Chapter 3 – Aviation Activity Forecasts

The overall goal of aviation activity forecasting is to prepare forecasts that accurately reflect current conditions, relevant historic trends, and provide reasonable projections of future activity that can be translated into specific airport facility needs anticipated during the next twenty years and beyond.

Introduction

This chapter provides updated aviation activity forecasts for Ephrata Municipal Airport (EPH) for the twenty-year master plan horizon (2016-2036). The most recent Federal Aviation Administration (FAA) approved aviation activity forecasts for EPH were developed in the 2004 Airport Master Plan update.

The forecasts presented in this chapter are consistent with current and historic role as a community general aviation airport. EPH is capable of accommodating a full range of general aviation activity, including business class turboprops and business jets. This level of capability expands the airport's role beyond the local Ephrata community and accommodates users throughout the region.

The forecasts of activity are unconstrained and assume the Port of Ephrata will be able to make the facility improvements necessary to accommodate the anticipated demand unless specifically noted. The Port of Ephrata will consider if any unconstrained demand will not or cannot be reasonably met through the evaluation of airport development alternatives later in the master plan.

The airport master plan forecasting process for general aviation airports as defined by the FAA, addresses elements critical to airport planning by focusing on two key activity segments: based aircraft and aircraft operations (takeoffs & landings). Detailed breakdowns of these activity segments include aircraft fleet mix, peak period activity, distribution of local and itinerant operations, and the determination of the critical aircraft, also referred to as the design aircraft.

The design aircraft represents the most demanding aircraft type or family of aircraft that uses an airport on a regular basis (a minimum of 500 annual takeoffs & landings). The existing and future design aircraft are used to establish a variety of FAA design standards for airfield facilities used in master planning. FAA airport design standards are organized into groupings reflecting the physical requirements of specific aircraft types. The activity forecasts also provide consistency in evaluating future demand-based facility requirements such as runway and taxiway capacity, aircraft parking, and hangar capacity.

Forecast Process

The FAA provides aviation activity forecasting guidance for airport master planning projects. FAA Advisory Circular (AC) 150/5070-6B, Airport Master Plans, outlines seven standard steps involved in the forecast process:

1) **Identify Aviation Activity Measures**: The level and type of aviation activities likely to impact facility needs. For general aviation, this typically includes based aircraft and operations.
2) **Previous Airport Forecasts**: May include the FAA Terminal Area Forecast (TAF), state or regional system plans, and previous master plans.
3) **Gather Data**: Determine what data are required to prepare the forecasts, identify data sources, and collect historical and forecast data.
4) **Select Forecast Methods**: There are several appropriate methodologies and techniques available, including regression analysis, trend analysis, market share or ratio analysis, exponential smoothing, econometric modeling, comparison with other airports, survey techniques, cohort analysis, choice and distribution models, range projections, and professional judgment.
5) **Apply Forecast Methods and Evaluate Results**: Prepare the actual forecasts and evaluate for reasonableness.
6) **Summarize and Document Results**: Provide supporting text and tables as necessary.
7) **Compare Forecast Results with FAA's TAF**: Follow guidance in FAA Order 5090.3C, Field Formulation of the National Plan of Integrated Airport Systems. In part, the Order indicates that forecasts should not vary significantly (more than 10 percent) from the TAF. When there is a greater than 10 percent variance, supporting documentation should be supplied to the FAA. The aviation demand forecasts are then submitted to the FAA for their approval.

Airport Service Area

The airport service area refers to the geographic area surrounding an airport that generates most "local" activity. A 30- or 60-minute surface travel time is typically used to approximate the boundaries of a service area for a specific general aviation airport. The population and economic characteristics of the airport service area and capabilities of competing airports within an airport's service area are important factors in defining locally generated demand for aviation facilities and services. Each or all of these can influence the airport's ability to attract transient aircraft activity.

In contrast, the service area for commercial airports often extends beyond a two-hour drive time due to the relatively small number of airports with scheduled airline service. Ephrata is located within the service areas (approximately a two-hour drive time) defined for three commercial airports: Pangborn Municipal Airport, Spokane International Airport, and Tri Cities Airport. Seattle-Tacoma International Airport is approximately a three-hour drive, but still attracts passengers from further distances since it is the largest airport in Washington, and offers international flights.

Figure 3-1 illustrates the approximate service area boundaries for EPH. Airports located beyond the service area typically have less impact on local airport activity due to the additional time required to reach those facilities. If numerous airports are located nearby, service areas often overlap. Overlapping service areas create competition between airports for items such as hangar facilities, aircraft maintenance, and aviation services such as avionics repair, aircraft painting, etc. These items are sensitive to cost, convenience and quality of facilities or services for both locally based and transient users.

A unique feature of the local airport service area is the presence of large flight training practice areas south and east of EPH. The practice areas are used by Big Bend Community College (BBBC) Aviation, which is based at Grant County International Airport (MWH) in Moses Lake (10 nautical miles southeast). BBCC flight training has accounted for a significant portion of aircraft operations at EPH since the beginning its flight training program in 1965. The close proximity of EPH and MWH provides convenient access to a facility that is ideal for flight training in a non-towered, uncongested airport environment. The Ephrata VORTAC, located 5.6 miles northeast of EPH and 11 miles northwest of MHW also supports instrument flight training in the region, which includes practice approaches to EPH. EPH accommodates a variety of flight training including pattern work (touch and goes, stop and go landings, etc.), crosswind, instrument, and nighttime flight training. Although BBCC does not base any of its flight training fleet (currently 26 aircraft) at EPH, it generates the largest volume of flight activity at the airport. The updated activity estimate prepared for this chapter estimates that BBCC accounted for approximately 52 percent of aircraft operations at EPH in 2016.

Table 3-1 lists the publicly owned, public use airports within a 50 nautical mile (air miles) radius of Ephrata. Ephrata Municipal Airport, Grant County International Airport, and Grand Coulee Dam Airport are the FAA funded airports (National Plan of Integrated Airport Systems – NPIAS) located in Grant County, and all are within the approximate 50 nautical mile service area boundary. The nearest airport providing passenger air service is Pangborn Memorial Airport in Wenatchee.

AIRPORT SERVICE AREA
FIGURE 3-1

EPHRATA MUNICIPAL AIRPORT
AIRPORT MASTER PLAN

CENTURY WEST ENGINEERING

TABLE 3-1: PUBLIC USE AIRPORTS IN VICINITY OF EPHRATA *(WITHIN 50 NAUTICAL MILES)*

AIRPORT	LOCATION	RUNWAY LENGTH(S) (FEET)	SURFACE	LIGHTED RUNWAY?	FUEL AVAILABLE?
Ephrata Municipal Airport	Ephrata	5,500 3,843 3,467	Asphalt	Yes Yes No	Yes
Grand Coulee Dam Airport	Grand Coulee	4,199	Asphalt	Yes	No
Grant County International Airport	Moses Lake	13,503 4 additional runways 2,936 to 10,000	Asphalt & Concrete	Yes	Yes
Mansfield Airport	Mansfield	2,575	Asphalt	Yes	No
Moses Lake Municipal Airport	Moses Lake	2,513	Asphalt	Yes	No
Odessa Municipal Airport	Odessa	3,125	Asphalt	Yes	No
Othello Municipal Airport	Othello	4,000	Asphalt	Yes	Yes
Pangborn Memorial Airport	Wenatchee	5,700 4,460	Asphalt	Yes	Yes
Quincy Municipal Airport	Quincy	3,660	Asphalt	Yes	No
Warden Airport	Warden	2,811	Asphalt	Yes	No
Wilson Creek Airport	Wilson Creek	2,500	Asphalt	No	No

Socioeconomic Trends and Forecasts

AREA ECONOMY

Historically, downturns in general aviation activity often occur during periods of weak economic conditions while growth typically coincides with favorable economic conditions. The recent economic recession and the slow recovery that followed, has constrained general aviation activity locally, statewide, and throughout the national airport system. However, the FAA's national long-term aviation forecasts[1] reflect overall strength in both the U.S. and regional economies. This forecast economic strength is expected to sustain modest growth in aviation activity over the long-term.

[1] FAA Aerospace Forecast (Fiscal Years 2016-2036)

The local and regional economy of Grant County has historically been led by agriculture, government, and manufacturing. These core sectors will continue to be leading employers in the region and provide opportunities for local businesses to expand into a variety of value added products and services.

The U.S. Bureau of Labor Statistics "Quarterly Census of Employment and Wage" (QCEW) 2015 data[2] was reviewed for Grant County to identify leading employment sectors and average annual wages as an indicator of current conditions in the local economy. **Table 3-2** and **Table 3-3** summarize the published data.

TABLE 3-2: TOP FIVE EMPLOYMENT SECTORS IN GRANT COUNTY (2015)

SECTOR	NUMBER OF JOBS	SHARE OF EMPLOYMENT
1. Agriculture, forestry and fishing	10,512	27.0%
2. Local government	6,509	16.7%
3. Manufacturing	5,085	13.0%
4. Retail trade	3,285	8.4%
5. Health Services	2,572	6.6%
All other industries	11,016	28.3%
Total covered payrolls	**38,979**	**100%**

TABLE 3-3: LEADING EMPLOYMENT SECTORS AND PAYROLLS IN GRANT COUNTY (2015)

SECTOR	TOTAL SECTOR PAYROLL	SHARE OF PAYROLL	AVERAGE ANNUAL SALARY
1. Local government	$319,568,967	22.0%	$49,096
2. Agriculture, forestry, and fishing	$271,388,860	18.7%	$25,817
3. Manufacturing	$256,788,694	17.7%	$50,499
4. Health Services	$90,340,927	6.2%	$35,124
5. Retail trade	$89,690,786	6.2%	$27,303
All other industries	$427,042,303	29.4%	$38,756
Total covered payroll (2015)	**$1,454,820,537**	**100%**	**$37,323**

It is noted that many of the employment sectors in Grant County are characterized by seasonal fluctuations in employment and modest wages. These factors contribute to lower average annual wages for Grant County compared to the statewide average. In 2015 the average income among all industry segments in Grant County was $37,323, which was approximately 65.9 percent of Washington's $56,642.

[2] Grant County Profile (updated October 2016). Don Meseck, Regional Labor Economist, WA Employment Security Department

The average unemployment rate for Grant County in 2015 was 7.1 percent, which was approximately 1.4 percentage points higher than the average statewide rate of 5.7%.[3] The December 2016 unemployment rate for Grant County was 9.7%, compared to the statewide average of 5.9 percent, which reflects some of the local employment seasonality noted earlier.

POPULATION

The population within an airport's service area, in broad terms, affects the type and scale of aviation facilities and services that can be supported. Although a large number of airport-specific factors can affect activities at an airport, changes in population often reflect other broader economic conditions that may also affect airport activity. The airport service area for EPH includes the City of Ephrata and Grant County. Although EPH is located in Ephrata, changes in population within the overall county may also impact activity at the airport.

HISTORIC POPULATION

Certified estimates of population for Washington counties and incorporated cities are developed annually by the state Office of Financial Management (OFM). The annual OFM estimates, coupled with the decennial U.S. Census, conducted every ten years, provide an indication of local area population trends over an extended period.

The April 1, 2016 OFM population estimate for Grant County was 94,610; the City of Ephrata (incorporated area only) population was estimated at 8,020. Historic population data and average growth rates for Grant County, the City of Ephrata, and Washington are summarized in **Table 3-4**. Population growth in Grant County outpaced Ephrata's in the 1990-2016 time frame, although both local and county growth are indicators of underlying economic growth.

[3] Washington State Employment Security Department, Labor Market and Economic Analysis Branch. 2-15 Annual Average Washington State Civilian Labor Force and Employment, April 11, 2016.

TABLE 3-4: HISTORIC POPULATION DATA

YEAR	GRANT COUNTY	CITY OF EPHRATA (INCORPORATED AREA ONLY)	EPHRATA SHARE (%) OF GRANT COUNTY POPULATION	WASHINGTON
1990[1]	54,798	5,349	9.8%	4,866,699
2000[1]	74,698	6,808	9.1%	5,894,281
2010[1]	89,120	7,664	8.6%	6,724,540
2015[2]	93,930	7,985	8.5%	7,061,410
2016[2]	94,610	8,020	8.5%	7,183,700
Average Annual Rates (AAR) of Growth (%)				
	GRANT COUNTY	CITY OF EPHRATA		WASHINGTON
1990-2000	3.15%	2.44%		1.9%
2000-2010	1.78%	1.19%		1.3%
2000-2016	1.49%	1.03%		1.2%
2010-2016	1.00%	0.76%		1.1%

Sources: 1. U.S. Census data 2. Office of Financial Management (OFM) annual estimates.

POPULATION FORECASTS

Office of Financial Management (OFM)

Long-term population forecasts for Grant County are prepared by the state Office of Financial Management (OFM) to support for counties planning under the Washington Growth Management Act (GMA). The forecasts are presented in three scenarios (Low, Medium, High), which are designed to provide "a reasonable range of possible population growth." The current OFM forecasts (2010-2040) were released in May 2012. For Grant County, the average annual growth rates in the three OFM scenarios range from approximately 0.8 to 2.2 percent. The OFM 2010-2040 Forecasts for Grant County and Washington State are summarized in **Table 3-5**.

TABLE 3-5: OFM POPULATION FORECASTS

	2010 US CENSUS	2015	2020	2025	2030	2035	2040
GRANT COUNTY							
OFM High Forecast *(2.15% AAR 2015-2040)*	89,120	101,720	114,890	128,250	141,846	155,335	168,812
OFM Medium Forecast[2] *(1.48% AAR 2015-2040)*	89,120	95,822	104,078	112,525	121,204	129,779	138,337
OFM Low Forecast *(.80% AAR 2015-2040)*	89,120	90,398	94,134	98,061	102,220	106,275	110,313
WASHINGTON							
OFM Medium Forecast *(.93% AAR, 2010-2040)*	6,724,540	7,022,200	7,411,977	7,793,173	8,154,193	8,483,628	8,790,981

Grant County Coordinated Population Forecast

The current comprehensive plans for Grant County and the City of Ephrata were prepared in the mid-2000s. Both jurisdictions are required to complete their periodic review and comprehensive plan updates by June 30, 2018. Based on the comprehensive plan update calendar, the locally-adopted forecasts of population used in this evaluation are more than 10 years old.

Grant County's 2006 County Comprehensive Plan update includes an evaluation of future population and employment, including allocations within the county. The analysis of forecast population was based on OFM's 2002 forecast for Grant County that extends from 2005 to 2025. The comprehensive plan utilized the "OFM High" forecast scenario (1.5 percent annual growth) as the preferred population forecast for Grant County. Allocations of the projected population were then assigned to sixteen urban growth areas in the county, with annual growth rates ranging from 0 to 5 percent annually through 2025. A 2 percent annual growth rate was selected for Ephrata. The City of Ephrata updated its comprehensive plan in 2007, utilizing the population forecast adopted by Grant County in 2006.

Table 3-6 summarizes the 2006 Comprehensive Plan forecast for Grant County and the 2007 Comprehensive Plan forecast for City of Ephrata.

TABLE 3-6: 2006 GRANT COUNT/2007 CITY OF EPHRATA COMPREHENSIVE PLAN POPULATION FORECASTS

	2000 ACTUAL	2005	2010	2015	2020	2025
GRANT COUNTY						
OFM High Forecast[1] *(1.5% AAR 2000-2025)*	74,698	87,238	96,502	104,523	111,029	117,459
EPHRATA (URBAN GROWTH AREA)						
City of Ephrata Comprehensive Plan 3% Forecast[3]	6,808[2]	7,731[3]	8,962[3]	10,390[3]	12,046[3]	13,964[3]

1. Table 3-10 OFM Population Forecasts for Grant County, Grant County Comprehensive Plan, 2006
2. Table 3-11 Population Projection and Distribution, Grant County Comprehensive Plan, 2006
3. City of Ephrata Comprehensive Plan, 3% Population Forecast (2007 Update, Page 10)

It is noted that the OFM forecasts used in the local comprehensive plans have been updated, and may be updated again before periodic review of the comprehensive plans is completed in 2018. For comparison, the 2002 OFM "High" forecast selected by Grant County and the updated 2012 version of the same forecast scenario are summarized in **Table 3-7**. The more recent OFM forecast utilized the 2010 Census as its base year population, projected slower growth between 2010 and 2015, and faster than previously forecast growth through 2040.

It is recognized that the existing comprehensive plan forecasts will be revised to reflect the OFM forecasts available at the time of the comprehensive plan update. However, to maintain consistency with current planning, the airport master plan will utilize the locally-adopted comprehensive plan forecasts in its population-based analyses.

TABLE 3-7: COMPARISION OF 2006 AND 2012 OFM "HIGH" POPULATION FORECASTS (GRANT COUNTY)

	2000	2005	2010	2015	2020	2025	2030	2035	2040
2002 OFM High Forecast[1] *(1.5% AAR 2000-2025)*	74,698	87,238	96,502	104,523	111,029	117,459	--	--	--
2012 OFM High Forecast[2] *(2.15% AAR 2010-2040)*	--	--	89,120[3]	101,720	114,891	128,253	141,847	155,337	168,810
Net Change	--	--	-7,382 (-7.7%)	-2,803 (-2.7%)	3,862 (+3.5%)	10,794 (+9.2%)	--	--	--

1. Current Locally-Adopted Comprehensive Plan Population Forecasts for Grant County
2. 2000 U.S. Census
3. Current OFM Long Term Forecast (High Scenario)
4. 2010 U.S. Census

National General Aviation Activity Trends

The early years of the 21st Century have presented numerous challenges for general aviation (GA). On a national level, most measures of GA activity declined sharply during "The Great Recession" and have only recently started to show modest signs of improvement.

In addition to the broad economic effects of the recession, general aviation has also experienced several other market pressures that have depressed activity. Chief among these have been the rising price and impending regulatory restriction of leaded aviation gasoline (AVGAS). After several years of evaluation and industry testing, the FAA is now moving into the final phase of testing that is expected to eventually result in a selected replacement unleaded fuel grade. The primary goal of developing a new blend of unleaded AVGAS is to comply with the Clean Air Act. The anticipated phase out of leaded aviation fuels is similar to the transition to unleaded automobile gasoline that occurred in the 1970s, albeit far more complicated based on the unique requirements of aircraft engines.

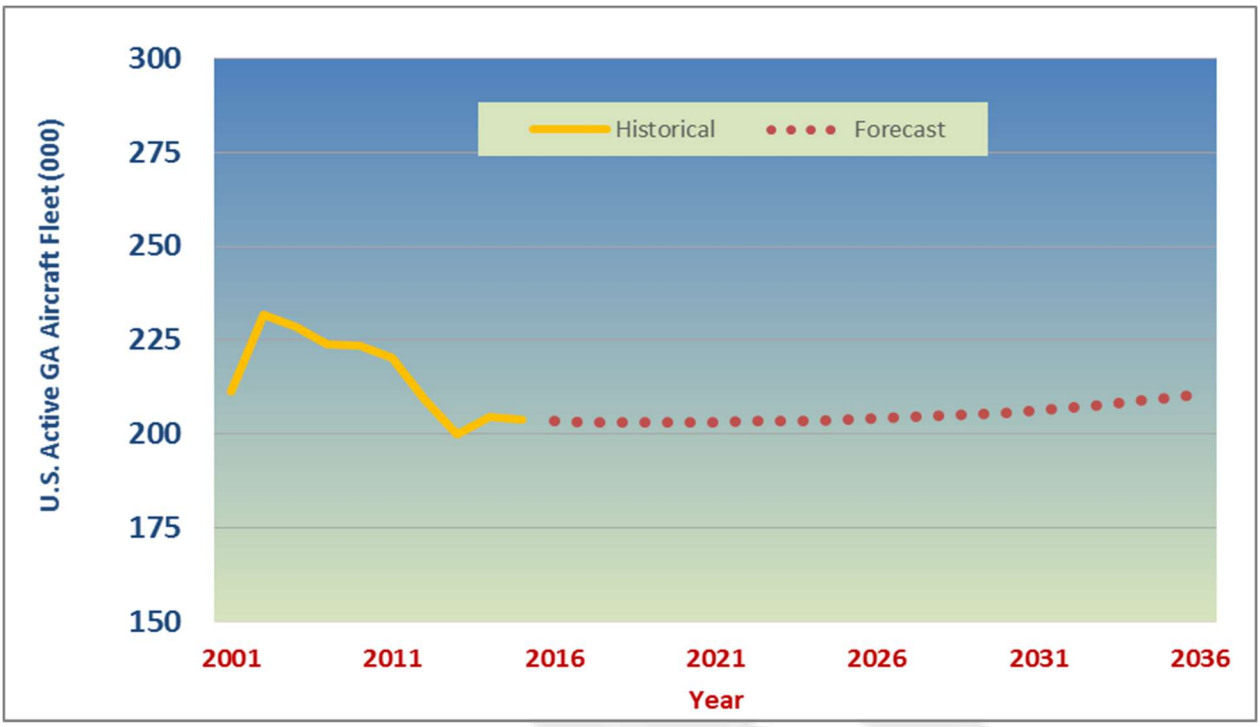
In 2015, the FAA estimated that 208 million gallons of AVGAS were consumed in the U.S., compared to 1.47 billion gallons of jet fuel (general aviation only). Based on FAA long-term forecasts, the piston general aviation fleet is expected to shrink by approximately 12 percent over the next twenty years, although AVGAS consumption is forecast to remain within 1 percent (+/-) of current levels during that period. By comparison, general aviation jet fuel consumption and the turbine fleet are forecast to increase by 54 percent during the same period.

With AVGAS consumption expected to remain at current levels for the foreseeable future, it is reasonable to conclude that the segments of piston-related aviation activity expected to grow, such as flight training, will consume an increasingly larger share of AVGAS within the current twenty-year planning period. Less active segments of piston activity will consume an increasingly smaller share of AVGAS. This trend would be expected to impact utilization levels (annual flight hours) differently for flight training and non-flight training piston aircraft. The anticipated system wide growth in several turbine-related activity segments provides a reasonable basis to assume that the conditions exist for turboprop, business jet, helicopter, and aerial applicator traffic to increase at airports that have historically accommodated these aircraft types.

As depicted in **Figure 3-2**, the active GA fleet has fluctuated within an overall decline over the last 15 years. The FAA's long-term forecasts predict the U.S. active GA aircraft fleet will grow by approximately 3 percent between 2015 and 2036, but will remain below recent peak levels.[4]

[4] FAA Aerospace Forecast Fiscal Years 2016-2036

FIGURE 3-2: US ACTIVE GENERAL AVIATION FLEET



Although the FAA maintains a modestly favorable long-term outlook, many of the activity segments associated with piston engine aircraft and AVGAS consumption are not projected to return to "pre-recession" levels by 2036. While some segments of general aviation are expected to grow at moderately high rates, most measures of the general aviation industry suggest modest, sustained growth above current levels is expected over the next twenty years. The FAA's annual growth assumptions for individual general aviation activity segments are summarized in **Table 3-8**.

TABLE 3-8: FAA LONG RANGE FORECAST ASSUMPTIONS (U.S. GENERAL AVIATION)

ACTIVITY COMPONENT	FORECAST ANNUAL AVERAGE GROWTH RATE (2015-2036)
Aircraft in U.S. Fleet	
Single Engine Piston Aircraft in U.S. Fleet	-0.7%
Multi-Engine Piston Aircraft in U.S. Fleet	-0.5%
Turboprop Aircraft in U.S. Fleet	1.3%
Turbojet Aircraft in U.S. Fleet	2.5%
Experimental Aircraft in U.S. Fleet	0.9%
Sport Aircraft in U.S. Fleet	4.5%
Piston Helicopters in U.S. Fleet	2.1%
Turbine Helicopters in U.S. Fleet	2.0%
Active GA Fleet (# of Aircraft)	0.2%
Active Pilots in U.S.	
Private Pilots	-0.6%
Commercial Pilots	-0.6%
Airline Transport Pilots	0.4%
Instrument Rated Pilots	0.1%
Sport Pilots	4.8%
Student Pilots (Indicator of flight training activity)	0.3%
Active GA Pilots (All Ratings)	0.1%
Hours Flown in U.S.	
Piston AC	-0.5%
Turbine AC	2.5%
Experimental AC	1.9%
Sport AC	5.0%
Total GA Fleet Hours	1.2%
Fuel Consumption in U.S.	
AVGAS (Gallons consumed - GA only)	0.0%
Jet Fuel (Gallons consumed – GA only)	2.1%

Source: FAA Long Range Aerospace Forecasts (FY 2016-2036)

The long-term expectations for general aviation now reflect focused opportunities for growth (flight training, sport aircraft use, business aviation, etc.) that are consistent with changing macroeconomic conditions and the more specific economic challenges associated with private aircraft ownership, rather than the broad and robust growth experienced during its formative years. Many of the traditional activity sectors associated with general aviation (single-engine and piston engine aircraft ownership, active private pilots, aircraft utilization, etc.) are expected to decline by 10 to 15 percent over the next twenty years—largely as the active aircraft fleet shrinks and the pilot population ages.

It is noted that within the overall forecast growth from 2015 to 2036, several segments are projected to decline in actual numbers including single engine piston aircraft (-14%) and multi-engine piston aircraft (-11%). These declines reflect attrition of an aging fleet, which is not being offset by new aircraft production. Encouraging areas within the GA fleet are found in turboprops (+32%), experimental aircraft (+20%), sport aircraft (+153%), and business jets (+66%) growth through 2036.

Aircraft manufacturing has shown generally positive results in the years following the end of the Great Recession. Production levels have fluctuated from year to year, although worldwide annual deliveries have largely remained above 3,000 units since 2011. The current market appears to reflect a heightened degree of uncertainty which has led to reduced demand for general aviation aircraft. The preliminary GAMA delivery data for 2016 (3,102 units) indicates three consecutive years of decline, with current levels approximately 15 percent below the recent peak of 3,664 units in 2013.[5]

The adaptation of both turbine and diesel engines for small general aviation aircraft by several established manufacturers; the development of a replacement for 100LL AVGAS; and the resurgence of unleaded automobile gasoline for a growing Light Sport Aircraft (LSA) and experimental aircraft fleet are positive developments that are expected to be significant in the long-term future of general aviation.

Historical & Current Aviation Activity

Aircraft operational data for EPH (takeoffs and landings, touch and go landings, etc.) are limited to estimates. As a non-towered airport, no records of operational activity are maintained. Airport-specific data including aviation fuel deliveries, instrument flight plan filings, and periodic based aircraft counts by airport management are used to supplement existing estimates, when available.

The primary measures of historical and forecast activity (based aircraft and aircraft takeoffs and landings/operations) are captured in state aviation system plans, airport master plans, and the FAA Terminal Area Forecast (TAF).

For the purposes of preparing updated aviation activity forecasts for the airport master plan, existing activity forecasts were reviewed, including the 2004 Ephrata Municipal Airport Master Plan update, the 2007 WSDOT

[5] General Aviation Manufacturers Association (GAMA), 2016 Preliminary Delivery Data; GAMA Annual Delivery Reports.

Aviation Long Term Air Transportation Study (LATS), and the FAA TAF. This review revealed significant inconsistencies that raised questions about the reliability of available data and forecasts.

Additional research was performed in an attempt to identify the primary deviations in data and their sources. Based on this review, it was determined that none of the recent estimates of activity for EPH, or the associated forecasts, accurately reflect current activity at EPH.

- The 2004 Airport Master Plan used a base year of 2001 with 89 based aircraft and 130,780 aircraft operations. The master plan cited information provided by Big Bend Community College (BBCC) (letter dated January 17, 2002), that estimated its annual activity at EPH to be 60,000 landings (120,000 operations). This activity accounted for the majority of the 130,780 operations estimated for 2001 and for all subsequent forecast years. The master plan projected based aircraft to increase from 89 to 102, and annual aircraft operations to increase from 130,780 to 149,110 between 2001 and 2021.

- The FAA Terminal Area Forecast (TAF) historical data for EPH also lists 89 based aircraft and 130,780 aircraft operations for 2001. Based on the sequence of events, it appears that the TAF was updated to reflect the updated master plan forecasts noted above. The TAF projects aircraft operations at EPH to increase from 130,780 to 204,888 between 2001 and 2045. The TAF based aircraft historical data and forecasts are more difficult to follow. The 2001 based aircraft numbers initially matched the master plan numbers, but then deviated significantly, including a change in the 2017 TAF update that reduced 2015's total by more than 60 percent (77 to 30), compared to the previous year (2014). The updated TAF based aircraft total does not correspond to either the FAA 5010-1 Airport Record Form or the current listing in the FAA based aircraft database (www.basedaircraft.com). The TAF projects an increase to 32 based aircraft in 2023, which then remains unchanged through 2045.

- The 2007 LATS forecast used a 2005 base year with 87 based aircraft and 30,450 aircraft operations. The LATS based aircraft forecast projects an increase from 87 to 184 between 2005 and 2030. Aircraft operations were forecast to increase from 30,450 to 64,400 between 2005 and 2030. Both forecasts deviate significantly from the current estimate of based aircraft and aircraft operations detailed later in the chapter.

Conclusion

The airport activity data contained in the three existing forecasts are greatly overstated. The similarity in data and the chronology of the source documents does not appear coincidental, suggesting a high degree of interdependence.

During our assessment of current airport activity, described in the following section, representatives from BBCC provided an updated estimate of their flight training activity at EPH. BBCC estimates their current level of flight training activity at 12,000 annual operations. They also indicate that this level has remained relatively stable in recent years and is expected to continue at similar levels for the foreseeable future.

Our conclusion is that each of the three forecasts relied on common or similar baseline data that was incorrectly estimated, then reused without significant revision. As a result, all of the activity projections were compromised and do not provide a reliable indication of activity at EPH, nor do they allow for a reliable analysis of historical or future trends.

For this reason, the existing TAF, LATS and 2004 master plan forecasts are deemed unreliable and will not be referenced further in the evaluation. The TAF and LATS forecasts should be updated at the next opportunity upon FAA acceptance of the updated airport master plan forecasts. The FAA will be required to document and adjust the anomaly appearing in the current TAF for both the current base year and all subsequent forecast years as part of its review and approval of the master plan forecasts.

CURRENT ESTIMATES OF ACTIVITY

Due to the absence of reliable historical airport activity data and aviation activity forecasts for EPH, new based aircraft and aircraft operations estimates will be used to support the updated airport master plan forecasts. As noted earlier, inadequate documentation of historical trends will require a true "snapshot in time" approach that relies heavily on the current estimates. Forecasts will be developed that build on the current estimates with scenarios that maintain, decrease, and increase activity compared to current levels. Although this forecasting approach is not highly scientific, the absence of data does not support more sophisticated forecasting analyses. However, the updated forecasts will provide reasonable projections extending from current data that will be adequate to define future airport facility needs.

Based Aircraft

EPH's 2016 based aircraft count in the FAA's www.basedaircraft.com database provides a higher level of accuracy than reflected in the other sources identified above. Although airports may find a small number of inaccurate database entries when a detailed inventory and verification of aircraft N numbers is conducted, the database generally provides a reasonable gauge of activity that is regularly reviewed by airport management. For planning purposes, the 2016 "validated" based aircraft count submitted to FAA by airport management, will serve as the established baseline for developing new based aircraft forecasts for the master plan. In October 2016, there were 53 total verified based aircraft at EPH.

The based aircraft fleet mix includes primarily single-engine piston aircraft and gliders, with a small number of multi-engine piston and turbine airplanes. The current based aircraft fleet is summarized in **Table 3-9**.

TABLE 3-9: EPH BASED AIRCRAFT (OCTOBER 2016)

AIRCRAFT TYPE	TOTAL
Single-Engine Piston	23
Multi-Engine Piston	2
Turboprop	2
Turbojet	0
Rotorcraft	0
Glider	26
Total Based Aircraft	**53**

Aircraft Operations

In order to develop a valid estimate of current activity from which to develop new forecasts, the planning team worked with airport management to identify the major users of the airport. Contacts were made with each of these groups to estimate current activity. Each segment of activity was reviewed by airport management and the planning team to verify an acceptable level of approximation. The primary airport user group segments operating at EPH in 2016 included:

- Big Bend Community College (BBCC) Aviation (flight training);
- Seattle Glider Council (gliders and tow planes; competitions, events);
- Civil Air Patrol (gliders, tow planes, auto-tow glider launches, powered fixed-wing flight training);
- Aerobatics Association (competitions, events);
- Aerial Applicator; and
- Other Locally Based and Transient General Aviation Users

The "other" aircraft activity captures flight activity generated by locally based aircraft (excluding gliders, which are counted separately) and all other transient aircraft. This segment is estimated by using an activity ratio of 210 operations per based aircraft ratio, which is consistent with FAA guidance for estimating basic air traffic at lower activity non-towered general aviation airports. By combining estimated activity from several specific groups of airport users, an updated estimate of aircraft operations was developed and is summarized in **Table 3-10**.

TABLE 3-10: 2016 ESTIMATE OF AIRCRAFT OPERATIONS (EPH)

ACTIVITY SEGMENT	AIRCRAFT OPERATIONS
BBCC - Fixed Wing Flight Training	12,000
Seattle Glider Council – Glider	1,250
Seattle Glider Council – Tow Plane	1,250
Civil Air Patrol – Glider	666
Civil Air Patrol – Tow Plane	182
Civil Air Patrol – Fixed Wing Powered AC Flight Training	458
Aerobatics	1,100
Agricultural Aircraft	298
Other (Non-Glider Based Aircraft and Transient)	5,670
Total Operations (2016)	**22,874**

The updated air traffic estimate of 22,874 operations and 53 based aircraft yields an activity ratio of 432 operations per based aircraft (OPBA), which is consistent with the established levels of flight training at airport.

Overview of Recent Local Events

FLIGHT TRAINING

The Big Bend Community College (BBCC) flight training program currently has 22 single engine and 1 multi-engine piston aircraft in their fleet. Based on its recorded log of flight hours, BBCC estimated a total of 60,000 aircraft operations in 2016, with 12,000 operations at EPH. BBCC estimates that 60 percent of their EPH operations utilize Runway 3/21 and 40 percent utilize Runway 11/29. College officials indicate that the current levels of flight training (enrollments, fleet size, etc.) is expected to be maintained for the foreseeable future.

AVIATION FUELING ACTIVITY

The Port of Ephrata provides self-service 100 low lead (100LL) aviation gasoline (AVGAS) for sale at EPH. Fuel delivery volumes at EPH have fluctuated within a relatively small range over the last six years. **Table 3-11** summarizes the fuel delivery data for EPH between 2011 and 2016 A notable decline in activity occurred between 2012 and 2013, where AVGAS deliveries decreased by approximately 29 percent. A discussion with airport management indicates that fuel prices increased to over $5 a gallon in 2013, likely reducing the feasibility for many to fly.

Beyond overall numbers, it is important to understand aircraft fueling patterns at EPH. A review of aviation fueling activity and aircraft use at EPH highlights several important factors affecting fuel demand:

- The BBCC flight training program currently generates more than half of the annual aircraft operations at EPH. However, BBCC does not typically purchase aviation fuel at EPH due to the short flight distance from its operations base in Moses Lake.
- Jet fuel is not available for sale at EPH. As a result, turbine aircraft operating at EPH either self-fuel (aerial applicators, etc.) or do not fuel on site (turboprops, jets and helicopters).
- Gliders account for nearly 10 percent of the annual aircraft operations at EPH, but do not require fuel (the associated tow planes are fueled on site).

As a result, aviation fueling activity at EPH reflects roughly 40 percent of overall airport operations. Any fluctuations in fueling activity should not be assumed to reflect changes in overall airport activity. However, the recent fueling trends do likely provide a reasonable indication of nominal upward and downward movement for locally based and transient piston-engine aircraft not involved in the activities noted above.

TABLE 3-11: EPH AVIATION FUEL DELIVERIES (GALLONS)

	2011	2012	2013	2014	2015	2016
Aviation Gasoline (100LL)	25,227	29,434	20,788	22,201	24,345	21,440
% Change from Prev. Year	-	16.7%	-29.4%	6.8%	9.6%	-11.9%

INSTRUMENT FLIGHT ACTIVITY

The FAA tracks flight activity data for aircraft operating under instrument flight rules in the national airspace system. Flight Aware is a company that has developed live flight tracking services for commercial and general aviation, based on data provided by FAA. Instrument flight plan data for EPH were obtained and analyzed for calendar year 2016 to assist in defining both instrument activity and business-related activity generated by turbine aircraft (potential design aircraft).

The data captures all civil aircraft filing instrument flight plans and listing EPH either as the originating or as the destination airport. Military aircraft are not included in the FAA instrument flight plan data. Aircraft may cancel IFR flight plans enroute, so not every flight plan actually results in an instrument operation. These data are summarized in **Table 3-12** by aircraft type and Airport Reference Code (ARC). The instrument flight plan filings (235) accounted for approximately 1 percent of airport operations estimated for 2016.

TABLE 3-12: EPH INSTRUMENT ACTIVITY (2016)

ARC	TYPE	REPRESENTATIVE AIRCRAFT	2016
Piston Aircraft (Fixed Wing)			
A-I	SEP/MEP	Cessna 182/Beechcraft Baron 55	81
B-I	MEP	Beechcraft Baron 58/Cessna 340, 414	80
		Subtotal - Piston	*161*
Turbine Aircraft (Fixed Wing)			
A-I	SETP	TBM 700/EPIC	0
A-II	SETP	Cessna Caravan/Pilatus PC12	20
B-I	METP	Beechcraft King Air 100/Piper Cheyenne/Rockwell Aero Commander 690	22
B-I	Jet	Raytheon-Beech Premier 400A/Embraer Phenom	2
B-II	METP	Beechcraft King Air 90/100/200/350	13
B-II	Jet	Cessna Citation 550 Bravo, Excel, Encore/Falcon 20, 200	12
C-I	Jet	Hawker HS125, Learjet 55	0
C-II	Jet	Bombardier Challenger/Gulfstream III	0
C-IV	Jet	Boeing 767 (KC-46 Pegasus - Military Aircraft)	1
D-I	Jet	Learjet 31/36/40	2
D-II	Jet	Gulfstream IV, V	2
		Subtotal - Turbine	*74*
Other			
--	HELI	Helicopter	0
		Total Instrument Operations	235

Source: Flight Aware

Aviation Activity Forecasts

PREVIOUS FORECASTS

As noted earlier, the existing aviation forecasts (FAA TAF, WSDOT LATS, and 2004 Airport Master Plan Update) are not recommended for use in evaluating air traffic at EPH.

UPDATED FORECASTS

The absence of reliable historical data presents a challenge in developing updated forecasts of aviation activity at EPH. Based on these limitations, forecasts were created that reflect the current relationship between the airport's based aircraft fleet and two other indicators: local population and the size of the regional based aircraft fleet. Aircraft operations forecasts were developed by applying the operations per based aircraft (OPBA) ratio derived from the 2016 estimates of activity described earlier. Three scenarios (increasing, decreasing and maintaining current relationships) were generated for each forecast to reflect the potential for change beyond current year assessment.

Based Aircraft

EPHRATA MUNICIPAL AIRPORT: EPHRATA UGA POPULATION

This forecast reviews the current statistical relationship between locally-based aircraft at EPH and the local population base. Forecasts were developed based on maintaining the current relationship, in addition to increasing and reducing the relationship. The basic assumption is that the number of aircraft based at a community airport may reflect other events within that community. In this case population provides a basic means of comparison, although it is recognized that airport activity and population may not be consistently, highly correlated. As noted earlier, the absence of reliable historical activity data prevents a more analytical assessment.

The Washington Office of Financial Management (OFM) 2016 population estimate for Ephrata was 8,020. When applied to the October 2016 updated count of 53 based aircraft at EPH, a ratio of 6.6 based aircraft per 1,000 Ephrata residents occurs. For purposes of developing new based aircraft projections, the City's selected comprehensive plan annual growth rate (3%) was applied to the 2016 OFM population estimate, then projected forward through the master plan period.

The *Increasing Share* forecast gradually increases EPH's based aircraft-to-population ratio from 6.6 to 7.9 aircraft (+20%) per 1,000 Ephrata residents over the next twenty years. The projection results in an increase from 53 to 115 based aircraft by 2036, which represents an average annual growth rate of **3.95 percent**. This projection assumes that EPF's based aircraft fleet will grow at a slightly faster rate than Ephrata's population over the next twenty years. Combining optimistic population growth with optimistic growth in airport activity produces a compounding effect, which results in significantly faster growth in based aircraft during the twenty year planning period.

The *Maintain Share* forecast maintains EPH's based aircraft-to-population ratio of 6.6 aircraft per 1,000 Ephrata residents over the next twenty years. The projection results in an increase from 53 to 96 based aircraft by 2036, which represents an average annual growth rate of **3.0 percent**. This projection assumes that EPF's based aircraft fleet will grow at the same rate as Ephrata's population over the next twenty years.

The *Decreasing Share* forecast gradually decreases EPH's based aircraft-to-population ratio from 6.6 to 5.4 aircraft (-20%) per 1,000 Ephrata residents over the next twenty years. The projection results in an increase from 53 to 64 based aircraft at by 2036, which represents an average annual growth rate of **1.95 percent**. It is noted that the declining based aircraft-to-population ratio is offset by optimistic population growth, which still results in overall growth in based aircraft during the twenty year planning period.

The population ratio based aircraft forecasts are summarized in **Table 3-13** and depicted on **Figure 3-3**.

TABLE 3-13: BASED AIRCRAFT FORECAST (BASED AIRCRAFT PER 1,000 EPHRATA RESIDENTS)

YEAR	EPH BASED AIRCRAFT	EPHRATA POPULATION[1]	BASED AIRCRAFT PER 1,000 RESIDENTS
Forecast – Decreasing Share (1.95% AAR) [2]			
2016	53	8,020	6.61
2021	59	9,297	6.35
2026	65	10,778	6.03
2031	71	12,495	5.68
2036	78	14,485	5.38
Forecast – Maintain Share (3.00% AAR) [2]			
2016	53	8,020	6.61
2021	61	9,297	6.61
2026	71	10,778	6.61
2031	83	12,495	6.61
2036	96	14,485	6.61
Forecast – Increasing Share (3.95% AAR) [2]			
2016	53	8,020	6.61
2021	65	9,297	6.94
2026	78	10,778	7.27
2031	95	12,495	7.60
2036	115	14,485	7.94

1. OFM, April, 2016 estimate.
2. AAR: annual average rate of growth (2016-2036)

FAA NORTHWEST-MOUNTAIN REGION (ANM) MARKET SHARE

A regional market share analysis was conducted that evaluated the EPH based aircraft fleet as part of the FAA's seven-state Northwest-Mountain Region.[6] In 2016, the FAA estimated based aircraft in the region at 23,303. The October 2016 EPH based aircraft total of 53 aircraft reported to FAA through the www.basedaircraft.com database accounted for approximately 0.227 percent[7] of the regional market in 2016.

Projections were developed that maintain, increase, and decrease EPH's current market share based on the FAA's regional Terminal Area Forecast.[8] The FAA projects the based aircraft fleet in the Northwest-Mountain Region to grow at an average annual rate of 0.962 percent between 2014 and 2040.

The **Decreasing ANM Market Share** forecast gradually reduces EPH's share of the ANM region from 0.227 to 0.182 percent, which equates to about a 20 percent reduction in market share over the next twenty years. The projection results in a decrease from 53 to 51 based aircraft (-2) by 2036, which represents -**0.19 percent** average annual growth. This projection assumes that the size of Ephrata's based aircraft fleet will remain largely unchanged over time, with a small reduction below current levels. The net loss of current aircraft through fleet attrition, retiring pilots, etc., will be partially offset by new aircraft. Maintaining current based aircraft levels at EPH while the overall region experiences modest growth will shrink market share over time.

The **Maintain ANM Market Share** forecast maintains EPH's 2016 share of the ANM region at 0.227 percent. The projection results in an increase from 53 to 64 based aircraft (+11) by 2036, which represents an average annual growth rate of **0.95 percent**. This projection assumes that Ephrata's growth in based aircraft will mirror the regional average over the next twenty years, which suggests an ability to respond to demand for facilities and services. This projection represents a net increase in based aircraft above current levels, which includes loss of existing aircraft through attrition.

The **Increasing ANM Market Share** forecast gradually increases EPH's 2016 share of the ANM region from 0.227 to 0.273 percent, which equates to about a 20 percent increase in market share over the next twenty years. The projection results in an increase from 53 to 77 based aircraft (+24) by 2036, which represents an average annual growth rate of **1.89 percent**. This projection assumes that Ephrata's growth in based aircraft will outpace regional growth over the next twenty years, which requires an ability increase demand for facilities and services. This projection also represents a net increase in based aircraft above current levels, which includes loss of existing aircraft through attrition.

The market share based aircraft forecasts are summarized in **Table 3-14** and depicted on **Figure 3-3**.

[6] ANM – FAA Northwest Mountain Region (WA, OR, ID, MT, WY, UT, CO)

[7] EPH 2016 Share of ANM Market 0.02274385

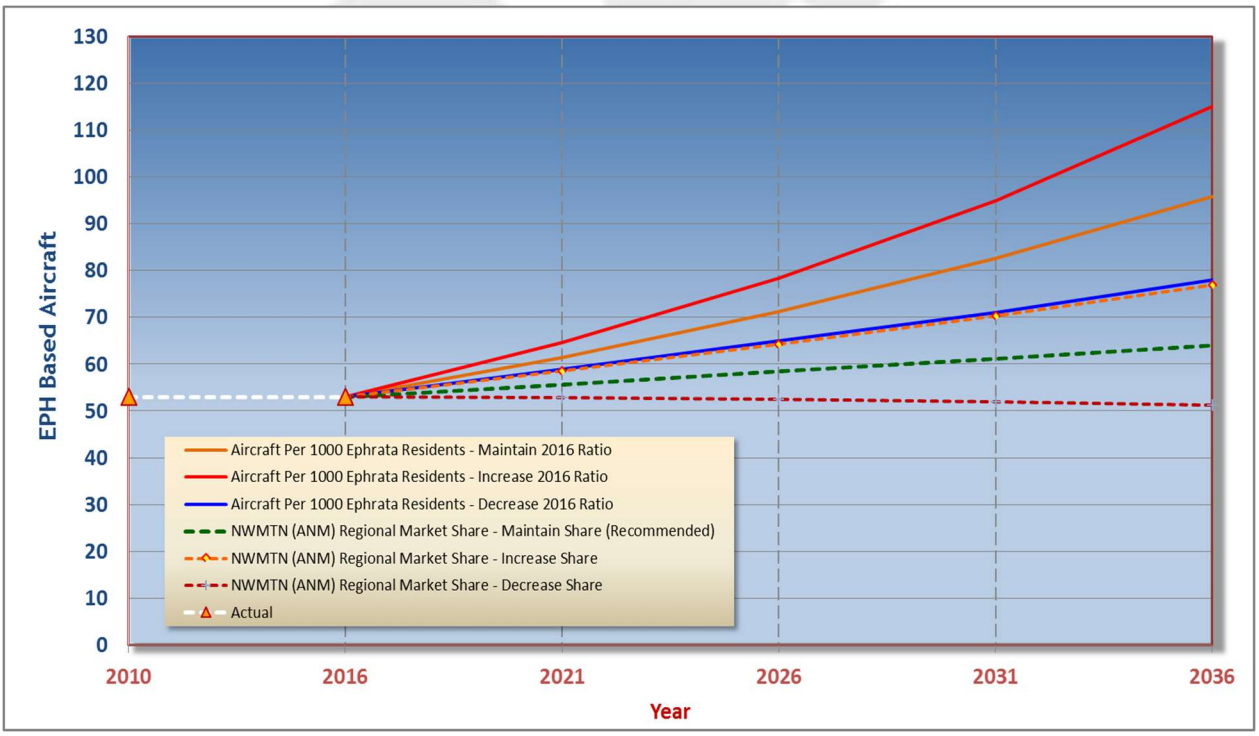
[8] FAA Terminal Area Forecast Summary, Fiscal Years 2015-2040

TABLE 3-14: REGIONAL MARKET SHARE BASED AIRCRAFT FORECAST

YEAR	EPH BASED AIRCRAFT	NW MTN. REGION (ANM) BASED AIRCRAFT[1]	ANM BASED AIRCRAFT AT EPH
Forecast – Decreasing Share (-0.19% AAR) [2]			
2016	53	23,303	0.002274385
2021	53	24,485	0.002160666
2026	53	25,687	0.002046947
2031	52	26,883	0.001933228
2036	51	28,154	0.001819509
Forecast – Maintain Share (0.95% AAR) [2] - Recommended Forecast			
2016	**53**	23,303	0.002274385
2021	**56**	24,485	0.002274385
2026	**58**	25,687	0.002274385
2031	**61**	26,883	0.002274385
2036	**64**	28,154	0.002274385
Forecast – Increasing Share (1.89% AAR) [2]			
2016	53	23,303	0.002274385
2021	58	24,485	0.002388104
2026	64	25,687	0.002501823
2031	70	26,883	0.002615542
2036	77	28,154	0.002729261

1. FAA Terminal Area Forecasts FY 2015-2040
2. AAR: annual average rate of growth (2016-2036)

FIGURE 3-3: EPH BASED AIRCRAFT FORECASTS



Summary (Based Aircraft Forecast)

The **Maintain ANM Market Share** forecast is recommended as the preferred based aircraft forecast for use in the airport master plan. This projection assumes that EPH will be able sustain growth in its based aircraft fleet that is in line with anticipated regional growth (**0.95 percent average annual growth**). This forecast provides a net increase of (+11) based aircraft over the twenty-year planning period. The recommended based aircraft forecast is summarized in **Table 3-13** and depicted on **Figure 3-3** (above).

The use of development reserves is recommended for determining activity-dependent facility needs such as aircraft parking and hangar demand to account for the higher degree of uncertainty associated with the forecasts. A development reserve equal to 100 percent of projected based aircraft or other measurable units (based and transient aircraft parking, etc.) will be adequate to accommodate future needs during the current planning period.

BASED AIRCRAFT FLEET MIX

The airport's current mix of based aircraft consists of single-engine and multi-engine piston aircraft, multi-engine turbine aircraft, and gliders. **Table 3-15** summarizes the projected based aircraft fleet mix for the planning period. **Figures 3-4** and **3-5** depict the current (2016) and long-term (2036) distribution of based aircraft by type. The based aircraft fleet mix during the planning period is expected to become slightly more diverse to include light sport aircraft, additional turbine aircraft, and helicopters. Gliders are expected to continue representing a significant portion of EPH's based aircraft fleet.

TABLE 3-15: FORECAST BASED AIRCRAFT FLEET MIX

AIRRAFT TYPE	2016	2021	2026	2031	2036
Single Engine Piston	23	24	25	25	26
Multi-Engine Piston	2	1	1	2	2
Turboprop	2	2	2	3	3
Business Jet	0	0	0	1	1
Helicopter	0	1	1	1	2
Glider	26	26	26	25	25
LSA/Sport	0	2	3	4	5
Total Based Aircraft	53	56	58	61	64

FIGURE 3-4: BASED AIRCRAFT FLEET MIX (2016)

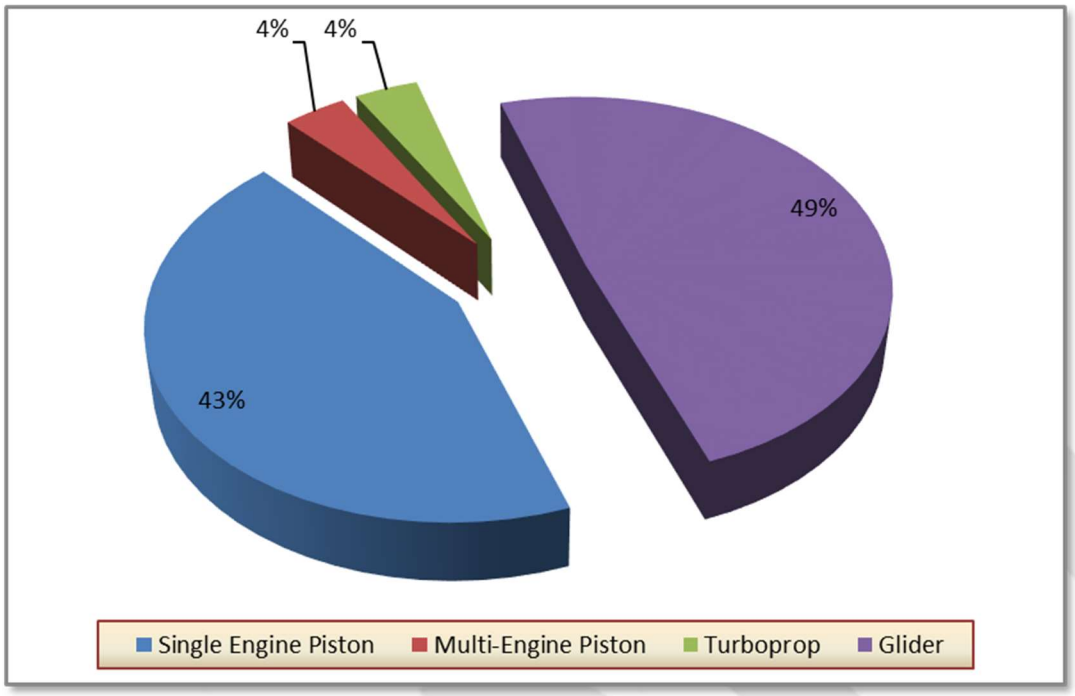
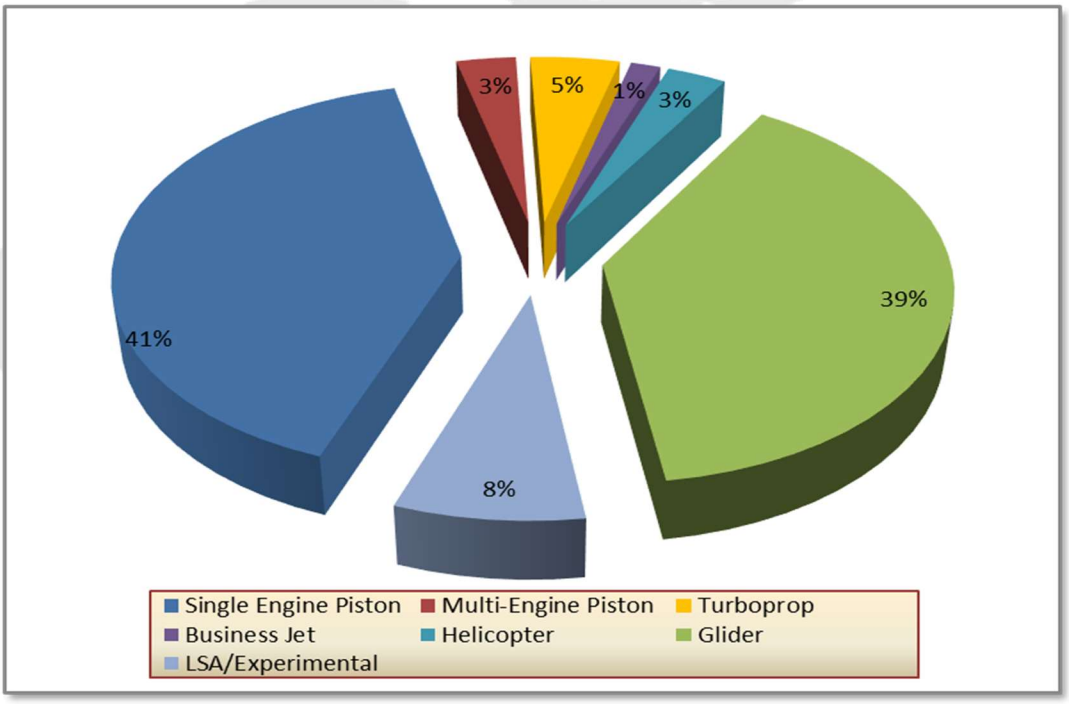


FIGURE 3-5: FORECAST BASED AIRCRAFT FLEET MIX (2036)



Aircraft Operations

The absence of reliable historical data and valid forecasts noted earlier also presents a challenge in developing updated forecasts of aircraft operations at EPH. The inability to compare new forecasts with existing projections limits the weighting and evaluation process that is normally used to establish the level of reasonableness of the recommended forecast.

The use of an "aircraft operations per based aircraft" (OPBA) ratio is recommended for projecting annual aircraft operations at EPH. The OPBA ratio derived from the 2016 estimates of activity described earlier in the chapter provides a reasonable basis for developing operations projections. As with the based aircraft forecasts described earlier, "increasing, decreasing and maintaining" scenarios were developed for aircraft operations to reflect the potential for change beyond current year assessment.

Additional information about use of activity ratios to estimate air traffic at non-towered airports is provided below.

FAA Guidance for Estimating Air Traffic at Non-Towered Airports:

The FAA provides planning guidance for estimating activity at general aviation airports without control towers, including the use of activity ratios to project aircraft operations from the number of based aircraft at the airport. In the absence of actual aircraft operations counts, an operations per based aircraft (OPBA) ratio is generally adequate for airport planning purposes. The OPBA is intended to reflect operations from both locally based and transient aircraft.

Prior to the recent economic recession, the FAA developed "typical" OPBA ratios for general aviation airports based on observations at airports throughout the United States.[9] The recommended ratios ranged from 250 to 450 operations per based aircraft depending on the size of the community, airport type, and the nature of the air traffic. These ratios were also consistent with a range of activity models derived from a detailed analysis of independent variables.[10] As noted earlier, most measures of general aviation activity tracked by FAA declined sharply during the recent economic recession and have not yet returned to pre-recession levels. The system wide impact has been a reduction in aircraft utilization, which translates into lower activity ratios. One notable exception is the number of active "Student Pilot" certificates, which has run opposite to most other pilot categories, growing at just less than 2 percent annually since 2001. Roughly translated, airports with established flight training activity have been more successful in maintaining or growing their flight activity during the last decade and have generally outperformed system wide averages.

As noted earlier, the current OPBA ratio of 432 at EPH is heavily influenced by well-established institutional flight training activity, which is expected to be maintained at current levels during the

[9] Field Formulation of National Plan of Integrated Airport Systems (FAA)
[10] Model for Estimating General Aviation Operations at Non-Towered Airports Using Towered and Non-Towered Airport Data (GRA, 2001)

planning. Based on a review of current activity, it is reasonable to assume that all user groups at EPH may experience normal growth in flight activity. It is also recognized that activity within a particular segment may increase, decrease, or be maintained at current levels.

AIRCRAFT OPERATIONS RATIOS (VARIABLE PROJECTIONS)

Three projections of annual aircraft operations were prepared for EPH utilizing the OPBA methodology described above. Each of the OPBA projections are applied to the recommended based aircraft forecast summarized previously in **Table 3-15**. The updated aircraft operations forecasts are summarized in **Table 3-16** and depicted in **Figure 3-5**.

Maintain OPBA Ratio. This projection maintains the current OPBA ratio of 432 through the twenty-year planning period. The projection assumes that aircraft utilization will remain at current levels and growth in aircraft operations will be driven primarily by the forecast net increase in based aircraft. This projection results in annual aircraft operations increasing from an estimated 22,874 to 27,662 by 2036, which represents an average annual growth rate of **0.95 percent.**

This forecast can be sustained by the current airfield capabilities (e.g., runway length, etc.). The current operational fleet mix would not change significantly, although it is expected to include more transient turboprop and business jet activity as Ephrata's commercial and industrial base expands. Increased agricultural and resource management use of aircraft at EPH is also expected to contribute the airport's operational profile. The current and future design aircraft reflect the functional capabilities of the existing runways.

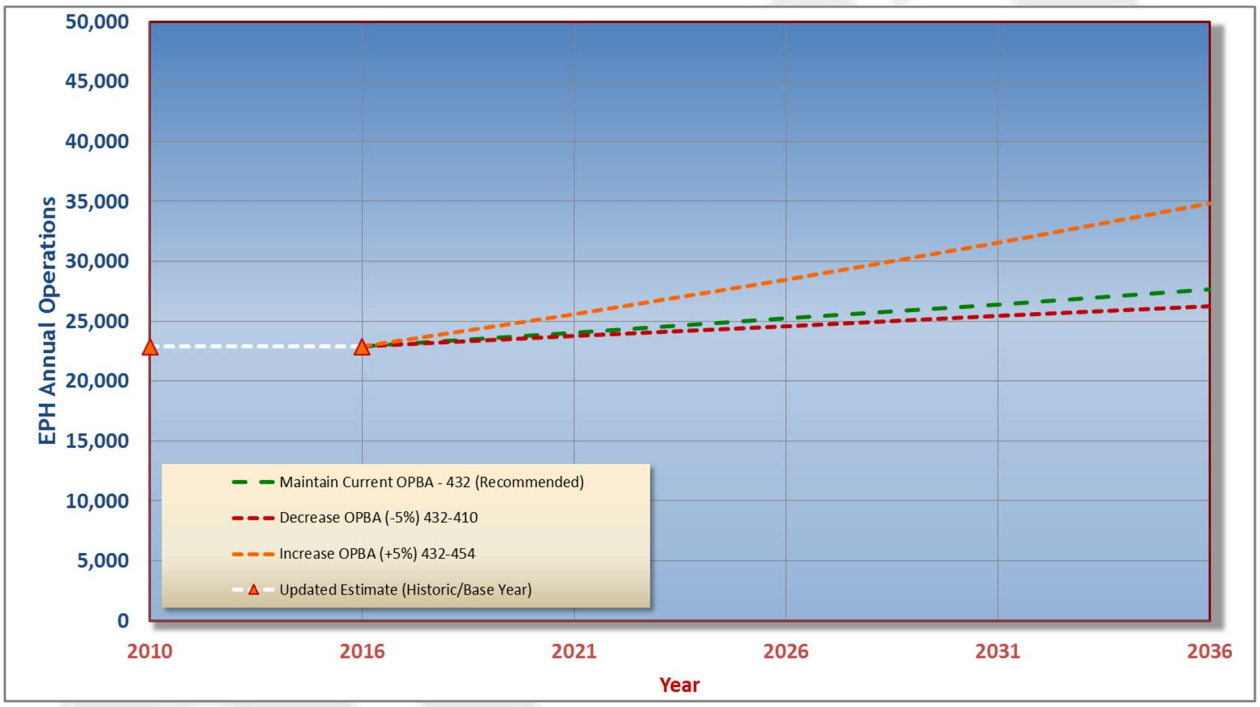
Increasing OPBA Ratio. This projection assumes a gradual 5 percent increase in OPBA through the planning period, from 432 to 454. The projection reflects an increase in activity (e.g., utilization) by local and transient aircraft. The assumptions from the previous projection regarding fleet mix and design aircraft also apply to this projection. This projection results in annual aircraft operations increasing from an estimated 22,874 to 34,854 by 2036, which represents an average annual growth rate of **2.13 percent.**

Decreasing OPBA Ratio. This projection assumes a gradual 5 percent decrease in OPBA through the planning period, from 432 to 410. The projection reflects a decline in activity (e.g., utilization) by local and transient aircraft. The assumptions from the other projections regarding fleet mix and design aircraft also apply to this projection. This projection results in annual aircraft operations increasing from an estimated 22,874 to 26,278 by 2036, which represents an average annual growth rate of **0.70 percent.** It is noted that the activity increase at EPH will occur despite a decline in aircraft utilization, due to expected growth in the region.

TABLE 3-16: AIRCRAFT OPERATIONS FORECASTS

	2016	2021	2026	2031	2036
Maintain Current OPBA Ratio (0.95% AAR 2016-2036) **Recommended Forecast**	**22,874**	**24,056**	**25,238**	**26,414**	**27,662**
Decrease Current OPBA Ratio (0.70% AAR 2016-2036)	22,874	23,758	24,606	25,422	26,278
Increase Current OPBA Ratio (2.13% AAR 2016-2036)	22,874	25,576	28,456	31,516	34,854

FIGURE 3-6: GENERAL AVIATION OPERATIONS FORECAST



Summary (Aircraft Operations Forecast)

The **Maintain OPBA Ratio** forecast is recommended as the preferred aircraft operations forecast for use in the airport master plan. This projection assumes that EPH will be able maintain current activity, and sustain growth consistent with anticipated regional growth (**0.95 percent average annual growth**). The recommended aircraft operations forecast is summarized in **Table 3-16** and depicted on **Figure 3-6** (above).

Local and Itinerant Operations

General aviation operations consist of aircraft takeoffs and landings conducted by GA aircraft. All aircraft operations are classified as local or itinerant. Local operations are conducted in the vicinity of an airport and include flights that begin and end at the airport. These include local area flight training, touch and go operations, glider and tow plane operations, aerobatics competitions, flightseeing, and other flights that do not involve a landing at another airport. Itinerant operations include flights between airports, including cross-country flights. Itinerant operations reflect specific travel between multiple points, often associated with business and personal travel.

Based on the assessment of current air traffic at EPH, it is estimated that the operational split is 81 percent local and 19 percent itinerant. It is recommended that the current air traffic distribution be applied to forecast aircraft operations during the current planning period.

Aircraft Operations Fleet Mix

Single engine piston and glider aircraft currently account for approximately 94 percent of airport operations, followed by multi-engine piston and turbine fixed wing aircraft, and helicopters.

It is expected that the current mix of air traffic will be largely maintained during the twenty-year planning period, although some changes are anticipated to reflect current trends in aircraft manufacturing. These include increased use by business aircraft (turboprops and jets), turbine aircraft commonly used in aerial application and resource management activities, and helicopters. The growing popularity of single-engine turboprops for personal and business use is also expected affect at operational fleet mix at EPH. Forecast glider operations at EPH are expected to represent approximately the percentage of overall fleet mix in the current planning period. The aircraft operations fleet mix forecast is summarized in **Table 3-17**.

TABLE 3-17: GENERAL AVIATION FORECAST AIRCRAFT OPERATIONS FLEET MIX

AIRCRAFT TYPE	2016	%	2021	%	2026	%	2031	%	2036	%
Single Engine Piston*	19,512	85	20,192	84	21,198	84	22,023	84	22,992	83
Multi Engine Piston	796	4	860	4	740	3	790	3	660	2
Turboprop	420	2	720	3	760	3	840	3	1,110	4
Jet	30	<1	60	<1	120	<1	160	<1	200	<1
Helicopter	200	<1	300	1	400	2	500	2	600	2
Glider	1,916	8	1,925	8	2,020	8	2,100	8	2,100	8
Total Operations	22,874	100	24,056	100	25,238	100	26,414	100	27,662	100

**Includes Sport and LSA*
Note: Percentages may not sum due to independent rounding

Design Aircraft

The selection of design standards for airfield facilities is based on the characteristics of the aircraft that are expected to use the airport as noted earlier. The **design aircraft** is defined as the most demanding aircraft or aircraft type operating at the airport with a minimum of 500 annual itinerant operations, as described by the Federal Aviation Administration (FAA):

"Substantial Use Threshold-Federally funded projects require that critical design airplanes have at least 500 or more annual itinerant operations at the airport (landings and takeoffs are considered as separate operations) for an individual airplane or a family grouping of airplanes. Under unusual circumstances, adjustments may be made to the 500 total annual itinerant operations threshold after considering the circumstances of a particular airport. Two examples are airports with demonstrated seasonal traffic variations, or airports situated in isolated or remote areas that have special needs."

The FAA groups aircraft into five categories (A-E) based on their approach speeds. Aircraft Approach Categories A and B include small, piston propeller aircraft, many small or medium business jet aircraft, and some larger aircraft with approach speeds of less than 121 knots (nautical miles per hour). Categories C, D, and E consist of the remaining business jets and larger jet and propeller aircraft generally associated with commercial and military use. These aircraft typically have approach speeds of 121 knots or more. The FAA has also established six airplane design groups (I-VI), based on the wingspan and tail height of the aircraft. The categories range from Airplane Design Group (ADG) I, for aircraft with wingspans of less than 49 feet, to ADG VI for the largest commercial and military aircraft.

The combination of airplane design group and aircraft approach speed for the design aircraft establishes the Airport Reference Code (ARC), which is used to define applicable airfield design standards. FAA classifies aircraft with a maximum gross takeoff weight greater than 12,500 pounds as "large aircraft" by the; aircraft 12,500 pounds and less are classified as "small aircraft." At airports with more than one runway, such as EPH, the ARC is assigned to each runway.

A list of typical general aviation and business aviation aircraft and their representative design categories is presented in **Table 3-18**. **Figure 3-7** illustrates representative aircraft in various design groups.

TABLE 3-18: GENERAL AVIATION AIRCRAFT & DESIGN CATEGORIES

AIRCRAFT	AIRCRAFT APPROACH CATEGORY	AIRPLANE DESIGN GROUP	MAXIMUM GROSS TAKEOFF WEIGHT (LBS)
Grumman American Tiger	A	I	2,400
Cessna 182 (Skylane)	A	I	3,100
Cirrus Design SR22	A	I	3,400
Beechcraft Bonanza A36	A	I	3,650
Socata/Daher TBM 700-930	A	I	6,579-7,394
Beechcraft Baron 58	B	I	5,500
Cessna 340	B	I	5,990
Cessna Citation Mustang	B	I	8,645
Embraer Phenom 100	B	I	10,472
Cessna Citation CJ1+	B	I	10,700
Beech King Air A100	B	I	11,800
Beechcraft 400A/Premier I	B	I	16,100
Piper Malibu (PA-46)	A	II	4,340
HpH Glasflugel 304 CZ (sailplane)	A	II	992
Schempp-Hirth Arcus (sailplane)	A	II	1,764
Cessna Caravan 675	A	II	8,000
Pilatus PC-12	A	II	10,450
Cessna Citation CJ2+	B	II	12,500
Cessna Citation II	B	II	13,300
Cessna Citation CJ3	B	II	13,870
Beech King Air 350	B	II	15,000
Cessna Citation CJ4	B	II	16,950
Embraer Phenom 300	B	II	17,968
Cessna Citation XLS+	B	II	20,200
Dassault Falcon 20/200	B	II	28,660
Bombardier Learjet 55	C	I	21,500
Beechcraft Hawker 800XP	C	II	28,000
Gulfstream 200	C	II	34,450
Cessna Citation X	C	II	36,100
Bombardier Challenger 300	C	II	37,500
Gulfstream III	C	II	69,700
Learjet 35A/36A	D	I	18,300
Gulfstream G450	D	II	73,900
Schleicher ASW 22 (sailplane)	A	III	2,255
Bombardier Global Express 5000	C	III	92,750

Source: AC 150/5300-13, as amended; aircraft manufacturer data.

A-I

12,500 lbs. or less (small)

Beech Baron 55
Beech Bonanza
Cessna 182
Piper Archer
Piper Seneca

B-I

12,500 lbs. or less (small)

Beech Baron 58
Beech King Air 100
Cessna 402
Cessna 421
Piper Navajo
Piper Cheyenne
Cessna Citation I

A-II, B-II

12,500 lbs. or less (small)

Super King Air 200
Pilatus PC-12
DHC Twin Otter
Cessna Caravan
King Air C90

B-II

Greater than 12,500 lbs.

Super King Air 300, 350
Beech 1900
Cessna Citation Excel
Falcon 20, 50
Falcon 200, 900
Citation II, Bravo XLS+
Citation CJ3

A-III, B-III

Greater than 12,500 lbs.

DHC Dash 7, Dash 8
Q-200, Q-300
DC-3
Convair 580
Fairchild F-27
ATR 72
ATP

C-I, D-I

Lear 25, 35, 55, 60
Israeli Westwind
HS 125-700

C-II, D-II

Gulfstream II, III, IV
Canadair 600
Canadair Regional Jet
Lockheed JetStar
Citation X
Citation Sovereign
Hawker 800 XP

C-III, D-III

Boeing Business Jet
Gulfstream 650
B 737-300 Series
MD-80, DC-9
Q-400
A319, A320
Gulfstream V
Global Express

C-IV, D-IV

B-757
B-767
DC - 8-70
DC - 10
MD - 11
L 1011

D-V

B - 747 Series
B - 777

AIRPORT REFERENCE CODES (ARC)
FIGURE 3.7

EPHRATA MUNICIPAL AIRPORT
AIRPORT MASTER PLAN

CENTURY WEST ENGINEERING

Current and Future Design Aircraft

The current air traffic at EPH consists of a variety of fixed-wing aircraft and helicopters. Each runway at EPH has a specific function, which corresponds to specific design aircraft.

Runway 3/21

The 2004 Airport Master Plan identified a Beechcraft Super King Air B 200 as the existing and future critical (design) aircraft for Runway 3/21. This aircraft is included in Airplane Design Group II (ADG II) and Aircraft Approach Category B, which corresponds to Airport Reference Code (ARC) B-II.

The majority of turbine aircraft operations at EPH are accommodated on Runway 3/21, and the majority of those operations are generated by Approach Category A and B aircraft. The current (2016) estimate for ADG II operations on Runway 3/21 is 396 operations. This includes single-engine and multi-engine turboprops and business jets. A locally-based aerial applicator generates approximately 250 annual ADG II operations with turbine-powered Air Tractor aircraft. Four additional ADG I business jet operations were also accommodated in 2016, according to instrument flight plan records. These aircraft have runway length requirements that are comparable to ADG II business jets or turboprops. Runway 3/21 also accommodates ADG I multi-engine piston aircraft activity, the majority of which is generated by Approach Category A aircraft. These aircraft have runway length requirements that exceed most single-engine turboprops.

Although current activity appears to be below the 500 annual operations threshold, there are indications of trending toward additional ADG II activity in the near future. Airport management reports that a second aerial applicator is expected to begin operations at EPH in 2017, generating an estimated 100 annual ADG II operations. In addition, it is reasonable to expect the continued expansion of region's agricultural and industrial base will contribute to growth in turbine aircraft activity at EPH.

The forecast volume of A/B-II activity is projected to exceed the 500 annual operations threshold within the first five years of the current planning period, and increase steadily during the planning period. The volume of business jet activity is expected to increase, but remain below 500 annual operations. Based on these factors, a composite grouping of A and B ADG II aircraft appears to provide a reasonable basis for defining current and future design aircraft for Runway 3/21.

ARC A-II and B-II is recommended for Runway 3/21 based on current and forecast activity. Within this grouping, the current design aircraft is a single-engine aerial applicator (A-II); the future design aircraft is a multi-engine turboprop (B-II).

- **Existing Design Aircraft**: Air Tractor 602 - Single Engine Turboprop; ARC A-II
- **Future Design Aircraft**: Air Tractor 802/Beechcraft King Air 250 - Single/Multi-Engine Turboprops; ARC B-II

Runway 4/22

Runway 4/22 accommodates the majority of glider activity at EPH. The 2004 Airport Master Plan identified a Glasflugel Kestrel (ADG I Small) as the existing and future critical (design) aircraft for Runway 4/22. The current inventory of 26 gliders based at EPH identifies 21 ADG II; 3 ADG III; and 2 ADG I aircraft. Based on the updated activity assessment and forecasts, the current and future design aircraft recommended for Runway 4/22 is an ADG II glider, such as an HpH Glasflugel 304 CZ. This aircraft is classified as "small" based on its operating weight, therefore ARC A-II (small) is appropriate for the runway.

Runway 11/29

Runway 11/29 provides crosswind runway capabilities for small aircraft. The 2004 Airport Master Plan identified a Cessna Skyhawk 172 as the existing and future critical (design) aircraft for Runway 11/29. This aircraft is classified as small airplane, and is included in Airplane Design Group I (ADG II) and Aircraft Approach Category A, which corresponds to Airport Reference Code (ARC) A-I (small).

Operational Peaks

It is estimated that peak month activity at EPH occurs during the summer (typically June) and accounts for approximately 10 percent of annual aircraft operations. This level of peaking is consistent with the mix of airport traffic, including flight training, and is expected to remain relatively unchanged during the planning period.

Peak day operations are defined by the average day in the peak month (design day) and the busy day in the typical week during peak month (busy day); the peak hour within the design day represents the design hour. The design day is calculated by dividing peak month operations by 30. The busy day is estimated to be 25 percent higher than the average day in the peak month (design day x 1.25). The design hour operations are estimated to equal 15 percent of design day operations. The operational peaks for each forecast year are summarized in **Table 3-19**.

TABLE 3-19: PEAK GENERAL AVIATION OPERATIONS FORECAST

ACTIVITY	2016	2021	2026	2031	2036
Annual Operations	22,874	24,056	25,238	26,414	27,662
Peak Month Operations (10%)	2,287	2,406	2,524	2,641	2,766
Design Day Operations (average day in peak month)	76	80	85	88	92
Busy Day Operations (assumed 125% of design day)	95	100	105	110	115
Design Hour Operations (assumed 15% of design day)	11	12	13	13	14

Forecast Summary

The summary of based aircraft and annual aircraft operations is provided in Table 3-20. Table 3-21 summarizes the operations forecast by airport reference code (ARC).

As with any long-term facility demand forecast, it is recommended that long-term development reserves be protected to accommodate demand that may exceed current projections. For planning purposes, a reserve capable of accommodating a doubling of the twenty-year preferred forecast demand should be adequate to accommodate unforeseen facility needs during the current planning period. However, should demand significantly deviate from the airport's recent historical trend, updated forecasts should be prepared to ensure that adequate facility planning is maintained.

TABLE 3-20: FORECAST SUMMARY

ACTIVITY	2016	2021	2026	2031	2036
Itinerant Operations					
General Aviation	20,570	21,630	22,684	23,734	24,846
Air Taxi/Commercial	16	20	30	40	50
Military	0	0	0	0	0
Total Itinerant Operations	**20,586**	**21,650**	**22,714**	**23,774**	**24,896**
Local Operations	2,288	2,406	2,524	2,640	2,766
Total Local & Itinerant Operations	22,874	24,056	25,238	26,414	27,662
Based Aircraft	53	56	58	61	64
Operations Per Based Aircraft	432	430	435	433	432

TABLE 3-21: FORECAST ACTIVTY BY ARC

DESCRIPTION	HISTORIC	FORECAST			
	2016	2021	2026	2031	2036
Summary of Aircraft Operations by ARC					
Small Airplanes (≤ 12,500 lbs. MGTW)					
A-I Glider	580	580	610	640	640
A-II Glider	1,316	1,320	1,380	1,420	1,420
A-III Glider	20	24	30	40	40
A-I Single-Engine Piston	19,512	20,192	21,198	22,094	22,992
B- I Multi-Engine Piston	796	860	740	720	660
A-I Single-Engine Turboprop	10	20	30	40	60
B-I Multi-Engine Turboprop	40	60	50	50	50
A-II Single-Engine Turboprop	150	260	280	300	380
B-I Jet	4	12	20	30	40
Large Airplanes (> 12,500 lbs. MGTW)					
B-II Single-Engine Turboprop	140	260	270	290	380
B-II Multi-Engine Turboprop	80	120	130	160	240
B-II Jet	22	40	80	100	120
C-I Jet	0	2	6	8	10
C-II Jet	0	2	6	10	12
D-I Jet	2	2	4	4	6
D-II Jet	2	2	4	8	12
Total All ARC (Fixed Wing)	22,674	23,756	24,838	25,914	27,062
Helicopter	200	300	400	500	600
Total – All Operations	**22,874**	**24,056**	**25,238**	**26,414**	**27,662**
Subtotals (Design Family of Aircraft* - Primary Runway)					
A/B-II Turboprops	370	640	680	750	1,000
A/B-I Jets	4	12	20	30	40
A/B-II Jets	22	40	80	100	120
C/D Jets	4	8	20	30	40
Total	**400**	**700**	**800**	**910**	**1,200**
Design Aircraft ARC	A/B-II Turboprop	A/B-II Turboprop	A/B-II Turboprop	A/B-II Turboprop	A/B-II Turboprop

** Current and Future Design Aircraft: ADG II Single-Engine & Multi-Engine Turboprop combined with all jets (Approach Categories A-D). Note: Multi-Engine Piston Aircraft have greater runway length requirements than most single-engine turboprops due to accelerate–stop distances.*

FAA Terminal Area Forecast (TAF) Assessment

Individual airport master plan forecasts are compared to the FAA's TAF, and significant deviations from the TAF must be approved by FAA. Occasionally, airport master planning reveals outdated or incorrect data in the TAF that has not previously been detected. In these cases, the FAA is responsible for assessing the accuracy of the TAF and for any required revisions.

For EPH, the evaluation of existing activity described in this chapter revealed significant variances in TAF historical and 2015 base year data, which adversely affects all subsequent (TAF) forecasts. As a result, no correlation exists between the TAF and the recommended master plan forecasts for EPH. **Table 3-22** compares the master plan based aircraft and operations forecasts with the corresponding TAF forecasts. It is noted that if the TAF baseline data were updated to reflect current locally-defined data and the existing TAF forecast annual growth rate (0.95%) was maintained, the correlation between the forecasts would be direct.

The FAA TAF comparison spreadsheet and FAA forecast approval letter are provided in **Appendix C.**

TABLE 3-22: EPH MASTER PLAN FORECAST COMPARED TO TAF

	2016	2021	2026	2031	2036
Based Aircraft					
Master Plan Forecast	**53**	**56**	**58**	**61**	**64**
TAF	30	30	32	32	32
Master Plan Net Difference (+/- %)	*+77%*	*+87%*	*+81%*	*+91%*	*+100%*
Annual Operations					
Master Plan Forecast	**22,874**	**24,056**	**25,238**	**26,414**	**27,662**
TAF	136,651	144,848	154,234	165,018	177,452
Master Plan Net Difference (+/- %)	*-83%*	*-84%*	*-84%*	*-84%*	*-84%*

Fifty-Year Forecast

Fifty-year demand forecasts were prepared by extrapolating the average annual growth rates (AAGR) for the recommended 20-year based aircraft and aircraft operations forecasts. The purpose of the 50-year projection is to provide an estimate of demand that can be used to approximate long-term aviation use land requirements for the airport. **Table 3-23** summarizes the 50-year forecast including the intermediate 30- and 40-year based aircraft and aircraft operations.

TABLE 3-23: 50-YEAR FORECAST (EPH)

ACTIVITY	2016	2036	2046	2056	2066
Annual Operations	22,874	27,662	30,420	33,452	36,787
Based Aircraft	53	64	70	77	85