CHAPTER 2

AVIATION ACTIVITY FORECASTS

Introduction

Aviation forecasts are an important part of the Master Planning process, as the need for Airport facilities is largely based on future activity. Local studies often consider airport Master Plan forecasts to assess related effects, such as local traffic and business trends. This chapter will present forecasts of aviation activity for the duration of the planning period in the following sections:

- **Forecasting Approach**
- **Commercial Activity**
- **General Aviation Activity**
- **Military Aviation**
- **Peak Activity**
- **Critical Aircraft**
- **Forecasts Summary and TAF Comparison**

2.1 Forecasting Approach

Forecasting airport activity levels must account for past, present, and future trends. These trends may be steady when examined on a macro level, such as steady enplanement growth on a national level, but may also experience systemwide shocks. These include the 2008 financial crisis and the 2020 COVID-19 pandemic. The impacts and recovery from these shocks must be incorporated into industry standard forecasting methodologies. The remainder of this section presents a high-level view of how these factors can be combined into a well-crafted forecast. Subsequent sections that focus on specific aviation activity metrics provide additional information as relevant.

2.1.1 COVID Impacts

As current trends influence the approach to forecasting, it should be considered that this forecast was prepared at the same time as the evolving impacts of the COVID-19 pandemic. Forecast approval is based on the methodology, data, and conclusions concurrent with the document preparation. However, consideration of the impacts of the COVID-19 pandemic on aviation activity is warranted to acknowledge the reduced confidence in growth projections using currently available data. Accordingly, Federal Aviation Administration (FAA) approval of this forecast does not constitute justification for future projects. Justification for future projects will be made based on activity levels at the time the project is requested for development. Documentation of actual activity levels meeting planning activity levels will be necessary to justify Airport Improvement Program (AIP) funding for eligible projects. With all of this in mind, industry standard approaches can still be employed to produce forecasts useful for planning purposes.

To derive forecasts from levels of activity that are derived from more usual conditions, and not impacted by a global pandemic, the base year of 2019 was used to project future activity but an estimate for 2021 activity levels have also been provided when possible. The years impacted by the pandemic, 2020 and 2021, are shown in each section and the impacts of COVID from 2019 to present day are discussed. In addition to capturing the impacts during the height of the pandemic, the ongoing recovery of each metric will be assessed before projecting future activity.

2.1.2 Forecasting Methodologies

Forecasting techniques that range from subjective judgment to sophisticated mathematical modeling may be used to project aviation activity. The techniques used in this master planning effort incorporate industry standard methodologies that assess current and future demand. Socioeconomic factors such as local population, income, and employment have also been analyzed for how they will influence aviation activity.

FAA Forecast

The FAA reports historical and projected aviation activity in the FAA Terminal Area Forecast (TAF), which is released annually. The TAF contains aviation activity forecasts for all active airports in the National Plan of Integrated Airport Systems (NPIAS). These forecasts include several activity measures, including based aircraft and operations. When the TAF forecasts no change, it may be deemed less valid due to recent activity fluctuations at both a local and national level. The TAF serves as an initial guide for future activity, is reviewed and may be used for long-range planning if its forecasts align with local trends.

Market Share

Market share, ratio, and top-down methodologies compare local levels of activity with a larger entity. Such methodologies imply that the proportion of activity that can be assigned to the local level is a regular and predictable quantity compared to the larger environment. Using this method in the aviation industry helps develop forecasts at the local level based on broader trends. Historical data is most commonly used to determine the share of total national traffic activity that a region or airport will capture.

Regression Analysis

A regression analysis examines the direct relationship between two or more sets of historical data. This methodology calls for examining two or more variables to determine their relationship. For example, an airport activity, such as enplanements or operations, is selected as the dependent variable while an outside factor such as local socioeconomic conditions is selected as the independent, or predictive, variable. Those independent variables examined in this chapter include population, employment, total earnings, and income for Minnehaha County. Historical and forecasted socioeconomic statistics for Minnehaha County were obtained from the economic forecasting firm Woods & Poole Economics (**Table 2-1**). Each of these trends have shown steady growth with only minor plateaus in earnings shortly after 2000 and following the 2008 recession.

Table 2-1 Local Socioeconomics (Minnehaha County)

Year	Population	Employment	Total Earnings[1]	Personal Income per Capita
2000	149,068	130,652	5,492,490	39,965
2001	150,775	130,993	5,439,218	39,665
2002	152,062	131,925	5,637,305	40,455
2003	153,740	132,739	5,798,629	41,058
2004	155,648	134,615	5,996,562	42,217
2005	157,778	137,099	6,221,020	43,677
2006	160,630	140,773	6,432,805	44,916
2007	163,577	144,061	6,773,895	46,616
2008	166,320	146,271	6,944,471	46,902
2009	168,482	144,441	7,157,646	46,291
2010	169,952	143,909	7,328,609	47,839
2011	171,433	146,224	7,093,276	46,088
2002	174,761	149,243	7,700,235	48,461
2003	177,982	151,394	7,515,506	46,054
2012	180,832	155,101	8,010,244	48,437
2013	183,485	157,063	8,512,709	51,352
2014	186,522	158,704	8,584,567	51,021
2015	190,028	160,807	8,898,262	51,956
2016	192,876	163,066	9,085,183	52,914
2017	194,693	165,691	9,455,448	54,218
2018	196,511	167,774	9,660,240	55,013
2019	198,366	170,176	9,885,392	55,879

Source: Woods & Poole Economics, Inc.

Notes: 1: x 1,000

Trend Analysis

Trend analysis is a type of regression analysis where time is the independent variable. This allows an analysis of how steadily activity has grown in the past. However, while a trend analysis can be a helpful benchmark of past activity, aviation is known for being a volatile industry due the many factors that influence it, such as fuel prices, government regulation, system shocks, and air service changes. Therefore, unless there is reason to believe that the future will reflect the past, which is uncommon in aviation, this forecast is best used as a benchmark for comparison. Several of the forecasts presented in this chapter use this methodology to analysis past trends for comparison to recent activity.

Growth Rate

This methodology uses the growth rates projected by relevant planning documents and applies these rates to Airport activity. These growth rates are often gleaned from state or federal planning documents such as the FAA TAF, FAA Aerospace Forecast, or the State Aviation System Plan (SASP). Some growth rates are incorporated into regression analysis or other forecasts. For instance, if the local population is expected to grow, that rate may be applied to the population and then the projected population can be used to forecast future enplanements. Once determined, relevant growth rates are applied to the appropriate types of Airport activity.

2.2 Commercial Activity

This section presents the major commercial activities at the Airport, primarily passenger enplanements and operations by commercial aircraft. A discussion of trends relevant to these metrics, including COVID impacts and recovery, are presented first followed by the forecasting methodologies leading to the selection of a preferred forecast for each activity metric.

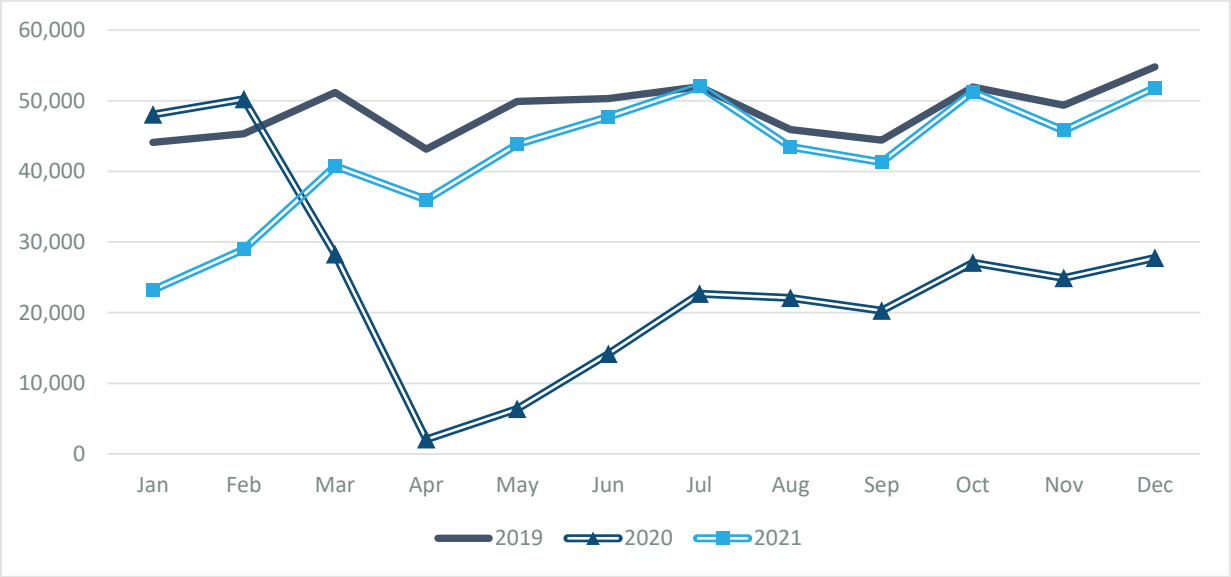
2.2.1 Enplanement Trends

Commercial aviation has experienced several ongoing trends over the past few years. Pilot shortages continue to drive some regional airlines to reduce the number of trips while increasing aircraft size, meanwhile the industry is adjusting for post-COVID demands, and aircraft fleet mixes are evolving. The initial portion of this section will discuss these trends in greater detail.

Passenger enplanements were significantly impacted during the height of the COVID-19 pandemic. Total annual domestic enplanements in 2020 fell to 41.3 percent of 2019 levels, as reported by the DOT T100 database. Travel restrictions and reduced seat capacity contributed to fewer enplanements during the pandemic. In 2021, even as many air carriers have returned to normal capacities, recovery is still under way and national activity has not yet reached pre-pandemic levels. Recovery from industry-wide level shocks can often take place over several years.

Nationally, the most recent data reported for the DOT T100 database, July 2021, indicated that national domestic enplanements were 11.4 percent less than those in July of 2019. While this is a great improvement over earlier in the year, such as the 58.1 percent difference that occurred in January, it has not yet reached 2019 activity levels. However, recovery at FSD is occurring more quickly, and Airport enplanements are compared for the years 2019 through 2021 in **Figure 2-1**. During the busier summer months, and even through September, domestic enplanements at FSD have recovered faster than the national average. During July of 2021, FSD enplanements even exceeded those of July 2019 slightly. This can be compared to the national average, which remained 11.4 percent below July 2019 national enplanements. While this is not a complete recovery, it is anticipated that enplanements will not linger below 2019 levels past 2022. Even though the first several months of 2021 saw significant continued impacts from COVID, Airport records indicated a total of 506,211 annual enplanements.

Figure 2-1 Year to Year FSD Enplanements Comparison



Source: Airport Records

2.2.2 Passenger Enplanements

Enplanement forecasts are a cornerstone of the master planning process as the number of passengers using an airport also influence operations, peak activity, and other metrics. This section summarizes historical enplanements at FSD and uses several industry standard methodologies to determine a future enplanement forecast. The final part of this section will discuss the strengths and weaknesses of the various forecasts and identify the preferred forecast selected for the 20-year planning period. As stated in Section 2.2.1, 2021 enplanements are recovering, and 2019 will be used as a base year for forecasting, although COVID impacts will be discussed.

Enplanements Forecast – Trend Analysis

Historical enplanements at FSD have grown steadily since the early 2000s, aside from temporary decreases during the 2008 recession and briefly in 2018. Enplanements declined from 2007 to 2009 before recovering quickly and have since resumed growth. The overall trend from the past decade is overall steady growth that has only been significantly impacted during major shocks such as the 2008 recession and 2019 pandemic. The resulting forecast by continuing this trend projects a growth to 946,601 enplanements by the end of the planning period, as shown in **Table 2-2**. A graphic depiction of the record of enplanements since 2002, as reported from the DOT T100 Database, is shown in **Figure 2-2** and includes the forecasted growth in enplanements. This is not intended to indicate enplanements will immediately return to pre-pandemic levels but is only shown to represent how past trends indicate future growth.

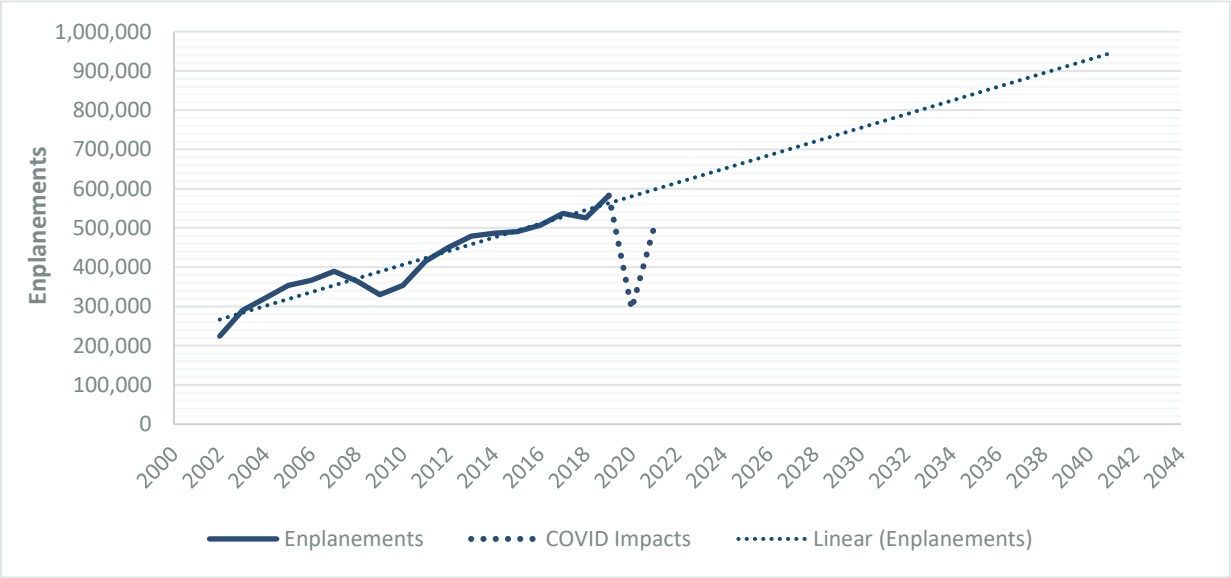
Table 2-2 Enplanement Forecast – Trend Analysis

Year	Enplanements
2019	582,500
2020	293,892
2021	506,211
2026	685,022
2031	772,215
2036	859,408
2041	946,601
CAGR[1]	2.23%

Source: DOT T100 Database, Airport Records

Notes: 1: Compound Annual Growth Rate (CAGR) from 2019 – 2041

Figure 2-2 Enplanement Forecast – Trend Analysis Chart



Enplanements Forecast – FAA Terminal Area Forecast

The FAA records passenger enplanements for all commercial service airports and releases this data annually in the TAF. Annual TAF data is based on the federal fiscal year (October through September) rather than the calendar year, so some discrepancy in annual enplanements is expected between the TAF and T100 Database. The 2021 TAF passenger enplanement forecast is shown in **Table 2-3**. The TAF estimates 385,593 enplanements in 2021, but this number had been nearly surpassed in September, and as explained in Section 2.2.1, 2021 enplanements have exceeded half a million. Nevertheless, the TAF projects strong growth to 718,232 enplanements in 2026 and 987,480 by the end of the planning period. As 2021 enplanements are considerably above the levels estimated in the TAF, the growth rates from 2021 to 2026 reported in the TAF are inflated. Since 2021 enplanements reported by FSD are already at 506,211, less dramatic growth is required over the next five years to arrive at the 718,232 enplanements projected for 2026.

Table 2-3 Enplanement Forecast – 2020 FAA TAF

Year	Enplanements
2019	563,396[1]
2020	290,810[1]
2021	385,593[2]
2026	718,232
2031	803,692
2036	894,468
2041	987,480
CAGR[3]	2.43 %

Source: 2020 FAA Terminal Area Forecast

Notes: 1: Based on 2020 TAF; 2: 2021 TAF estimate has been exceeded
3: Compound Annual Growth Rate (CAGR) from 2019 – 2041

Enplanements Forecast – Regression Analysis

Regression analysis derives the relationship between several independent variables based on their historic changes. If there is a high correlation between variables, then a forecast can be created which utilizes this relationship. The prediction ability of a given forecast is measured by the R^2 value, where 0 indicates no relationship and 1 indicates a perfectly influential relationship. The historical passenger enplanements at FSD were compared to the independent variables shown in **Table 2-4**, along with their R^2 values. These variables were compared to the T100 database records, as the reporting year is the same instead of the TAF, which reports the federal fiscal year. All of these models reported a strong correlation between local socioeconomics and Airport activity. Generally, a value of 0.9 would be desirable before using this methodology to determine a forecast. Some of these variables meet this standard, and the end of this section compares various methodologies to determine an appropriate preferred forecast.

Table 2-4 Regression Analysis Variables

Independent Variable	R^2 Value
Population	0.908
Employment	0.924
Total Earnings	0.888
Personal Income per Capita	0.838
Multivariate[1]	0.914

Notes: 1: Included the population and employment variables

Enplanement Forecast – Local

Forecasts are often checked against local socioeconomic and historic trends. Socioeconomic growth is expected to continue to support increasing enplanements after recovery from COVID impacts have occurred. From 2008-2019, enplanements increased at a CAGR of 3.53%[1]. The "local" forecast projects a recovery that also makes up for anticipated enplanement growth that would have occurred if not for the pandemic. The forecast applies the 3.53% growth rate experienced for the 12 years preceding COVID (2008-2019) to the subsequent 12-year period (2020-2031). The local forecast then applies a lower growth rate for the 2032-2041 timeframe consistent with the 30-year enplanement growth rate at FSD from 1990-2019 (3.03% CAGR). The local forecast projects 2026 enplanement levels nearly identical to the TAF, but grows to 1,151,447 enplanements by the end of the planning period (**Table 2-5**).

Table 2-5 Enplanement Forecast – Local

Year	Enplanements
2021	506,211
2026	718,320
2031	854,376
2036	991,851
2041	1,151,447
CAGR[3]	3.15%

Source: 2020 FAA Terminal Area Forecast

Notes: 1: Based on 2020 TAF; 2: 2021 TAF estimate has been exceeded 3: Compound Annual Growth Rate (CAGR) from 2019 – 2041

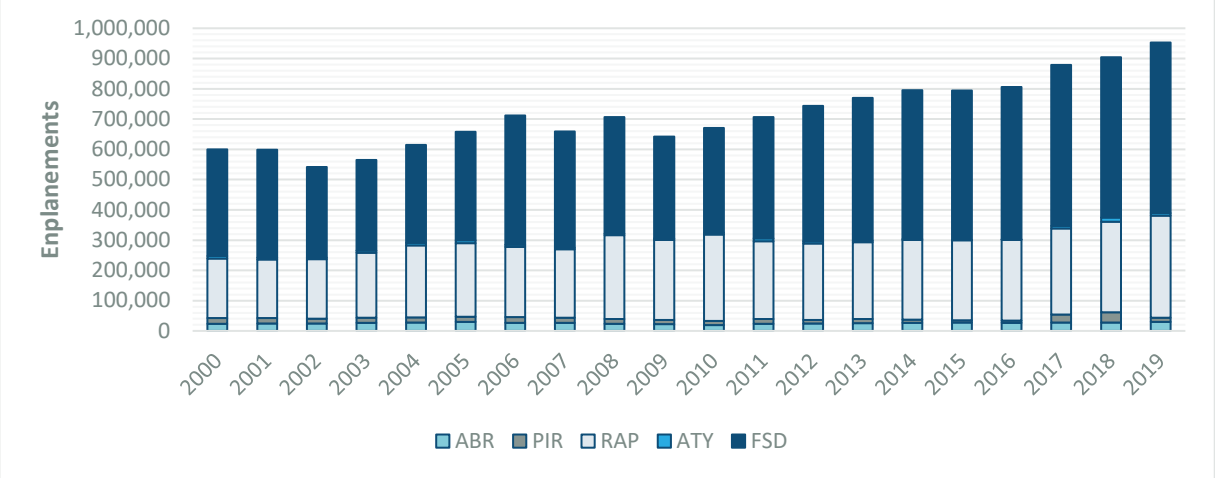
Enplanements Forecast – Market Share

This methodology measures local activity as part of the statewide whole. In **Figure 2-3**, the percentage of enplanements at each commercial service airport in South Dakota are shown as part of the state total. The vast majority of state enplanements, greater than 90 percent, occur at two airports: the Rapid City Regional Airport (RAP) and Sioux Falls Regional Airport (FSD). The other three sampled airports: Aberdeen Regional Airport (ABR), Watertown Regional Airport (ATY), and Pierre Regional Airport (PIR) make up the remainder of South Dakota enplanements. The FSD market share has changed modestly over time. Between 2009 and 2019, the lowest market share of SD enplanements occurred in 2010, with 51.5 percent of South Dakota annual enplanements. However, since 2011, FSD enplanements have stayed around 60 percent.

The increasing trend of market share for South Dakota's enplanements is more apparent when isolated and viewed graphically, as shown in **Figure 2-4**. While there have been periodic fluctuations in the Airport's enplanement market share it can also be seen that the historic trend has been overall growth. In the most recent five-year period depicted, 2015 – 2019, the Airport held an average of 60.6 percent of South Dakota's enplanement market. This average can then be used to determine future activity levels.

[1] A 12-year period starting in 2008 was chosen over a 10-year period because 2009 and 2010 enplanement levels were negatively impacted by the Great Recession and were not considered reliable baseline years to develop trend lines.

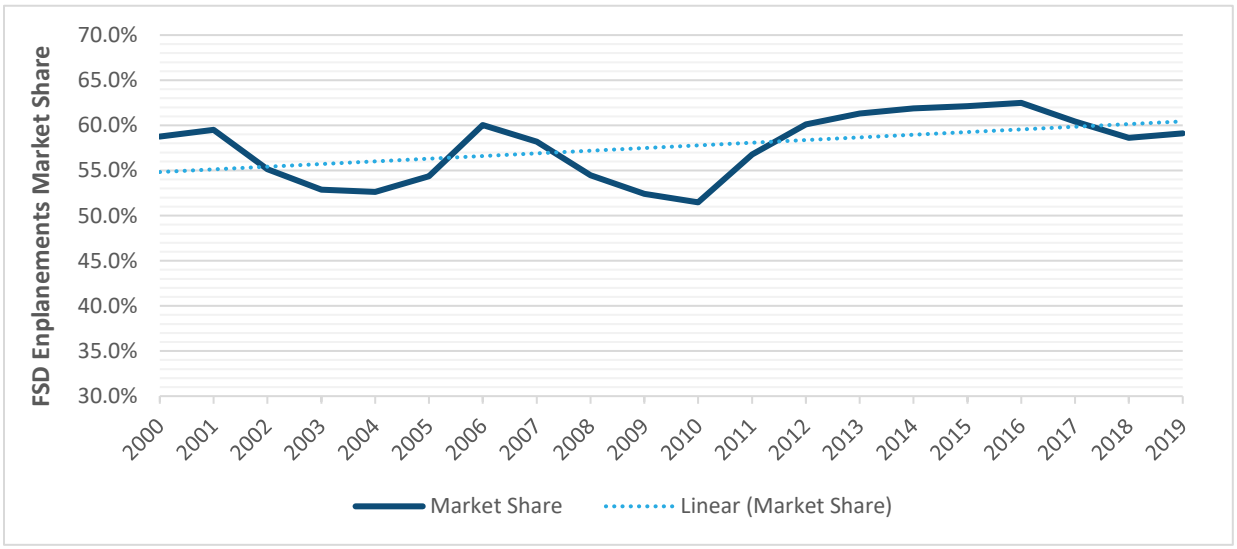
Figure 2-3 Historic Enplanements for Market Share Airports



Source: 2020 FAA TAF

Notes: ABR: Aberdeen Regional Airport; PIR: Pierre Regional Airport; RAP: Rapid City Regional Airport; ATY: Watertown Regional Airport

Figure 2-4 Historic FSD Market Share of South Dakota Enplanements



Source: 2020 FAA TAF

Notes: ABR: Aberdeen Regional Airport; PIR: Pierre Regional Airport; RAP: Rapid City Regional Airport; ATY: Watertown Regional Airport

The 2020 FAA TAF projects future enplanements for all the airports used in the selected market. These projections were totaled for the forecast period and 60.6 percent of the total was reallocated to FSD. However, if this methodology was unaltered, it would incorrectly allot only 416,747 enplanements to FSD in 2021. To correct this, the growth rate projected during the planning period can be applied to the corrected number of 2021 enplanements. This process can be seen in **Table 2-6**.

Table 2-6 Enplanement Forecast – Market Share

Year	Market Enplanements	FSD Market Share	FSD Enplanements Based on %[1]	FSD Adjusted Enplanements
2021	687,702	60.6%	416,747	506,211
2026	1,109,650	60.6%	672,448	614,665
2031	1,232,624	60.6%	746,970	746,355
2036	1,362,871	60.6%	825,900	906,258
2041	1,494,953	60.6%	905,942	1,100,421
CAGR[2]	3.96%	-	3.96%	3.96%

Notes: 1: This is the 2021 market share for FSD enplanements based on the 2020 TAF. However, enplanements in 2021 for FSD are underrepresented so the growth rate has been applied to the 2021 estimated enplanements. 2: CAGR shown is for 2021 – 2041.

Enplanements Forecast – Preferred Forecast

The various enplanement forecasts presented throughout this section are compared in detail in **Table 2-7** and graphically in **Figure 2-5**. Their strengths and weaknesses are discussed in this section with the selection of the preferred methodology. Each projects considerable growth, ranging from a projected annual CAGR of 1.56 percent to 2.58 percent. Although this may appear as a strong projection, historic trends indicate that a strong precedent of growth, as from 2009 to 2019 the Airport experienced an annual CAGR of 5.28 percent.

The Trend Analysis considers previous shocks to the system (2000 to 2019). When this record is used to project future activity, it shows a growth rate of 2.36 percent for the planning period. While this is a reasonable projection of future growth, it is derived by using the past to model the future. As discussed in Section 2.2.1, the aviation industry is currently undergoing changes to how it carries passengers and the type of aircraft expected to be used. As this model does not adequately anticipate future changes, it is dismissed from consideration.

The Market Share forecast uses statewide growth to forecast future activity at FSD. This forecast shows a slower initial increase in enplanements, as FSD is recovering faster than anticipated for other South Dakota Airports, before eventually growing to the highest projected level of enplanements at the end of the planning period. However, in recent years FSD has hosted over 60 percent of all enplanements in South Dakota. When a single data input dominates the market share input it tends to be less useful. As the single input, in this case FSD, has such a strong contribution to the entire market, this method was dismissed from consideration.

The Local Growth forecast assumes socioeconomic growth in the region will continue to support enplanement growth at rates experienced over different time periods during the last thirty years. This results in the greatest projection of forecasted enplanements, with 1,151,477 by the end of the planning period at a CAGR of 3.15 percent. Although this level of growth is not unprecedented at FSD, it may not continue for the next two decades. Therefore, while this forecast is reasonable, it was not selected as the preferred forecast.

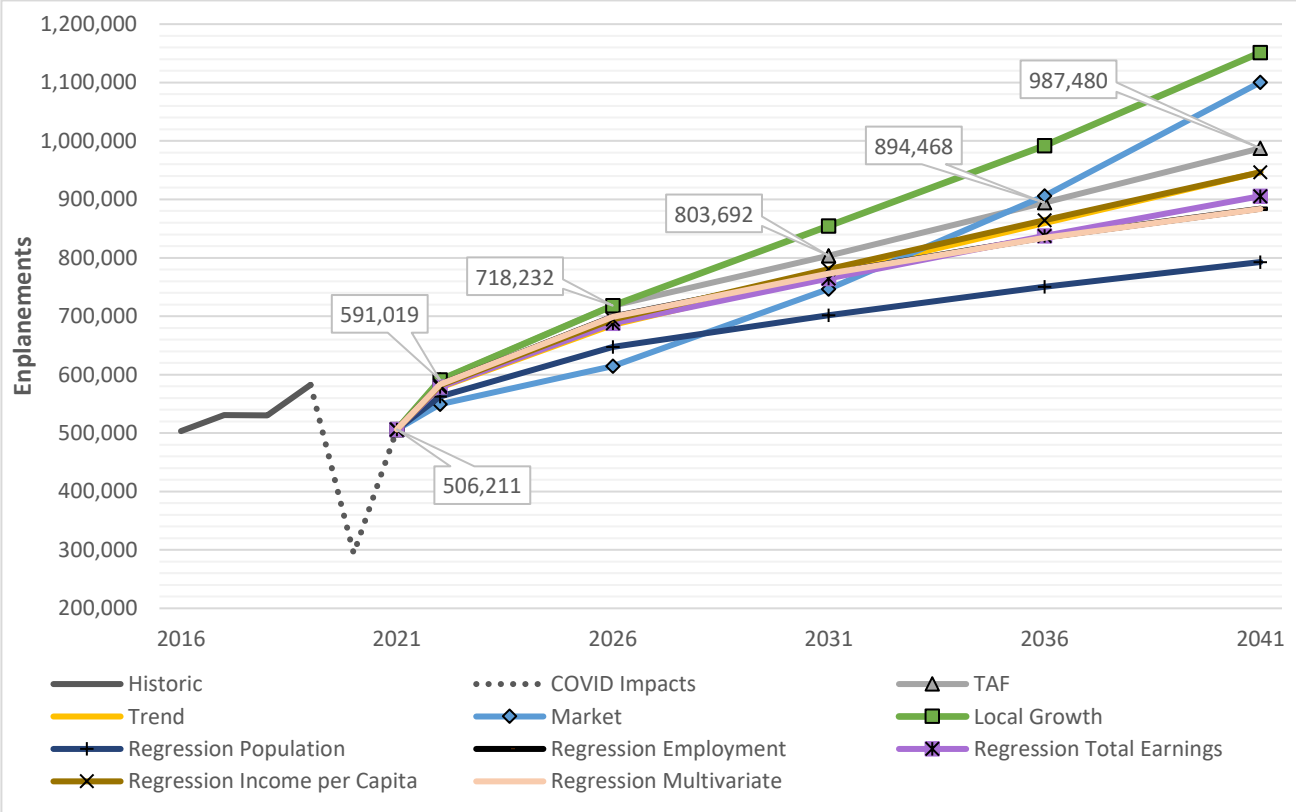
Table 2-7 Enplanement Forecasts – Summary

Year	FAA TAF	Trend Analysis	Market Share	Local Growth	Regression Analysis				
					Population	Employment	Total Earnings	Income per Capita	Multivariate
2019	**563,396**	563,396	563,396	563,396	563,396	563,396	563,396	563,396	563,396
*2020**	***290,810***	*290,810*	*290,810*	*293,892*	*290,810*	*290,810*	*290,810*	*290,810*	*290,810*
*2021**	***506,211***	*506,211*	*506,211*	*506,211*	*506,211*	*506,211*	*506,211*	*506,211*	*506,211*
2026	**718,232**	681,604	610,607	718,320	647,392	699,309	688,169	694,775	699,020
2031	**803,692**	767,882	741,427	854,376	701,956	773,230	764,834	780,692	772,831
2036	**894,468**	854,159	900,275	991,851	750,696	834,609	837,357	864,287	834,138
2041	**987,480**	940,437	1,093,156	1,151,447	792,774	884,108	905,578	946,447	883,597
CAGR[1]	*2.43%*	*2.23%*	*2.93%*	*3.15%*	*1.41%*	*1.91%*	*2.03%*	*2.23%*	*1.91%*

** Airport Records*

Notes: 1: The CAGR here is shown from 2019 – 2041. This may vary from the 2021 – 2041 shown in some forecast sections.

Figure 2-5 Enplanement Forecasts - Comparison



Collectively, the Regression Analysis forecasts show a strong correlation with local socioeconomic activity and project considerable growth through the planning period. While these are desirable attributes, it is difficult to tie a single socioeconomic variable to the activity of an airport. Airports can be more dominantly influenced by greater catchment areas, service changes, or the introduction of a new air carrier. Therefore, while the use of regression analysis provides valuable insight to the activity at FSD, this is not a recommended forecasting method for the Airport.

Finally, the FAA TAF projects the 987,480 enplanements by the end of the planning period. This growth has been demonstrated as feasible and the TAF's projection of a future CAGR of 2.58 percent is very reasonable. The TAF projection also aligns closely with many of the regression analysis forecasts. When the regression forecasts are taken collectively, they support a forecast similar to the TAF by showing similar projections with strong R^2 values. Therefore, the TAF is selected as the preferred enplanement forecast.

2.2.3 Commercial Aircraft Trends

Before analyzing the trends in commercial aviation, it should first be established what is considered commercial aviation, for master planning purposes, by the FAA. The FAA TAF separates commercial operations into three distinct categories: air carrier operations, commuter operations, and air taxi operations, as defined in **Table 2-8**. The first category, air carrier operations, is defined by the TAF as any operation by a commercial aircraft with a seating capacity of more than 60 seats or a maximum payload of more than 18,000 pounds. Although both commuter and air taxi operations each consist of aircraft below this threshold, commuter operations are scheduled while air taxi operations are unscheduled, on-demand flights. Air taxi operations are typically conducted by charter companies such as local fixed based operators (FBO) and fractional ownership aircraft operators. Large charter operations would usually count as air carrier traffic due to the size of the aircraft. Cargo operations may also be classified as either air carrier or air taxi operations depending on the type of aircraft utilized.

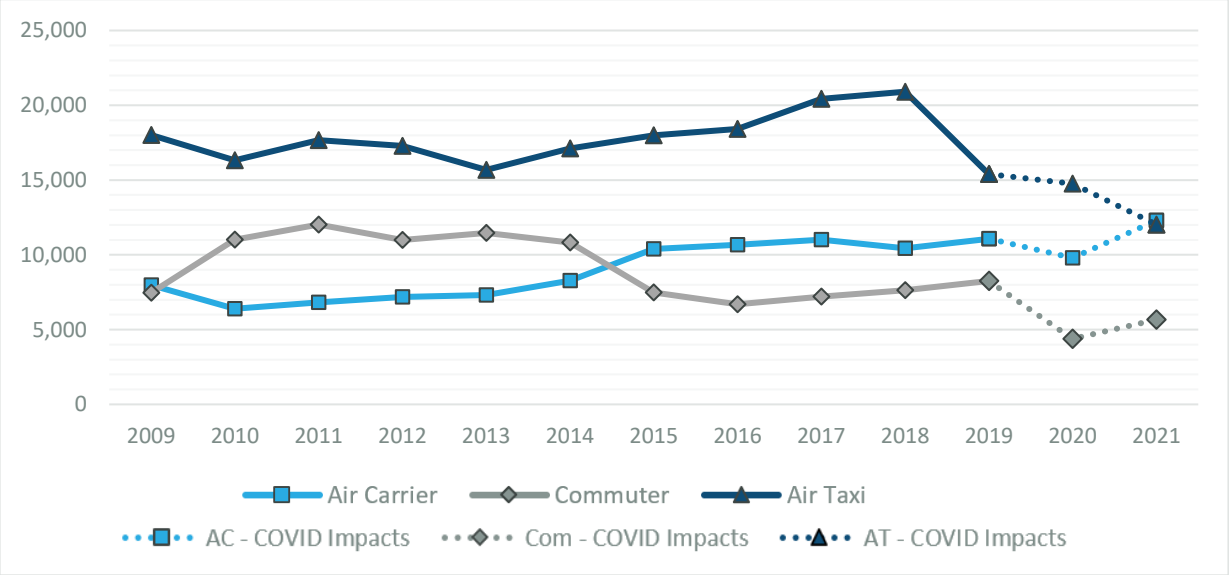
Table 2-8 FAA Commercial Operator Classification

Operation Categories	Commercial	Aircraft Capacity	Scheduled	Do Passengers Count as Enplanements?
Air Carrier	Yes	More than 60	Typically, Yes	Yes
Commuter	Yes	60 or Less	Yes	Yes
Air Taxi	Yes	60 or Less	Typically, No	No

Both air carrier and commuter operations are often scheduled operations and are therefore easier to determine. As air taxi operations may be either passenger or cargo operations, are generally unscheduled, and use similar aircraft to GA operations, establishing an accurate count of air taxi operations can be challenging. To divide operations into these three categories several databases were reviewed. The Traffic Flow Management System Counts Database (TFMSC) records flight plans filed by pilots. Since most air carrier and commuter traffic file flight plans, this database accounts for nearly all air carrier and commuter

operations. These operations were then manually divided into the commuter and air carrier categories based on the number of seats per aircraft. To determine air taxi operations, the Operations Network (OPSNET) database was reviewed. This database records the number of operations at towered airports by each category, although the commuter and air taxi operations are grouped together. The known number of commuter operations, determined by reviewing the DOT T100 database, was then subtracted from the OPSNET air taxi/commuter category to determine the total number of air taxi operations. This reveals air taxi operations to be a significant portion of commercial operations, at 43.7 percent in 2019. The results of this historic analysis can be seen in **Figure 2-6** while a breakdown of these operations by specific aircraft type is available in **Appendix H**. In this figure, the year 2021 has an estimated number of operations as this information is not available at the time of this writing. The process for determining this estimate is explained in greater detail below.

Figure 2-6 Historic Commercial Operations



Source: DOT T100, OPSNET Database

Note: 2021 is an estimate based on the TAF DOT T100 records

To develop an estimate for the number of commercial operations conducted in 2021, the TAF was first surveyed. For the year 2021, the TAF reported a forecasted estimate of 12,294 air carrier operations. Air carrier operations were more insulated from COVID related reductions in operations compared to commuter aircraft, as passenger flights were often consolidated onto larger aircraft. This can be seen in the comparatively minor reduction in operations between 2019 and 2020, where air carrier operations decreased by 11.5 percent compared to the 46.9 percent reduction in commuter operations during the same period. As of June 2021, 7,332 operations have been conducted by air carrier aircraft. As this is only half of the year, the TAF estimate of 12,294 operations seems a reasonable, though perhaps conservative estimate.

Commuter operations are recovering more slowly. As of June 2021, only 1,647 annual operations were recorded by the DOT T100. Although the beginning of the year was more impacted by COVID, as shown by the enplanements in Section 2.2.1, the later half of the year has been more closely aligned with 2019 levels. This anticipates that commuter aircraft will be significantly more active in the later half of 2021 as schedules return to more normal levels. If half of the 2019 commuter operations are applied to the year to date 2021 commuter operations, then a total of 5,772 operations would be projected for the year. However, additional information is needed to support this claim. The same flight schedule used for the peak month average day, which is selected and discussed in greater detail in Section 2.5.1. and shown in **Appendix H**, can be used to estimate commuter operations.

Enplanements first surpassed pre-COVID monthly activity levels in July of 2021. Likewise, air carrier schedule for that month shows a return to operations similar to 2019. Wednesdays were found to resemble the average day of July 2021 most closely. Commuter operations during this day can be isolated to show that 22 operations are conducted by the legacy air carriers during this day. These legacy operations are less likely to change with the season than other carriers at FSD, such as Allegiant or Frontier. It then follows that the number of average daily operations by commuter aircraft (22 operations) can be multiplied by the remaining days of the year, from July 1st through December 31st (183 days). This estimates 4,026 commuter operations for the duration of the year. When these operations are combined with the 1,647 operations from January through June, reported by the DOT T100, a total of 5,673 commuter operations are predicted for 2021.

The FSD commuter fleet has become more homogenous in recent years as the Embraer 140, typically a 44-seat aircraft, has significantly decreased operations since its peak use in 2014. Meanwhile the air carrier fleet has grown in size and become more diverse. From 2015 to 2019 over 11 types of different air carrier aircraft have conducted an average of at least 1 operation per day annually. Air carrier aircraft have become steadily more dominant since 2010, growing from 20 percent of commercial operations to 33 percent in 2019. This trend is expected to continue as the commuter fleet decreases in size and is redistributed to serve smaller markets, such as airports in the Essential Air Service program.

The decrease in commuter aircraft has been anticipated on a federal forecasting level and is supported by recent aircraft orders. In 2019 SkyWest conducted approximately 5,980 operations with the CRJ200 at FSD, which had considerably more operations by a 50-seat aircraft than any other carrier. SkyWest is also the top operator of CRJ200s in the nation with a fleet of 141 CRJ200s. However, these aircraft have finite lifetimes, and SkyWest has placed no new orders for them. Instead, the air carrier has ordered 16 Embraer 175s to prepare for the transition to larger aircraft. A brief period of growth is likely for the commuter aircraft as COVID impacts subside, before being allocated to smaller markets before retirement.

As described above, the commuter operations were determined using the T100 Database and subtracted from the combined commuter/air taxi operations category reported by the TAF. As there were 17,702 combined operations, the 5,673 estimated commuter operations can be subtracted from this total to reveal 12,029 air taxi operations. The number of operations for all commercial aircraft in 2021 are shown below in **Table 2-9**.

Table 2-9 2021 Commercial Operations Estimate

Air Carrier	Commuter	Air Taxi	Total
12,294	5,673	12,029	29,996

2.2.4 Commercial Aircraft Forecast

The number of future operations by commercial aircraft can be derived in a similar fashion to how 2021 was estimated. Air carrier aircraft are expected to increase in use, becoming the dominate aircraft type for scheduled enplanements at busy airports like FSD. The TAF projects an increase in air carrier aircraft from 12,294 operations in 2021 to 28,071 operations in 2041. While it is expected that some commuter aircraft, like the popular 50-seat CRJ200, will remain in service for several years they will be transitioned to smaller markets that better fits their capacity.

Currently, FSD offers flights to fifteen different destinations through five different air carriers. Airlines are experiencing strong passenger load factors even as they increase the average number of seats per aircraft serving FSD. As shown in **Table 2-10**, load factors have remained near or above 80 percent while the average number of seats per aircraft have increased from around 70 at the beginning of the previous decade to above 80 in recent years. This, unsurprisingly, is due to the strong growth in enplanements seen in the past decade. From 2009 to 2019 the Airport experienced a 67.4 percent increase in enplanements, an annual Compound Annual Growth Rate (CAGR) of 5.28 percent. This supports continued growth of air carrier aircraft to become the dominant aircraft following both local trends of passenger growth and fleet mix and national air carrier industry trends which is reported in the 2021-2041 Aerospace Forecast to increase by 4.2 percent CAGR for the planning period.

Table 2-10 Commercial Operational Trends

Year	Load Factor	Average Seats	Enplanements
2009	72.9%	78.5	336,634
2010	77.3%	68.5	345,052
2011	80.7%	70.5	401,259
2012	84.7%	71.2	446,581
2013	85.2%	71.4	472,268
2014	85.3%	69.4	492,113
2015	85.2%	74.6	493,650
2016	84.4%	82.3	503,346
2017	79.9%	85.3	530,983
2018	83.5%	81.4	530,232
2019	85.5%	81.0	563,396

Source: DOT T100 Database

The 2021-2041 Aerospace Forecast projects the future activity of air taxi and commuter aircraft together in a single category. Beginning 2019, this document shows a decline in the collective category continuing until 2026. These operations are then expected to increase through the rest of the planning period, to 2041. This fluctuation closely mirrors the anticipated decrease in the commuter fleet and while representing the continued growth of air taxi operations. If the period from 2026 – 2041 is examined, the period by which

commuter aircraft are expected to be a smaller proportion of the national fleet, then a growth rate of 1.17 percent can be derived to determine future air taxi growth. Once the number of these aircraft operations are determined, they can be subtracted from the joint commuter/air taxi category to reveal the remaining commuter operations. These results can be seen in **Table 2-11**. While this forecasts closely follows anticipated national trends and reflects strong local growth for air carrier operations, air taxi operations are shown with modest growth compared to historic trends. For 2009 through 2019, there were an average of 17,750 annual air taxi operations and in 2018 20,908 operations occurred. Therefore, what is shown for the future forecast of air taxi operations is a conservative average of activity. It is reasonable that operations may exceed 20,000 again in the near future but annual variations in this operational type, such as those that have occurred historically, are expected to continue. Overall, the future of commercial operations at FSD is anticipated to be strong, growing from an estimated 29,996 operations in 2021 to 48,117 operations by 2041.

Table 2-11 Commercial Operations Forecast

Year	Air Carrier	Commuter	Air Taxi	Total
2019	11,562	8,249	15,399	35,210
2020	11,095	4,382	14,748	30,225
2021	12,294	5,673	12,029	29,996
2026	20,526	301	16,705	37,532
2031	22,915	259	17,706	40,880
2036	25,456	211	18,766	44,433
2041	28,071	156	19,890	48,117
CAGR	4.11%	-16.44%	1.17%	1.43%

Notes: CAGR is shown for 2019 to 2041

2.3 General Aviation Activity

General aviation (GA) is a versatile industry and represents all civil aviation activity not defined as commercial. GA includes a variety of users and activities, including corporate and business operators, recreational users, flight training, agricultural applications, and law enforcement and other government uses. At FSD, GA operations comprised 41.2 percent of all operations at the Airport in 2019. As there is a consistent presence of air carrier service, cargo and air taxi operations this means a considerable amount of GA traffic. While COVID heavily impacted aviation as a whole, GA operations were more insulated than many aspects of typical commercial operations. GA operators benefited from additional flexibility, less exposure to the traveling public, and smaller crew and passenger numbers, and a generally smaller aircraft sterile cabin to maintain.

GA operations have mirrored air carrier operations in some ways, with a reduction in operations from 28,212 operations in 2019 to 24,198 operations in 2020. The estimate for 2021 was done by comparing the year-to-date GA operations from January to September for 2019 and 2021 and determining there was a 1.3 percent difference in operations, as shown in **Table 2-12**. This percentage can be applied to the monthly GA operations for the duration of 2021 to result in a total of 27,306 GA operations. This means the 2020 14.2 percent

decrease in operations from 2019 to 2020 were quickly recovered as the current estimate for 2021 is only 1.3 percent lower than 2019 levels.

Table 2-12 Annual GA Operations Comparison

Year	2019	2021	2021 v 2019 %
Jan	1,892	1,746	-7.7%
Feb	1,876	1,904	1.5%
Mar	2,541	2,446	-3.7%
Apr	2,090	2,238	7.1%
May	2,497	2,221	-11.1%
Jun	2,760	2,616	-5.2%
Jul	2,814	2,896	2.9%
Aug	2,674	2,974	11.2%
Sep	2,423	2,240	-7.6%
YTD Total	**21,567**	**21,281**	**-1.3% (Average)**
Oct*	2,348	2,317	-1.3%
Nov*	1,867	1,843	-1.3%
Dec*	1,889	1,864	-1.3%
Total (Estimate)	**27,671**	**27,306**	**-1.3 (Average)**

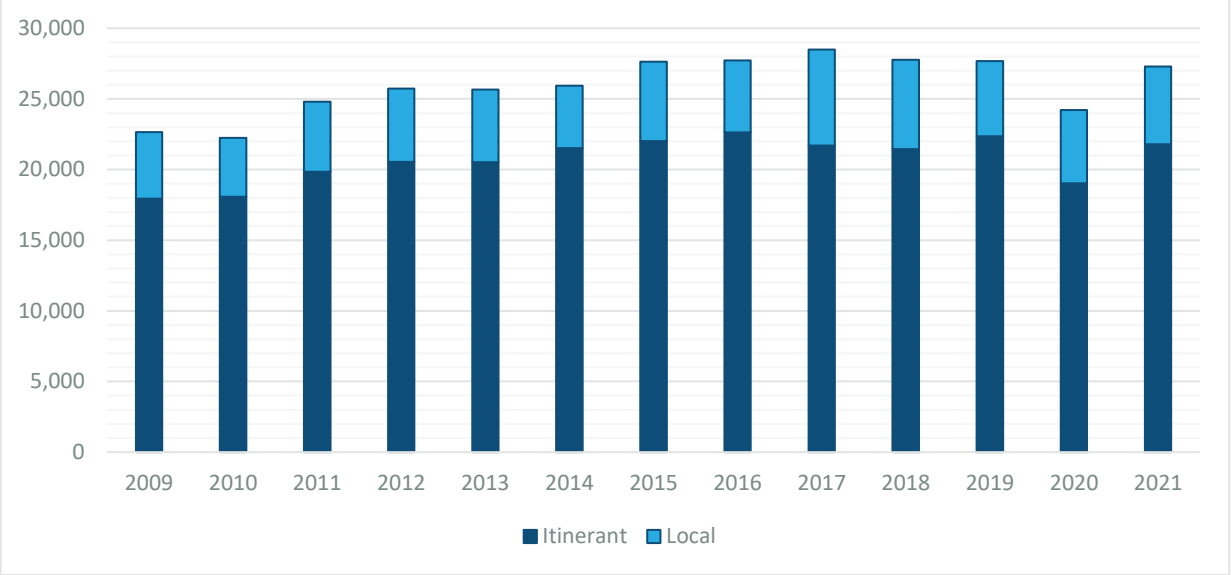
Source: OPSNET Database

Notes: October through December was estimated for 2021

2.3.1 General Aviation Operations

GA Operations have been a consistent presence at the Airport for several decades. Even at their lowest number of operations following the 2008 recession, GA operations accounted for 36 percent of total Airport activity, with 22,244 operations in 2010. General aviation operations have also been strong historically, with an annual CAGR of 1.98 percent from 2009 – 2019. Since then, operations have increased steadily with only minor stalls in growth, as shown in **Figure 2-7**. It can be seen that itinerant operations, or those that do not either originate or terminate at the Airport, are a dominant operational type. From 2009 through 2020, a total of 79.8 percent of GA operations were itinerant leaving the remaining 20.2 percent as local operations. Local operations are those that operate in the local traffic pattern or originate and terminate at the Airport after remaining within 20 miles of the Airport. Local operations are most common for pilots conducting either recreational or training flights.

Figure 2-7 Historic GA Operations



Source: OPSNET Database

GA Operations Forecast – FAA Terminal Area Forecast

The TAF GA operations are shown in **Table 2-13**. The TAF reports that approximately 80 percent of GA operations are itinerant operations over the past decade (2011 – 2021) and expects a similar split in forecasted years. Local operations, while a smaller portion, are expected to grow modestly through the planning period. Combined, this results in a total of 31,013 annual GA operations by the end of the planning period, or a CAGR of 0.43 percent.

Table 2-13 GA Operations Forecast – FAA TAF Forecast

Year	Itinerant	Local	Total Operations
2019	22,569	5,643	28,212
2020	19,420	4,778	24,198
2021	20,707	4,831	25,538
2026	23,679	5,104	28,783
2031	24,109	5,393	29,502
2036	24,547	5,698	30,245
2041	24,993	6,020	31,013
CAGR[1]	0.46%	0.29%	0.43%

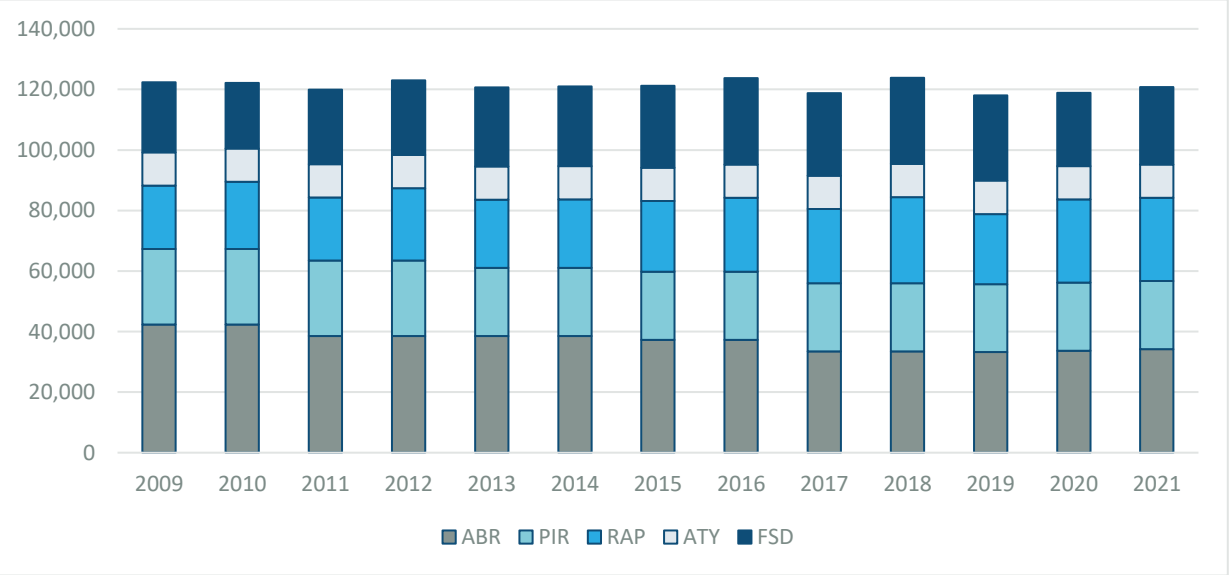
Source: 2020 FAA Terminal Area Forecast

Notes: 1: CAGR from 2019 – 2041

GA Operations Forecast – Market Share

The market share forecast projects growth at FSD as a portion of the total projected GA growth at other airports in South Dakota. As scheduled air service tends to change the dynamic and number of GA operations, only other commercial service airports in South Dakota were selected for comparison, as this better reflects the operating conditions at FSD. **Figure 2-8** shows the companion airports and the total number of GA operations in commercial service airports in South Dakota. While a market share forecast is an industry standard, it relies on gathering reliable data for the established market. In this case, many of the commercial service airports in South Dakota do not have an Air Traffic Control tower. This severely limits the ability the gather reliable general aviation data as these operations are not reliably recorded by many of the databases that capture air carrier traffic or larger business aviation. The merits of this forecast will be further discussed at the end of this section.

Figure 2-8 Historic GA Operations for Market Share Airports



Source: 2020 FAA Terminal Area Forecast

Notes: ABR: Aberdeen Regional Airport; PIR: Pierre Regional Airport; RAP: Rapid City Regional Airport; ATY: Watertown Regional Airport

In a ten year period, 2009 – 2019, FSD has held an average of 21.4 percent of the total GA operations for the determined market. In more recent years, 2015 – 2019, this has grown slightly to 23 percent. The GA industry is currently undergoing a shift to more business operations as recreational flight becomes less common. Due to the evolving nature of GA the five year period average of 23 percent was selected to represent future FSD GA operations. If this percentage is applied to the total number of GA operations projected by the TAF for these Airports, then a total of 32,135 operations is shown by the end of the planning period. However, like the enplanements market share forecast, this can be adjusted to account for the 2021 estimate of GA Operations by applying the market share growth rate to these operations. This results in a growth to 31,548 operations, as shown in **Table 2-14**.

Table 2-14 GA Operations Forecast – Market Share Forecast

Year	Market GA Operations	FSD Market Share	FSD GA Operations Based on %	FSD Adjusted GA Operations
2021	120,772	23.0%	27,778	27,306
2026	127,016	23.0%	29,214	28,310
2031	130,935	23.0%	30,115	29,350
2036	135,099	23.0%	31,073	30,429
2041	139,533	23.0%	32,093	31,548
CAGR	*0.72%*	-	*0.72%*	*0.72%*

Notes: 1: This is the 2021 market share for FSD enplanements based on the 2020 TAF. However, enplanements in 2021 for FSD are underrepresented so the growth rate has been applied to the 2021 estimated enplanements.

GA Operations Forecast – FAA National Aerospace Forecast

The FAA releases the National Aerospace Forecast biannually. This document primarily supports budget and planning needs for the FAA. However, it also provides many trends relevant to forecasting at a given airport. Table 32 of the document projects the total number of combined operations for national towered airports. The growth rates shown for local and itinerant GA operations nationally from 2021 through 2041 can be applied to the projected number of operations in 2021 at FSD. This methodology projects 32,194 operations by the end of the planning period, as shown in **Table 2-15**.

Table 2-15 GA Operations Forecast – FAA National Aerospace Forecast

Year	Itinerant	Local	Total Operations
2019	22,569	5,643	28,212
2020	19,420	4,778	24,198
2021[1]	21,817	5,489	27,306
2026	22,795	5,658	28,452
2031	23,815	5,833	29,648
2036	24,882	6,013	30,894
2041	25,996	6,198	32,194
CAGR[2]	0.64%	0.43%	0.60%

Source: 2020 FAA Terminal Area Forecast, 2021 – 2041 FAA Aerospace Forecast

Notes: 1: Estimate based on year to year estimate 2: Compound Annual Growth Rate (CAGR) from 2019 – 2041

GA Operations Forecast – 2020 South Dakota State Aviation System Plan

Similar to the FAA projections of national operational trends, the South Dakota Department of Transportation projects future aviation activity at the 56 system airports in the 2020 State Aviation System Plan (SD SASP). The growth rate from the 2020 SD SASP preferred forecast can be extrapolated and applied to the estimated 2021 operations, shown in **Table 2-16**. However, the forecast in the SASP was derived using an operations based forecast that the FAA has been moving away from in recent years. The end of this section will discuss the merits of this methodology in greater detail.

Table 2-16 GA Operations Forecast – 2020 SD SASP

Year	GA Operations
2019	28,212
2020	24,198
2021	27,306
2026	30,247
2031	31,790
2036	33,412
2041	33,319
CAGR[1]	0.76%

Source: 2020 SD SASP

Notes: 1: Compound Annual Growth Rate (CAGR) from 2019 – 2041

GA Operations Forecast – Preferred Forecast

Each of the forecasts in this section are compared in **Table 2-17** and presented graphically in **Figure 2-9**, and they project a similar level of growth. General aviation operations have been strong historically, with an annual CAGR of 1.98 percent from 2009 – 2019. Although these forecasts are more modest compared to historic growth, this does align with expected national trends. Nationally, general aviation has experienced a trend of transition as piston aircraft have become less common while turbine aircraft, conducted as business operations, have become more common. Although the forecasts shown below do not immediately indicate strong growth, piston aircraft are expected to continue to conduct less of the total operations at FSD. This is supported by currently unoccupied T-hangars, suitable for smaller piston aircraft, while both of the FBOs at the Airport have a significant waiting list of larger turbine aircraft desiring to base their aircraft at FSD and existing local aircraft that desire either new or upgraded hangars. This transition contributes to more modest growth as general aviation continues to evolve.

While growth is expected to be modest, the FAA TAF shows a CAGR through the planning period of only 0.43 percent. This is considerably slower growth than has historically occurred and is not expected to be applicable to FSD given the existing waitlist of aircraft and growing local socioeconomics.

The 2020 SD SASP projects the strongest growth of the considered forecasts, but the growth is derived from an operations per based aircraft (OPBA) forecast in the 2020 SD SASP. As previously stated, using past trends to forecast future trends is not generally a reliable methodology. The OPBA methodology determines the ratio of operations to based aircraft in the past and then uses that ratio to forecast future operations. However, as the general aviation industry is undergoing a significant transition, this is not considered to be a reliable methodology and was dismissed from consideration.

In a similar fashion, the market share forecast has underlying weak points. While the methodology is industry standard, it depends on reliable data to produce a reasonable forecast. Many of the airports in the selected market do have an air traffic control tower and so are not able to accurately count GA operations and instead estimates from the TAF are the primary source of information on these operations. As three of the five sampled airports do not have an operating tower this can greatly skew the results of this forecast and it was therefore dismissed.

Finally, the growth rate derived from the 2021-2041 Aerospace Forecast projects future activity based on the anticipated growth rate of national activity. While a national trend may not be reflected at all airports on a granular level, the growth of historic GA operations at FSD and the existing waitlist for additional hangar space show that general aviation is an active part of demand at FSD. As this forecast shows local growth while maintaining a sound methodology this forecast is the preferred GA operations forecast.

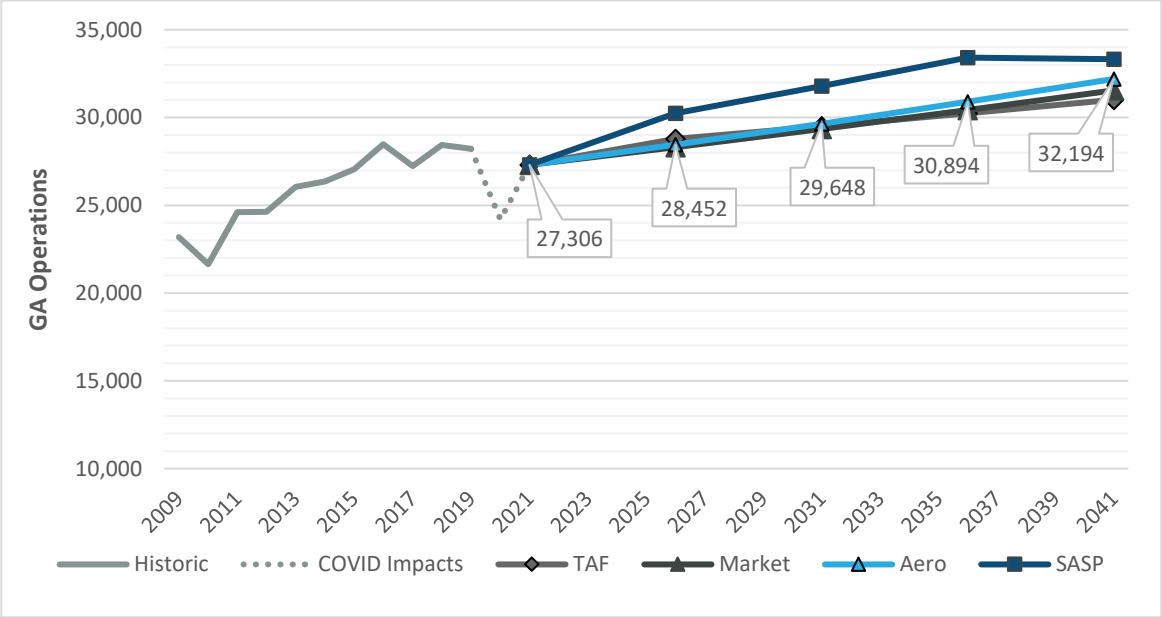
Table 2-17 GA Operations - Summary

Year	TAF	Market	Aerospace Forecast	SASP
2019	28,212	28,212	**28,212**	28,212
2020	24,198	24,198	**24,198**	24,198
2021	27,306	27,306	**27,306**	27,306
2026	28,783	28,310	**28,452**	30,247
2031	29,502	29,350	**29,648**	31,790
2036	30,245	30,429	**30,894**	33,412
2041	31,013	31,548	**32,194**	33,319
CAGR[1]	*0.64%*	*0.72%*	***0.83%***	*1.00%*

Source: 2020 FAA Terminal Area Forecast

Notes: 1: Compound Annual Growth Rate (CAGR) from 2021 – 2041 and so may align with the CAGR for 2019 – 2021 shown in previous sections.

Figure 2-9 GA Operations - Comparison



2.3.2 Based Aircraft

Based aircraft are those housed at an airport for the majority of the year and are airworthy. Based aircraft drive several types of facility needs such as hangars, tie-downs, and FBO services. Currently, FSD hosts 111 based aircraft, which are primarily comprised of single engine piston aircraft, as is common at airports with a GA presence (**Table 2-18**). Existing based aircraft at FSD mirror national trends, as there is an existing waitlist at the Airport for jet aircraft while piston aircraft have shown less demand. Of the based aircraft at FSD, 18 are military. While these aircraft will be accounted for in the projection of future based aircraft, growth for military aircraft numbers are more based on federal policy and their growth will not be included in this master planning effort.

Table 2-18 Current Based Aircraft

Aircraft Type	Based Aircraft
Single-engine	55
Multi-engine	34
Jet	4
Helicopters	0
Gliders	0
Military	18
Total	111

Source: 5010 Reporting

Based Aircraft Forecast – FAA Terminal Area Forecast

The 2020 FAA TAF indicates that based aircraft at FSD will increase from a total of 111, as currently indicated by the 5010 record, to 150 by the end of the planning period, a CAGR of 1.5 percent (**Table 2-19**). This modest growth aligns with the reduced growth of piston aircraft, which tend to be more numerous, and the growth of a smaller but expanding turbine aircraft fleet.

Table 2-19 Based Aircraft Forecast – FAA TAF Forecast

Year	Based Aircraft
2021	111
2026	120
2031	129
2036	139
2041	150
CAGR[1]	1.5%

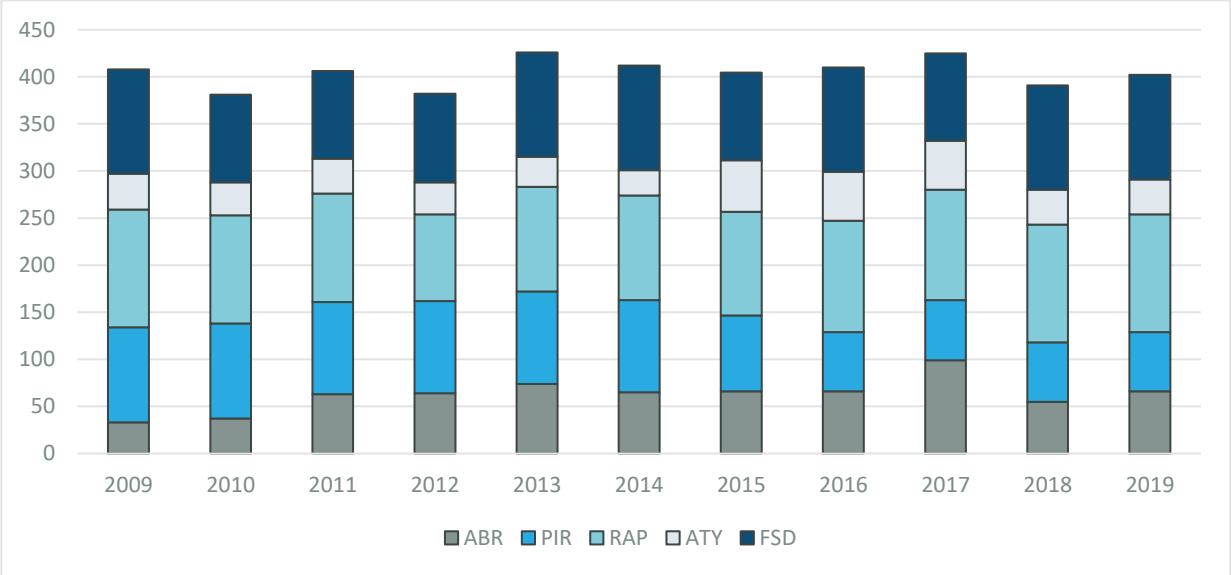
Source: 2020 FAA Terminal Area Forecast

Notes: 1: Compound Annual Growth Rate (CAGR) from 2021 – 2041

Based Aircraft Forecast – Market Share

The market share forecast projects based aircraft growth at FSD as a portion of the total projected growth in South Dakota, like the market share forecast for GA Operations. **Figure 2-10** shows the historic based aircraft for the selected market. Like the GA Operations market share forecast, one of the limitations with this methodology is that if historic information is suspect of being faulty for any of the market share airports, it undermines the entire methodology. In this case, there are significant jumps between the number of aircraft at many of these airports annually. The end of this section will discuss these forecast limitations.

Figure 2-10 Historic Based Aircraft for Market Share Airports



Source: 2020 FAA TAF

Notes: 2015 for PIR was reported as zero so it was averaged between 2016 and 2014. ABR: Aberdeen Regional Airport; PIR: Pierre Regional Airport; RAP: Rapid City Regional Airport; ATY: Watertown Regional Airport

In a ten year period, 2009 – 2019, FSD has held an average of 25.5 percent of the total based aircraft for the determined market and has held steady in recent years as 2015 – 2019 this percent was 25.6 percent. Similar to the GA operations market forecast, the more recent five year average was used due to the evolving nature of general aviation. If 25.6 percent of the future market share is applied to the total number of based aircraft projected by the TAF for these Airports, then a total of 125 based aircraft are shown by the end of the planning period. However, like the other market share forecast, this can be adjusted to account for 2021 based aircraft by applying the market share growth rate. This process is shown in **Table 2-20** and results in a growth to 132 aircraft.

Table 2-20 Based Aircraft Forecast – Market Share Forecast

Year	Market Based Aircraft	FSD Market Share	FSD Based Aircraft Based on %	FSD Adjusted Based Aircraft
2021	410	25.6%	105	111
2026	430	25.6%	110	116
2031	449	25.6%	115	121
2036	469	25.6%	120	127
2041	489	25.6%	125	132
CAGR	*0.88%*	-	*0.88%*	*0.88%*

Notes: 1: This is the 2021 market share for FSD based on the 2020 TAF. However, based aircraft in 2021 for FSD are underrepresented so the growth rate has been applied to the 2021 estimated based aircraft.

Based Aircraft Forecast – 2020 SD SASP

Like the GA Operations forecast, the 2020 SD SASP forecasted the number of based aircraft at FSD. As the SASP only forecasted out to 2038, the growth rate was derived from the forecast and applied to the existing number of aircraft at FSD. Shown in **Table 2-21**, projections indicate a growth from 111 to 135 based aircraft.

Table 2-21 Based Aircraft Forecast – 2020 SD SASP

Year	Based Aircraft
2021	111
2026	117
2031	122
2036	129
2041	135
CAGR[1]	0.98%

Based Aircraft Forecast – Preferred Forecast

The based aircraft forecasts presented in this section are compared in **Table 2-22**. The Market Share forecast is not an ideal forecast for this metric as based aircraft records are not always kept up to date at all airports. Historic information for based aircraft at some of the sample airports fluctuate greatly or may stay the same for several years. This indicates that there may be some inaccuracies in the records that then negatively impact the forecast integrity. For these reasons, this forecast was dismissed from consideration.

The SASP is a reasonable forecast and anticipates modest growth. However, it shows a growth of only five aircraft from 2021 to 2026, and already, more aircraft than this are on the waiting list for FSD. The existing limitation at FSD is not a lack of demand but a lack of hangar space to house interested aircraft. The preferred based aircraft forecast should show an initial rapid increase, as hangar space is made available, instead of slow and steady growth driven by national growth.

The TAF shows more appropriate initial growth consistent with the existing waitlist. Both of the FBOs at the Airport have an existing waitlist of large aircraft, such a business jets and other turbine aircraft. An increase of nine aircraft in five years is a reasonable assumption as additional hangars are built. Continued growth at FSD is consistent with local socioeconomic and business development, such as the 640,000 Amazon fulfillment facility currently under construction and scheduled to open in 2022. Based its alignment with the anticipated growth and existing waitlist, the 2020 FAA TAF is selected as the preferred forecast.

Table 2-22 Based Aircraft Forecast – Summary

Year	TAF	Market Share	SASP
2021	**111**	111	111
2026	**120**	116	117
2031	**129**	121	122
2036	**139**	127	129
2041	**150**	132	135
CAGR[1]	**1.50%**	0.88%	0.98%

Notes: 1: Compound Annual Growth Rate (CAGR) from 2021 – 2041

The fleet mix projected by the TAF shows most of the based aircraft growth occurring via single-engine and multi-engine aircraft. Although some of these multi-engine aircraft would likely include turbine aircraft, it is not expected that single engine aircraft will be the dominant factor in near-term growth at FSD. The existing waitlist indicates that larger aircraft will be a more rapid source of growth while single-engine pilots have expressed less interest in locating at the Airport or upgrading hangars. Therefore, the fleet mix shown by the TAF has been adjusted to include both the correct number of current aircraft and the increase in jets has been modified to reflect existing demand, as shown in **Table 2-23**.

Table 2-23 Based Aircraft Fleet Mix

Year	Single-engine	Jet	Multi-engine	Helicopter	Other	Total
2021	55	4	34	0	18	111
2026	56	10	36	0	18	120
2031	57	14	40	0	18	129
2036	62	16	43	0	18	139
2041	65	18	49	0	18	150

2.4 Military Aviation

There is a moderate is comparison to other activity types but there is a consistent military presence at FSD due to the presence of the Army National Guard and Air National Guard. In the past decade, military operations have made up between 4.5 and 10.8 percent of total Airport operations, averaging to 7.7 percent. Historical military operations have averaged just over 5,000 operations per year for the past decade. The FAA TAF projects 3,076 itinerant and 1,250 local military operations per year through 2041, a total of 4,326 operations. Although this is slightly below recent historic data, the preferred forecast methodology for military operations is the FAA TAF as military operations are driven more by federal policy decisions than local conditions.

2.5 Peak Activity

Annual forecasts and other broad-spectrum levels of airport activity may not adequately describe the complex needs of airport facilities. Annual metrics are only useful when activity tends to be evenly distributed over the hours, days, and months of the year. However, most airports have peak periods when demand surpasses annual averages. As a result, it is important to identify and forecast peak period activity levels.

Peak activity forecasts are presented in the following sections so that Chapter 3, *Facility Requirements*, can determine what facilities will be required to accommodate the peak demand. However, if planning is contingent on the absolute busiest periods of activity, it can lead to overestimation, overspending, and inefficiencies. As a result, these peak activity forecasts focus on the average day during the peak months for passenger and aircraft activity, rather than the absolute peak day. In addition, analysis of peak enplanements should not be contingent on charter activity due to the less predictable nature of charter operations and associated enplanements.

2.5.1 Peak Hour Enplanements

Peak activity forecasts should identify the "design hour" flow of passengers and aircraft. The design hour is an estimate of the peak hour of the average day of the busiest month. This approach provides sufficient facility capacity for most days of the year. The first step in this process is to determine the peak month using data from the DOT T100 Database. From 2015 to 2019, the average peak month was July, which averaged 9.2 percent of annual enplanements. These years range are shown in **Table 2-24** with the monthly passengers as a percentage of annual enplanements. In **Table 2-25** this percentage is applied to the forecasted future enplanements from the preferred passenger forecast in Section 2.2.2 to determine the number of peak month passengers.

Table 2-24 Historic Monthly Passenger Enplanements Compared to Annual

Variable	2015	2016	2017	2018	2019
Total	490,492	506,996	536,705	525,284	572,063
Monthly Average	40,874	42,250	44,725	43,774	47,672
Monthly Maximum	44,912	45,903	51,216	47,309	54,111
Peak Month	March	March	July	November	December
PM % of Year	9.2%	9.1%	9.5%	9.0%	9.5%

Table 2-25 Forecasted Peak Month Enplanements

Year	Annual Enplanements	Peak Month Percentage	Peak Month Enplanements
2021*	502,869	9.2%	46,264
2026	718,232	9.2%	66,077
2031	803,692	9.2%	73,940
2036	894,468	9.2%	82,291
2041	987,480	9.2%	90,848

Notes: 2021 is based on the estimate determined in Section 2.2.1.

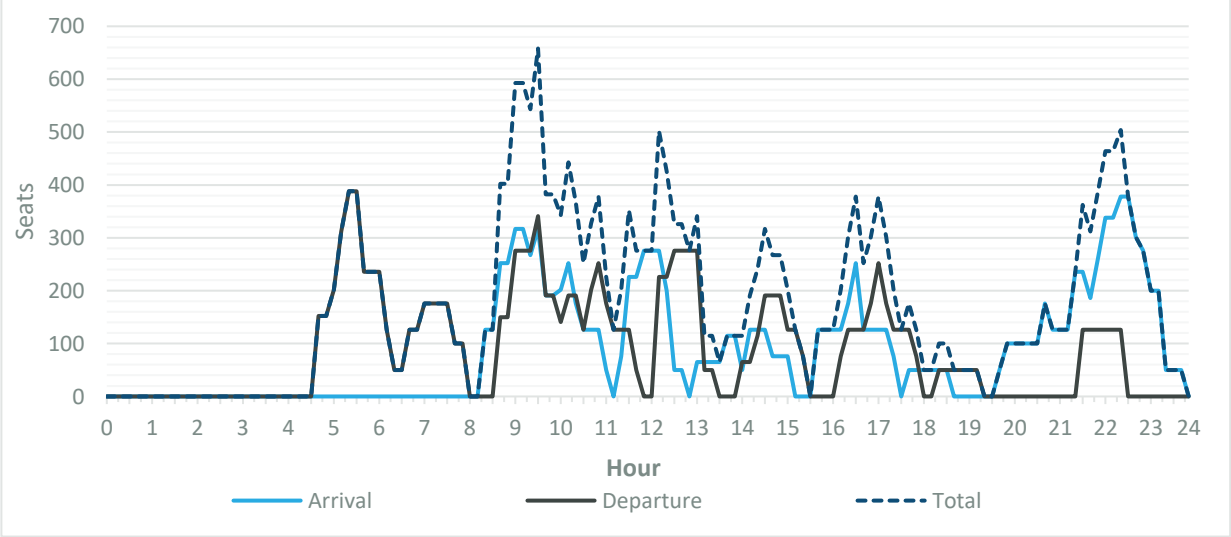
Once peak month enplanements were determined, the air carrier schedule from July 2021 was analyzed to determine how operations and seats were distributed according to the day of the week. By determining the average number of operations and seats per day of the week, a daily schedule then can be selected that closely matches the average to determine hourly trends. **Table 2-26** shows the average number of hourly seats for both arriving and departing was 2,026 while the average number of operations was 27. This closely matches the schedule for Wednesday of July 2021, which had 28 daily arrival and departure operations and 2,102 arriving and departing seats. Therefore, the air carrier schedule for this day can be examined to determine actual peak hour statistics.

Table 2-26 Peak Month Trends by Day (July 2021)

Day	Scheduled Seats		Scheduled Operations	
	Arrivals	Departures	Arrivals	Departures
Sunday	2,126	2,176	28	29
Monday	1,850	1,850	26	26
Tuesday	1,850	1,850	26	26
Wednesday	2,102	2,102	28	28
Thursday	2,252	2,252	29	29
Friday	1,850	1,850	26	26
Saturday	2,152	2,102	29	28
Average	**2,026**	**2,026**	**27**	**27**
Total	**14,182**	**14,182**	**192**	**192**

To determine the peak hour characteristics at FSD, it was assumed that passengers arrive one hour prior to departure and remain at the Airport up to 60 minutes after arrival. The 60-minutes period was selected as it allows time for departing passengers to check in and make their way through security and navigate to their gate and for arriving passengers to navigate the airport, collect their baggage, and find or coordinate transportation from the Airport. Each hour was divided into 10-minute periods to evaluate the total number of passengers at the Airport at a given time. On the day selected, a Wednesday in July 2021, different types of operations were represented. This includes the legacy carriers, such as Delta, United, and American, as well as some of the more intermittent weekly operations conducted by carriers such as Allegiant and Frontier. **Figure 2-11** shows the hourly seats and the full schedule used for this day is available in **Appendix H**.

Figure 2-11 Hourly Seats



Source: ACRP Report 25 Tool, Airport Records

The peak period for departing seats was found to be from 5:30 a.m. to 6:29 a.m., as five aircraft from the legacy carriers depart at the beginning of the day. Arriving seats peak at night from 10:30 p.m. to 11:29 p.m. as the final flights of the day arrive, also from legacy carriers. However, the total peak period does not occur at the extremes of the day but mid-morning, from 9:40 a.m. to 10:39 a.m. as multiple arrivals and departures are occurring within the same hour, from both legacy carriers and the intermittent carriers. During this time, a total of 658 seats are considered active. As the selected day of Wednesday during July 2021 had a total of 4,204 arriving and departing seats, this means that 15.7 percent of daily seats were active during the peak hour (**Table 2-27**).

Table 2-27 Forecasted Peak Month Seats

Seat Type	Peak Hour Time	Peak Hour Seats	Seats Daily Total	% of Daily
Peak Arriving Seats	10:30 p.m. – 11:29 p.m.	378	2,102	18.0%
Peak Departure Seats	5:30 a.m. – 6:29 a.m.	388	2,102	18.5%
Peak Combined Seats	9:40 a.m. – 10:39 a.m.	658	4,204	15.7%

It is assumed that the number of departing seats will be similar to the number of departing passengers. Therefore, as the percentage of departing seats has been determined, this percentage can then be applied to the future average day of the peak month enplanements to determine the number of anticipated departing passengers during future design days. This information is combined with the previously determined design periods and projected seats to determine the future peak hour in **Table 2-28**.

Table 2-28 Forecasted Peak Hour Enplanements

Year	Annual Enplanements	Peak Month	Average Day of Peak Month	Peak Hour % of Daily	Peak Hour Enplanements
2021	502,869	46,264	1,492	18.5%	276
2026	718,232	66,077	2,132	18.5%	394
2031	803,692	73,940	2,385	18.5%	441
2036	894,468	82,291	2,655	18.5%	491
2041	987,480	90,848	2,931	18.5%	542

2.5.2 Peak Hour Commercial Operations

One of the primary reasons to consider peak hour operations is that if multiple aircraft intend to use facilities simultaneously beyond its capacity, this can lead to congestion and delays. The focal point of peaking operations is the terminal area and its passenger boarding bridges. Currently, the Airport passenger terminal has seven gates. An analysis of the same Wednesday of July 2021 schedule referenced above can be used to determine the number of gates used at any one time. Similar to passengers, air carrier aircraft must take time to prepare after arrivals and before departures. This can include enplaning or deboarding passengers, cleaning the aircraft (which has grown more demanding since the enactment of COVID protocols), and aircraft fueling. During the Wednesdays of July 2021, the example average day of the peak month, 28 daily departures and 28

daily arrivals utilized the terminal. When the schedules are considered with the hours divided into 10-minute increments, the peak hour was determined to occur at 9:40 a.m. when all seven gates are utilized. The activity during that day can be seen in **Figure 2-12** and **Table 2-29**.

Figure 2-12 Hourly Operations

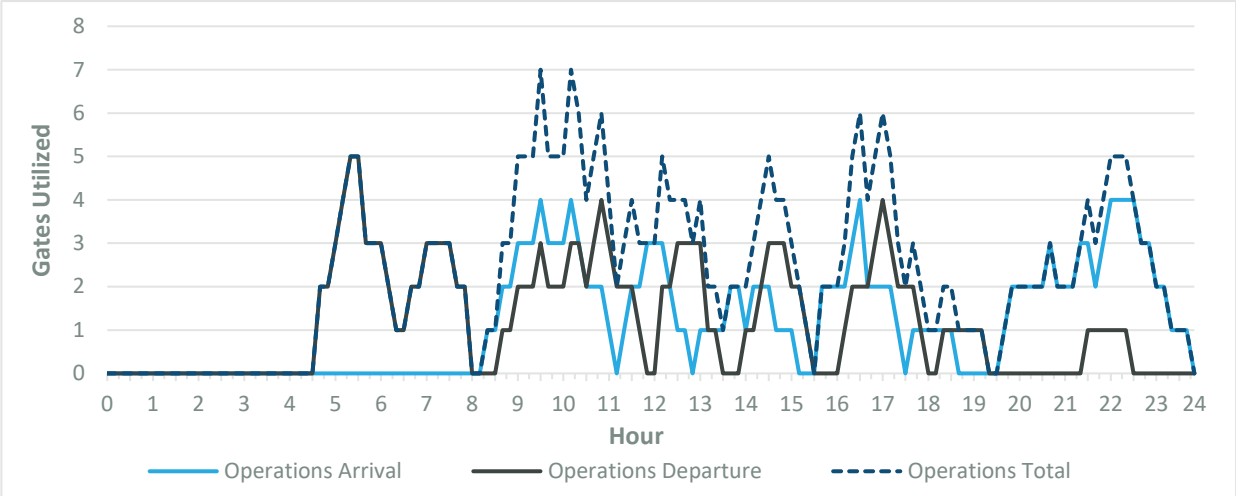


Table 2-29 Forecasted Peak Month Gate Utilization

Operation Type	Peak Hour Time	Peak Hour Operations	Operations Daily Total	% of Daily
Peak Arriving Terminal Aircraft	9:40 a.m. – 10:39 a.m.	4	28	14.3%
Peak Departure Terminal Aircraft	5:30 a.m. – 6:29 a.m.	5	28	17.9%
Peak Combined Terminal Aircraft	9:40 a.m. – 10:39 a.m.	7	56	12.5%

These percentages can then be applied to the commercial operations forecast developed in Section 2.2.3. To plan for terminal area needs, the intent is to identify any aircraft expected to use the terminal gates. Air carrier aircraft, as categorized by the FAA, are those that have more than 60 seats or weight greater than 18,000 pounds, for example, the Boeing 757-300, a large aircraft that operates at FSD, but only in a cargo role and not making use of the terminal. Similarly, air taxi aircraft are often small aircraft that may include business jets or smaller cargo aircraft. These aircraft will generally utilize private business hangars or the FBO instead of the terminal. With the focus being terminal utilization, the same peak month as the passenger enplanements has been used. This can then be divided by 31, as July has 31 days, and then the percentage of peak hour operations determined above can be applied. This process is shown in **Table 2-30** and projects a growth from the current seven aircraft to just over 10 aircraft simultaneously utilizing gates.

Table 2-30 Forecasted Peak Hour Gate Utilization

Year	Terminal Operations[1]	Peak Month	Average Day of Peak Month	Peak Hour % of Daily	Peak Hour Operations
2021	18,066	1,662	53.6	12.5%	6.7
2026	20,792	1,913	61.7	12.5%	7.7
2031	23,111	2,126	68.6	12.5%	8.6
2036	25,572	2,353	75.9	12.5%	9.5
2041	28,097	2,585	83.4	12.5%	10.4

Notes: Based on Air Carrier and Commuter Operations

2.6 Critical Aircraft

The design of facilities at an airport should accommodate the most demanding aircraft expected to use the facility (e.g., runway or taxiway) regularly. According to FAA Advisory Circular (AC) 150/5000-17, *Critical Aircraft and Regular Use Determination,* regular use is defined as 500 annual operations, including both itinerant and local operations, but not touch-and-go operations. In the AC, this aircraft is also referred to as the design aircraft, and it is crucial to identify it during the planning process. If no single aircraft is the most demanding aircraft, a grouping of aircraft with similar characteristics that make regular use of the airport can be used. Design aircraft within a specific grouping include those with comparable operational performance characteristics and/or physical dimensions. According to the AC, each runway should have its own, separate design aircraft determination.

Design aircraft are categorized according to Runway Design Code (RDC), which signifies the design standards to which a runway is to be built. The RDC is a combination of an Approach Aircraft Category (AAC), an Aircraft Design Group (ADG), and the approach visibility minimums of the runway in question. The AAC relates to aircraft approach speed, while ADG is based on aircraft wingspan and tail height. The AAC and ADG are based on the fastest and largest aircraft, respectively, that are expected to operate on the runway and adjacent taxiways on a regular basis (500 operations per year). **Table 2-31** defines AAC parameters, and **Table 2-32** defines ADG parameters. Visibility minimums are expressed by runway visual range (RVR) values in increments of 1,200, 1,600, 2,400, 4,000, and 5,000 feet.

Table 2-31 Aircraft Approach Category

AAC	Enplanements
A	Approach speed less than 91 knots
B	Approach speed 91 knots or more but less than 121 knots
C	Approach speed 121 knots or more but less than 141 knots
D	Approach speed 141 knots or more but less than 166 knots
E	Approach speed 166 knots or more

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

Table 2-32 Airplane Design Groups

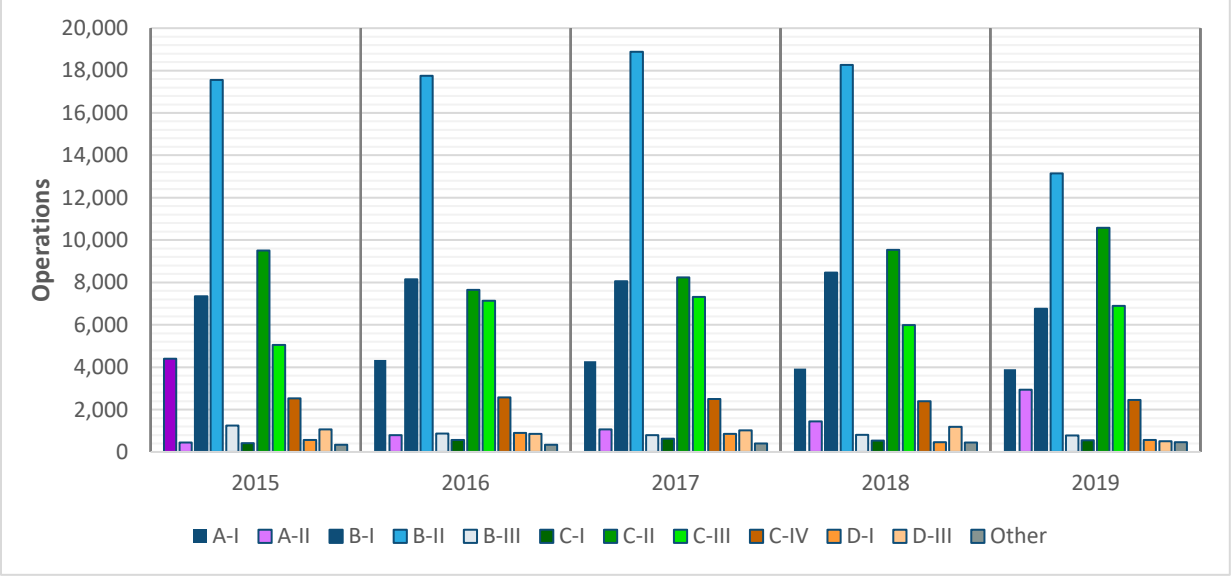
Group	Tail Height	Wingspan
I	Less than 20 feet	Less than 49 feet
II	20 feet to less than 30 feet	49 feet to less than 79 feet
III	30 feet to less than 45 feet	79 feet to less than 118 feet
IV	45 feet to less than 60 feet	118 feet to less than 171 feet
V	60 feet to less than 66 feet	171 feet to less than 214 feet
VI	66 feet to less than 80 feet	214 feet to less than 262 feet

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

2.6.1 Current Critical Aircraft

The TFMSC database can be assessed to pull many of the most demanding aircraft that operate at FSD. This database records instrument flight plans and shows both the AAC and ADG of the arriving aircraft. In **Figure 2-13** operations by aircraft are grouped by RDC from 2015 – 2019. The most demanding aircraft groups with a comparatively high number of operations include C-IV and D-III. The average number of operations with a RDC designation of a C-IV were 4,976 operations while D-III aircraft had 1,855 operations. Each of these groups surpass the 500 annual operations required to be considered the critical aircraft.

Figure 2-13: Aircraft Operations by Runway Design Code



Source: TFMSC Database

Aircraft with the D-III RDC designation include large narrowbody air carrier aircraft such as variants of the Boeing 737 and MD 80 series as well as some large business aircraft such as the Gulfstream G500. The C-IV aircraft also include large narrowbody aircraft such as the Boeing 757-200 and widebody aircraft such as the Airbus 300 and Boeing 767. Some military aircraft are also included in the C-IV group but are not an overwhelming presence. The aircraft in these two categories are shown below with the number of operations they have conducted in **Table 2-33**.

Table 2-33 Potential Critical Aircraft Fleet Mix

Aircraft	Wingspan	Height	Approach Speed	2015	2016	2017	2018	2019
RDC C-IV Aircraft								
Airbus A300 B4-600	147 feet	55 feet	137 knots	420	440	416	748	1,254
Airbus A310 All Series	144 feet	52 feet	139 knots	0	0	0	92	62
Boeing 757-200	135 feet	45 feet	137 knots	2,894	2,840	2,800	2,260	1,746
Boeing 757	125 feet	45 feet	137 knots	2	0	0	0	0
Boeing 767-300	156 feet	53 feet	140 knots	1,634	1,608	1,646	1,618	1,768
C-130 Hercules	133 feet	39 feet	130 knots	94	198	104	54	54
C-130J Hercules	133 feet	39 feet	130 knots	2	16	4	0	16
Boeing KC-135	131 feet	42 feet	128 knots[1]	20	44	14	8	6
Airbus A300 B4-600	147 feet	55 feet	137 knots	420	440	416	748	1,254
Airbus A310 All Series	144 feet	52 feet	139 knots	0	0	0	92	62
Boeing 757-200	135 feet	45 feet	137 knots	2,894	2,840	2,800	2,260	1,746
C-IV Aircraft Total Operations				**5,066**	**5,146**	**4,984**	**4,780**	**4,906**
RDC D-III Aircraft								
Boeing 737-800	113 feet	41 feet	142 knots	566	242	388	1,406	754
Boeing 737-900	113 feet	41 feet	141 knots	24	32	24	224	216
Gulfstream V/G500	93 feet	26 feet	125 knots	40	52	66	68	28
Gulfstream	55 feet	18 feet	130 knots	4	4	0	4	12
Boeing MD 83	108 feet	30 feet	144 knots	1,270	1,228	1,092	590	0
Boeing MD 88	108 feet	30 feet	144 knots	222	138	458	82	8
Boeing P-8 Poseidon	118 feet	41 feet	142 knots[2]	16	12	0	4	0
D-III Aircraft Total Operations				**2,142**	**1,708**	**2,028**	**2,378**	**1,018**

Notes: 1: These dimensions are based on the Boeing 707-320, a similar version of this aircraft in the civilian sector given more available information 2: Based on the Boeing 737-800 aircraft

Of these aircraft the most common aircraft in each category during 2019 are the Boeing 737-800 (D-III) and Boeing 767-300 (C-IV). As the most demanding characteristic can be taken from each family this means the Airport's RDC designation is D-IV. The critical aircraft designation is shown below with example aircraft in **Table 2-34**.

Table 2-34 Market Share Forecast

Aircraft	Runway Design Group	Taxiway Design Group	MTOW
Boing 737-800	D-III	3	174,200
Boeing 767-300	C-IV	5	350,000

Notes: MTOW: Maximum Takeoff Weight

2.6.2 Future Critical Aircraft

The existing critical aircraft has conducted an average of 1,655 operations annually over the past five years. The number of operations has remained similar over this duration, with a modest increase in 2019. Operations by large aircraft are expected to continue to increase as smaller aircraft phase out. In order for the RDC for the Airport to change from its current category, C-IV, to a more demanding one, a larger aircraft would need to frequent FSD. The types of aircraft that fall into a larger category, such as the Boeing 787 a C-V aircraft, are used most commonly on international flights or transcontinental domestic flights. Unless international operations are introduced at FSD, an increase in the current RDC is unlikely within the planning period. Therefore, D-IV is also selected as the future RDC designation. However, even if the RDC is not expected to increase, the number of operations by these aircraft is anticipated to grow.

2.7 Forecasts Summary and TAF Comparison

Finally, the FAA templates for summarizing and documenting airport planning forecasts, and for comparing forecasts with the FAA TAF, are presented in **Table 2-35** and **Table 2-36**. The forecasts presented in this chapter will be used in combination with findings in the first chapter to determine facility requirements at the Airport in Chapter 3.

Table 2-35: Template for Comparing Airport Planning and TAF Forecast

Activity	Year	Master Plan Forecast	TAF	MPF/TAF
Passenger Enplanements				
Base yr.	2021	506,211	385,593	31.3%
Base yr. + 5yrs.	2026	718,232	718,232	0.0%
Base yr. + 10yrs.	2031	803,692	803,692	0.0%
Base yr. + 15yrs.	2036	894,468	894,468	0.0%
Base yr. + 20yrs.	2041	987,480	987,480	0.0%
Commercial Operations				
Base yr.	2021	29,996	29,996	0.0%
Base yr. + 5yrs.	2026	37,532	37,532	0.0%
Base yr. + 10yrs.	2031	40,880	40,880	0.0%
Base yr. + 15yrs.	2036	44,433	44,433	0.0%
Base yr. + 20yrs.	2041	48,117	48,117	0.0%
Total Operations				
Base yr.	2021	61,628	59,860	3.0%
Base yr. + 5yrs.	2026	70,310	70,641	-0.5%
Base yr. + 10yrs.	2031	74,854	74,708	0.2%
Base yr. + 15yrs.	2036	79,653	79,004	0.8%
Base yr. + 20yrs.	2041	84,637	83,456	1.4%

Table 2-36: Template for Summarizing and Documenting Airport Planning Forecasts	2021	2026	2031	2036	2041	Base Yr. to +5	Base Yr. to +10	Base Yr. to +15	Base Yr. to +20
Passenger Enplanements									
TOTAL	506,211	718,232	803,692	894,468	987,480	*7.25%*	*4.73%*	*3.87%*	*3.40%*
Operations									
Itinerant									
Air carrier	12,294	20,526	22,915	25,456	28,071	*10.80%*	*6.42%*	*4.97%*	*4.21%*
Commuter/air taxi	17,702	17,006	17,965	18,977	20,046	*-0.80%*	*0.15%*	*0.46%*	*0.62%*
Total Commercial	29,996	37,532	40,880	44,433	48,117	*4.58%*	*3.14%*	*2.65%*	*2.39%*
General aviation	21,790	22,705	23,659	24,654	25,691	*0.83%*	*0.83%*	*0.83%*	*0.83%*
Military	3,076	3,076	3,076	3,076	3,076	*0.00%*	*0.00%*	*0.00%*	*0.00%*
Local									
General aviation	5,516	5,747	5,989	6,241	6,503	*0.83%*	*0.83%*	*0.83%*	*0.83%*
Military	1,250	1,250	1,250	1,250	1,250	*0.00%*	*0.00%*	*0.00%*	*0.00%*
TOTAL OPERATIONS	61,628	70,310	74,854	79,653	84,637	*2.67%*	*1.96%*	*1.73%*	*1.60%*
Peak Hour									
Terminal Operations	7	8	9	10	10	*2.82%*	*2.53%*	*2.36%*	*2.22%*
Enplanements	276	394	441	491	542	*7.38%*	*4.80%*	*3.91%*	*3.43%*
Based Aircraft									
Single Engine (Nonjet)	55	56	57	62	65	*0.36%*	*0.36%*	*0.80%*	*0.84%*
Multi Engine (Nonjet)	34	36	40	43	49	*1.15%*	*1.64%*	*1.58%*	*1.84%*
Jet Engine	4	10	14	16	18	*20.11%*	*13.35%*	*9.68%*	*7.81%*
Helicopter	0	0	0	0	0	-	-	-	-
Other	18	18	18	18	18	*0.00%*	*0.00%*	*0.00%*	*0.00%*
TOTAL	111	120	129	139	150	*1.57%*	*1.51%*	*1.51%*	*1.52%*