Chapter Four: FACILITY REQUIREMENTS

Airport Master Plan Update

Aurora State Airport

In this chapter, existing airport facilities are evaluated to identify their functionality, condition, compliance with design standards, and capacity to accommodate demand projected in Chapter Three, *Aeronautical Activity Forecasts*.

The objective of this effort is to identify what facilities are needed and the adequacy of the existing airport facilities in meeting those needs. Where differences between existing and needed facilities are noted, this chapter identifies when those additional facilities may be needed. Once the facility requirements have been established, alternatives for providing these facilities will be created with input from the Oregon Department of Aviation (ODA), the Federal Aviation Administration (FAA), and the Planning Advisory Committee (PAC). The alternatives will be discussed in Chapter Five.

FAA Advisory Circular 150/5070-6B, *Airport Master Plans*, states the following about this stage of the planning process:

> Planners should determine what, if any, additional facilities will be required to accommodate forecast activity. This task begins with an assessment of the ability of existing facilities to meet current and future demand. If they cannot, planners must determine what additional facilities will be needed to accommodate the unmet demand.
>
> In some cases, the airport sponsor may decide that it is in the community's best interest for the airport not to continue to grow to accommodate forecast activity, or to accommodate forecast activity only up to a point. In these cases, the master plan should document this decision and indicate the probable consequences of the decision (e.g., demand will be capped, the demand will go unmet, or the demand will be diverted to another airport).

At this time, ODA has not decided to constrain Aurora State Airport's ability to meet the unconstrained forecasts presented in Chapter Three. Such a decision may occur later. Facility requirements were constrained in the 2000 airport master plan update because ODA made a policy decision to do so. In the 2000 Master Plan update, forecasting determined the Airport Reference Code (ARC) as B-II, which meant that airport design should accommodate light jets and turboprop aircraft, as well as less demanding aircraft types. Unconstrained forecasting projected jet traffic at the Airport would grow so that the future ARC would be C-II, which meant that airport design should accommodate more medium-sized jets. ODA made a policy decision to constrain the forecasts by constraining the ARC to B-II. Since then, aircraft activity growth has exceeded both the unconstrained and constrained forecasts in the 2000 master plan update. Current activity has passed the FAA's threshold for the ARC to be C-II. This has been possible because the airfield is adequate for many operators of Aircraft Approach Category C airplanes, even though the Airport does not meet all design standards for ARC C-II. In this current master plan update, ODA will examine the impacts of meeting ARC C-II design standards and of accommodating the unconstrained forecasts from Chapter Three. It is anticipated that airport development alternatives analyzed in the next chapter will compare meeting the unconstrained demand forecasts fully, with accommodating no growth, and with accommodating constrained growth. This will allow ODA, with advice from the PAC, to make an informed decision about the possibility of constraining Airport growth.

BACKGROUND

Airport Planning and Development Criteria

Airport planning and development criteria are often defined by both federal and state agencies. The FAA provides specific guidance concerning dimensional standards and many state agencies provide generalized guidance based on facilities offered and aircraft activity levels. Both sets of planning criteria are discussed below, along with some industry criteria.

State and Federal Criteria

ODA has created general guidelines in the 2007 Oregon Aviation Plan (OAP) for airport planning and development based on the roles or categories of airports within the statewide system. The OAP identified five airport categories, each with its own set of performance criteria. The categories are based on factors such as the Airport's function, the type and level of activity at the Airport, and the facilities and services available. The Aurora State Airport (Airport) is classified as Category II – Urban General Aviation Airport. The function of this category is to support all general aviation aircraft and accommodate corporate aviation activity, including business jets, helicopters, and other general aviation activity. The OAP identified a few deficiencies at the Airport for meeting Category II minimum and desired criteria. To correct these deficiencies, the OAP recommends the Airport should:

- Increase Airport Reference Code from B-II to C-II
- Correct parallel taxiway / runway centerline separation (deficiency corrected in 2008)
- Install precision instrument approach
- Install medium intensity taxiway lighting (MITL) (deficiency corrected in 2008)
- Construct designated cargo apron

The FAA specifies design standards by ARC and instrument approach visibility minimums. The ARC is a coding system used to relate airport design criteria to the operational (Aircraft Approach Category – AAC) and the physical characteristics (Airplane Design Group – ADG) of the airplanes intended to operate at an airport. In the previous chapter, it was determined that the ARC at the Airport is C-II, which is exemplified by the IAI Astra 1125. The airport design standards applicable for the IAI Astra 1125 are also applicable for many mid-sized business jets. An AAC of C represents aircraft with an approach speed between 121 and 141 knots. An ADG of II represents aircraft with tail heights of 20 to 30 feet and wingspans from 49 to 79 feet.

The Airport currently has nonprecision instrument approaches. For determining airport design criteria, instrument approach visibility minimums are divided into three categories:

- Visual and not lower than one-mile (currently at the Airport)
- Not lower than ¾-mile
- Lower than ¾-mile

The 2007 OAP and multiple Airport users – by means of survey – have indicated that a precision instrument approach procedure at the Airport would be desirable. New technology allows instrument approaches using the Global Positioning System (GPS) at a minimal cost, in terms of navigational aids and cockpit equipment. For many general aviation airports however, the cost of upgrading facilities (*e.g.*, larger safety clearances, installing lights) to the minimum requirements for the different approach visibility categories is a significant constraint to establishing or improving an instrument approach. This chapter presents the requirements of all the different instrument approach visibility minimums to aid in assessing the feasibility of an instrument approach, considering existing constraints.

Industry Criteria

The next paragraphs outline criteria important to the users of business jets and other business-oriented components of general aviation. These criteria are useful for planning the Airport's future but do not provide sufficient justification for the FAA to fund a project.

The National Business Aviation Association (NBAA) provides optimum and acceptable airport guidelines for corporate jets and turboprops, as shown in **Table 4A**. The guidelines describe specific aspects of airports important to business aviation operators, but are not intended to replace or override airport requirements under federal funding requirements. Table 4A indicates several features that the Airport lacks, including more runway length and instrumentation.

Table 4A. National Business Aviation Association Airport Guidelines

Airport Feature	Optimum		Acceptable	
Runways	Dimensions (ft.)[1]	Weight Capacity (lbs)[2]	Dimensions (ft.)	Weight Capacity (lbs)
Heavy Jet (above 50,000 pounds)	8,603 x 150	120,000	6,314 x 100	75,000
Medium Jet (up to 50,000 pounds)	6,314 x 100	75,000	5,742 x 100	50,000
Light Jet (up to 25,000 pounds)	5,170 x 100	50,000	4,597 x 75	20,000
Very Light Jet / Turboprop (up to 12,500 pounds)	4,597 x 75	25,000	3,453 x 60	15,000
	Taxiways for all runways 200 x 300 ft. ramp area min. Stabilized overruns on longest runway		Adequate ramp for maneuvering / parking	
Air Traffic Control (ATC) Tower	24 hours		None	
Lighting	Full approach light system High intensity runway lights Visual glideslope indictor on all runways		Runway End Identifier Lights (REIL) or Omnidirectional Approach Lighting System (ODALS) Medium intensity runway lights Visual glideslope on instrument runway Pilot controlled lights	
Instrument Procedures	Area Navigation (RNAV) Standard Instrument Departures (SIDs) Standard Terminal Arrival Route (STARs)		Area Navigation (RNAV) Standard Instrument Departures (SIDs) Standard Terminal Arrival Route (STARs)	
Weather Reporting	ASOS		AWOS	
Services	Full-service Fixed Base Operator (FBO)[3] Transient hangar space FAR Part 107[4] type security De-icing		Enclosed passenger waiting area Fuel/tiedowns Elementary security Telephone	
Maintenance	FAR Part 145 Repair Station		Minimal maintenance (tire/battery service, etc.)	
Amenities	Nearby hotel/motel Nearby restaurant		Distant hotel/motel Vending machines	

Source: NBAA Airports Handbook.

---

[1] *Runway lengths from NBAA (standard 59 degrees & sea level) were adjusted for Airport conditions (elevation, temperature, runway gradient) described later in this chapter. Actual runway lengths needed for specific aircraft in specific circumstances will vary.*

[2] *Aircraft weights shown are for the group's Maximum Takeoff Weight (MTOW). "Acceptable" runway weight capacities are to accommodate 100% of the fleet within each category. "Optimum" runway weight capacities accommodate 100% of the category's fleet, as well as occasional use by aircraft in larger categories.*

[3] *Staffed 24/7, fuel, passenger and crew lounge, rental cars, shuttle/crew car, vending machine*

[4] *Now TSR (Transportation Security Regulation) Part 1542.*

AIRFIELD REQUIREMENTS

As discussed in Chapter Two, airfield facilities are those related to the arrival, departure, and ground movement of aircraft. Airfield facility requirements are addressed for the following areas:

- Airfield Capacity
- Airfield Design Standards
- Runway Orientation, Length, Width, and Pavement Strength
- Taxiways
- Airport Visual Aids
- Airport Lighting
- Radio Navigational Aids and Instrument Approach Procedures
- Other Airfield Recommendations

Airfield Capacity

The capacity of the runway system to accommodate existing and future aircraft operations was determined using the FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*. This publication describes throughput methods for calculating airport capacity derived from computer models the FAA uses to analyze airport capacity and reduce aircraft delay.

Capacity determined by using the advisory circular reflects the level of aircraft operations at which average delay per aircraft is not more than four minutes. The advisory circular describes two different methods of calculating runway capacity. Both methods assume there are no airspace limitations that would adversely affect flight operations.

One method of calculating capacity is to look at runway diagrams in Figure 2.1 of the circular. The FAA recommends using the capacity numbers in Figure 2.1 only for long-range planning and acknowledges that the assumptions underlying the capacity numbers are not applicable to every airport. Figure 2.1 shows that the capacity of a single runway with a mix index[5] below 20% – conditions at Aurora State Airport – is as follows:

Annual Service Volume (ASV)	230,000 operations
Visual Flight Rules (VFR) Hourly Capacity	98 operations
Instrument Flight Rules (IFR) Hourly Capacity	59 operations

[5] *Mix index is the percentage of total aircraft operations by Class C aircraft (those with maximum takeoff weights between 12,500 and 300,000 pounds) plus three times the percentage of Class D aircraft (those over 300,000 pounds maximum takeoff weight). Mix index at Aurora State Airport was estimated assuming 80% of jet aircraft operations are in Class C, 10% of the turboprop aircraft operations are in Class C, and no operations are in Class D. Consequently, the estimated mix index for the Airport in 2010 is 11%. The mix index rises slightly over time, to 12% in 2015, 13% in 2020, and 16% in 2030.*

A more detailed analytical method from *Airport Capacity and Delay* found that specific circumstances at Aurora State Airport account for a lower estimation of the Airport's current capacity. The calculation of ASV considers three different weather conditions—92% of the time when weather is above VFR minimums, 3% of the time when weather is below VFR minimums but above the Airport's instrument approach minimums, and 5% of the time no operations occur because weather is below the instrument approach minimums.[6] Runway utilization (percentage of the time Runway 17 or 35 is used) was not a factor, since the taxiway exit locations are the same from either runway end.

Over the forecast period, the capacity of the Airport will decline as the mix index (percentage of airplanes with maximum takeoff weights over 12,500 pounds) increases. Other circumstances, such as the instrument approach visibility minimums, are assumed to remain the same. **Table 4B** shows how capacity declines and demand increases in the future. It compares annual and hourly capacity to annual and hourly demand over the forecast period.

Table 4B. Capacity Analysis (Aircraft Operations)

2010	**Annual**	**VFR Hourly**	**IFR Hourly**
Capacity	207,473	111	62
Demand	90,909	36	2
Ratio Demand to Capacity	44%	32%	3%
2015	Annual	VFR Hourly	IFR Hourly
Capacity	199,717	107	61
Demand	98,321	39	3
Ratio Demand to Capacity	50%	36%	5%
2020	Annual	VFR Hourly	IFR Hourly
Capacity	197,778	106	61
Demand	106,338	42	3
Ratio Demand to Capacity	55%	40%	5%
2030	Annual	VFR Hourly	IFR Hourly
Capacity	186,144	99	60
Demand	124,386	49	4
Ratio Demand to Capacity	67%	49%	7%

[6] *Instrument weather conditions were determined from Aurora State Airport weather data for 2000 through 2009 obtained from the National Oceanic and Atmospheric Administration (NOAA). The ten years of data included 77,646 weather observations made by the Airport's ASOS. Some data interpolation is required to estimate that IFR weather occurs 8% of the time. The lowest visibility minimums of instrument approaches to the Airport are 1 mile—a condition that is estimated to occur 5% of the time.*

The table shows that the demand forecast for the Airport stays below the capacity through 2030. FAA guidance[7] recommends planning for increased capacity (*e.g.*, additional taxiway exits, a new runway, or supplemental airport) when an airport reaches 60% to 75% of its capacity. Table 4B indicates that planning for additional capacity should not be required until near the end of the planning period.

Number and Orientation of Runways

The number of runways needed for an airport depends upon the level of aviation demand and wind coverage. The previous airfield capacity analysis concluded that an additional runway is not needed for the 2030 unconstrained forecast of aircraft operations. An analysis of wind coverage found that a crosswind runway is not needed at the Airport, as explained below.

For the operational safety and efficiency of an airport, it is desirable for the primary runway to be oriented as close as possible to the direction of the prevailing wind. This reduces the impact of crosswind components during landing or takeoff. Wind coverage is the percent of the time crosswind components are below an acceptable velocity. The desirable minimum wind coverage for an airport is 95%, based on maximum crosswind speeds that are defined for different sizes of aircraft (lower for smaller aircraft). Ten years of wind data (2000 through 2009) at Aurora State Airport were examined. The analysis found that Runway 17/35 exceeds the 95% threshold for a 10.5-knot (12 mph) crosswind, which is the maximum for the smallest airplanes.

Airfield Design Standards

FAA Advisory Circular 150/5300-13, *Airport Design,* sets forth the FAA's recommended standards for airport design. A few of the more critical design standards are those for runways and the areas surrounding runways, including:

- Runway Safety Area (RSA)
- Object Free Area (OFA)
- Obstacle Free Zone (OFZ)
- Runway Protection Zone (RPZ)

The RSA is a defined surface surrounding the runway that is prepared or suitable for reducing the risk of damage to airplanes in case of an airplane undershoot, overshoot, or an excursion from the runway.

The OFA is an area on the ground centered on the runway or taxiway centerline that is provided to enhance the safety of aircraft operations. No above ground objects are allowed except for those that need to be located in the OFA for air navigation or aircraft ground maneuvering purposes.

The OFZ is a volume of airspace that is required to be clear of objects, except for frangible items required for the navigation of aircraft. It is centered along the runway and extended runway centerline.

The RPZ is an area off each runway end whose purpose is to enhance the protection of people and property on the ground. The RPZ is trapezoidal in shape and centered about the extended runway

---

[7] *FAA Order 5090.3C, Field Formulation of the National Plan of Integrated Airport Systems (NPIAS), Table 3-2.*

centerline. The dimensions of an RPZ are a function of the runway ARC and approach visibility minimums. Among other things, the FAA recommends that RPZs be clear of all residences and places of public assembly (churches, schools, hospitals, etc.) and that airport owners acquire the land within the RPZs so they can control the use of land.

In addition to these design standards, the FAA provides recommended dimensions for runway width, taxiway width, taxiway safety areas, and others. **Table 4C** compares the Airport's existing B-II dimensions to the design standards for ARC C-II. The ARC C-II standards in Table 4C are based on three approach categories. One column reflects the existing approach minimums – visual and not lower than 1 statute mile. The other approach categories are not lower than ¾ statute mile and lower than ¾ statute mile.

Table 4C. Airfield Design Standards

		Existing Dimensions (ARC B-II)	ARC C-II Visual and not lower than 1 statute mile	ARC C-II Not lower than ¾ statute mile	ARC C-II Lower than ¾ statute mile
Runway Width		100’	100’	100’	100’
Runway Centerline to Parallel Taxiway Centerline Separation		300’	300’	300’	400’
RSA	Width	150’	500’	500’	500’
	Length beyond runway end	300’	1,000’	1,000’	1,000’
OFA	Width	500’	800’	800’	800’
	Length beyond runway end	300’	1,000’	1,000’	1,000’
OFZ	Width	250’	400’	400’	400’
	Length beyond runway end	200’	200’	200’	200’
Precision OFZ [8]	Width	N/A	N/A	N/A	800’
	Length	N/A	N/A	N/A	200’
RPZ	Inner Width	500’[9]	500’	1,000’	1,000’
	Outer Width	700’	1,010’	1,510’	1,750’
	Length	1,000’	1,700’	1,700’	2,500’
Runway Blast Pads	Width	0’	120’	120’	120’
	Length	0’	150’	150’	150’
Runway Shoulder Width		10’	10’	10’	10’
Taxiway Width		35’	35’	35’	35’
Taxiway Safety Area Width		79’	79’	79’	79’
Taxiway Object Free Area Width		131’	131’	131’	131’

Source: FAA Advisory Circular 150/5300-13

[8] *A Precision OFZ (POFZ) is a volume of airspace beginning at the runway threshold and at the threshold elevation. It is in effect only when the following three conditions are met: Vertically guided approach, reported ceiling below 250’ and/or visibility less than ¾ mile, and an aircraft on final approach within two miles of runway threshold.*

[9] *Existing RPZ dimensions meet the ARC B-II criteria for approaches with minimums not lower than 1 mile, which represents the existing instrument approach procedures into the Airport.*

The Airport meets or exceeds all B-II design standards for visual/not lower than 1 statute mile. Except for RPZ size, the Airport also meets or exceeds B-II design standards for not lower than ¾ statute mile approach minimums. For ARC B-II with approach minimums lower than ¾ statute mile, the Airport is deficient for RSA, OFA, and RPZ standards. When upgrading an airport's ARC from B-II to C-II, there are prominent increases in the dimensions of RSA, OFA, OFZ width, and RPZ, as shown in Table 4C.

Runway Length

The runway length required for an aircraft is different for landing and for takeoff, and it depends on several factors such as airport elevation, temperature, runway gradient, airplane operating weights, runway surface conditions (*i.e.*, wet or dry), and others. A single airplane using Aurora State Airport will require different runway lengths at different times, depending on temperature, runway surface condition, the airplane's weight, which varies with the stage length (length of trip or distance between refueling stops), and other factors.

FAA Advisory Circular 150/5325-4B, *Runway Length Requirements for Airport Design*, the FAA's Airport Design Computer Program, and aircraft manufacturers' specifications were consulted for guidance on recommended runway length at the Airport. In addition, aircraft operators were surveyed to quantify operations that are constrained by the current runway length at Aurora State Airport.

Both the Advisory Circular and the FAA's computer program classify aircraft based on weight. For "small" airplanes (those with maximum takeoff weights of 12,500 pounds or less), the classifications are further divided into two additional categories - small airplanes with fewer than 10 passenger seats and small airplanes with 10 or more passenger seats. Additionally, the program displays recommended runway lengths for airplanes between 12,500 and 60,000 pounds maximum takeoff weight. The computer program, using site-specific data, reflects runway length recommendations by grouping general aviation aircraft into several categories, reflecting the percentage of the fleet within each category. **Table 4D** summarizes the FAA's generalized runway length recommendations for the Airport.

The current runway length of 5,004 feet accommodates 100% of the small aircraft fleet with fewer than 10 passenger seats. However, the recommended lengths for larger aircraft exceed the current runway length.

Table 4D indicates that a longer runway may be needed at Aurora State Airport for airplanes over 12 ,500 pounds maximum takeoff weight. Table 4A also indicated a longer runway might be needed at the Airport for light and medium jets, according to NBAA recommendations. Planning for a longer runway may be justified based on these two tables, but to obtain FAA funding for a runway extension requires additional justification that is described in the next paragraphs.

Table 4D. Runway Length Requirements

Airport and Runway Data	
Airport elevation	200 feet
Mean daily maximum temperature of the hottest month	84° F
Maximum difference in runway centerline elevation	2 feet
Wet and slippery runways	
Runway Lengths Recommended for Airport Design	
Small airplanes with less than 10 passenger seats	
To accommodate 75 percent of these small airplanes	2,510 feet
To accommodate 95 percent of these small airplanes	3,060 feet
To accommodate 100 percent of these small airplanes	3,630 feet
Small airplanes with 10 or more passenger seats	4,190 feet
Large airplanes of 60,000 pounds or less	
75% of these large airplanes at 60% useful load	5,330 feet
75% of these large airplanes at 90% useful load	7,000 feet
100% of these large airplanes at 60% useful load	5,500 feet
100% of these large airplanes at 90% useful load	7,850 feet

Source: FAA's Airport Design Computer Program, Version 4.2D, AC 150/5325-4B, Runway Length Requirements for Airport Design.

Runway Length Justification Process

FAA guidance states that to justify funding a runway extension, at least 500 annual itinerant aircraft operations must exhibit a need for an extension now or within the next five years. Determining the particular aircraft model(s) critical for runway length is much easier at a commercial service airport than at a general aviation airport because at a commercial service airport individual airlines mostly use the same type of airplanes and they publish flight schedules that facilitate quantifying numbers of operations and stage lengths. Gathering such data for a general aviation airport is more difficult. In addition, the FAA requires rigorous justification for extending runways at general aviation airports, including documentation from the operators of airplanes needing a longer runway with the individual N numbers of their airplanes and number of constrained operations. A constrained operation is one that must reduce payload for takeoff, or stop en route for fuel, for example.

To quantify constrained operations at Aurora State Airport, questionnaires were distributed to the operators of larger aircraft that use the Airport frequently. Transient aircraft operators were identified from IFR flight plan records. The questionnaires received are in **Appendix I** and the operators who identified constrained operations are listed in **Table 4E**.

Table 4E contains a list of business jets that have operated at the Airport in recent years, as documented by IFR flight plans. The table also indicates which airplane models are based at the Airport and gives the number of constrained operations reported by based and transient users of the Airport. The table lists airplane models in the order of runway length required at maximum takeoff weight, from shortest to longest. Many models listed in the table need a longer runway at maximum takeoff weight than Aurora State Airport's 5,004 feet; these airplanes can use the Airport because they are operating at less than their maximum takeoff weights and/or the temperature is lower than 84 degrees. Usually, airplanes are constrained for takeoff due to high summer temperatures; however, for some airplanes operating under air taxi or fractional jet regulations, the constrained operation is landing on a wet or slippery runway. In addition, the lengths in Table 4E are based solely on aircraft performance requirements. Some operators may have additional requirements based on company operations specifications or insurance.

Table 4E. Business Jet Runway Length Requirements at Aurora State Airport

TYPE	ARC	Max. Takeoff Weight (lbs)	Takeoff Distance (MTOW)	Based at UAO	Constrained Operations Reported
CESSNA 551 CITATION II/SP	B-II	12,500	3,042	No	
CESSNA 501 CITATION I/SP	B-I	11,850	3,249	Yes	
CESSNA 500 CITATION	B-I	11,850	3,364	No	
CESSNA 550 CITATION II	B-II	13,300	3,433	No	
CESSNA 525 CITATION (CJ-1)	B-I	10,400	3,536	Yes	
CESSNA 525B CITATIONJET III (CJ-3)	B-II	13,870	3,651	Yes	JHRD Investment
CESSNA 560 CITATION V ULTRA	B-II	16,300	3,651	Yes	
LEARJET 31	C-I	16,500	3,915	No	
CESSNA 525A CITATIONJET II (CJ-2)	B-II	12,500	3,926	Yes	
CESSNA 560 CITATION ENCORE	B-II	16,830	4,087	Yes	
CESSNA 560 CITATION EXCEL	B-II	20,000	4,121	Yes	Management West
CESSNA 550 CITATION BRAVO	B-II	14,800	4,133	No	
RAYTHEON 390 PREMIER	B-1	12,500	4,353	No	
BEECHJET 400A/T/ T-1A JAYHAWK	C-I	16,100	4,786	No	
LEARJET 45	C-I	20,200	4,845	Yes	Premier Air
MITSUBISHI MU-300	B-I	14,630	4,936	No	
DASSAULT FALCON 900	B-II	45,500	5,373	No	
DASSAULT FALCON 50	B-II	37,480	5,413	No	
CESSNA 650 CITATION VII	C-II	23,000	5,568	Yes	
DASSAULT FALCON 7X	B-II	69,000	5,586	Yes	
DASSAULT FALCON 900 EX	C-II	48,300	5,723	Yes	CSIM
LEARJET 35/36	C-I	18,300	5,740	No	
CESSNA 750 CITATION X	C-II	36,100	5,901	No*	RJ2/DB Aviation
CESSNA 650 CITATION III/VI	C-II	21,000	5,912	Yes*	RJ2/DB Aviation
DASSAULT FALCON 2000	B-II	35,800	6,016	No	
RAYTHEON/HAWKER 125-1000 HORIZON	C-II	36,000	6,027	Yes	

**RJ2/DB Aviation plans to replace the Cessna 650 Citation III/VI with the Cessna 750 Citation X in the near future.*

Table 4E. Business Jet Runway Length Requirements at Aurora State Airport (cont.)

TYPE	ARC	Max. Takeoff Weight (lbs)	Takeoff Distance (MTOW)	Based at UAO	Constrained Operations Reported
IAI - ASTRA 1125	C-II	23,500	6,084	Yes	Novellus, American Medical Concepts, Transcendent Investments
LEARJET 55	C-I	21,500	6,096	No	
LEARJET 60	D-I	23,500	6,153	No	
RAYTHEON/HAWKER 125-800	B-I	28,000	6,176	Yes	WAC Charter
EMBRAER 135	C-II	41,887	6,177	No	Aero Air
GULFSTREAM IV	D-II	71,780	6,257	No	
IAI - GALAXY 1126/Gulfstream G200	C-II	34,850	6,314	No	Anonymous
BOMBARDIER CL-601	C-II	41,250	6,544	No	Anonymous, Aero Air
BOMBARDIER CL-604	C-II	47,600	6,544	No	Anonymous
GULFSTREAM V	D-III	89,000	6,877	No	Vulcan Flight
BOMBARDIER BD-700 GLOBAL EXPRESS	C-III	93,500	7,232	No	Vulcan Flight, Y2K Aviation

Source: WHPacific, 2010, using business jet characteristics published by the Central Region FAA in 2001, manufacturers' specifications, based aircraft from Oregon Department of Aviation aircraft registration records, constrained operators from runway length survey conducted in 2009 and 2010. List includes only business jet models that have documented operations at the Airport according to IFR flight plan records or an operator who wants to use the Airport. Takeoff distances are based only on aircraft performance; federal aviation regulations, company policies, or insurance requirements may require more length. Takeoff distances for standard conditions were adjusted (+14.8%) to account for design conditions at Aurora state Airport.

The runway lengths listed in Table 4E use the manufacturers' takeoff distance for standard conditions (sea level and 59 degrees F). These lengths were increased 14.8% to account for the higher elevation (200 feet MSL), higher design temperature (84 degrees), and runway gradient (2 feet of difference between runway high and low points). The formula for determining the amount of increase is:

Altitude Correction
(7% per 1,000' above sea level)
L = Takeoff length @ sea level
L1 = Length corrected for altitude
L1 = (.07 * E / 1000) * L + L

Temperature Correction
(0.5% per degree above standard temperature in hottest month)
T1 = Adjusted Standard Temperature
T = Mean Max High Temperature
L2 = Length corrected for altitude & temperature

(Std Temp adjusted to Sea Level)
T1 = 59 - (3.566 * E / 1000)
L2 = (.005*(T - T1)) * L1 + L1

Effective Gradient Correction (takeoff only)

(10' for each 1' difference between High / Low Point)	G = Difference between high / low point in feet L3 = RW length corrected for altitude, temperature & gradient L3 = G * 10 + L2

For three aircraft models, operators report constrained operations although the takeoff distance listed in Table 4E is less than the length of Runway 17/35. Two mentioned constraints on hot summer days, which are likely days when the temperature exceeds 84 degrees.

The runway length survey (Appendix I) identified the number of aircraft operations constrained at the Airport annually total 473, using only existing aircraft with N numbers and operators' names identified and using the average number of constrained operations if the operator identified a range of operations. Operators who wished to remain anonymous identified 12 more annual constrained operations. One operator based at the Airport, RJ2/DB Aviation, plans to replace its 650 Citation III/VI with a 750 Citation X, which would be constrained by runway length more often (an estimated 40 times per year compared to 30 for the existing aircraft).

To justify funding a runway extension, the FAA will not accept information for which the operator or the aircraft is not specifically identified. The identified number of constrained operations, 473, does not meet the 500 operations threshold at present time. Applying to 473 an annual growth rate of 3.6%[10], the number of annual constrained operations would reach 500 in 2012.

The 500 annual constrained operations threshold is projected to occur within five years. Even if jet traffic does not grow as fast as projected, it is likely the number of constrained operations will exceed 500 within the 20-year planning period. Consequently, ODA may want to consider planning for a runway extension now, in order to protect the airspace needed, among other things. To justify FAA funding for a planned extension, operators may need to be surveyed again in the future to identify operations that may be constrained.

Table 4E indicates the longest runway required for ARC C-II aircraft (Bombardier CL-601 and CL-604) that use the Airport is 6,544 feet, at maximum takeoff weight. This is 1,540 feet longer than the existing Runway 17/35. The longest runway required for an Aircraft Approach Category B aircraft (Raytheon/Hawker 125-800) is 6,176 feet, at maximum takeoff weight. This is 1,172 feet longer than the existing Runway 17/35. Most takeoffs are at weights under the certified maximum, so that the runway length needed is less. On the other hand, temperatures in the summer can exceed the 84 degrees used to determine runway length in Table 4E.

In the formulation of development alternatives, one or more alternatives might consider a runway extension, in order to evaluate relevant consequences.

[10] *Table 3M in Chapter Three shows the jet operations forecast, from 10,909 annual operations in 2010 to 22,389 annual operations in 2030, which equates to a 3.6% average annual growth rate.*

Runway Width

The current runway width of 100 feet meets the FAA's recommended standard for C-II aircraft and the current instrument approach, as well as for a precision approach with lower than ¾ mile visibility minimums.

Runway Pavement Strength

The most important feature of airfield pavement is its ability to withstand repeated use by the most weight-demanding aircraft that operates at an airport. The pavement strength rating of Runway 17/35 is 30,000 pounds for single wheel gear and 45,000 pounds for dual-wheel gear. The maximum takeoff weight of ARC C-II aircraft in Table 4E is more than 45,000 pounds (dual-wheel gear). The Airport's parallel taxiway is now designed for 60,000 pounds (dual-wheel gear), and this is the next "break point" in pavement design from the runway's current design strength. The current strength rating is adequate for the current runway length and using aircraft, because the larger aircraft are operating in a constrained situation – whether it is runway length or high ambient temperature – and are not likely at the maximum takeoff weight for that aircraft. Any future runway lengthening would affect the pavement strength required, as it would remove some of the constraints.

Taxiways

The runway currently has a full-length parallel taxiway. A full-length parallel taxiway provides a safe, efficient traffic flow and eliminates the need for aircraft to back-taxi before takeoff or after landing. The FAA recommends a parallel taxiway for nonprecision instrument approaches with visibility minimums of one mile or more and requires a parallel taxiway for instrument approaches with visibility minimums lower than one mile. The 2007 OAP recommends placement of high-speed (acute-angled) exit taxiways as part of the desired criteria. To have room for acute-angled exit taxiways, the runway centerline to parallel taxiway centerline spacing must be at least 400 feet for ADG II.

Runway centerline to parallel taxiway centerline separation distance is another important criterion to examine. The recommended distance is based on satisfying the requirement that no part of an aircraft on a taxiway or taxilane centerline is within the runway safety area or penetrates the runway obstacle free zone (OFZ). The current distance between the runway centerline and the parallel taxiway centerline is 300 feet, which meets the standard for C-II instrument runways with visibility minimums not lower than ¾ mile. However, it is deficient for the 400 feet for C-II runways with lower than ¾ mile visibility minimums.

Similar to runway width, taxiway width is also determined by the ADG of the most demanding aircraft to use the taxiway. The existing taxiways at the Airport are 35 feet wide, which meet the design standard.

The connectors and parallel taxiway system on Airport property meets FAA recommended standards and should be maintained through preventative pavement maintenance.

Taxilanes have object free area requirements, which are slightly less than for taxiways, because aircraft are moving more slowly on taxilanes than on taxiways. For ADG II, the taxilane OFA is 115 feet. Taxilanes in areas serving only ADG I aircraft should meet the 79-foot wide OFA requirement. Most taxilanes at the Airport are on private property. All taxilane development on private property should be designed to the same design standards as taxilanes on ODA property. However, if a situation is constrained from meeting taxiway/taxilane safety and object free areas, the FAA provides the following guidance for showing that a modification of these standards will provide an acceptable level of safety:

- Taxiway safety area width equals the airplane wingspan
- Taxiway OFA width equals 1.4 times airplane wingspan plus 20 feet
- Taxilane OFA width equals 1.2 times airplane wingspan plus 20 feet

Airport Visual Aids

Airports commonly include a variety of visual aids such as pavement markings and signage to assist pilots using the airport.

Pavement Markings.

Runway markings are designed according to the type of instrument approach available on the runway. FAA Advisory Circular 150/5340-1J, *Standards for Airport Markings*, provides the guidance for airport markings. Precision markings are currently in place on Runway 17/35, which is adequate for all types of instrumentation currently at the Airport and for any upgrades to a precision approach.

There are runway holding position markings on all taxiways adjoining the runway. The purpose of these markings is to ensure that aircraft waiting for arriving or departing aircraft to clear the runway are not in the RSA. In addition to runway holding position markings, all taxiways are clearly marked with centerlines. Existing taxiway markings at the Airport are adequate.

Airfield Signage.

The Airport currently has lighted hold signs on taxiways adjoining the runway. The existing signage is sufficient for the existing airfield layout. Any future additional taxiways and aprons will require additional signs. While not required to meet FAA design standards, it is recommended through-the-fence operators also install signage on future taxiways and taxilanes.

Airport Lighting

Beacon.

The Airport's rotating beacon is adequate for the planning period.

Visual Approach Aids.

As discussed in Chapter Two, the Airport has three forms of visual approach aids. A four-box Visual Approach Slope Indicator (VASI) is located on each runway end. Runway 17 also has an Omnidirectional Approach Lighting System (ODAL) and Runway End Identification Lights (REILs). A precision approach path indicator (PAPI) is similar to VASI, but the lights are in a single row, rather than two rows. A PAPI is a more precise form of glide slope indicator, and it is recommended that ODA upgrade to a PAPI system.

Runway and Taxiway Lighting.

Airport lighting systems provide critical guidance to pilots at night and during low visibility conditions. Runway 17/35 and the parallel taxiway are equipped with medium intensity lighting. It is recommended this system be maintained throughout the planning period.

If a precision instrument approach were implemented, an instrument approach lighting system more extensive than the ODAL system would be required.

Effective ground movement of aircraft at night is enhanced by the availability of taxiway lighting. The adjacent taxiways or taxilanes at the Airport have edge reflectors, which is adequate for the planning period.

The Airport is equipped with pilot-controlled lighting (PCL). PCL allows pilots to turn runway lighting on and control its intensity using the radio transmitter in their aircraft. The PCL system is energy-efficient and should be maintained.

Radio Navigational Aids & Instrument Approach Procedures

Radio Navigational Aids. There is a localizer navigational aid at the Airport. Additionally, the Battle Ground and Newberg VORs (Very High Frequency Omni-Directional Range) can be used to guide a pilot to the Airport.

Instrument and Noise Abatement Procedures. The Airport has several nonprecision instrument approaches, as detailed in Chapter Two. The lowest visibility minimum for the approaches is 1 statute mile for aircraft in Aircraft Approach Categories A and B. For Aircraft Approach Category C, the lowest approach visibility minimums are 1-1/4 statute mile. For most instrument approaches, 1-1/2 mile visibility minimums apply for Category C, and minimums for Category D aircraft are generally higher. When weather is below the minimums prescribed by the Airport's instrument approaches, aircraft cannot land, and the Airport is closed in effect to air transportation.

The previous airfield capacity analysis estimated that weather is below 1-mile visibility 5% of the time. The Airport would be below Approach Category C and D minimums a higher percentage of the time. Low visibility weather is not spread evenly throughout the year. In the months of May through August, visibility is below 1-mile less than 1% of the time on average, but in the months of November through January the weather is below approach minimums more than 10% of the time.[11]

Having an approach that is usable in lower visibility minimums would make the Airport a more reliable mode of air transportation, which is particularly important for emergency and business use. Meeting the typical minimums for an Instrument Landing System (200-foot ceiling and/or ½-mile visibility) would halve the amount of Airport "closure," since weather is below these minimums 2.3% of the time. However, since lower visibility minimums would increase the size of certain FAA design standards shown in Table 4C, improving the instrument approach capability of the Airport to provide visibility minimums lower than 1 mile should be considered in the development alternatives for the Airport. Implementing any new instrument approach procedures will need evaluation by the FAA Flight Procedures Office.

If a better instrument approach is obtained, it should be for Runway 35, since that runway accommodates more traffic and is the preferential runway for noise abatement purposes. The

[11] *Weather data obtained from NOAA for 2000-2009.*

preferable and safest direction for takeoff and landing is into the wind, although wind is not a consideration in runway choice when winds are calm. At Aurora State Airport, the wind is calm (below 5 knots) about 60% of the time.[12] To reduce noise impact, Runway 35 has been designated the preferential/calm-wind runway. When the wind is strongest it is usually from the south, which for safety requires pilots to use Runway 17. The noise analysis prepared in 2002[13] estimated that 80% of aircraft operations could be on Runway 35 if it were designated the calm-wind runway and certain changes were made to instrument approaches and procedures. Runway 35 has since been designated the calm wind runway, but the other changes have not yet been implemented. The additional noise abatement procedures recommended in 2002 were as follows:

- Establish an additional departure procedure for Runway 35 that would allow a 90-degree right turn at 900 feet MSL. (The FAA is working on this now, at ODA's request.) These procedures would be mandatory when operating under instrument flight rules. Air traffic controllers could direct visual flight rules traffic to use the procedure.
- Change the altitude limit on left turns when departing Runway 35, which would allow turns at 900 feet MSL rather than the existing 1200 feet MSL.
- Investigate the potential to allow a back-course approach to Runway 35, which would utilize the Runway 17 localizer for approaches to Runway 35. According to the DECIBEL Committee and ODA, an upgrade to the existing Runway 17 DME is required before this is possible.

The back-course approach to Runway 35 relates to one of the planning issues identified in Chapter One. Flight students use the Runway 17 localizer approach to aid in training during calm-wind conditions, which creates conflicting traffic patterns with the preferential use of Runway 35. The FAA is transitioning to GPS-based approaches from traditional Instrument Landing Systems that use ground-based navigational aids such as localizers. Consequently, it may be difficult to upgrade a traditional radio-type navigational aid or obtain a new instrument approach using one.

Other Airfield Recommendations

Traffic Pattern. The current traffic pattern requires left hand traffic for Runways 17 and 35 for noise abatement. ODA has worked extensively to create noise abatement procedures to avoid flights over noise sensitive areas. **Exhibit 4A** depicts the fixed wing and helicopter traffic patterns at Aurora State. ODA will continue to work with airport users and educate them on the noise abatement procedures.

Wind Indicators/Segmented Circle. The existing windcone and segmented circle are located on the west side of the runway at about midfield. These facilities are adequate and should be maintained throughout the planning period.

---

[12] *NOAA weather data for 2000-2009 indicates the wind is between 0 and 3 knots 45.7% of the time and between 4 and 6 knots 28.4% of the time.*

[13] *Harris Miller Miller & Hanson Inc.: Final Memorandum to Daren Griffin, State Airports Manager Oregon Department of Aviation about Aurora State Airport Noise Mitigation Program, May 31, 2002.*

Weather Reporting. Real-time weather reporting at the Airport is supplied via Automated Surface Observation System (ASOS). No changes are recommended.

LANDSIDE REQUIREMENTS

Landside facilities are those facilities necessary for handling aircraft on the ground and those facilities that provide an interface between the air and ground transportation modes. Landside requirements are addressed for the following facilities:

- Hangars
- Aprons and Aircraft Parking
- Aviation Businesses and Services
- Air Traffic Control Tower

As the following analysis shows, the amount of land currently owned by ODA and the adjacent undeveloped land that is appropriately zoned is insufficient to accommodate the landside development needed to meet the 20-year forecast. In the next stage of the planning process, in which development alternatives are evaluated, it will be decided if the land area for future based aircraft storage and other aviation purposes should be constrained or not. **Table 4F** summarizes the projections of additional land development needed to meet the forecast demand. The rest of this section describes how these land requirements were determined.

The projection of land needed to accommodate the forecast growth in aviation demand over the next 20 years is 39.6 acres. Currently, about 9 acres of ODA land are undeveloped, and about 26 acres of private property appropriately zoned for Airport development[14] are undeveloped.

Table 4F. Projected Landside Development Requirement (acres)

Facilities	2011-2015	2016-2020	2021-2030	Total
Hangars	4.9	5.4	12.7	23.0
Aprons	1.5	1.5	3.4	6.5
Cargo Apron	0.9	0.0	0.0	0.9
Aviation Businesses & Services	1.5	1.6	3.9	7.0
Air Traffic Control Tower	2.0	0.0	0.0	2.0
Fire Station	0.2	0.0	0.0	0.2
Total	11.0	8.5	20.0	39.6

Source: WHPacific, Inc., 2011.

[14] This includes about half of the 27.5-acre site that was recently rezoned for Helicopter Transport Services. Helicopter Transport Services is now building on about half of the site. Zoning on that site only allows for helicopter-related uses at this time.

AURORA AIRPORT NOISE ABATEMENT PROCEDURES:
PREFERRED TRAFFIC PATTERN

CALM WIND RWY 35

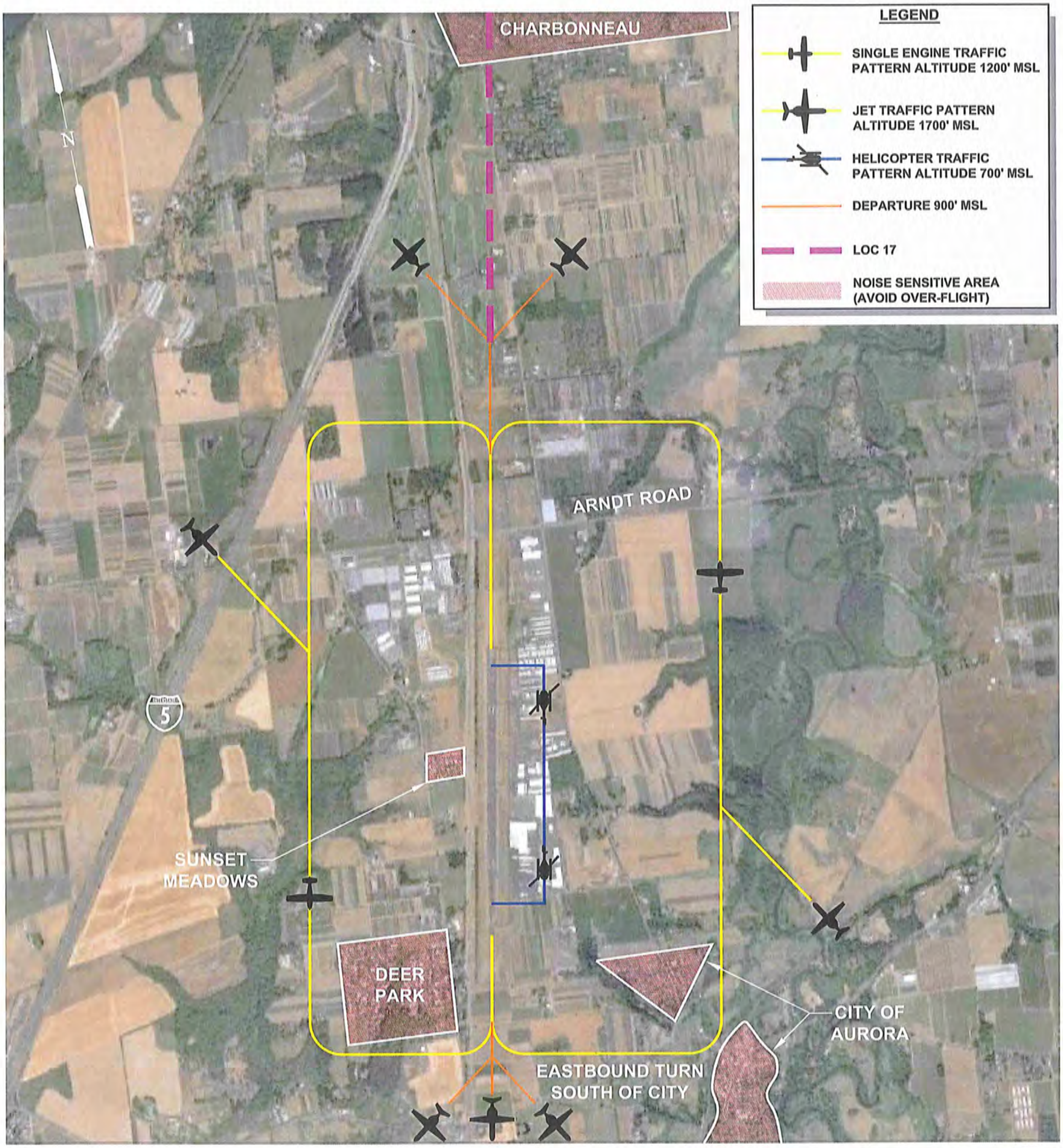


Exhibit 4A ~ Noise Abatement Procedures

Nov 18, 2010

Aurora State Airport

Aurora, OR

WHPacific

9755 SW Barnes Rd, Suite 300
Portland, OR 97225
503-626-0455 Fax 503-526-0775
www.whpacific.com

032033–PLAN–NA01.DWG

Hangars

Based aircraft can be stored in hangars or at apron tiedowns. Aircraft value, climate, security concerns, the relative cost and availability of hangars vs. tiedowns, and individual preference can influence an aircraft owner's choice between a hangar and a tiedown. Nationwide and at Aurora State Airport, the trend has been to favor hangars over tiedowns. Since the 2000 Master Plan Update, the number of tiedowns at the Airport has decreased from 180 to 83, due partly to hangar construction.

For this analysis, it is assumed that hangars will be built for all the additional based aircraft forecast, and the need for additional tiedowns and apron parking will be limited to transient aircraft. With few exceptions, hangars are not eligible for the FAA's Airport Improvement Program grant funding. Consequently new hangar construction on ODA-owned land would likely be privately funded on land leased from the ODA. Where "through-the-fence" access to the Airport is possible, private land ownership is possible.

Hangar facilities at the Airport consist of a combination of T-hangars and conventional hangars. T-hangars typically store one aircraft in one unit, which is attached to other units. Conventional hangars are stand-alone buildings that can store one or more aircraft.

The area required to store an aircraft varies not only with the size of the aircraft, but also with the hangar configuration and layout. T-hangars are especially efficient because each unit has a "T" shaped floor plan that molds to the shape of an airplane, and individual T-hangar units "nest" back-to-back to form a long rectangular building with aircraft access along two sides. Conventional hangars have rectangular floor plans and usually can store multiple aircraft of different sizes efficiently. Conventional hangars provide more storage flexibility than T-hangars, but have the disadvantage that it is sometimes necessary to move airplanes to get one out from behind another one. Within the Southend Airpark are some conventional hangars with aircraft doors on two (opposite) sides. This is highly convenient but uses more land.

FAA Advisory Circular 150/5300-13, *Airport Design*, Appendix 5, shows nested T-hangar layouts that accommodate between 10 and 14 aircraft per acre, depending upon whether the taxilanes between hangars allow two-way or one-way traffic. These layouts are based on hangars with clear door widths of 40 feet and depths of 30 feet, and would accommodate many Airplane Design Group I aircraft. Willamette Aviation's T-hangars numbered 80 through 83 on Exhibit 2B demonstrate this density of aircraft storage. Fourteen aircraft per acre would be the maximum density achievable at the Airport for the smallest airplanes.

Table 4G outlines the criteria used to project hangar requirements. The table lists a representative aircraft for each of the based aircraft types forecast in Chapter Three. The "footprint" of each aircraft example is the square footage resulting from multiplying the airplane's width (wingspan or rotor diameter) times its length. The table lists a low, high, and average hangar area for each aircraft type. The low hangar area for the single engine, multi-engine, and turboprop represents T-hangar area where the building shape conforms to the airplane shape. The table also lists low, high, and average ratios of land area to hangar area. These account for the taxilanes necessary for aircraft circulation, as well as land around buildings for fire separation and drainage.

Table 4G. Criteria for Hangar Requirements

Criteria	Single Engine	Multi-Engine Piston	Turbo-prop	Jet	Heli-copter
Example Aircraft	Cessna 172	Beech Baron	King Air	Cessna Citation III	Bell 206B
Footprint (width x length, sq. ft.)	980	1,126	2,387	2,969	1,322
Low Hangar Area per Aircraft (sq. ft.)	1,000	1,200	2,500	3,500	1,500
High Hangar Area per Aircraft (sq. ft.)	2,000	3,000	4,000	5,000	3,000
Average Hangar Area per Aircraft (sq. ft.)	1,500	2,100	3,250	4,250	2,250
Average Vehicle Parking Space per Aircraft	0.2	0.2	0.5	1.5	0.2
Low Land Area per Aircraft including taxilanes = 3.1 x hangar area					
High Land Area per Aircraft including taxilanes = 4.3 x hangar area					
Average Land Area per Aircraft including taxilanes = 3.7 x hangar area					
Average Land Area per Vehicle Parking Space = 450 sq. ft.					

Source: WHPacific, Inc. 2010.

Vehicle access is another component of hangar development addressed in Table 4G. Aircraft owners typically park their vehicles in their individual hangars when they are flying, so vehicle parking in T-hangar and small conventional hangar areas are primarily needed when passengers drive separately from the pilot. For single-engine, multi-engine piston, and helicopter hangar areas, the ratio is one vehicle parking space to five aircraft. The higher vehicle parking ratios for turboprop and jet aircraft reflect higher aircraft utilization and higher passenger capacity. The land area per vehicle parking space, 450 square feet, provides for access drives and individual parking spaces.

Using the average criteria from Table 4G, the hangar building and land requirements for the next 20 years are as shown in **Table 4H**. Table 4H shows that the hangar development demand projected through 2030 needs a total of 23.0 acres.

Table 4H. Hangar Requirements

	Single Engine	Multi-Engine Piston	Turbo-prop	Jet	Helicopter	Total
Additional Aircraft						
2011-2015	15	0	3	4	3	25
2016-2020	12	1	1	6	6	26
2021-2030	28	2	6	14	9	59
Total	55	3	10	24	18	110
Additional Hangar Area (sq. ft.)						
2011-2015	22,500	0	9,750	17,000	6,750	56,000
2016-2020	18,000	2,100	3,250	25,500	13,500	62,350
2021-2030	42,000	4,200	19,500	59,500	20,250	145,450
Total	82,500	6,300	32,500	102,000	40,500	263,800
Additional Vehicle Parking Spaces						
2011-2015	3	0	2	6	1	11
2016-2020	2	0	1	9	2	14
2021-2030	6	0	3	21	2	32
Total	11	0	5	36	5	57
Additional Land Area (acres)						
2011-2015	1.9	0.0	0.8	1.5	0.6	4.9
2016-2020	1.6	0.2	0.3	2.3	1.2	5.4
2021-2030	3.6	0.4	1.7	5.3	1.7	12.7
Total	7.1	0.5	2.8	9.0	3.5	23.0

Source: WHPacific, Inc., 2011.

Aprons and Aircraft Parking

The FAA has developed an approach for determining the number of tiedowns needed for transient aircraft operating at an airport. The source of the methodology to determine the number of additional tiedowns needed in the future is *Airport Design*, Appendix 5:

1. Identify the increase in peak, or design, day operations
2. Divide by 2 (50% of operations are departures)
3. Multiply by 50% or 25% depending on aircraft type. Assume 50% of the fixed wing airplanes will be on the apron at the same time during the peak day. For helicopters use 25% to account for the higher ratio of operations per aircraft and other differences in helicopter usage.

The operations fleet mix and design day operations forecasts from Table 3Q were used to calculate the number of additional transient aircraft parking spaces needed. **Table 4I** shows that 25 additional transient parking spaces are needed over the 20-year planning period. The FAA recommends using a ratio of 360 square yards (3,240 sq. ft.) of transient tiedown apron per single engine piston aircraft. This apron area is 3.3 times larger than the footprint of the Cessna 172 (Table 4G) to account for spacing between aircraft and taxilanes. The 3.3 multiplier was applied to other example footprint areas from

Table 4G--turboprop (King Air), jet (Cessna Citation III), and helicopter (Bell 206B)--to determine apron area. To project the land area required for transient parking aprons, the apron area was multiplied by 1.5. Table 4I shows that from 2011 through 2030 25 additional transient parking places will be needed, requiring 187,780 square feet of apron and 6.5 acres.

Table 4I. Transient Tiedown Requirements

	Jet	Turboprop	Piston	Helicopter	Total
Additional Transient Aircraft Parking					
2011-2015	2	2	0	2	6
2016-2020	3	1	1	1	6
2021-2030	6	3	1	3	13
Total	11	6	2	6	25
Additional Apron Area (sq. ft.)					
2011-2015	19,600	15,760	0	8,740	44,100
2016-2020	29,400	7,880	3,240	4,370	44,890
2021-2030	58,800	23,640	3,240	13,110	98,790
Total	107,800	47,280	6,480	26,220	187,780
Additional Land Area (acres)					
2011-2015	0.7	0.5	0.0	0.3	1.5
2016-2020	1.0	0.3	0.1	0.2	1.5
2021-2030	2.0	0.8	0.1	0.5	3.4
Total	3.7	1.6	0.2	0.9	6.5

Source: WHPacific, Inc., 2011.

The amount of pavement needed for transient helicopter parking is actually less than shown in Table 4I, since helicopters can hover-taxi to parking positions. However, paving or otherwise controlling dust in the taxilanes and spaces between helicopter parking pads is recommended. While there are two helipads on private property, a public helicopter landing and takeoff area is needed on ODA property. Aurora State Airport has a considerable amount of helicopter traffic beyond that associated with tenants and through-the-fence helicopter operators. A new public helicopter takeoff and landing area with associated parking positions should be located to reduce potential conflict with fixed wing aircraft, enhance noise mitigation, and comply with the guidance in FAA Advisory Circular 150/5390-2B, *Heliport Design*.

The 2007 OAP recommends Category II airports have designated cargo aprons. A cargo apron for Aurora State Airport would need to be approximately 25,000 square feet to allow one of the larger Airplane Design Group II aircraft to taxi, turn, and maneuver on the ramp. This assumes truck loading/unloading on the ramp and no need for a cargo terminal building. The land area for this apron would be approximately 0.9 acres.

Aviation Businesses and Services

Excluded from the inventory of existing facilities in Chapter Two was the major heavy-lift helicopter charter business (Helicopter Transport Services) now building on 27.48 acres of privately owned land southeast of the Airport. Initially, about half the site will be developed, with a 126,000 square foot building, a heliport, and five helicopter parking positions. Undeveloped portions of the property will be available for Helicopter Transport Services expansion or other helicopter-related uses according to the zone change application approved by Marion County on March 10, 2010.

In addition to Helicopter Transport Services, other businesses are likely to establish or grow when and if the projected increase in based aircraft and aircraft operations occur. The projected based aircraft increase is 31% over the next 20 years. As discussed in Chapter Two, FBO services are provided by three vendors. At this time service from the existing FBOs is sufficient; however, growth in aviation activity may necessitate expansion of the existing businesses or even the establishment of a new FBO. A 31% increase in aviation activity would result in more revenue from fuel sales and other aviation services, probably more employees and vehicles, and possibly more building area devoted to repair and maintenance, pilot and passenger amenities, and flight training. More likely than the establishment of a fourth FBO would be the establishment of new specialized aviation service operators, providing specific aircraft repair or maintenance services.

Currently, AvGas and Jet A fuel is available for sale at the Airport from multiple vendors. To account for the additional fuel sales that would occur with the projected increase in aircraft operations, vendors may add storage tanks or increase the frequency of fuel deliveries. Fuel tanks owned by Aurora Aviation are located near the parallel taxiway, which is not ideal. A location convenient for truck deliveries would be better for fuel storage, and land near the parallel taxiway would be better used for aircraft. Consideration for relocating the fuel tanks once they have exceeded their useful life is recommended.

Estimating the additional building and land area that might be required to serve the additional aviation activity projected for the Airport is difficult, particularly considering that much of the growth will be on private property. Table 2B indicated 23% of the current buildings at the Airport contain businesses instead of aircraft storage. If the building area for new/expanded businesses equalled 23% of the additional based aircraft hangar area, the additional building area needed through 2030 would be approximately 60,700 square feet. The land area would be up to 7 acres to include land around buildings, aircraft and vehicular access, and adequate vehicular parking.

Air Traffic Control Tower (ACTC)

In April 2009, the FAA's Systems and Policy Analysis Division informed ODA that the Airport was eligible to apply for the Federal Contract Tower program based on its calculated 1.64 benefit/cost ratio. In the FAA's benefit/cost ratio, the denominator is the cost of air traffic controller staffing and the numerator sums the financial benefits from averted collisions, other accidents, and efficiency. The benefits increase over time with the FAA's Terminal Area Forecast for growth in based aircraft, general aviation aircraft operations, and air taxi operations. The 1.64 benefit/cost ratio is for a 15-year period; the calculated ratio exceeds 1.0 in the first year, and grows to over 2.0 in the fifteenth year. The FAA will recalculate the ratio annually, and as long as the benefit/cost ratio remains over 1.0 and the program is funded, the FAA will fully fund personnel costs. The FAA will not fund the capital or operating costs of the tower. In 2010, the Oregon legislature awarded Aurora State Airport a $2.69 million grant for tower construction through the Connect Oregon III program.

Through this master planning process, and in conjunction with the FAA's Airport Facilities Terminal Integration Laboratory (AFTIL), ODA will be locating the ATCT site. Two acres are required for the building and its associated features (*i.e.*, parking lot, utility structures). For security purposes, the entire facility and parking must be enclosed with a fence. Alternative locations adequate for the ATCT will be identified in the development alternatives.

SUPPORT FACILITY REQUIREMENTS

Facilities and infrastructure that are not classified as airfield or landside are known as Support Facilities. The following support facilities were evaluated:

- Airport Access
- Emergency Services
- Airport Maintenance
- Airport Fencing
- Utilities
- Storm Drainage

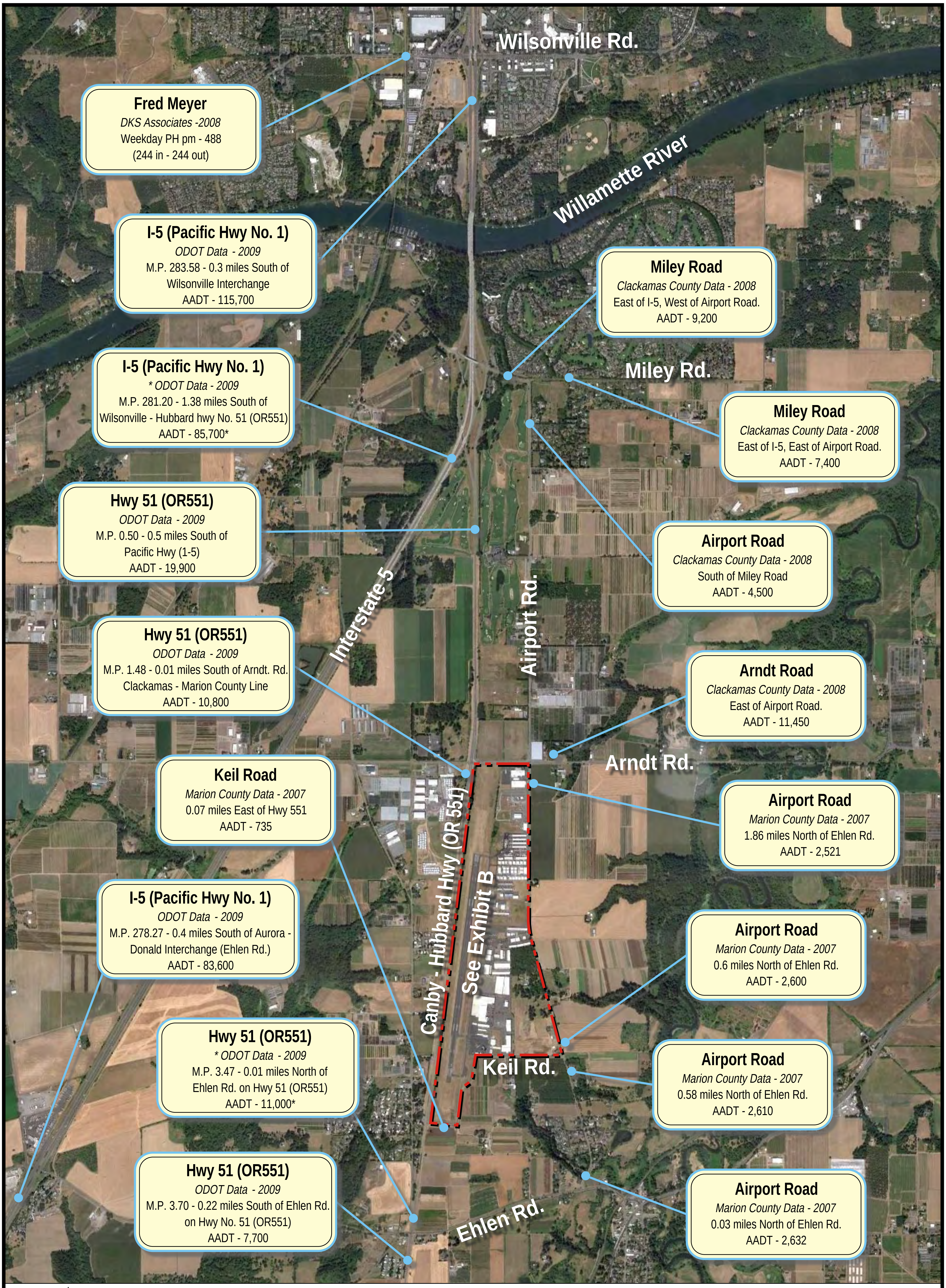
Airport Access

During the initial PAC meeting, several members expressed concern that the Master Plan process would not consider the automobile traffic impact to the surrounding roadways, specifically Airport Road and Interstate 5 (I-5) near Wilsonville. As a result, the following information has been incorporated in this Master Plan Update; data sheets and supplemental reports are included in **Appendix J**:

1. Traffic Count Information for the 11 Airport gates gathered by Oregon DOT (ODOT).
2. Traffic Count data from other available sources including Marion and Clackamas Counties, ODOT, DKS Associates, and Group Mackenzie.

ODOT's Transportation Data Section placed traffic counting tubes at the 11 gates at the Airport to determine the number of vehicles passing through the gates. The counters were placed on October 18, 2010 and removed on October 25, 2010. The Annual Average Daily Traffic (AADT) and Peak Hour traffic numbers were then generated. AADT represents the total number of vehicles traveling in both directions in a 24-hour period. The findings of this sampling is shown in **Table 4J**, as well as Exhibits **4B and 4C**.

Traffic count information, including the Rural Transportation System Plan 2005 update and the 2007 traffic count data, was obtained from the Marion County website. The Clackamas County website provided traffic data from the Comprehensive Plan with updates from January 17, 2008. Information for roads near the Airport is presented in **Table 4K and 4L**.



N

SCALE

1000 0 500 1000

(FEET)

1 INCH = 1000 FT.

AADT = Annual Average Daily Traffic

PH = Peak Hour

* - Automatic Counter

WHPacific

9755 SW Barnes Rd, Suite 300
Portland, OR 97225
503-626-0455 Fax 503-526-0775
www.whpacific.com

034317-C-EP02.DWG

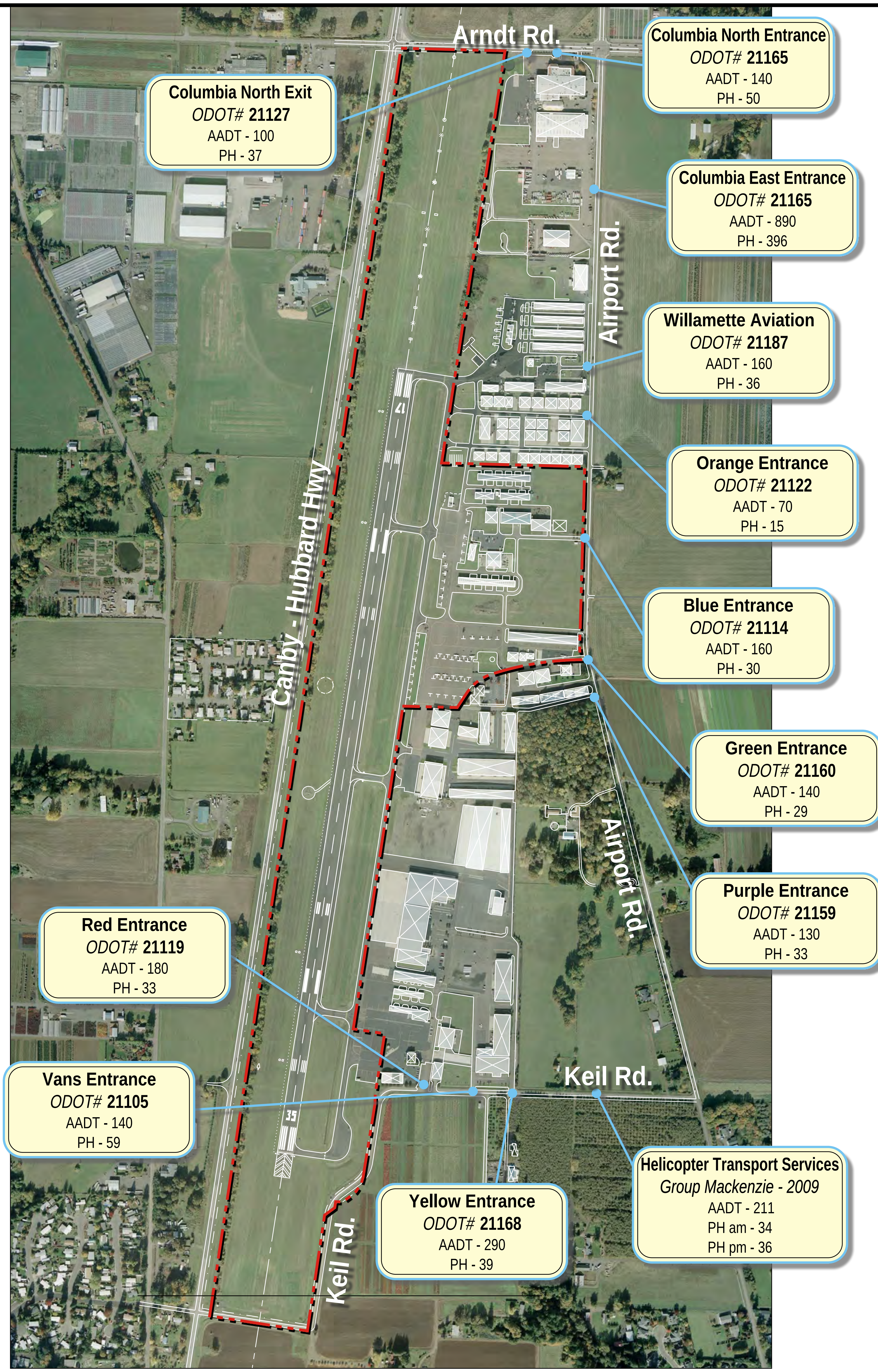
Aurora State Airport

Aurora, OR

January 27, 2011

Exhibit 4B

Traffic Study



N

SCALE
300 0 150 300
(FEET)
1 INCH = 300 FT.

AADT = Annual Average Daily Traffic
PH = Peak Hour

ODOT Data Collected 10/18/10 to 10/25/10

034317-C-EP02.DWG

WHPacific
9755 SW Barnes Rd, Suite 300
Portland, OR 97225
503-626-0455 Fax 503-526-0775
www.whpacific.com

Aurora State Airport
Aurora, OR

January 27, 2011

Exhibit 4C
Traffic Study

Table 4J. Aurora State Airport Estimated AADT

Site number	Description	Estimated AADT	Peak Hour
21227	Columbia North Exit	100	37
21165	Columbia North Entrance	140	50
21157	Columbia East Entrance	890	396
21187	Willamette Aviation	160	36
21122	Orange Entrance	70	15
21114	Blue Entrance	160	30
21160	Green Entrance	140	29
21159	Purple Entrance	130	33
21168	Yellow Entrance	290	39
21105	Van's Entrance	140	59
21119	Red Entrance	180	33
	Total	**2,400**	

Table 4K. Marion and Clackamas Counties Roadway AADT

Marion County			
Road	**Description**	**AADT (2007)**	**Functional Classification**
Airport Road	0.30 miles north from Ehlen Rd	2,632	Major Collector
	0.58 miles from Ehlen Road (south of Keil Rd)	2,610	
	0.60 miles from Ehlen Road (north of Keil Rd)	2,600	
	1.86 miles from Ehlen Road (south of Airport Rd)	2,521	
Keil Road	0.07 miles from Hwy 551	735	Local
	0.89 miles from Hwy 551 (west of Airport Rd)	720	
Arndt Road	0.01 miles west of Airport Road	10,062	Local
	0.24 miles from Airport Rd (east of Hwy 551)	9,500	
	0.26m from Airport Rd (west of Hwy 551)	2,500	
Ehlen Road	west of Airport Rd	8,408	Arterial
	east of Airport Rd	9,500	
Clackamas County			
Road	**Description**	**AADT (2008)**	**Functional Classification**
Arndt Road	east of Airport Rd	11,450	Major Arterial
	Airport Rd (south on Miley Rd)	4,500	
Miley Road	east of Airport Rd	7,400	Collector
	east of I-5	9,200	Minor Arterial

Source: Marion County Rural Transportation System Plan 2005 and website and Clackamas County Comprehensive Plan 2004 and website.

As Table 4K illustrates, the AADT of the Airport Entrances represent a large portion of Airport Road's and Keil Road's AADTs.

Marion County roads are designed to accommodate certain levels of activity, as shown in Table 4L. As reported, many of the roadways within Marion County are currently exceeding the AADT to which the road was designed. Clackamas County does not design roads based on roadway volume; the qualitative design definition for Clackamas County roads indicates Arndt Road and Miley Road generally conform with the definition given.

Table 4L. Design Standards for Functional Classification

Functional Classification	Typical AADT	Definition
Marion County		
Arterial	1,000 - 10,000	A roadway intended to carry large volumes of traffic and connect major traffic generators, cities, recreational areas, and major segments of transportation networks. High capacity is achieved through allowing higher speed, limited access, wider roadway and movement preference at intersections with lesser standard roadways.
Major Collector	500 - 1,500	A roadway intended to carry intermediate volumes of traffic and collect and distribute traffic from local streets to arterials, state highways or small population centers.
Local	0 - 500	A roadway serving short distance, intra-neighborhood and residential needs. They are characterized by minimal access limitations, lowest traffic movement preference at intersections with collectors and arterials, and minimum widths. These factors lead to minimum traffic carrying capacity, but provide maximum access to adjacent property.
Clackamas County		
Major Arterial	--	Carries local and through traffic to and from destinations outside local communities and connects cities and rural centers. Moderate to heavy volume; moderate to high speed.
Minor Arterial	--	Connects collectors to higher order roadways. Carries moderate volume at moderate speed.
Collector	--	Principle carrier within neighborhoods or single land use areas. Links neighborhoods with major activity centers, other neighborhoods, and arterials. Generally not for through traffic. Low to moderate volume; low to moderate speed. New collectors should intersect minor arterials rather than major arterials.

Source: Marion County Public Works (2005) and Clackamas County Roadway Standards (2010).

Data for roads under the jurisdiction of ODOT was also obtained. **Table 4M** presents the AADT for both Interstate 5 and Highway 551. While the Airport influences Airport and Keil Roads, the Airport's impact to the ODOT roadways is minimal.

Table 4M. ODOT Roadway AADT

Road	Description	Milepost	AADT (2009)	Functional Classification
Interstate 5 (I-5)	0.4 miles south of Aurora Donald Interchange (Ehlen Rd)	278.27	83,600	Freeway
	1.38 miles south of Hwy 551	281.20	85,700	
	0.30 miles south of Wilsonville Interchange	283.58	115,700	
Highway 551	0.22 miles south of Ehlen Rd	3.70	7,700	Highway
	0.01 miles north of Ehlen Rd	3.47	11,000	
	0.01 miles south of Arndt Rd	1.48	10,800	
	0.50 miles south of I-5	0.50	19,900	

Source: ODOT website traffic counts.

The Helicopter Transport Services (HTS) Transportation Impact Analysis prepared by Group Mackenzie in May 2009 and the Fred Meyer Transportation Impact study in Wilsonville prepared by DKS Associates in August 2008 were obtained for comparative purposes. The HTS analysis reported an AADT of 211, with a morning peak hour of 34 and evening peak hour of 36. These results are typical of other Airport entrances. The Fred Meyer traffic study did not produce an AADT; however, the weekday afternoon peak hour was 488 (244 in and 244 out).

Aurora State Airport Traffic Summary. As stated above, a total of 11 gates (driveways) at the Airport were surveyed and the AADT and peak hour traffic volumes determined. The total AADT of all 11 gates equaled 2,400, plus the projected 211 AADT from HTS when their development is completed in 2011, for a total from the Airport of 2,611 AADT. It should be noted that the three Columbia Helicopters' gates contribute 1,130 AADT or 47% of the total airport-generated vehicular traffic volume. Columbia Helicopters' main activity is helicopter maintenance and support activities that do not rely on the runway and taxiway system or generate similar numbers of operations as the majority of the other airport businesses or FBOs.

Airport Road traffic Summary. As noted in Table 4K, the 2007 Marion County data indicates that approximately 2,600 vehicles travel along Airport Road between Ehlen Road and Arndt Road, utilizing it as a cut through between the City of Aurora and Hwy 551/I-5. According to Karen Odenthal, Marion County Planner, this data will be updated in 2011 and the numbers are anticipated to increase.

Aurora State Airport Vehicular Traffic Impact to the Boone Bridge. Assuming 75% of the Airport-generated traffic travels north and south on I-5 the Airport's impact to would equate to 1,800 AADT out of the 115,700 AADT as indicated by the ODOT counter just north of the Boone Bridge – or .015% of the AADT for I-5 at that location. The current employment numbers at the Airport are estimated to be approximately 750, which equates to 3.2 trips per employee. If a 1.19% employment growth rate (based on the Employment Model in Chapter Three, *Forecasts*, pg 3-21) is applied, the total employment in 2030 will be 950, which would equate to an Airport-generated AADT 0f 3,040; still an insignificant impact when compared to that of a development such as a Fred Meyers with a peak hour volume of 488 vehicles to the roadway system.

Future Roadway improvements. Numerous improvements to the roadway transportation systems in the airport environs have been identified by the various agencies.

- **Marion County.** Ehlen Road at Boones Ferry and Highway 551, add a left turn lane on Ehlen Road; possible realignment; and possible traffic signal at Boones Ferry to be coordinated with State Highway signal.

  Airport Road is currently designated by Marion County as a Major Collector and is a two lane road with narrow shoulders and no pedestrian or bike lanes. According to Karen Odenthal, on January 25, 2011, Marion County is planning to update its Transportation System Plan. Ms. Odenthal indicated that improvements to Airport Road would likely be identified and a general recommendation would be made to widen the travel lanes, shoulders and add pedestrian/bike lanes. She was, however, uncertain as to the priority the potential project would be given.

- **City of Aurora.** Ehlen Road and Airport Road intersection, add a signal and a left turn lane eastbound on Ehlen Road to Airport Road northbound.

- **ODOT.** Ehlen Road and Hwy 551, signal improvements, left turn lane southbound to Ehlen Road, and coordinated improvements with Marion County. Highway 551 and Keil Road, possible left turn lane southbound along Hwy 551 to Keil Road.

- **Clackamas County.** Airport Road at Miley Road intersection, realign, add turn lanes and install signal. Airport Road between Arndt road and Miley Road, reconstruct and widen to rural standards.

Recommendations. It is recommended that ODA continue to work with and support Marion County and the City of Aurora as improvements to Airport Road are considered. It will be important that appropriate considerations be given to the entrances (gates) to the Airport and business along Airport Road. The question of funding these improvements should be part of the discussions and it is appropriate that future development, both public and private, participate on a similar proportionate share as HTS recently has; see Group Mackenzie report, HTS 2009 pgs 14 and 17 in Appendix J.

Emergency Services

The Marion County Sheriff Department and Oregon State Police provide emergency services at the Airport, since it is located within Marion County and also owned by the State of Oregon. For large-scale emergencies that have a regional or statewide impact, Marion County has entered into an Inter-County Mutual Aid Agreement, wherein other counties would be available to respond.

The Aurora Rural Fire Protection District (District) provides fire protection. A 500,000-gallon fire suppression system was recently installed to assist the District in protecting the Airport. There are no Aircraft Rescue and Firefighting (ARFF) facilities available at the Airport. The District was contacted to solicit their concerns relating to the Airport. The foremost concern is to have a place at the Airport to house the District's airport fire response apparatus. The building needs only to accommodate a crash truck and a quick response medical unit. For planning purposes, a 2,000-square foot building on a 0.2-acre site should be adequate. The District's preference for the location is near the ATCT or near the fire water pump site.

Airport Maintenance

Airport maintenance is adequately provided by ODA and the Oregon Department of Transportation (ODOT). ODA provides snow removal services. No changes are recommended

Airport Fencing

Fencing surrounds the perimeter of the Airport Environs. All access points have gates, although not all gates are automated. It is advised that the non-automated gates be upgraded.

Utilities

Utilities available at the Airport include electricity, water, septic, and telephone. Septic needs are met by individual septic tanks and drain field systems. New septic systems will be required for buildings with sanitary facilities, and may limit growth potential at the Airport until sewer service is provided. The lack of sewer service is a particular problem for establishing food service facilities. Extensions of electricity, water, and telephone to future facilities will be required as needed. The City of Aurora has express concerns that additional groundwater wells or expansion of water facilities at the Airport will have negative impacts upon the City's current water supply. Drinking water quality is also a concern for the City. Continued development and/or potential expansion of airport facilities without proper advanced planning and feasibility assessments regarding the Airport's ability to meet water, sewer, and fire protection needs concerns the City.

Storm Drainage

The need for additional hangars, other buildings, aprons, and airfield pavements has been identified. These facilities will increase the Airport's existing impervious surfaces. These additional surfaces must be evaluated to ensure that the requirements of the 1200-Z[15] stormwater discharge permit are met. Because a specific layout for future development has not been defined yet, the exact amount of increased impervious surface is to be determined. The alternatives analysis will provide additional details regarding stormwater impacts of each alternative. The analysis will also include Department of Environmental Quality (DEQ) requirements, water treatment, and detention.

---

[15] *The federal Clean Water Act mandates jurisdictional control of the quality of stormwater runoff. This mandated program is found in the Code of Federal Regulation part 122.26. The Airport may fall under the scope of these regulations and may need to apply for a National Pollution Discharge Elimination Permit (NPDES) for the discharge of rain water to the surface water system. In Oregon, this is typically referred to as a 1200-Z General Permit.*

Environmental review of individual development will be required to meet National Environmental Policy Act regulations where federal funding is used. All state and local regulations will be addressed, as required.

AIRSPACE

Currently the airspace surrounding the Airport is Class E, which has no communications requirements. The FAA has accepted the justification provided by ODA for an air traffic control tower and ODA has secured funding for its construction. When the ATCT is operational the airspace around the Airport will change to Class D. Class D has communications requirements and the ATCT will provide sequencing and traffic advisories to VFR aircraft operating into and out of the Airport, and IFR traffic separation. Most likely the ATCT will only operate part-time (closed at night), at which time the airspace will go back to Class E. ODA should coordinate with FAA regarding the airspace changes and help educate pilots of the new operating requirements.

LAND USE PLANNING & ZONING RECOMMENDATIONS

In general, the Airport meets State and County land use requirements. Even so, the ODA and Marion County should work towards several items regarding land use and zoning around the Airport. Recommendations are provided below.

Zoning Code

- ODA should consider working with Marion County to rezone the underlying designations within the Airport property as “Airport” to ensure that only compatible uses occur within the Airport property boundary. The rezoning would be based on Oregon Administrative Rules Division 13, *Airport Planning*, which provides guidelines for local government land use compatibility to encourage and support the continued operation and vitality of Oregon’s airports.
- Marion County should consider adopting the standards of ORS 836.616, which authorizes certain airport uses and activities to occur at the Airport.
- A portion of the Airport Overlay, which protects FAR Part 77 Imaginary Surfaces, extends into Clackamas County. The Overlay should be maintained and updated as needed based on any airport layout changes recommended in this Master Plan.

Comprehensive Plan

- If Marion County adopts this Master Plan, it would adopt it as a component of the Marion County Comprehensive Plan and all projects identified within the Plan would receive "conditional use" approvals for development. As such, a Traffic Impact Analysis would be necessary for any projects that would have a significant impact on area ground transportation, prior to the County’s adoption, in order to meet Statewide Goal 12. Alternatively, ODA could not submit the Plan to Marion County and instead apply for conditional approvals for individual projects. The advantages and disadvantages of these options will be further discussed in Chapter Five as development alternatives are identified.

- Adopt a title notice or similar requirement to inform purchasers of property within one mile of the Airport that their property is located adjacent to or in close proximity to the Airport and their property may be affected by a variety of aviation activities. Note that such activities may include but are not limited to noise, vibration, chemical odors, hours of operations, low overhead flights, and other associated activities.