2 High Scenario

The High Scenario aircraft operations forecast was defined according to the following parameters:

- In the first year after the base year (2022), activity would grow at the average annual growth rate experienced at FCM between 2014 and 2019, 5.54%. This represents a case in which near-term growth will remain consistent with recent years.
- For the subsequent three years, the year-over-year growth rate would decrease linearly to 1.0% in 2025, based on the long-term growth in national general aviation hours flown given in the FAA Aerospace Forecast Fiscal Years 2021-2041. This assumes that the recent growth is not indefinitely sustainable, and that growth will come in line with national trends.
- Every year thereafter through the end of the forecast period, activity would grow at 1.0% year-over-year.

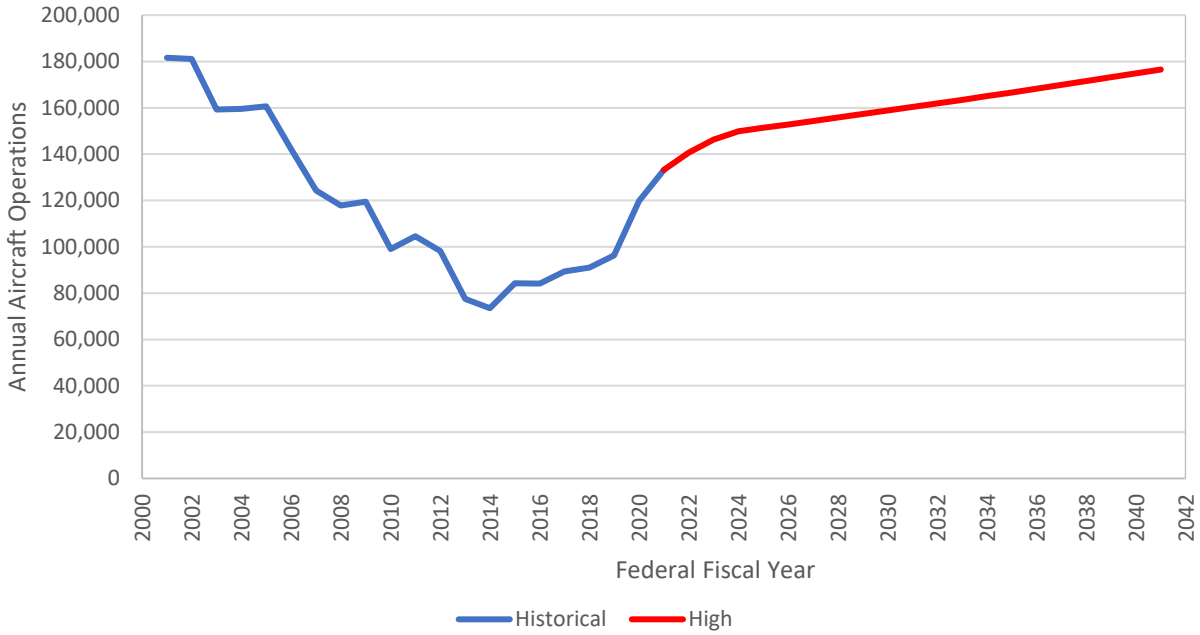
The forecast level of activity in the High Scenario would not alter FCM's designation as a General Aviation and Reliever airport within the forecast period.

The High Scenario fleet mix forecast applied the same normalized fleet mix percentages as in the Base Scenario to the High Scenario operations forecast. The High Scenario based aircraft forecast was based on the application of the same ratio of annual operations to based aircraft as in the Base Scenario.

2.4.2.1 Aircraft Operations

The forecast number of aircraft operations at FCM from 2021 to 2041 for the High Scenario is shown on **Figure 2-20** and summarized in **Table 2-15**.

Figure 2-20: FCM High Scenario Forecast Aircraft Operations



Source: HNTB (forecast); 2021 FAA Terminal Area Forecast, published in 2022 (historical).

Table 2-15: Summary of FCM High Scenario Forecast Aircraft Operations

Federal Fiscal Year	Aircraft Operations	Average Annual Growth Rate (Period)
2021	133,217	N/A
2026	152,806	2.78% (2021-2026)
2031	160,334	0.97% (2026-2031)
2041	176,522	0.97% (2031-2041)

Source: HNTB forecast.

2.4.2.2 Fleet Mix

The forecast High Scenario fleet mix percentages were assumed to be identical to those of the Base Scenario. However, because the total forecast number of annual aircraft operations differs between the two scenarios, the number of operations by AAC, ADG, Operation Type, and AAC-ADG combination in each scenario is also different.

Table 2-20, **Table 2-21**, **Table 2-22**, and **Table 2-23** summarize the High Scenario forecast fleet mix in terms of operations by AAC, ADG, Operation Type, and AAC-ADG combination, respectively, and the associated fleet mix percentages for select forecast years.

Table 2-20: High Scenario Forecast Fleet Mix by AAC (Fiscal Year)

AAC	FY 2021 Operations (Percentage)	FY 2026 Operations (Percentage)	FY 2031 Operations (Percentage)	FY 2041 Operations (Percentage)	FY 2021 2041 Operations CAGR
A	106,669 (80.1%)	119,233 (78.0%)	121,519 (75.8%)	124,882 (70.7%)	0.8%
B	21,044 (15.8%)	26,701 (17.5%)	30,967 (19.3%)	41,426 (23.5%)	3.4%
C	3,626 (2.7%)	4,736 (3.1%)	5,634 (3.5%)	7,853 (4.4%)	3.9%
D	50 (0.0%)	65 (0.0%)	78 (0.0%)	108 (0.1%)	3.9%
Helicopter & Balloon / Blimp	1,828 (1.4%)	2,070 (1.4%)	2,137 (1.3%)	2,252 (1.3%)	1.0%
TOTAL	**133,217 (100.0%)**	**152,806 (100.0%)**	**160,334 (100.0%)**	**176,522 (100.0%)**	**1.4%**

Notes:
Base year (2021) operations counts in this table will differ from actual base year counts due to the normalization of the percentage to exclude "N/A".
Totals and subtotals may not add to 100% due to rounding.

Source: HNTB forecast.

Table 2-21: High Scenario Forecast Fleet Mix by ADG (Fiscal Year)

ADG	FY 2021 Operations (Percentage)	FY 2026 Operations (Percentage)	FY 2031 Operations (Percentage)	FY 2041 Operations (Percentage)	FY 2021 2041 Operations CAGR
I	112,178 (84.2%)	125,794 (82.3%)	128,682 (80.3%)	133,463 (75.6%)	0.9%
II	19,189 (14.4%)	24,912 (16.3%)	29,480 (18.4%)	40,758 (23.1%)	3.8%
III	23 (0.0%)	30 (0.0%)	36 (0.0%)	50 (0.0%)	3.9%
Helicopter & Balloon / Blimp	1,828 (1.4%)	2,070 (1.4%)	2,137 (1.3%)	2,252 (1.3%)	1.0%
TOTAL	**133,217 (100.0%)**	**152,806 (100.0%)**	**160,334 (100.0%)**	**176,522 (100.0%)**	**1.4%**

Notes:
Base year (2021) operations counts in this table will differ from actual base year counts due to the normalization of the percentage to exclude "N/A".
Totals and subtotals may not add to 100% due to rounding.

Source: HNTB forecast.

Table 2-22: High Scenario Forecast Fleet Mix by Operation Type (Fiscal Year)

Operation Type	FY 2021 Operations (Percentage)	FY 2026 Operations (Percentage)	FY 2031 Operations (Percentage)	FY 2041 Operations (Percentage)	FY 2021-2041 Operations CAGR
Piston	106,773 (80.1%)	118,571 (77.6%)	119,919 (74.8%)	120,854 (68.5%)	0.6%
Turboprop	9,451 (7.1%)	12,351 (8.1%)	14,699 (9.2%)	20,514 (11.6%)	4.0%
Carrier Jet & Jet	15,149 (11.4%)	19,797 (13.0%)	23,562 (14.7%)	32,883 (18.6%)	4.0%
Military	15 (0.0%)	17 (0.0%)	18 (0.0%)	18 (0.0%)	1.0%
Helicopter & Balloon / Blimp	1,828 (1.4%)	2,070 (1.4%)	2,137 (1.3%)	2,252 (1.3%)	1.0%
TOTAL	**133,217 (100.0%)**	**152,806 (100.0%)**	**160,334 (100.0%)**	**176,522 (100.0%)**	**1.4%**

Notes:
Base year (2021) operations counts in this table will differ from actual base year counts due to the normalization of the percentage to exclude "Unknown".
Totals and subtotals may not add to 100% due to rounding.

Source: HNTB forecast.

Table 2-23: High Scenario Forecast Fleet Mix by AAC-ADG Combination (Fiscal Year)

AAC-ADG Combination	FY 2021 Operations (Percentage)	FY 2026 Operations (Percentage)	FY 2031 Operations (Percentage)	FY 2041 Operations (Percentage)	FY 2021-2041 Operations CAGR
A-I	104,747 (78.6%)	116,723 (76.4%)	118,532 (73.9%)	120,719 (68.4%)	0.7%
A-II	1,922 (1.4%)	2,511 (1.6%)	2,987 (1.9%)	4,164 (2.4%)	3.9%
B-I	6,316 (4.7%)	7,615 (5.0%)	8,418 (5.3%)	10,329 (5.9%)	2.5%
B-II	14,728 (11.1%)	19,086 (12.5%)	22,549 (14.1%)	31,097 (17.6%)	3.8%
C-I	1,115 (0.8%)	1,456 (1.0%)	1,732 (1.1%)	2,415 (1.4%)	3.9%
C-II	2,505 (1.9%)	3,273 (2.1%)	3,893 (2.4%)	5,427 (3.1%)	3.9%
C-III	6 (0.0%)	7 (0.0%)	9 (0.0%)	12 (0.0%)	3.9%
D-II	33 (0.0%)	43 (0.0%)	51 (0.0%)	71 (0.0%)	3.9%
D-III	17 (0.0%)	22 (0.0%)	27 (0.0%)	37 (0.0%)	3.9%
Helicopter & Balloon / Blimp	1,828 (1.4%)	2,070 (1.4%)	2,137 (1.3%)	2,252 (1.3%)	1.0%
TOTAL	**133,217 (100.0%)**	**152,806 (100.0%)**	**160,334 (100.0%)**	**176,522 (100.0%)**	**1.4%**

Notes:
Base year (2021) operations counts in this table will differ from actual base year counts due to the normalization of the percentage to exclude "N/A".
Totals and subtotals may not add to 100% due to rounding.

Source: HNTB forecast.

Unlike the Base Scenario, the High Scenario fleet mix forecast projects an absolute increase in operations for all aircraft classifications, even though the fleet mix percentages of smaller aircraft (e.g., AAC A, ADG I, and/or piston classifications) are forecast to decrease. The total operations growth in the High Scenario offsets the declining fleet mix percentages for these smaller aircraft, resulting in a net growth in operations for these smaller aircraft, albeit at a slower rate than for larger aircraft.

2.4.2.3 Based Aircraft

For the High Scenario based aircraft forecast, the ratio of annual aircraft operations to total based aircraft in the Base Scenario was assumed to the remain constant as in the High Scenario. This ratio is summarized for select years in **Table 2-24**.

Table 2-24: Ratio of Annual Aircraft Operations to Based Aircraft

FEDERAL FISCAL YEAR	FORECAST AIRCRAFT OPERATIONS (BASE SCENARIO)	FORECAST BASED AIRCRAFT (BASE SCENARIO)	RATIO
2021	133,217	333	400.05 : 1
2026	134,929	336	401.03 : 1
2031	137,147	341	402.22 : 1
2041	143,298	354	405.17 : 1

Source: HNTB forecast.

The proportions of each based aircraft type (Single Engine, Multi Engine, Jet, Helicopter, Other) for each year in the High Scenario were assumed to be the same as those for each year in the Base Scenario. These percentages are summarized in **Table 2-25**.

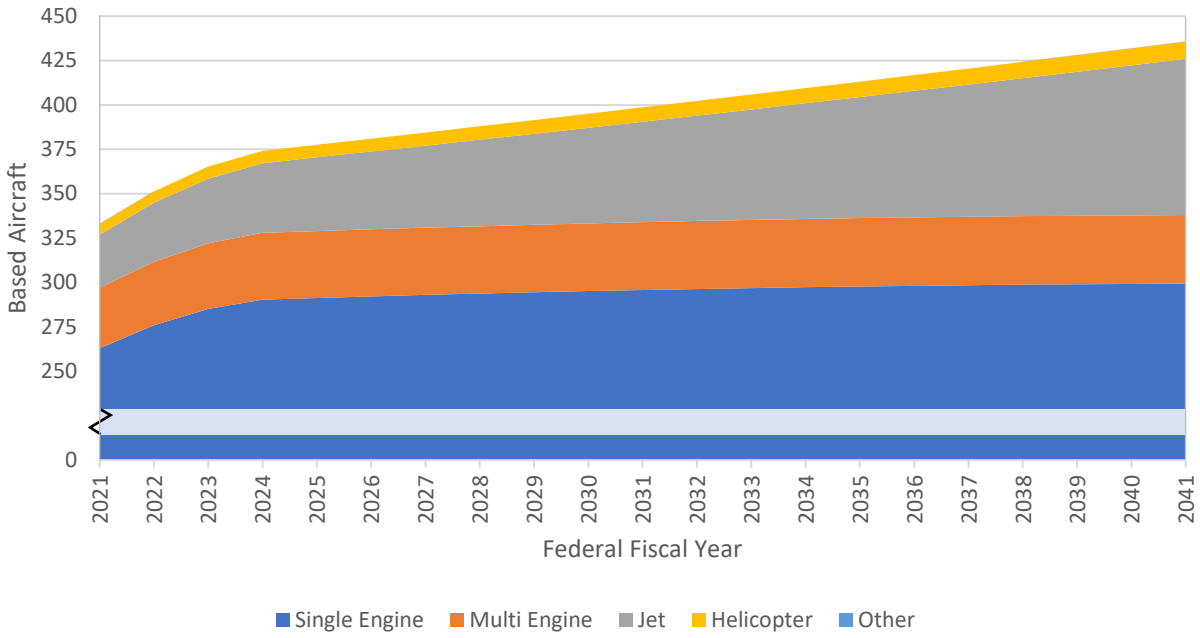
Table 2-25: Based Aircraft Forecast Fleet Proportions

	Proportion of Fleet					
FEDERAL FISCAL YEAR	SINGLE ENGINE	MULTI ENGINE	JET	HELICOPTER	OTHER	TOTAL
2021	79.0%	10.2%	9.0%	1.8%	0.0%	**100.0%**
2026	76.7%	9.9%	11.5%	1.9%	0.0%	**100.0%**
2031	74.2%	9.6%	14.2%	2.0%	0.0%	**100.0%**
2041	68.7%	8.9%	20.2%	2.2%	0.0%	**100.0%**

Source: HNTB forecast.

The based aircraft forecast for the High Scenario was derived by applying the ratio of annual aircraft operations to total based aircraft (**Table 2-24**) to the forecast number of annual operations in the High Scenario, and then applying the proportions of each based aircraft type (**Table 2-25**). The results are summarized on **Figure 2-21** and in **Table 2-26.**

Figure 2-21: FCM High Scenario Forecast Based Aircraft



Source: HNTB forecast.

Table 2-26: Summary of FCM High Scenario Forecast Based Aircraft

FEDERAL FISCAL YEAR	SINGLE ENGINE	MULTI ENGINE	JET	HELICOPTER	OTHER	TOTAL
2021	263	34	30	6	0	**333**
2026	292	38	44	7	0	**381**
2031	296	38	57	8	0	**399**
2041	299	39	88	10	0	**436**
2021-2041 CAGR	0.6%	0.6%	5.5%	2.4%	0.0%	**1.4%**

Source: HNTB forecast.

Like the High Scenario fleet mix forecast, the absolute numbers of single-engine and multi-engine based aircraft are forecast to increase, even though their percentages of the total based aircraft fleet decline. This means that single-engine and multi-engine based aircraft are forecast to grow at a slower rate than jet based aircraft, and at a slower rate than the average based aircraft growth rate.

2.4.3 Low Scenario

The Low Scenario aircraft operations forecast was defined according to the following parameters:

- In 2022, activity would revert to 2020 levels.
- Between 2022 and 2027, activity would grow at the same rate as the TAF, which is a lower rate than the Base Scenario.
- Activity would drop by 5% in 2028, representative of a future recession.
- Activity would recover by 2% per year for two consecutive years after 2028.
- After 2030, activity would grow at the same rate as the TAF.

The Low Scenario was constructed to protect for the possibility that the recent growth in activity at FCM in 2021 was not permanent, as well as the possibility of a future economic downturn. The Low Scenario also represents the possibility of slower long-term growth, which could result if the Airport Traffic Control Tower cab is not relocated. Without this relocation, much of the south side of the airport would be unable to be developed, which could inhibit growth in based aircraft and business jet operations.

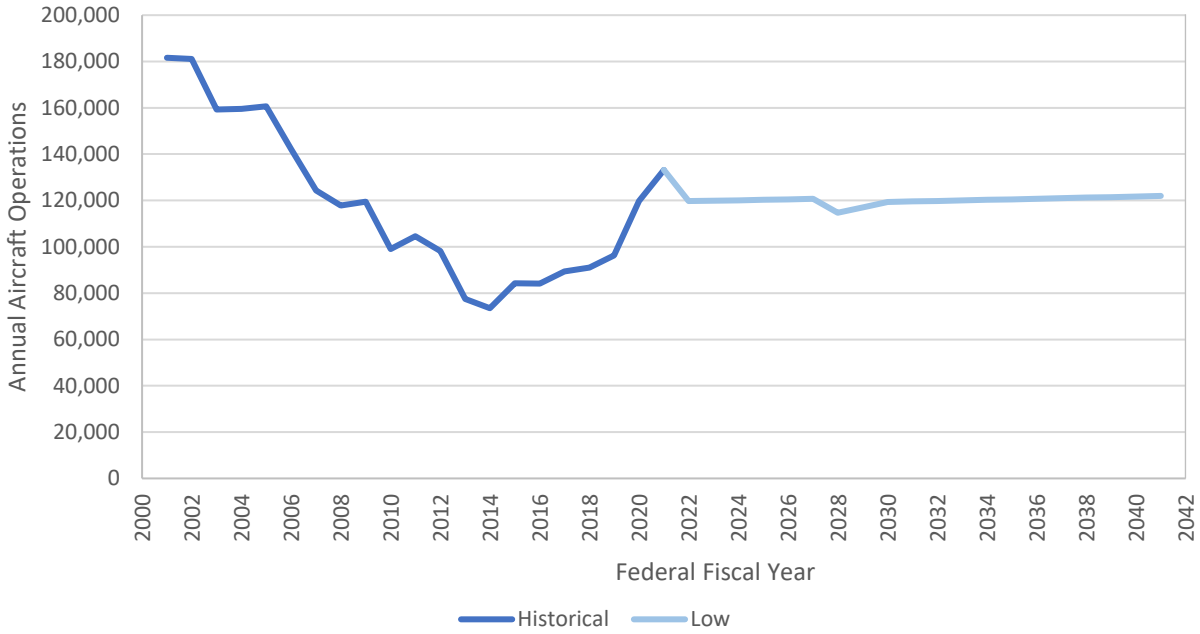
The Low Scenario fleet mix forecast applied the same normalized fleet mix percentages as in the Base Scenario to the Low Scenario operations forecast. The Low Scenario based aircraft forecast was based on the application of the same ratio of annual operations to based aircraft as in the Base Scenario.

2.4.3.1 Aircraft Operations

The Low Scenario assumed that the growth in aircraft operations experienced 2021 was temporary, and that 2022 demand levels would regress to 2020 levels. Between 2022 and 2027, the annual growth rates would be identical to those of the TAF: approximately 0.15% from 2022 through 2025, followed by approximately 0.20% from 2026 through 2027. In 2028, activity would decrease by 5% to represent an economic downturn, followed by a two-year recovery of 2% growth per year. After 2030, the annual growth rates would be identical to that of the TAF (approximately 0.20%).

The forecast number of aircraft operations at FCM from 2021 to 2041 for the Low Scenario is shown on **Figure 2-22** and summarized in **Table 2-27**.

Figure 2-22: FCM Low Scenario Forecast Aircraft Operations



Source: HNTB (forecast); 2021 FAA Terminal Area Forecast, published in 2022 (historical).

Table 2-27: Summary of FCM Low Scenario Forecast Aircraft Operations

FEDERAL FISCAL YEAR	AIRCRAFT OPERATIONS	AVERAGE ANNUAL GROWTH RATE (PERIOD)
2021	133,217	N/A
2026	120,500	-1.99% (2021-2026)
2031	119,566	-0.16% (2026-2031)
2041	121,933	0.20% (2031-2041)

Source: HNTB forecast.

2.4.3.2 Fleet Mix

The forecast Low Scenario fleet mix percentages were assumed to be identical to those of the Base Scenario. However, because the forecast number of annual aircraft operations differs between the two scenarios, the number of operations by AAC, ADG, Operation Type, and AAC-ADG combination in each scenario is also different.

Table 2-28, **Table 2-29**, **Table 2-30**, and **Table 2-31** summarize the Low Scenario forecast fleet mix in terms of operations by AAC, ADG, Operation Type, and AAC-ADG combination, respectively, and the associated fleet mix percentages for select forecast years.

Table 2-28: Low Scenario Forecast Fleet Mix by AAC (Fiscal Year)

AAC	FY 2021 Operations (Percentage)	FY 2026 Operations (Percentage)	FY 2031 Operations (Percentage)	FY 2041 Operations (Percentage)	FY 2021 2041 Operations CAGR
A	106,669 (80.1%)	94,025 (78.0%)	90,620 (75.8%)	86,263 (70.7%)	-1.1%
B	21,044 (15.8%)	21,056 (17.5%)	23,093 (19.3%)	28,615 (23.5%)	1.5%
C	3,626 (2.7%)	3,735 (3.1%)	4,201 (3.5%)	5,425 (4.4%)	2.0%
D	50 (0.0%)	52 (0.0%)	58 (0.0%)	75 (0.1%)	2.0%
Helicopter & Balloon / Blimp	1,828 (1.4%)	1,633 (1.4%)	1,594 (1.3%)	1,555 (1.3%)	-0.8%
TOTAL	**133,217 (100.0%)**	**120,500 (100.0%)**	**119,566 (100.0%)**	**121,933 (100.0%)**	**-0.4%**

Notes:
Base year (2021) operations counts in this table will differ from actual base year counts due to the normalization of the percentage to exclude "N/A".
Totals and subtotals may not add to 100% due to rounding.

Source: HNTB forecast.

Table 2-29: Low Scenario Forecast Fleet Mix by ADG (Fiscal Year)

ADG	FY 2021 Operations (Percentage)	FY 2026 Operations (Percentage)	FY 2031 Operations (Percentage)	FY 2041 Operations (Percentage)	FY 2021 2041 Operations CAGR
I	112,178 (84.2%)	99,199 (82.3%)	95,961 (80.3%)	92,190 (75.6%)	-1.0%
II	19,189 (14.4%)	19,645 (16.3%)	21,984 (18.4%)	28,154 (23.1%)	1.9%
III	23 (0.0%)	24 (0.0%)	26 (0.0%)	34 (0.0%)	2.0%
Helicopter & Balloon / Blimp	1,828 (1.4%)	1,633 (1.4%)	1,594 (1.3%)	1,555 (1.3%)	-0.8%
TOTAL	**133,217 (100.0%)**	**120,500 (100.0%)**	**119,566 (100.0%)**	**121,933 (100.0%)**	**-0.4%**

Notes:
Base year (2021) operations counts in this table will differ from actual base year counts due to the normalization of the percentage to exclude "N/A".
Totals and subtotals may not add to 100% due to rounding.

Source: HNTB forecast.

Table 2-30: Low Scenario Forecast Fleet Mix by Operation Type (Fiscal Year)

Operation Type	FY 2021 Operations (Percentage)	FY 2026 Operations (Percentage)	FY 2031 Operations (Percentage)	FY 2041 Operations (Percentage)	FY 2021 2041 Operations CAGR
Piston	106,773 (80.1%)	93,503 (77.6%)	89,427 (74.8%)	83,418 (68.5%)	-1.2%
Turboprop	9,451 (7.1%)	9,740 (8.1%)	10,962 (9.2%)	14,170 (11.6%)	2.0%
Carrier Jet & Jet	15,149 (11.4%)	15,612 (13.0%)	17,571 (14.7%)	22,714 (18.6%)	2.0%
Military	15 (0.0%)	13 (0.0%)	13 (0.0%)	13 (0.0%)	-0.8%
Helicopter & Balloon / Blimp	1,828 (1.4%)	1,633 (1.4%)	1,594 (1.3%)	1,555 (1.3%)	-0.8%
TOTAL	**133,217 (100.0%)**	**120,500 (100.0%)**	**119,566 (100.0%)**	**121,933 (100.0%)**	**-0.4%**

Notes:
Base year (2021) operations counts in this table will differ from actual base year counts due to the normalization of the percentage to exclude "Unknown".
Totals and subtotals may not add to 100% due to rounding.

Source: HNTB forecast.

Table 2-31: Low Scenario Forecast Fleet Mix by AAC-ADG Combination (Fiscal Year)

AAC ADG Combination	FY 2021 Operations (Percentage)	FY 2026 Operations (Percentage)	FY 2031 Operations (Percentage)	FY 2041 Operations (Percentage)	FY 2021 2041 Operations CAGR
A-I	104,747 (78.6%)	92,045 (76.4%)	88,392 (73.9%)	83,387 (68.4%)	-1.1%
A-II	1,922 (1.4%)	1,980 (1.6%)	2,227 (1.9%)	2,876 (2.4%)	2.0%
B-I	6,316 (4.7%)	6,005 (5.0%)	6,277 (5.3%)	7,135 (5.9%)	0.6%
B-II	14,728 (11.1%)	15,051 (12.5%)	16,816 (14.1%)	21,480 (17.6%)	1.9%
C-I	1,115 (0.8%)	1,148 (1.0%)	1,292 (1.1%)	1,668 (1.4%)	2.0%
C-II	2,505 (1.9%)	2,581 (2.1%)	2,903 (2.4%)	3,748 (3.1%)	2.0%
C-III	6 (0.0%)	6 (0.0%)	7 (0.0%)	9 (0.0%)	2.0%
D-II	33 (0.0%)	34 (0.0%)	38 (0.0%)	49 (0.0%)	2.0%
D-III	17 (0.0%)	18 (0.0%)	20 (0.0%)	26 (0.0%)	2.0%
Helicopter & Balloon / Blimp	1,828 (1.4%)	1,633 (1.4%)	1,594 (1.3%)	1,555 (1.3%)	-0.8%
TOTAL	**133,217 (100.0%)**	**120,500 (100.0%)**	**119,566 (100.0%)**	**121,933 (100.0%)**	**-0.4%**

Notes:
Base year (2021) operations counts in this table will differ from actual base year counts due to the normalization of the percentage to exclude "N/A".
Totals and subtotals may not add to 100% due to rounding.

Source: HNTB forecast.

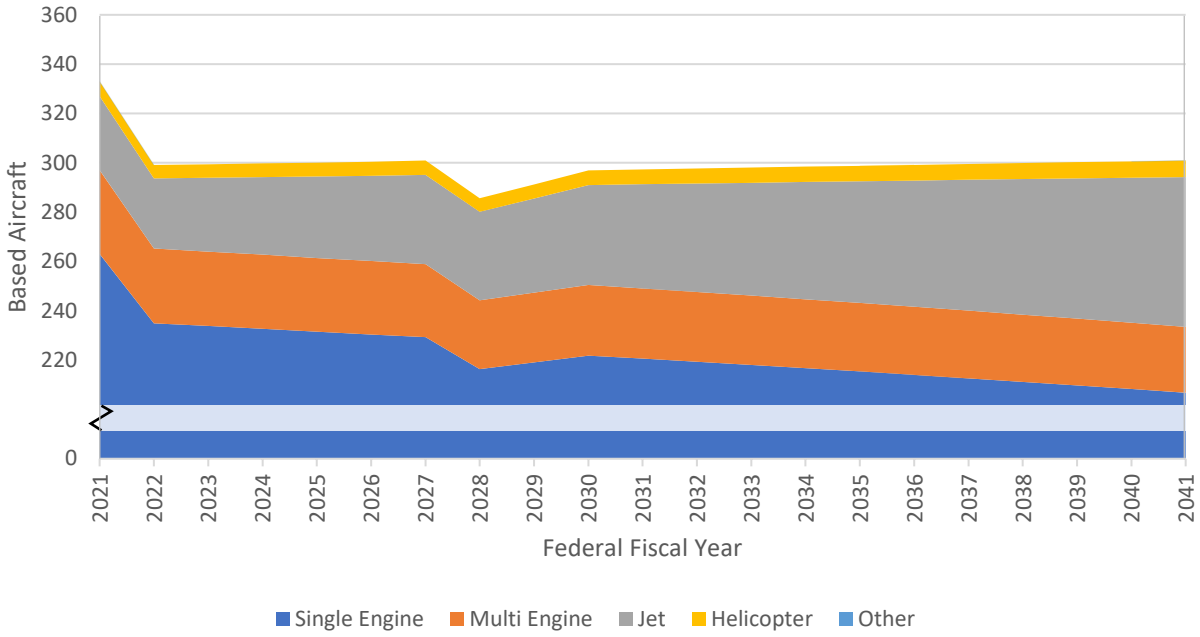
Like the Base Scenario, the Low Scenario fleet mix forecast projects a decrease in operations for smaller aircraft belonging to the AAC A, ADG I, and/or piston classifications. Those conducted by AACs B and C, ADG II, and/or turboprop and jet classifications are forecast to experience the greatest increase.

Critical to note in **Table 2-30** is that even under the Low Scenario with a loss in total aircraft operations between 2021 and 2041, jet aircraft operations are still forecast to increase. This is forecast to occur because of the overall trends in the general aviation fleet, with piston aircraft declining and being replaced by jet aircraft.

2.4.3.3 Based Aircraft

For the Low Scenario based aircraft forecast, the same approach was followed as for the High Scenario based aircraft forecast (refer to Section 2.3.2.3). The Low Scenario based aircraft forecast is summarized on **Figure 2-23** and in **Table 2-3232**.

Figure 2-23: FCM Low Scenario Forecast Based Aircraft



Source: HNTB forecast.

Table 2-32: Summary of FCM Low Scenario Forecast Based Aircraft

FEDERAL FISCAL YEAR	SINGLE ENGINE	MULTI ENGINE	JET	HELICOPTER	OTHER	TOTAL
2021	263	34	30	6	0	**333**
2026	230	30	35	6	0	**300**
2031	221	28	42	6	0	**297**
2041	207	27	61	7	0	**301**
2021-2041 CAGR	-1.2%	-1.2%	3.6%	0.5%	0.0%	**-0.5%**

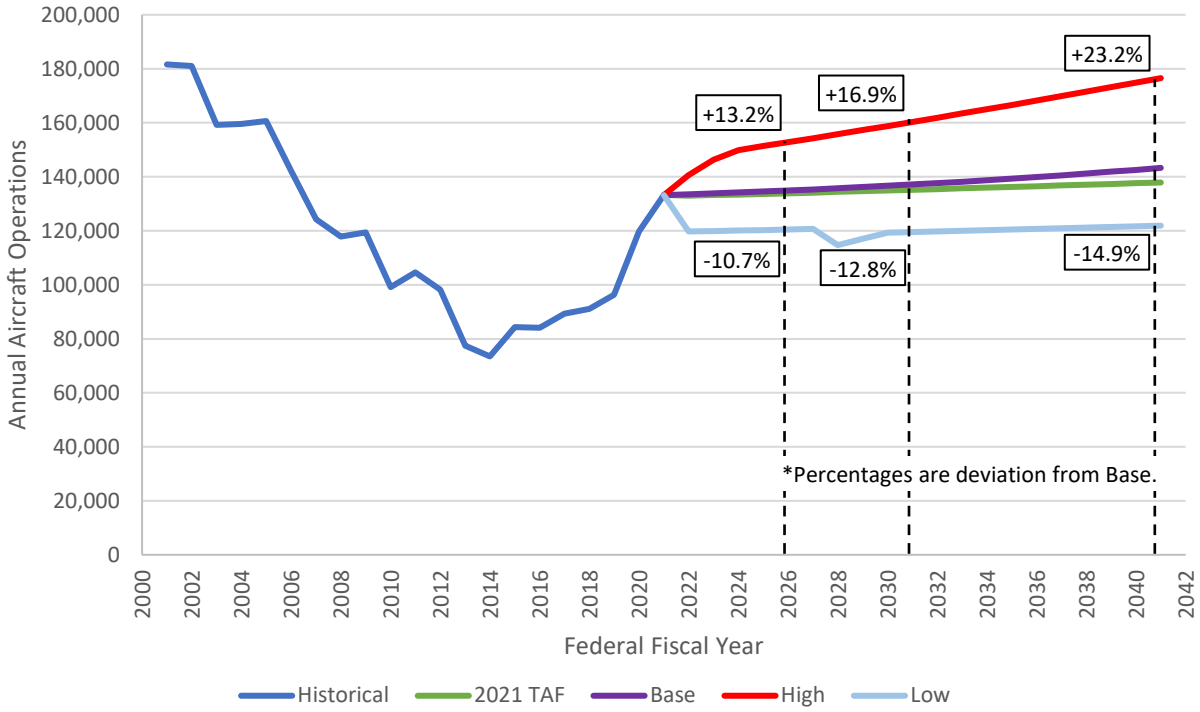
Source: HNTB forecast.

Like the Low Scenario operations forecast, based jet aircraft are forecast to increase, even though total based aircraft are forecast to decrease. This is forecast to occur because of the overall trends in the general aviation fleet, with piston aircraft declining and being replaced by jet aircraft. However, the losses in single-engine and multi-engine based aircraft are forecast to be greater than the increases in based jet aircraft.

2.4.4 Forecast Scenario Summary by Fiscal Year

The forecast aircraft operations at FCM for the Base, High, and Low Scenarios are summarized on **Figure 2-24** and in **Table 2-33**. **Figure 2-24** includes the 2021 TAF for FCM for comparison.

Figure 2-24: FCM Aircraft Operations Forecast Scenarios by Fiscal Year



Source: HNTB and 2021 FAA Terminal Area Forecast, published 2022.

Table 2-33: Summary of Forecast Aircraft Operations by Scenario by Fiscal Year

FEDERAL FISCAL YEAR	AIRCRAFT OPERATIONS		
	BASE	HIGH	LOW
2021	**133,217**	133,217	133,217
2026	**134,929**	152,806	120,500
2031	**137,147**	160,334	119,566
2041	**143,298**	176,522	121,933

Source: HNTB forecast.

2.4.5 Forecast Scenario Summary by Calendar Year

Planning activity levels for the LTP will be set based on calendar years rather than fiscal years. Accordingly, the forecasts were translated from fiscal year to calendar year using a weighted average of the two fiscal years that each calendar year straddles. The formula that was used to map fiscal year activity to calendar activity is provided below for a generic "Year [X]".

*Calendar Year [X] activity = (¾ * Fiscal Year [X] activity) + (¼ * Fiscal Year [X + 1] activity)*

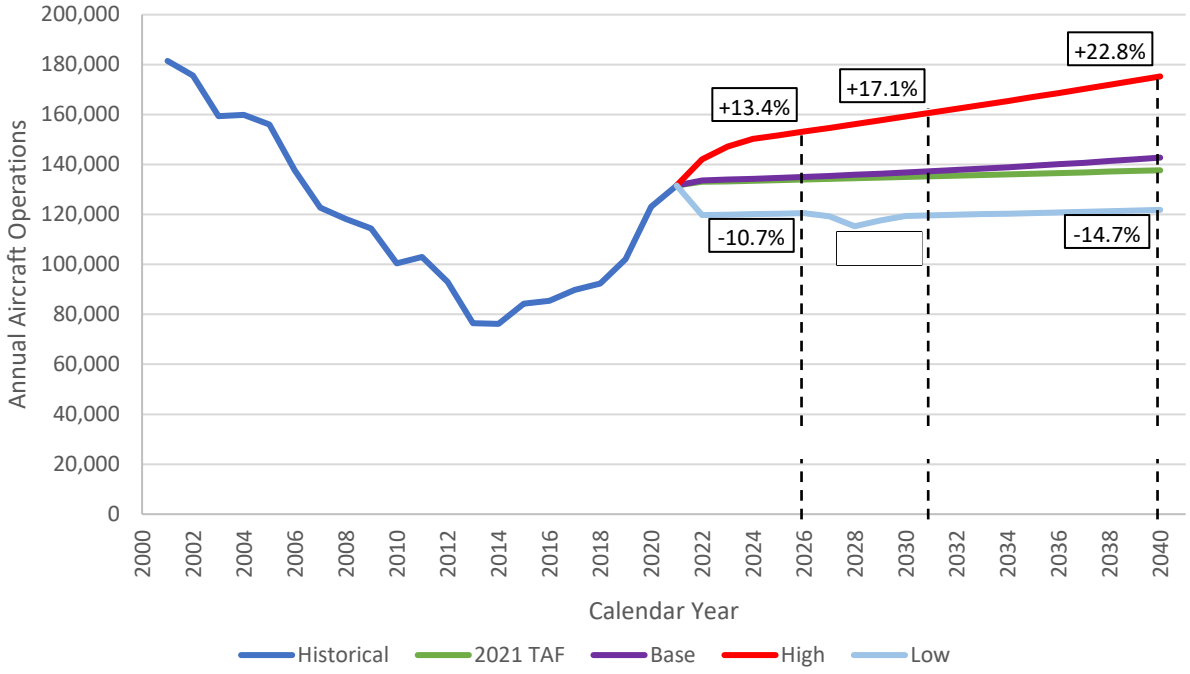
This calculation was applied to all forecast years 2022 through 2040. Historical data were used for calendar year 2021.

Figure 2-25 presents the forecast aircraft operations for the Base, High, and Low Scenarios by calendar year, with the 2021 FAA TAF included for comparison, translated to calendar years for 2022 through 2040.

Table 2-34 provides detail by calendar year for the aircraft operations forecast for the Base Scenario. **Table 2-35** summarizes forecast business jet activity for the Base Scenario in select forecast calendar years.

Table 2-36 summarizes the Base Scenario fleet mix in terms of forecast operations by AAC-ADG combination and the respective percentages for select forecast calendar years. The Base Scenario forecast number of aircraft based at FCM by calendar year is shown on **Figure 2-26** and summarized in **Table 2-37**. All calendar year forecasts are through 2040, consistent with the scope of the LTP.

Figure 2-25: Aircraft Operations Forecast Scenarios by Calendar Year



Source: HNTB and 2021 FAA Terminal Area Forecast, published 2022.

Table 2-34: FCM Base Scenario Forecast Aircraft Operations by Calendar Year

Calendar Year	A-I Piston	A-I Carrier Jet & Jet	A-I Turbo-prop	A-II Turbo-prop	B-I Piston	B-I Carrier Jet & Jet	B-I Turbo-prop	B-I Military	B-II Piston	B-II Carrier Jet & Jet	B-II Turbo-prop	C-I Carrier Jet & Jet	C-II Carrier Jet & Jet	C-III Carrier Jet & Jet	D-II Carrier Jet & Jet	D-III Carrier Jet & Jet	Helicopter & Balloon / Blimp	N/A AAC-ADG Piston	N/A AAC-ADG Unknown	Difference between MACNOMS and OPSNET	Total
2021	71,539	146	1,493	1,354	2,245	2,028	141	15	541	6,061	3,765	785	1,764	4	23	12	1,828	1,339	1,256	36,953	**133,293**
2022	71,050	150	1,531	1,389	2,230	2,081	145	15	537	6,219	3,863	805	1,810	4	24	12	1,828	1,330	1,268	37,310	**133,601**
2023	70,563	154	1,571	1,425	2,215	2,135	148	15	534	6,381	3,964	826	1,857	4	24	13	1,828	1,320	1,280	37,671	**133,929**
2024	70,080	158	1,612	1,462	2,199	2,191	152	15	530	6,547	4,067	848	1,906	4	25	13	1,828	1,311	1,293	38,035	**134,276**
2025	69,600	162	1,654	1,500	2,184	2,248	156	15	526	6,717	4,173	870	1,955	4	26	13	1,828	1,302	1,305	38,402	**134,643**
2026	69,124	166	1,697	1,539	2,169	2,306	160	15	523	6,892	4,281	893	2,006	5	26	14	1,828	1,293	1,318	38,774	**135,029**
2027	68,650	170	1,741	1,579	2,154	2,366	164	15	519	7,071	4,393	916	2,058	5	27	14	1,828	1,285	1,331	39,148	**135,436**
2028	68,180	175	1,787	1,620	2,140	2,428	169	15	516	7,255	4,507	940	2,112	5	28	14	1,828	1,276	1,344	39,527	**135,864**
2029	67,714	179	1,833	1,663	2,125	2,491	173	15	512	7,444	4,624	964	2,167	5	28	15	1,828	1,267	1,356	39,909	**136,312**
2030	67,250	184	1,881	1,706	2,111	2,556	178	15	509	7,637	4,745	989	2,223	5	29	15	1,828	1,258	1,370	40,294	**136,782**
2031	66,790	189	1,930	1,750	2,096	2,622	182	15	505	7,836	4,868	1,015	2,281	5	30	16	1,828	1,250	1,383	40,684	**137,274**
2032	66,332	194	1,980	1,796	2,082	2,690	187	15	502	8,040	4,995	1,041	2,340	5	31	16	1,828	1,241	1,396	41,077	**137,788**
2033	65,878	199	2,031	1,842	2,067	2,760	192	15	498	8,249	5,125	1,068	2,401	5	32	16	1,828	1,233	1,410	41,474	**138,325**
2034	65,427	204	2,084	1,890	2,053	2,832	197	15	495	8,464	5,258	1,096	2,464	6	32	17	1,828	1,224	1,423	41,875	**138,885**
2035	64,979	209	2,139	1,940	2,039	2,906	202	15	491	8,684	5,395	1,125	2,528	6	33	17	1,828	1,216	1,437	42,280	**139,468**
2036	64,534	215	2,194	1,990	2,025	2,981	207	15	488	8,910	5,535	1,154	2,594	6	34	18	1,828	1,208	1,451	42,688	**140,075**
2037	64,092	220	2,251	2,042	2,011	3,059	213	15	485	9,142	5,679	1,184	2,661	6	35	18	1,828	1,199	1,465	43,101	**140,707**
2038	63,654	226	2,310	2,095	1,998	3,139	218	15	481	9,380	5,827	1,215	2,730	6	36	19	1,828	1,191	1,479	43,517	**141,363**
2039	63,218	232	2,370	2,149	1,984	3,220	224	15	478	9,624	5,978	1,247	2,801	6	37	19	1,828	1,183	1,493	43,938	**142,045**
2040	62,785	238	2,432	2,205	1,970	3,304	230	15	475	9,874	6,134	1,279	2,874	7	38	20	1,828	1,175	1,508	44,363	**142,752**
Annual Growth Rate	-0.68%	2.60%	2.60%	2.60%	-0.68%	2.60%	2.60%	0.00%	-0.68%	2.60%	2.60%	2.60%	2.60%	2.60%	2.60%	2.60%	0.00%	-0.68%	0.97%	0.97%	**0.36%**

Source: HNTB forecast.

Table 2-35: Forecast Business Jet Operations: Nationwide, Twin Cities, and FCM by Calendar Year

CALENDAR YEAR	NATIONWIDE BUSINESS JET OPERATIONS	TWIN CITIES MARKET SHARE	TWIN CITIES BUSINESS JET OPERATIONS	FCM PROPORTION	FCM BUSINESS JET OPERATIONS
2021	5,326,090	0.68%	36,466	32.8%	11,957
2026	5,398,892	0.63%	33,776	42.3%	14,276
2031	5,953,465	0.59%	35,140	44.4%	15,585
2040	7,099,163	0.53%	37,736	45.0%	16,964
CAGR 2021-2040	1.52%	-1.32%	0.18%	1.67%	1.86%

Note: Average annual growth rates differ from the fiscal year-based forecast because the calendar year 2021 activity differs from fiscal year 2021 activity.

Source: HNTB forecast.

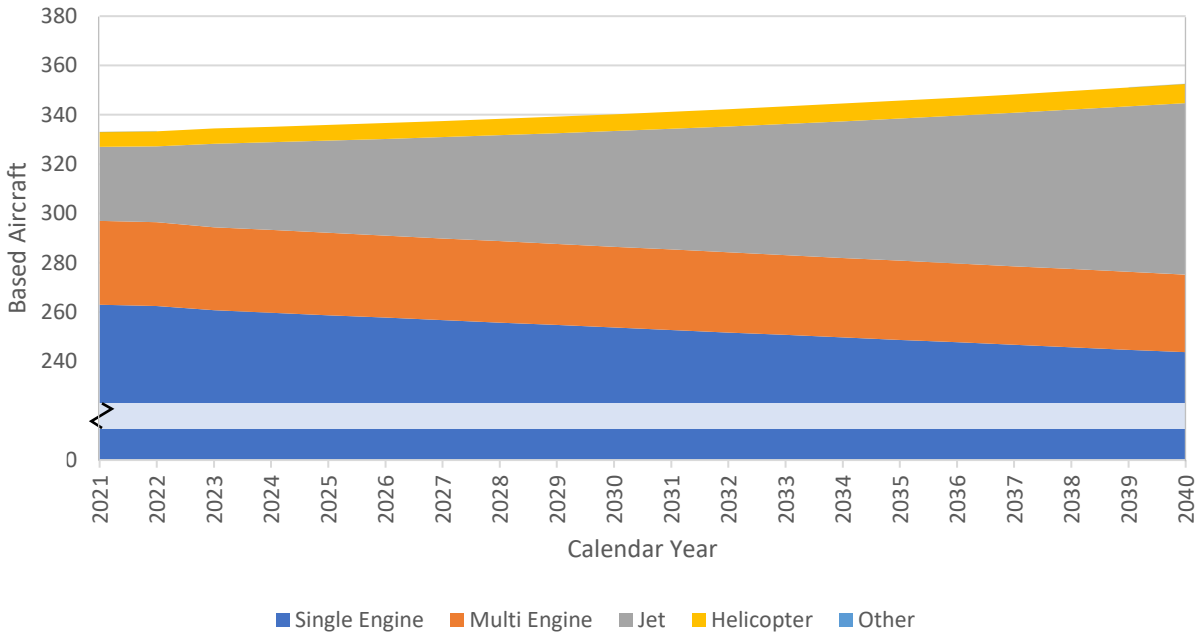
Table 2-36: Base Scenario Forecast Fleet Mix by AAC-ADG Combination (Calendar Year)

AAC ADG COMBINATION	CY 2021 OPERATIONS (PERCENTAGE)	CY 2026 OPERATIONS (PERCENTAGE)	CY 2031 OPERATIONS (PERCENTAGE)	CY 2040 OPERATIONS (PERCENTAGE)	FY 2021 2041 OPERATIONS CAGR
A-I	104,663 (78.5%)	102,983 (76.3%)	101,306 (73.8%)	98,255 (68.8%)	-0.3%
A-II	1,936 (1.5%)	2,233 (1.7%)	2,573 (1.9%)	3,311 (2.3%)	2.9%
B-I	6,335 (4.8%)	6,747 (5.0%)	7,226 (5.3%)	8,285 (5.8%)	1.4%
B-II	14,828 (11.1%)	16,968 (12.6%)	19,420 (14.1%)	24,743 (17.3%)	2.7%
C-I	1,123 (0.8%)	1,295 (1.0%)	1,492 (1.1%)	1,920 (1.3%)	2.9%
C-II	2,524 (1.9%)	2,910 (2.2%)	3,354 (2.4%)	4,315 (3.0%)	2.9%
C-III	6 (0.0%)	7 (0.0%)	8 (0.0%)	10 (0.0%)	2.9%
D-II	33 (0.0%)	38 (0.0%)	44 (0.0%)	57 (0.0%)	2.9%
D-III	17 (0.0%)	20 (0.0%)	23 (0.0%)	30 (0.0%)	2.9%
Helicopter & Balloon / Blimp	1,828 (1.4%)	1,828 (1.4%)	1,828 (1.3%)	1,828 (1.3%)	0.0%
TOTAL	**133,293 (100.0%)**	**135,029 (100.0%)**	**137,274 (100.0%)**	**142,752 (100.0%)**	**0.4%**

Notes:
Base year (2021) operations counts by AAC-ADG combination in this table will differ from actual base year counts due to the normalization of the percentage to exclude "N/A".
Totals and subtotals may not add to 100% due to rounding.

Source: HNTB forecast.

Figure 2-26: FCM Base Scenario Forecast Based Aircraft by Calendar Year



Source: HNTB forecast.

Table 2-37: Summary of FCM Base Scenario Forecast Based Aircraft (Calendar Year)

CALENDAR YEAR	SINGLE ENGINE	MULTI ENGINE	JET	HELICOPTER	OTHER	TOTAL
2021	263	34	30	6	0	**333**
2026	258	33	39	6	0	**337**
2031	253	33	49	7	0	**341**
2040	244	31	70	8	0	**353**
2021-2040 CAGR	-0.4%	-0.4%	4.5%	1.4%	0.0%	**0.3%**

Source: HNTB forecast.

2.5 Critical Aircraft

Advisory Circular 150/5000-17, *Critical Aircraft and Regular Use Determination*, defines the "critical aircraft" as the most demanding aircraft type or grouping of aircraft with similar characteristics that makes regular use of the airport, where regular use is 500 annual operations or more. The legacy critical aircraft for FCM is given by the Airport Reference Code of B-II aircraft. When constructed, FCM's major airfield facilities (e.g., runways and taxiways) were built to meet design standards for this aircraft type. However, FCM has effectively been operating as a C-II airport with known facility deficiencies for at least five years, as the number of annual operations conducted by these aircraft types has exceeded 500.

For every fiscal year from 2017 through 2021 at FCM, operations conducted by aircraft belonging to AAC C and ADG II have exceeded the threshold of 500 annual operations recommended for the selection of a critical aircraft.

Table 2-38 provides the historical counts of aircraft operations at FCM by AAC and ADG per fiscal year, as derived from analysis of MACNOMS data. While MACNOMS data do not represent all operations at FCM, the C-II group still exceeded 500 annual operations. Therefore, for the LTP, the critical aircraft for FCM is recommended to be updated to Airport Reference Code C-II.

In Fiscal Year 2021, there were 1,753 identified operations conducted by C-II aircraft, as reported in and analyzed from the MACNOMS data set. **Table 2-39** lists the number of operations conducted at FCM in 2021 for each aircraft type belonging to this intersection. The specific aircraft type that will be used as the future critical aircraft in the LTP is the Bombardier Challenger 300 (CL30/CL35).

Table 2-38: FCM Aircraft Operations by AAC and ADG, Fiscal Years 2017-2021

		FEDERAL FISCAL YEAR				
AAC	ADG	2017	2018	2019	2020	2021
A	I	8,304	9,301	17,193	47,290	73,290
A	II	571	816	888	795	1,345
A	III	2	0	0	0	0
B	I	4,461	4,441	4,093	3,531	4,419
B	II	10,138	10,729	11,462	8,564	10,305
B	III	5	6	0	2	0
C	I	845	869	749	565	780
C	II	1,035	1,407	1,643	1,171	1,753
C	III	20	12	10	0	4
C	IV	0	0	0	1	0
D	II	34	28	12	18	23
D	III	40	14	102	49	12
Helicopter		267	148	488	734	1,819
N/A		40,749	41,220	32,337	5,750	2,603
TOTAL (MACNOMS)		**66,471**	**68,991**	**68,977**	**68,470**	**96,353**
Difference between MACNOMS and OPSNET		**22,876**	**22,069**	**27,261**	**51,240**	**36,864**

Notes:
"N/A" represents operations for which an aircraft type was not available in the MACNOMS data.
MACNOMS data for Fiscal Year 2017 only include data from January 1, 2017, through September 30, 2017.

Source: HNTB analysis of MACNOMS data.

Table 2-39: FCM Fiscal Year 2021 Aircraft Operations by C-II Aircraft

AIRCRAFT TYPE	OPERATIONS
Bombardier Challenger 300	854
Embraer Phenom 300	537
Canadair Challenger	152
Gulfstream Galaxy G200	90
Embraer EMB-545	38
Textron Aviation Corporate Jet	24
Embraer 145	16
Gulfstream G150	12
Embraer 135	10
Gulfstream G280	9
Israel Aircraft 1125 Astra	6
Learjet 70/75	5
TOTAL	**1,753**

Source: HNTB analysis of MACNOMS data, October 2020 to September 2021.

For taxiway design, the most demanding Taxiway Design Group (TDG) that makes regular use of the airport will be used. **Table 2-40** provides the historical counts of aircraft operations at FCM by TDG per fiscal year between 2017 and 2021. TDG 2A is the most demanding TDG exceeding 500 annual operations at FCM.

Table 2-40: FCM Aircraft Operations by TDG, Fiscal Years 2017-2021

	FEDERAL FISCAL YEAR				
TDG	2017	2018	2019	2020	2021
1A	13,937	14,712	22,343	50,783	77,218
1B	3,491	4,460	4,787	3,705	5,515
2A	6,700	7,197	7,747	5,770	6,640
2B	153	49	74	26	40
3	16	14	14	0	4
Helicopter & Balloon / Blimp	267	148	491	734	1,828
N/A	41,907	42,411	33,524	7,452	5,108
TOTAL (MACNOMS)	**66,471**	**68,991**	**68,977**	**68,470**	**96,353**
Difference between MACNOMS and OPSNET	**22,876**	**22,069**	**27,261**	**51,240**	**36,864**

Notes:
"N/A" represents operations for which an aircraft type was not available, the aircraft's Taxiway Design Group could not be matched within the FAA Aircraft Characteristics Database (last updated 2018), or the FAA Aircraft Characteristics Database lacked the aircraft's Main Gear Width (MGW) and Cockpit to Main Gear (CMG) dimensions.
MACNOMS data for Fiscal Year 2017 only include data from January 1, 2017, through September 30, 2017.

Source: HNTB analysis of MACNOMS data.

In Fiscal Year 2021, there were 6,640 identified operations conducted by aircraft belonging to TDG 2A, as reported in, and analyzed from, the MACNOMS data set. **Table 2-41** lists the number of operations conducted at FCM in 2021 for each aircraft type belonging to this TDG.

Table 2-41: FCM Fiscal Year 2021 Aircraft Operations by TDG 2A Aircraft

AIRCRAFT TYPE	OPERATIONS
Cessna Citation Jet Family	**3,372**
Beechcraft King Air Family	**3,138**
Beechcraft 1900	**97**
Gulfstream IV/G450	**23**
Embraer EMB-110 Bandeirante	**4**
Piaggio P-180 Avanti	**4**
Gulfstream 6	**2**
TOTAL	**6,640**

Source: HNTB analysis of MACNOMS data, October 2020 to September 2021.

2.6 Comparison to FAA Terminal Area Forecast

The forecast will be submitted to the FAA for approval for use in the LTP. According to Advisory Circular 150/5760-6B, *Airport Master Plans*, forecasts approved by the FAA must be supported by acceptable forecasting analysis and must be consistent with the TAF. For General Aviation and Reliever airports with greater than 100,000 annual operations or 100 based aircraft—such as FCM—consistency with the TAF is defined as the following:

1. Forecasts differ by less than 10 percent in the 5-year period and 15 percent in the 10-year period;
2. Forecasts do not affect the timing or scale of an airport project;
3. Forecasts do not affect the role of the airport as defined in FAA Order 5090.3—that is, they would not alter the airport's designation as a General Aviation or Reliever airport.

Table 2-42 provides a side-by-side comparison of the Base Scenario forecast to the TAF. Because FCM will serve a negligible level of passenger enplanements and/or air cargo, the only forecast metric compared with the TAF was total aircraft operations. The Base Scenario forecast falls within the acceptable limits for TAF consistency.

Table 2-42: Base Scenario Forecast Comparison with TAF

		TOTAL AIRCRAFT OPERATIONS		
DEMAND LEVEL	FEDERAL FISCAL YEAR	BASE SCENARIO FORECAST	TAF	PERCENT VARIANCE
Base year	2021	133,217	133,217	0.0%
Base year + 5 years	2026	134,929	133,884	0.8%
Base year + 10 years	2031	137,147	135,197	1.4%
Base year + 15 years	2036	139,919	136,528	2.5%

Source: HNTB and 2021 FAA Terminal Area Forecast, published 2022.

2.7 Forecast Summary

The Base Scenario forecast will be used as the basis for requirements and alternatives in the LTP. **Table 2-43** presents the key activity levels in the Base Scenario forecast.

Table 2-43: Forecast Summary

FORECAST YEAR	FY 2021	FY 2026	FY 2031	FY 2041
Annual Operations	133,217	134,929	137,147	143,298
Compound Annual Growth Rate (CAGR) from 2021	-	0.26%	0.29%	0.37%
Based Aircraft	333	336	341	354

Source: HNTB Base Scenario Forecast.