Chapter Three AERONAUTICAL ACTIVITY FORECAST

Aviation demand forecasts help to determine the size and timing of needed airport improvements. This chapter indicates the types and levels of aviation activity expected at the Mulino Airport during a 20-year forecast period. Projections of aviation activity for the Airport were prepared for the near-term (2012), mid-term (2017), and long-term (2027) timeframes. These projections are generally unconstrained and assume the Port of Portland (Port) or its potential successor, the Oregon Department of Aviation (ODA), will be able to develop the various facilities necessary to accommodate based aircraft and future operations. The methodology followed is from *Forecasting Aviation Activity by Airport* (GRA, Incorporated, 2001, July), which is the Federal Aviation Administration's (FAA) recommended guidance for airport forecasting.

The primary objective of a forecasting effort is to define the magnitude of change in aviation activity that can be expected over time. Because of the cyclical nature of the economy, it is virtually impossible to predict with certainty year-to-year fluctuations in activity, especially when looking 20 years into the future. However, trends can be identified and used to study long-term growth potential. While a single line is often used to express the anticipated growth, it is important to remember that actual growth may fluctuate above and below this line. Forecasts serve only as guidelines and planning must remain flexible to respond to unforeseen aviation facility needs and the economic/external conditions giving rise to those needs.

The aviation demand forecasts were developed within the framework of the strategic analysis documented in Chapter One. The Mulino Airport will likely continue to serve the type of

aircraft it has historically served—small (maximum gross takeoff weight of 12,500 pounds), mostly single engine piston aircraft. The current Airport Reference Code for the Mulino Airport is B-II, exemplified by the Beech King Air aircraft. The majority of aircraft located in the study area can be served by the Mulino Airport. Larger, faster, and heavier aircraft originating in or destined for the southeastern part of the Portland metro are better served by nearby Aurora State Airport.

Forecasts for the following aviation activity parameters are presented in this chapter:

- Based Aircraft, including fleet mix. The number and type of based aircraft help determine the future aircraft hangar, tiedown apron, and auto parking facility requirements.
- Aircraft Operations, including annual, peak, local vs. itinerant, and fleet mix. This information helps in analyzing runway capacity and determining runway, taxiway, and navigation aid requirements. The critical aircraft is derived from the fleet mix. The critical aircraft and its airport reference code determine many airfield design requirements, such as runway length, pavement strength, runway and taxiway width, and safety clearances needed for the runway and taxiways. The aircraft operations forecast provides some of the input for the computer modeling that estimates future aircraft noise exposure.

Prior to projecting future activity at the Mulino Airport, national and regional aviation trends and forecasts were reviewed. Socioeconomic trends in the Portland metro area were also analyzed to identify how they might affect aviation demand at the Airport.

NATIONAL AVIATION TRENDS AND FORECASTS

Ten years ago general aviation (GA) in the United States of America was growing, due not only to an expanding economy, but also to the General Aviation Revitalization Act (GARA) of 1994. GARA set an 18-year limit on the liability of GA aircraft and component manufacturers, spurring production of single engine piston aircraft. It is this aircraft type that has accounted for the majority of the nation's GA activity.

Five years ago, the terrorist attacks of 9/11 dampened GA activity with their affect on the national economy and the imposition of new aviation security restrictions. While the piston aircraft component of GA suffered in the aftermath of 9/11, the business, or corporate, segment of GA has grown. This growth is partly due to security measures implemented at commercial service airports and the increased personal travel times that have resulted. Business aircraft usage provides: employee time savings, increased enroute productivity, minimized time away from home, enhanced industrial security, enhanced personal safety, and management control over scheduling.

Many of the nation's employers who use GA are members of the National Business Aircraft Association (NBAA). The NBAA's *Business Aviation Fact Book 2004* indicates that approximately 75 percent of all Fortune 500 businesses operate GA aircraft and 92 of the Fortune 100 companies operate GA aircraft. Business use of GA aircraft ranges from small, single-engine aircraft rentals to multiple aircraft corporate fleets supported by dedicated flight crews and mechanics. General aviation aircraft use allows employers to transport personnel and

air cargo more efficiently than commercial passenger flights. Businesses often use GA aircraft to link multiple office locations or to reach existing and potential customers. Business aircraft use by smaller companies has escalated as various chartering, leasing, time-sharing, fractional ownership, interchange agreements, partnerships, and management contracts have emerged. Fractional ownership arrangements have experienced rapid growth. NBAA estimated that 2,591 companies used fractional ownership arrangements in 1999; by 2004 that number had grown to 6,217 companies, more than doubling over the five year period. The fixed base operators at the Aurora State Airport report that NetJets, Flight Options, Citation Shares, and Flex Jets fractional ownership companies use that airport.

FAA Aerospace Forecasts Fiscal Years 2006-2017 describes aviation trends and forecasts growth in GA aircraft, hours flown, and pilots. Comparing 2005 with 2004, GA aircraft manufacturers reported a 10% increase in shipments, the active GA fleet grew 1.0%, and flight hours increased nearly 3.8%. Single engine piston aircraft grew 0.5% from 2004 to 2005, while turbojet aircraft grew 4.2%. The number of student pilots decreased slightly (0.8%), ending two consecutive years of growth. The total number of pilot certificates declined 1.5% from 2004 to 2005. In 2005, the total number of active pilot certificates was 609,603, GA aircraft hours flown totaled 28.3 million, and the active GA fleet totaled 214,591 aircraft. Two-thirds of the active GA fleet was single engine piston aircraft similar to the type of aircraft based at the Mulino Airport.

The FAA projects 0.9% annual growth in pilots through 2017 and the active GA fleet is projected to grow at an average annual rate of 1.4%.

The business/corporate side of GA is expected to continue growing faster than personal/sport use, benefiting from a growing market for the new, relatively inexpensive (between $1 and $2 million) microjets. The FAA's forecast assumes that 100 microjets, which are also called Very Light Jets (VLJ), will enter the market in 2006, growing to 4,950 aircraft by 2017 (still only 2.3% of all GA aircraft, however). Some believe that the VLJ will revolutionize the aviation industry by supporting true "air taxi" service. In fact, DayJet,[1] a new air taxi operator formed in 2002 in Florida, plans to launch a "per-seat, on-demand" jet service throughout the southeastern U.S. near the end of 2006 using a fleet of Eclipse 500 VLJ[2] aircraft. Other VLJs under development or undergoing certification are the Adam A-700, Safire S-26, and Cessna Mustang.

The FAA also projects high growth for the new category of Sport Aircraft. In 2004 the Sport Pilot Rule was issued, requiring a driver's license rather than a medical certificate, a factor that may draw older pilots back into aviation.

Rotorcraft (helicopters) and fixed-wing turbine aircraft are projected to increase at higher rates than fixed-wing piston aircraft. Increased utilization of aircraft is projected for the future, resulting in higher growth rates for hours flown than for the number of aircraft. **Table 3A** presents the FAA's forecast growth rates for GA aircraft and hours flown.

[1] www.DayJet.com

[2] Designed for Airport Reference Code B-II (small) aircraft, Mulino Airport's airfield is adequate for the Eclipse 500, which is an Airport Reference Code A-I aircraft.

Table 3A. FAA General Aviation Forecasts, Average Annual Growth Rates through 2017

Aircraft Category	Aircraft	Hours Flown
Total GA	1.4%	3.2%
Total Piston Fixed Wing	0.3%	1.2%
Single Engine	0.3%	1.2%
Multi-engine	0.1%	1.1%
Total Turbine Fixed Wing	4.3%	7.5%
Turboprop	2.2%	1.2%
Turbojet	6.0%	10.2%
Total Rotorcraft	4.4%	3.9%
Piston	6.7%	6.8%
Turbine	2.7%	2.8%
Experimental	1.2%	1.7%
Sport Aircraft	19.5%	21.9%

Note: Average annual growth rates are for the period 2005 through 2017 except for Sport Aircraft. Since Sport Aircraft is a new category of aircraft for the FAA, lacking historical records, the average annual growth rate shown is for the years from 2007 to 2017.
Source: FAA Aerospace Forecasts Fiscal Years 2006-2017, Tables 27 and 28.

REGIONAL AVIATION TRENDS AND FORECASTS

While broad industry trends influence aviation activity at individual airports, regional and local factors may have a greater influence.

The Oregon Aviation Plan[3] describes the following trends that would fuel aviation demand:

- Continued migration into the state – new residents will depend on air transportation to maintain ties with family and friends.
- Population growth in the Portland metro area and the Willamette Valley
- Growth in high-tech industries (export-oriented and high-value products)
- Growth in just-in-time delivery
- Growth in tourism
- Increase in air travel by the general public as it has become increasingly affordable
- An aging population with a large amount of discretionary income.

GA operations in the state have been projected to grow more slowly than commercial operations, 37% from 1999 to 2018, which equates to an average annual growth rate of 1.4%.

Owned and operated by the State of Oregon, the Aurora State Airport is the closest publicly owned airport to Mulino, located eight nautical miles away in Marion County. **The Aurora State Airport Master Plan Update[4] included an unconstrained forecast of 1.3% annual growth in based aircraft, from 256 in 1997 to 345 in 2017.** Aircraft operations were forecast

[3] Oregon Department of Transportation, Aeronautics Division. (2000, February).
[4] W&H Pacific. (2000, October).

using a ratio of 339 operations per based aircraft. The forecast reflected the relative attractiveness of the airport within the region due to:

- excellent ground access via Interstate 5
- facilities that accommodate most GA aircraft and allow instrument approaches
- a wide range of services
- the benefit of facility ownership because hangar development is on private property
- competitive prices for leases, fuel, and other charges.

Troutdale Airport is owned and operated by the Port of Portland and located in Multnomah County, near the Columbia River. The 2004 Troutdale Airport Master Plan Update[5] considered factors such as the potential closure of Evergreen Field in Vancouver and the possible forced reduction of based aircraft at Pearson Airpark. Both of these airports are located nearby in Clark County, Washington. Weather was noted as a factor affecting activity levels at the Troutdale Airport. Columbia River gorge winds provide more visual weather than other Portland area airports, an attractive feature to visual flight rule (VFR) pilots. On the other hand, ice storms can be particularly bad at Troutdale, which discourages pilots. The Troutdale Airport Master Plan Update states that the number of based aircraft at airports within the greater Portland area has increased at an annual rate of 1.9% per year since the late 1980s. It reports that the movement of aircraft between airports is relatively common, based on airport closures, changes in the availability or price of fuel, FBO or maintenance services, flight training, and hangar space. The average number of aircraft operations per based aircraft at Troutdale was 520 between 1998 and 2001. In 2002 Troutdale Airport had 193 based aircraft (92% single engine). According to the FAA's 2006 Terminal Area Forecast, based aircraft at Troutdale grew to 197 in 2003 and then dropped to 177 in 2004, possibly illustrating the movement of aircraft between airports. **The Troutdale Airport Master Plan Update projects that based aircraft will grow at an annual rate of 1.8% through 2022. The aircraft operations forecast is based upon a ratio of 357 operations per based aircraft.**

Hillsboro Airport, located in Washington County, is also owned and operated by the Port. According to the Hillsboro Airport Master Plan Update,[6] the airport had 363 based aircraft (67% single engine) in 2003. Analysis found that the Hillsboro Airport's market share was declining. While aircraft registrations were increasing in Washington County at the highest rate in the metro area, Hillsboro Airport was not capturing all the potential growth in based aircraft. **The forecast for based aircraft growth, 1.4% annually through 2010 and then 1.0% annually from 2011 through 2025**, assumed that Hillsboro Airport would recapture a greater share of the based aircraft in Washington County. A pilot survey conducted for the Master Plan Update found that aircraft owners prefer to base their aircraft close to home or work. The Master Plan Update also notes that privately-owned airports such as Skyport Airport and Stark's Twin Oaks Airport might not be able to stay open long-term.

Airport closures are an issue nationwide. According to the Aircraft Owners and Pilots Association (AOPA), "Public-use airports in the United States are closing at the rate of about one

[5] Aron Faegre & Associates and Century West Engineering. (2004, October).
[6] Coffman and Associates. (2005, June).

every two weeks."[7] Private-use airports are also closing, possibly at an even faster pace, since they typically do not gain revenue from the public through fuel sales, aircraft repair services, hangar rent, or similar sources. There are several factors fueling the trend to close GA airports, particularly those that are privately owned. Liability concerns and insurance costs contribute to airport closures. Urban growth causes the value of the airport land to rise, resulting often in sale of the land for residential and other development. The heirs of airport owners sometimes choose to sell the airport rather than continue its operation. Some retiring airport owners sell to a buyer who plans to redevelop the land rather than accept a lower price from a buyer who wants to continue operating the airport. Encroaching urban growth often erects obstacles in runway approaches or eliminates the feasibility of airport expansion, decreasing the airport's viability. New neighborhoods around airports increase pressure to control or close them because of aircraft noise.

According to ODA records, 17 airports have closed in Oregon in the last ten years. Nearly half the airports that closed, as shown in **Table 3B**, were located in the northwest part of the state. Not listed in Table 3B is Evergreen Field in Vancouver, Washington, just across the Columbia River from Portland, which closed in July 2006. Evergreen Field was home to approximately 165 based aircraft before its closure was announced.

Table 3B. Airport Closures in Northwest Oregon

Year Closed	Airport	County
1997	Cubport	Multnomah
2001	Cubehole	Linn
2001	Hayden Mtn.	Washington
2003	Green River	Linn
2003	Basl Hill Farms Airstrip	Marion
2005	Myers	Washington
2005	S & H Aircraft Painting	Linn
2006	Waynes	Linn

Source: Public and private airport closures provided by ODA, 2006, October.

Fairways Airport, located a mere 6 nautical miles from Mulino Airport, is reportedly going to close soon. Fairways Airport is a privately owned, private-use airport with 31 based aircraft, according to Table 1A in Chapter One. The waiting list for a hangar at the Mulino Airport has grown in the last year; reportedly, one of the reasons for this growth is the potential closure of Fairways Airport. The Port has a list of 37 individuals waiting for a hangar at the Mulino Airport. Three names have been on the list since 1999. The list includes four names from 2004, four from 2005, and 13 added in the first nine months of 2006.

REGIONAL SOCIOECONOMIC TRENDS AND FORECASTS

Aviation activity at an airport is usually tied closely to the local and regional economy. As population around the airport grows, airport activity grows. Aviation activity has also traditionally been linked to employment and income factors because of the discretionary nature of personal and business travel as well as the recreational nature of some GA activity.

[7] *AOPA Pilot*. (2006, October). AOPA Airport Support Network Section.

Mulino Airport is located in Clackamas County, but has a 30-minute service area that extends into four other counties (Washington, Multnomah, Marion, and Yamhill). **Table 3C** presents historical and projected populations for the five-county area. This table also presents average annual growth rates for population.

Table 3C. Historical and Projected Populations

Year	Clackamas County	Marion County	Multnomah County	Washington County	Yamhill County	Total
			Historical			
1970	166,088	151,309	556,667	157,920	40,213	1,072,197
1980	241,919	204,692	562,640	245,808	55,332	1,310,391
1990	278,850	228,483	583,887	311,554	65,551	1,468,325
2000	338,391	284,834	660,486	445,342	85,500	1,814,553
			Projected			
2010	391,536	323,128	711,909	542,678	98,932	2,068,183
2020	460,323	367,018	756,390	660,367	119,011	2,363,109
2030	536,123	410,022	800,565	788,162	141,505	2,676,377
			Average Annual Growth Rates			
			Historical			
1970 - 1980	3.8%	3.1%	0.1%	4.5%	3.2%	2.0%
1980 - 1990	1.4%	1.1%	0.4%	2.4%	1.7%	1.1%
1990 - 2000	2.0%	2.2%	1.2%	3.6%	2.7%	2.1%
			Projected			
2000 - 2010	1.5%	1.3%	0.8%	2.0%	1.5%	1.3%
2010 - 2020	1.6%	1.3%	0.6%	2.0%	1.9%	1.3%
2020 - 2030	1.5%	1.1%	0.6%	1.8%	1.7%	1.3%

Source: Historical Population Data - US Census Bureau, Projected Population Data – Office of Economic Analysis, Department of Administrative Services, State of Oregon, April 2004

Clackamas County has been growing and is projected to grow faster than the five-county area as a whole, although at a slightly slower pace than Washington and Yamhill Counties.

Table 3C depicts how the population in the five-county area has shifted and will shift in the future. In 1970, 52% of the residents in the five-county area lived in Multnomah County; by 2030, it is projected that only 29% will live in Multnomah County. Washington County's share of residents is projected to grow the most, but Clackamas County's will also grow significantly. Clackamas County accounted for 15% of the five-county population in 1970, but its share is projected to grow to 20% by 2030.

Higher income usually correlates with GA activity. In the five-county region, Clackamas County has the highest per capita personal income, as shown in **Table 3D**.

Table 3D. Per Capita Personal Income History, Five Counties, OR, and the U.S.

County	1980	1990	2000	Annual Growth 1980-2000
Clackamas County	$11,395	$20,865	$36,556	6.0%
Multnomah County	$11,381	$20,770	$32,329	5.4%
Washington County	$11,983	$20,969	$33,178	5.2%
Marion County	$9,602	$16,832	$24,439	4.8%
Yamhill County	$9,437	$16,049	$24,364	4.9%
State of Oregon	$10,113	$18,010	$28,097	5.2%
U.S.	$10,114	$19,477	$29,845	5.6%

Source: US Bureau of Economic Analysis, 2006

From 1970 to 2000, the total number of people employed within Clackamas County grew twice as fast as the population growth in the County, from 48,979 to 190,727. This strong employment growth in the county could mean increased business aviation activity at airports located there. An indication of the growth and diversification of employment within the County is the current construction of an 87-acre heavy-industrial park in Molalla; anticipated tenants include an industrial plastic recycling plant and a manufacturer of medical devices.[8]

Table 3E shows that Clackamas County residents have a slightly higher than average propensity to own aircraft, compared to the five-county area as a whole. Proportionately, significantly more Clackamas County residents own aircraft than Washington, Multnomah, or Marion County residents. Low density development, residential airparks, higher-than-average income, and the proximity of outdoor recreation opportunities may all contribute to the popularity of general aviation in Clackamas County.

Table 3E. Comparison of Population and Aircraft Registration

Area	Population	Registered Aircraft	Registered Aircraft per 1,000 Population
Clackamas County	361,300	872	2.4
Washington County	489,785	798	1.6
Multnomah County	692,825	1,147	1.7
Marion County	302,135	542	1.8
Yamhill County	90,310	413	4.6
Five-County Totals	1,936,355	3,772	1.9
State of Oregon Totals	3,631,440	9,385	2.6

Source: Population as of 2005, estimated by Portland State University's Population Research Center. Registered aircraft data from FAA Civil Aviation Registry, October 14, 2006.

In recent years, unemployment in Oregon has been higher than the U.S. as a whole. In July 2006, the unemployment rate was 5.3%, compared to 4.8% for the U.S. The unemployment rate in the Portland-Vancouver-Beaverton metropolitan statistical area (MSA) was also 5.3%. In contrast, unemployment in Clackamas County was 4.9%, indicating the relative strength of its economy within the metro area. For the last 20 years or so, Oregon has been moving from a resource-based economy to a more mixed manufacturing and marketing economy, with an

[8] Oregon Employment Department, (2005, September).

emphasis on high technology. The high-tech sector has grown in the Portland metro area, while more rural parts of the state have been less successful at changing to a new economy.[9] Molalla, the closest incorporated town to the Mulino Airport, is typical of many small communities whose economic base has been shifting from the timber industry.

In spite of the fact that Portland is the state's largest urban area, agriculture is a significant part of the Portland metro area economy, accounting for 25% of the state's total agricultural sales in 2005. Specialty products are the driving force for agriculture's success. Clackamas County leads the metro area in agricultural sales revenue ($361.9 million). The County has a strong nursery industry and is the state's top producer of Christmas trees (with 1,670 acres devoted to growing this particular crop). The county is also Oregon's second largest producer of chicken eggs, and is a significant producer of fruits and berries. Clackamas County has 46,000 acres planted in crops. The most predominant crops are hay and forage.[10]

As of July 2006, total non-farm employment (seasonally adjusted) in the Portland-Vancouver-Beaverton MSA was 1,006,900, representing 95% of total employment. Of these non-farm jobs, 87% were in private industry and 13% were in federal, state, or local government. The leaders in private industry jobs were trade, transportation, and utilities (201,200 jobs), professional and business services (135,100 jobs), manufacturing (128,200 jobs), and educational and health services (118,800 jobs).

BASED AIRCRAFT FORECAST

The based aircraft forecast begins by presenting historical numbers of based aircraft. Then, various forecast models prepared for the Airport are analyzed and the preferred forecast for based aircraft and fleet mix through 2027 is presented.

Historical Based Aircraft Data

Table 3F indicates historical numbers of based aircraft from 1984 through 2006, as reported in the FAA's 2006 Terminal Area Forecast and updated by the Port.

All of the aircraft based at the Airport are single engine piston. Records show that up to two multi-engine aircraft have been based at the Airport at one time. Until recently the Civil Air Patrol based two gliders at the Airport, but they were destroyed in 2005.[11]

[9] Oregon Bluebook. Retrieved 10/16/06 at http: Bluebook.state.or.us/facts/economy.
[10] Oregon Employment Department. (2006, September). *Workforce Analysis, Portland Trends*.
[11] The Civil Air Patrol hopes to obtain a glider and tow plane soon, so they can reinstate cadet orientation rides at Mulino Airport (an estimated 960 annual aircraft operations).

Table 3F. Historical Based Aircraft at Mulino Airport

Year	Based Aircraft	Year	Based Aircraft
1984	39	1996	57
1985	39	1997	57
1986	39	1998	57
1987	39	1999	53
1988	39	2000	53
1989	39	2001	53
1990	39	2002	53
1991	30	2003	53
1992	30	2004	42
1993	30	2005	40
1994	30	2006*	40
1995	45		

**Partial calendar year figure with no significant changes anticipated through year-end.*
Source: 1984-2004, FAA Terminal Area Forecasts, 2006. 2005 – 2006, Port of Portland

Based Aircraft Forecast Through 2027

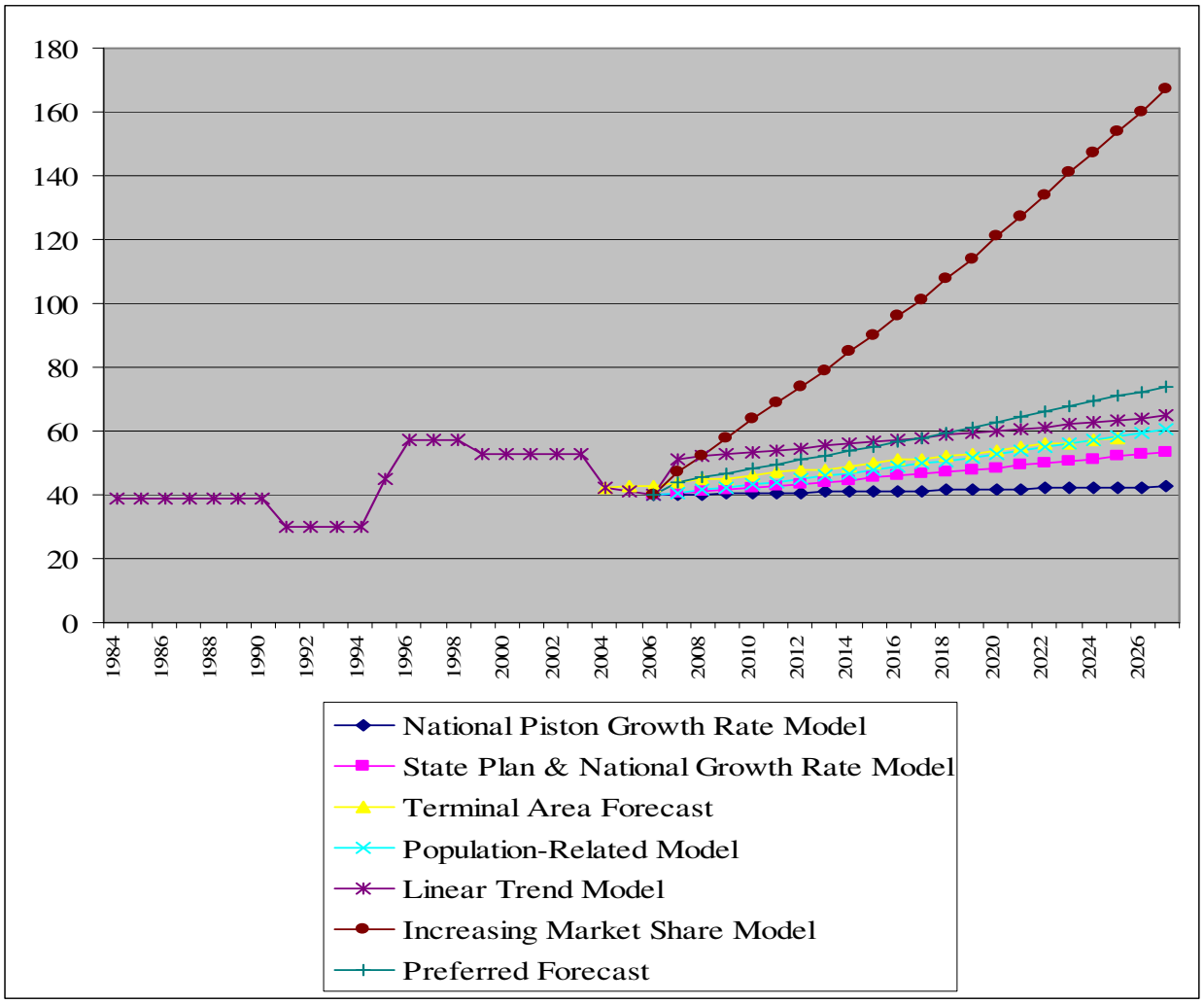
Six different forecasts or forecasting models were developed to provide a range of the possible numbers of based aircraft. The average annual growth rates for these six models ranged from 0.3% to 7.0%, as shown in **Table 3G**. Each forecast is described in the paragraphs to follow. **The preferred forecast was derived by a simple averaging of the six possible forecasts, which resulted in an average annual growth rate of 3.0%.** All six and the preferred forecast are described and evaluated below, and the reason for selecting the preferred forecast is explained. **Exhibit 3A** graphically compares these forecasts. While the exhibit presents the forecasts as increasing year-by-year according to average growth rates, actual growth will occur in steps, as hangars are constructed and made available for based aircraft.

Table 3G. Comparison of Based Aircraft Forecasts

Year	National Piston Growth Rate Model	State Plan & National Growth Rate Model	Terminal Area Forecast	Population-Related Model	Linear Trend Model	Increasing Market Share Model	Preferred Forecast
2006	40	40	43	40	40	40	40
2012	41	43	48	45	55	74	51
2017	41	47	51	50	58	101	58
2027	43	54		61	65	167	74
Annual Growth	0.3%	1.4%	1.5%	2.0%	2.3%	7.0%	3.0%

Source: W&H Pacific, 2006.

Exhibit 3A. Graphic Comparison of Based Aircraft Forecasts



Source: W&H Pacific, 2006.

National Piston Growth Rate Model (0.3% Average Annual Growth)

All the airplanes based at the Mulino Airport now and in the past have been piston-powered. It is reasonable to assume that the based aircraft at the Mulino Airport may grow at the rate forecast for piston airplanes nationwide, shown in Table 3A. However, this model does not take into consideration that the population in Clackamas County is projected to grow faster than the U.S. population (1.5% annually compared to 1.0%). Also, it does not take into consideration the possibility of airplanes moving from nearby airports that are either closing or at capacity.

State Plan & National Growth Rate Model (1.4% Average Annual Growth)

The average annual growth rate for GA in the Oregon Aviation Plan is the same as the FAA's projected growth rate for the national GA fleet shown in Table 3A. One potential problem with this model is that local influences on the number of based aircraft at the Mulino Airport are not considered.

Terminal Area Forecast (1.5% Average Annual Growth)

The FAA's Terminal Area Forecast for the Mulino Airport, prepared in 2006, shows 1.5% annual growth from 2004 (its base year) to 2025. (Coincidentally, 1.5% annual growth is the rate projected for Clackamas County population in Table 3C.) Mulino's Terminal Area Forecast is based upon the forecasts prepared in the 1993 Master Plan Update. The reasoning behind the forecast is nearly 15 years old and may need updating.

Population-Related Model (2.0% Average Annual Growth)

The population of Clackamas County is projected to grow at a rate that is 50% higher than that for the nation (average annual growth of 1.5% compared to 1.0%). Because of this, it is reasonable to expect that GA aircraft would increase at a faster pace in the Mulino Airport vicinity than in the nation as a whole (1.4% per year). Based aircraft at the Mulino Airport might reasonably be expected to grow 2.0% per year because of the faster regional population growth.

Linear Trend Model (2.3% Average Annual Growth)

The linear trend model projects a straight-line continuation of the historical trend into the future. Future growth consistent with the historical trends is likely limited without additional hangar development. With the planned hangar expansion; however, growth may not be limited by lack of hangar storage.

Increasing Market Share Model (7.0% Average Annual Growth)

This forecast model assumes that the closure and constraints on privately owned airports in the Mulino service area will result in some shifting of based aircraft from privately owned airports to the Mulino Airport. Within approximately a half-hour drive of the Mulino Airport are 21 airports. Mulino and these 21 airports have a combined 669 based aircraft. The full list of airports and their based aircraft are in Tables 1A and 1B of Chapter One. Other than Mulino, the major airports are Aurora State (387 aircraft), Lenhardt Airpark (59 aircraft), Valley View (33 aircraft), Dietz Airpark (32 aircraft), Fairways Airport (31 aircraft), and Workman Airpark (27 aircraft). The Increasing Market Share Model assumes the number of aircraft in the Mulino Airport service area will grow at an average annual rate of 1.3%. This growth rate matches the growth rate forecast for Aurora State Airport. It is slightly lower than population growth projected in Clackamas County (1.5%) and slightly lower than national growth projected for the GA fleet (1.4%). Using a lower rate is reasonable because of the preponderance of single engine piston aircraft, which are projected to grow much more slowly than other types of GA aircraft. Of the total 669 aircraft based at the 22 airports, 87% are single engine piston aircraft.

The Increasing Market Share Model adopts the 1.3% annual growth rate from the Terminal Area Forecast for Aurora State Airport, which was based on its Master Plan Update. The forecast model applies this growth rate to the total number of based aircraft in the service area, and also assumes that every year two aircraft (on average) are relocated to the Mulino Airport from another airport in the service area. Relocations would be due primarily to closure and constraints at privately owned airports within the service area. **Table 3H** presents the resulting forecast for the service area. According to this forecasting model, the Aurora State Airport would retain 60% of the based aircraft in the service area through 2027, while the Mulino Airport's share would grow from 6% to 19%. The resultant growth of the Mulino Airport to 167 aircraft in 2027 represents a high average annual growth rate of 7.0%. However, this forecast model might not

overstate the growth potential, considering the fact that there is currently a waiting list of 37 people for a hangar at the Mulino Airport and considering the potential impact of building new hangars and making fuel available.

Table 3H. Potential Service Area Forecast

Year	Aurora State Airport	Mulino Airport	20 Other Service Area Airports	Total
2006	398	40	231	669
2012	430	74	219	723
2017	461	101	209	771
2027	521	167	189	877
Annual Growth	1.3%	7.0%	-0.9%	1.3%

Preferred Forecast (3.0% Average Annual Growth)

The average of the previous forecasts represents a 3.0% average annual growth rate from 40 based aircraft to 74 aircraft in 2027—a reasonable scenario for planning airport development. The Increasing Market Share Model's annual growth rate of 7% seems unreasonably high. On the other hand, the other forecast rates of 0.3% to 2.3% annual growth are based on no change in the Mulino Airport's market share. The preferred forecast addresses the likelihood that one or more privately owned airports in the service area will be closed or capacity constrained in the future. One airport user projected approximately 10 aircraft would relocate from Fairways Airport to Mulino Airport in 2007 if the hangars were available. If this occurs, and then 2.0% annual growth (same rate as projected population growth) occurs after 2007, the number of based aircraft in 2027 would be 74, the same number that results from a 3.0% annual growth rate applied to the 2006 number of based aircraft.

Consistent with the strategic analysis presented in Chapter One, the fleet mix of aircraft will not change appreciably. **Table 3I** presents the based aircraft fleet mix forecast. The forecast includes a small number of multi-engine aircraft in the future. Multi-engine aircraft have been based at the Airport in the past. The Airport's ability to accommodate aircraft with wingspans up to 79 feet should be attractive to the owners of multi-engine aircraft, which tend to be larger than single engine aircraft.

Table 3I. Preferred Based Aircraft Fleet Mix Forecast

Year	Single Engine	Multi-engine	Total
2006	40	0	40
2012	50	1	51
2017	56	2	58
2027	71	3	74

Source: W&H Pacific, 2006.

AIRCRAFT OPERATIONS FORECAST

This section begins with a review of historical trends in aircraft operations. Previous aircraft operations forecasts are reviewed and the preferred aircraft operations forecast is explained and presented. Other forecast information presented in this section includes operations fleet mix, critical aircraft and Airport Reference Code, local vs. itinerant operations, and peak activity.

Historical Aircraft Operations Data

Table 3J presents the history of annual aircraft operations according to the FAA's Terminal Area Forecast. Operations are divided into two basic categories: itinerant and local. Local operations are defined as touch-and-go, or training operations, as well as any other operations that stay within 20 miles of the Airport. All other operations are categorized as itinerant. Another distinction for aircraft operations at the Mulino Airport is that they occur in either GA or air taxi aircraft. Air taxi aircraft operations are chartered, for-hire, passenger-carrying commercial flights.

Table 3J. Historical Aircraft Operations

	Itinerant Operations			Local Operations			
Year	Air Taxi	GA	Total	GA	Military	Total	Total Operations
1980	0	7,000	7,000	20,000	0	20,000	27,000
1981	75	7,000	7,075	20,000	0	20,000	27,075
1982	75	11,000	11,075	11,000	0	11,000	22,075
1983	0	4,200	4,200	12,000	0	12,000	16,200
1984	100	4,200	4,300	12,000	0	12,000	16,300
1985	100	4,200	4,300	12,000	0	12,000	16,300
1986	100	4,200	4,300	12,000	0	12,000	16,300
1987	100	4,200	4,300	12,000	0	12,000	16,300
1988	0	4,681	4,681	13,460	0	13,460	18,141
1989	100	4,200	4,300	10,000	0	10,000	14,300
1990	100	4,200	4,300	12,000	0	12,000	16,300
1991	100	6,000	6,100	9,000	0	9,000	15,100
1992	100	4,200	4,300	12,000	0	12,000	16,300
1993	100	4,200	4,300	12,000	0	12,000	16,300
1994	100	4,200	4,300	12,000	0	12,000	16,300
1995	100	4,200	4,300	12,000	0	12,000	16,300
1996	100	19,200	19,300	12,800	0	12,800	32,100
1997	100	19,517	19,617	13,012	0	13,012	32,629
1998	100	19,850	19,950	13,234	0	13,234	33,184
1999	100	20,199	20,299	13,467	0	13,467	33,766
2000	100	20,548	20,648	13,700	0	13,700	34,348
2001	100	20,490	20,590	13,661	0	13,661	34,251
2002	100	20,853	20,953	13,903	0	13,903	34,856
2003	100	21,217	21,317	14,145	0	14,145	35,462
2004*	100	21,577	21,677	14,385	0	14,385	36,062
2005**	100	21,941	22,041	14,627	0	14,627	36,668
2006**	100	22,304	22,404	14,870	0	14,870	37,274

**Does not match annual operations from FAA's Airport Master Record (5010 Form) for 2004, which is 21,300.*
***Forecast numbers from Terminal Area Forecasts, FAA, 2006*
Source: Terminal Area Forecasts, FAA, 2006.

The 2006 estimate of 37,274 annual aircraft operations in Table 3J may be inaccurate. The FAA's Airport Master Record (5010 Form with 9/10/04 inspection date) reported 21,300 operations for the 12 months preceding August 31, 2004. The Airport Master Record number is considerably lower than the number for 2004 in the Terminal Area Forecast (36,062 operations). Besides being inconsistent with each other, the operations numbers from the Airport Master Record and the Terminal Area Forecast have been criticized as being overstated. Annual operations of 21,300 or 37,274 seem high for a GA airport with only 40 based aircraft and no flight school. However, there is no way to determine a more correct number, short of documenting actual activity over the course of a full year.

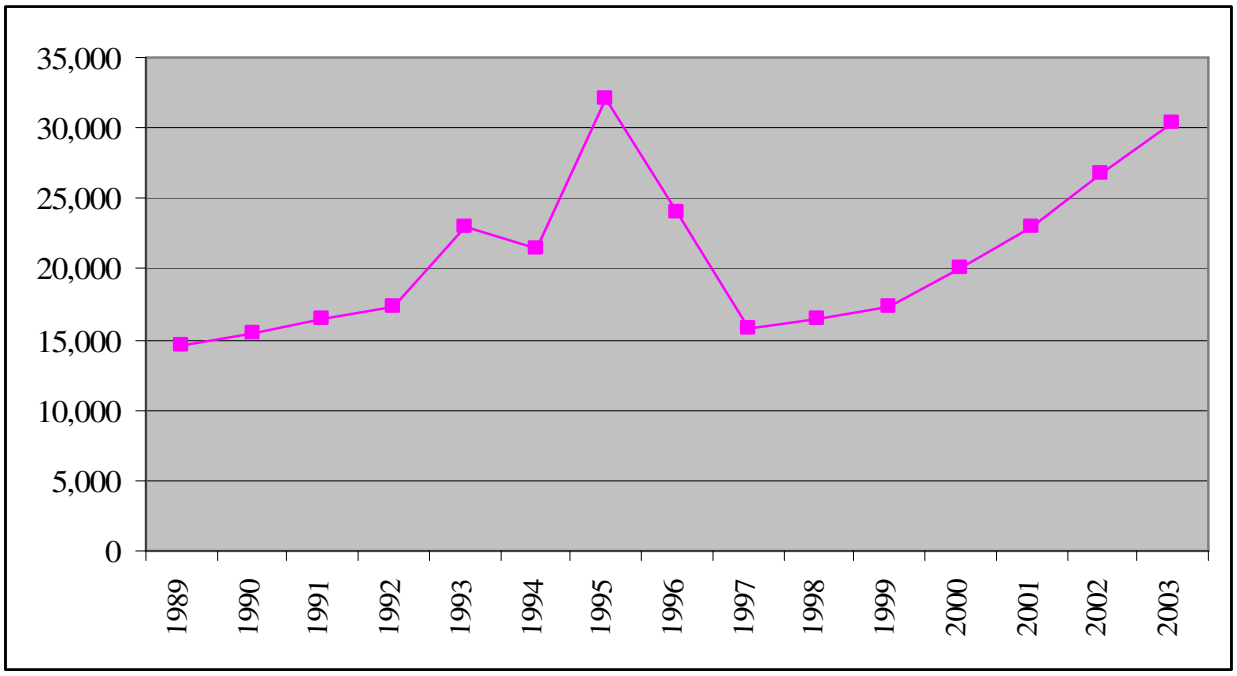
It is difficult to measure aircraft operations at airports lacking air traffic control towers and even harder at unattended airports (no fixed base operator). For such airports, the numbers of annual aircraft reported in the FAA's Terminal Area Forecast are usually based on numbers reported in FAA Airport Master Records (5010 Forms), although this does not appear to be the case in 2004. Airport Master Records are not updated every year and the numbers reported on Airport Master Records are often estimates by airport management. The source of the operations numbers for the Mulino Airport may have been derived from the ODA's RENS Aircraft Activity Counter Program, as detailed below.

The ODA periodically places an acoustical counter, which records the sound of aircraft takeoffs, at non-towered airports around the state. Annual aircraft operations are then estimated based on the sampling. Occasionally the counter records sounds other than aircraft or fails to record an aircraft operation. In addition, the sample period may not reflect average activity, leading to a faulty estimation of annual operations. Nevertheless, the acoustical counter records help understand the level and trends of aircraft operations. Counter records for the Mulino Airport, shown in **Exhibit 3B**, indicate that operations grew from around 15,000 in 1989 to more than 30,000 in 1995. They dropped down to approximately 15,000 in 1997. Since 1997, operations have risen fairly steadily to over 30,000 in 2003. The dramatic increase in operations between 1994 and 1995 (from 21,470 to 32,138) may be due to the fact that 1995 was the first year that the counts included rotary aircraft.

The acoustical counter records in Exhibit 3B do not match the Terminal Area Forecast operations in Table 3J. For example, Exhibit 3B shows operations derived from the acoustical counter increased 50% between 1994 and 1995, a period of no operations growth according to Table 3J. However, Table 3J shows a doubling of operations between 1995 and 1996. Possibly the acoustical counter data's increase in operations in 1995 was attributed to helicopter activity that had not been acoustically counted in previous years, and an increase was reported a year later in the Terminal Area Forecast.

In spite of their differences, both the Terminal Area Forecast and acoustical counter records show operations growing since 1997, a period in which the number of based aircraft declined. This is most likely due to an increasing amount of traffic by transient aircraft rather than more operations by based aircraft. Since the number of based aircraft declined while the number of operations grew, the number of operations by based aircraft would have to grow to an unreasonably high number if there were no increase in transient aircraft operations.

Exhibit 3B. Historical Aircraft Operations - Acoustical Counter Records



Note: 1990, 1991, 1996, 1998, 2000, and 2002 operations were interpolated between years when acoustical counting occurred.
Source: ODA RENS Aircraft Activity Counter Program.

Other measures of activity were sought to identify trends in traffic levels at the Airport. The amount of fuel sold over a period of time is often used, but it is not applicable to Mulino because no fuel is sold at the Airport. The number of breakfasts sold at the annual pancake breakfast fly-in that the Oregon Pilots Association sponsors every June measures activity at the fly-in, which is Mulino Airport's busiest time. The Oregon Pilots Association, Mulino Chapter, reports a steady increase in the number of breakfasts sold from 1,150 in 2002 to 1,375 in 2006, although it is possibly due to an increase in drive-in participation instead of fly-in participation:

Aircraft Operations Forecast Through 2027

The national FAA forecasts presented in Table 3A indicate that GA aircraft usage will increase. While the fleet is projected to grow 1.4% per year, hours flown are projected to grow 3.2% per year. For the piston fleet, the hours flown are projected to grow 1.2% annually, while the number of piston aircraft is projected to grow only 0.3% annually. Based upon these differences in growth rates, it would be logical to assume that aircraft operations will grow at a higher rate than based aircraft nationally.

On the other hand, dividing 2006 operations by the number of based aircraft results in an average of 932 operations per based aircraft. This is a very high ratio of operations to based aircraft. The FAA has recommended using 450 operations per based aircraft to estimate operations at very busy reliever airports. Rural/remote airports with little itinerant traffic should have about 250 operations per based aircraft. Comparing the historical aircraft operations and based aircraft records in Tables 3J and 3F, respectively, the Mulino Airport's operations per based aircraft ratio

has been as low as 367 (in 1989) and has averaged 568 since 1984. Looking at the nine years of RENS operations counts available between 1989 and 2003, the ratio of operations per based aircraft has been as high as 765, as low as 276, and has averaged 529.

Table 3K presents three forecasts for aircraft operations. The FAA's Terminal Area Forecast was based upon the 1993 Mulino Airport Master Plan Update. It projects an average annual growth of 1.5% through 2025. The Linear Trend Forecast projects a straight-line continuation of the historical trend for each component of aircraft operations, resulting in the following growth rates:

Air taxi	+2.2% average annual growth
GA itinerant	+2.7% average annual growth
GA local	-0.6% average annual growth
Total operations	+1.6% average annual growth

The preferred forecast does not depend upon the accuracy of the 2006 operations number reported in the Terminal Area Forecast, as the Linear Trend Forecast does. **Instead, the preferred aircraft operations forecast uses the historical 23-year average of 568 operations per based aircraft. By using the historical average of 568 operations per based aircraft, there is some continuity with historical records of operations.** While a ratio of 350 operations might be more consistent with general FAA guidance (between the 250 operations per based aircraft expected at a rural/remote airport with little itinerant traffic and the 450 operations per based aircraft expected at a busy reliever airport), it would probably understate operations. Understating numbers of operations would be a serious concern when they are used to determine noise exposure. In addition, the RENS acoustical count estimates that are available for nine years average 529 operations per based aircraft, which is close to the historical Terminal Area Forecast average of 568.

To project annual operations in the future, the based aircraft forecast numbers from Table 3I were multiplied by 568. **Because the 568 operations per based aircraft ratio is much lower than the single-year 2006 ratio of 932 operations per based aircraft, the preferred aircraft operations forecast shows a decline in operations from 2006 to 2012, and only 0.6% average annual growth from 2006 to 2027.** The reduced operations between 2006 and 2012 result in smaller noise contours for the Airport, as is indicated in the drawing in Chapter 7.

Table 3K. Comparison of Aircraft Operations Forecasts

Year	Terminal Area Forecast	Linear Trend	Preferred Forecast
2006	37,274*	37,274*	37,274*
2012	40,697	40,199	28,968
2017	43,789	44,275	32,944
2027	-	52,426	42,032
Average Annual Growth	1.5%	1.6%	0.6% from 2006 – 2027 2.5% from 2012 – 2027

**The accuracy of the base year (2006) operations figure is questionable; a more accurate number may be 21,300, the number reported for 2004 in the FAA's Airport Master Record (5010 Form).*
Source: W&H Pacific, 2006, except 2006 figures and figures in Terminal Area Forecast column are from Terminal Area Forecast, FAA, 2006.

Very likely, the 2006 operations number reported in the Terminal Area Forecast and shown in Table 3K is much higher than reality. If 2006 operations are actually closer to the 21,300 operations reported for 2004 in the Airport Master Record, the preferred forecast for operations would show growth rather than decline between 2006 and 2012. For the years after 2006, the preferred forecast for operations shows growth comparable to the preferred forecast for based aircraft, since it is derived from the based aircraft forecast.

Table 3L presents the breakdown of the preferred forecast for aircraft operations. Following the table is an explanation of how the breakdown was determined.

Table 3L. Preferred Aircraft Operations Forecast

Year	Air Taxi	GA Itinerant	GA Local	Total
2006	100	22,304	14,870	37,274
2012	121	17,308	11,539	28,968
2017	141	19,682	13,121	32,944
2027	194	25,103	16,735	42,032

Source: W&H Pacific, 2006.

Air taxi operations have been listed as 100 per year since 1989. One of the national trends that is expected to affect the Mulino Airport is a significant increase in air taxi aircraft operations. Air taxi operations are projected to increase at 3.2% annually, which is the FAA's forecast increase for air taxi aircraft hours flown (the same as GA aircraft hours flown in Table 3A). Despite this growth, air taxi aircraft operations will represent less than 0.5% of total operations in 2027.

The reported split between itinerant and local operations has been 60% itinerant and 40% local for the last ten years. The preferred forecast assumes future GA operations will be similarly divided between itinerant and local.

The Airport has no air carrier or military aircraft operations now, and it is assumed this will be the case over the planning period. The Airport's ARC B-II airfield is not adequate for use by air carrier aircraft, which seat over 60 passengers and are typically ARC C-III and larger. Military aircraft use other airports in the metro.

Operations Fleet Mix

Many transient aircraft use the Mulino Airport today and this situation is not anticipated to change in the future. Because of transient aircraft traffic, the fleet mix for aircraft operations is not the same as the fleet mix for based aircraft. For example, while there are no helicopters based at the Airport, there are many helicopter operations occurring there. Helicopter training from flight schools in Hillsboro and Aurora occurs often at the Mulino Airport. Less frequently, helicopter operations for medevac and firefighting occur at the Airport.

None of the air taxi aircraft operating at the Airport are based there. Some of the estimated air taxi operations are by air ambulances and others are chartered for business or recreation purposes. Generally, air taxi aircraft are larger and faster than the single engine piston aircraft based at the Airport.

Table 3M presents the estimated current (2006) and projected future operations fleet mix. The current fleet mix was estimated from surveys and interviews with Airport users. Table 3M indicates that current operations include single and multi-engine piston aircraft, turboprops, and helicopters. In the future, it is projected that air taxi and GA aircraft using the Airport will include more turboprops, such as the King Air models, and eventually even some turbojet aircraft, such as the new VLJs, which will be comparably priced. The first certificated VLJ, the Eclipse 500, is categorized Airport Reference Code A-I and is well below 12,500 pounds takeoff weight. The Mulino Airport airfield can easily accommodate the Eclipse 500, and it is likely that a few VLJ operators will use the Mulino Airport to access destinations in the local area. However, throughout the forecast period, the Aurora State Airport's location, facilities, and services will continue to be more attractive to turbojet operators and their passengers than the location, facilities, and services at the Mulino Airport.

Table 3M. Preferred Operations Fleet Mix Forecast

Year	Single Engine Piston	Multi-Engine Piston	Turboprop	Turbojet	Helicopter
2006	86.6%	1.1%	0.3%	0.0%	12.0%
2012	86.0%	1.5%	0.5%	0.0%	12.0%
2017	86.0%	1.0%	1.0%	0.0%	12.0%
2027	85.5%	1.0%	1.0%	0.5%	12.0%

Source: W&H Pacific, 2006.

Critical Aircraft and Airport Reference Code

Based upon the estimated operations fleet mix in Table 3M for 2006, there are slightly over 500 annual operations in multi-engine piston (410) and turboprop aircraft (119) now. By 2027, the annual number of operations by multi engine piston, turboprop and turbojet aircraft is projected to reach 1,050 (2.5% of 42,032). For existing and future conditions, the Beech King Air represents the critical design aircraft--Airport Reference Code B-II and 12,500 pounds maximum takeoff weight.

Peak Demand Forecast

As airport activity often fluctuates from month to month, day to day, and hour to hour, airfield and landside facilities are traditionally designed to accommodate reasonable peak levels of use. Interviews with Mulino Airport users have resulted in some consensus about the peaks and valleys of airport use. The Airport is busier in the summer than in the winter, and it is busier on the weekends than during the week.

In preparing the peak demand forecast, it was useful to compare Mulino with other airports in the area. Peak activity characteristics are available for Troutdale and Aurora State Airports in their most recent Master Plan Updates. Troutdale's peak activity characteristics are especially useful because they were determined by air traffic control data. Their based aircraft fleet mix and the type of activities that occur there are also somewhat similar to Mulino.

- An estimated 12% of annual operations are projected to occur during the peak summer month. This is about the same proportion as occurs at Troutdale Airport (11.7%). It is higher than Aurora State Airport (10%), but this is to be expected, since Aurora State has more business traffic, which is less seasonal than recreational traffic.
- The design day operations are the peak month operations divided by 31 days.
- The peak hour is estimated to be 20% of the design day. At Aurora, it is 11% of the design day. Unlike Mulino, Aurora State Airport's operations occur at night as well as during the daytime. Troutdale's Master Plan Update reports 19.71% of peak day operations occurring in the peak hour.

Table 3N presents the operations forecasts resulting from peak demand factors described above.

Table 3N. Preferred Peak Operations Forecast

	2012	2017	2027
Annual Operations	28,968	32,944	42,032
Peak Month	3,476	3,953	5,044
Design Day	112	128	163
Peak Hour	22	26	33

Source: W&H Pacific, 2006.

SUMMARY OF FORECASTS

The long term growth of the Airport will be influenced by national and regional trends outlined within this chapter. The elements of the aeronautical activity forecast for the Mulino Airport are summarized in **Table 3O**. The FAA, as documented in **Appendix G**, has approved the aeronautical activity forecast.

With this forecast data, the next step in the master planning process is to calculate the ability of existing facilities to meet the forecasted demand. Additionally, the next chapter will identify needed enhancements of airside and/or landside facilities to accommodate forecasted demand.

Table 3O. Summary of Preferred Mulino Airport Aeronautical Activity Forecasts

Forecast Element	2006	2012	2017	2027
BASED AIRCRAFT				
Single Engine Piston	40	50	56	71
Multi-engine Piston	0	1	2	3
Total	40	51	58	74
AIRCRAFT OPERATIONS				
Air Taxi	100	121	141	194
GA Itinerant	22,304	17,308	19,682	25,103
GA Local	14,870	11,539	13,121	16,735
Total	37,274	28,968	32,944	42,032
OPERATIONS FLEET MIX				
Single Engine Piston	32,274	24,912	28,332	35,937
Multi-engine Piston*	400	435	329	420
Turboprop	100	145	329	420
Turbojet	0	0	0	210
Helicopters	4,500	3,476	3,953	5,044
Total	37,274	28,968	32,944	42,032
PEAK DEMAND (OPERATIONS)				
Peak Month	4,473	3,476	3,953	5,044
Average Day/Peak Month	144	112	128	163
Peak Hour	29	22	26	33

**Multi-engine Piston operations decline from 2012 to 2017 because their share of the operations mix declines from 1.5% to 1.0%, as shown in Table 3M. Their share of the operations mix stays at 1.0% between 2017 and 2027 and so the number of multi-engine operations grows from 2017 to 2027 because total operations are projected to grow.*
Source: W&H Pacific, 2006.