CHAPTER C.

Facility Requirements

INTRODUCTION. In efforts to quantify an airport's future facility needs, it is necessary to translate the forecasted aviation activity into specific physical requirements. Therefore, this chapter analyzes the actual types and quantities of facilities and/or the required improvements to existing facilities needed to accommodate the projected demand safely and efficiently. For those components determined to be deficient, the type, size, or amount of facilities required to meet the demand is identified. Two separate analyses are included: those requirements related to airside facilities, and those requirements related to landside facilities.

This analysis uses the forecasts presented in the preceding chapter for establishing future development at the Airport. This is not intended to dismiss the possibility that due to the unique circumstances that exists at the Airport and within the region that either accelerated growth or consistently higher or lower levels of activity may occur. Aviation activity levels should be monitored for consistency with the forecasts.

As presented in the preceding chapter, an airport's runway and taxiways should be designed in accordance with the specified Airport Reference Code (ARC) based on the "Design Aircraft". The FAA defines "Design Aircraft" as an aircraft or group of aircraft within an ARC that have a minimum of 500 annual operations at an airport. The existing Airport Layout Plan (ALP) indicates Runway 17/35 is designated as ARC C-II and Runway 08/26 is designated as ARC B-II. It should also be noted that the Runway 17/35 west side parallel taxiway system (i.e., Taxiway "W" and the associated connector taxiways) has historically been designed and maintained to Airplane Design Group (ADG) III dimensional standards, and this designation will be carried forward in this planning document even though it is understood that the FAA will only fund improvement and maintenance projects to standards as indicated by the demand at the time.

Airside Facility Requirements

This section presents the analysis of requirements for airside facilities necessary to meet the anticipated aviation demand at Olympia Regional Airport. Airside facilities examined include runways, taxiways, runway protection zones, navigational aids, and lighting.

Runway Orientation

Surface wind conditions have a direct effect on airport functionality. Runways that are not oriented to take the fullest advantage of prevailing winds will restrict the capacity of the airport to varying degrees. When landing and taking off, aircraft are able to operate on a runway properly and safely as long as the wind velocity perpendicular to the direction of flight (defined as a crosswind) is not excessive. The wind coverage analysis translates the crosswind velocity and direction into a "crosswind component". Smaller aircraft are more easily affected by crosswinds than larger aircraft, so therefore, they have a smaller crosswind component.

The determination of the appropriate crosswind component is dependent upon the ARC, which as described above, is C-II for Runway 17/35 and B-II for Runway 08/26. According to AC 150/5300-13, *Airport Design*, the maximum crosswind component used for ARCs A-I and B-I is 10.5-knot, a 13-knot maximum crosswind component is used for ARCs A-II and B-II, and for ARCs C-I and C-II, a 16-knot maximum crosswind component is used.

Accurate and timely wind velocity and directional data during all weather conditions were obtained from the National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center (NCDC), which compiled the data from the Automated Surface Observing System (ASOS) located on the Airport. Using this data, an all weather wind rose was constructed and is presented in the following illustration entitled *ALL WEATHER WIND ROSE*.

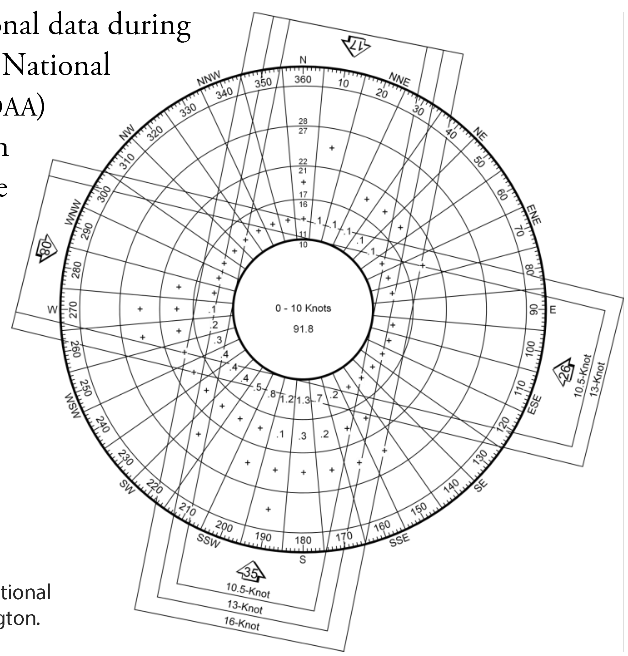


Figure C1
All Weather Wind Rose

Source: National Oceanic and Atmospheric Administration, National Climatic Data Center. Station 72792, Olympia Washington. Period of Record: 2000-2009.

The desirable wind coverage for an airport is 95%, which means that the runway system should be oriented so that the maximum crosswind component is not exceed more than 5% of the time annually. Based on the all weather wind analysis for Olympia Regional Airport, the existing runway system provides approximately 100.00% wind coverage for the 16-knot crosswind component, 99.99% for the 13-knot crosswind component, and 99.82% for the 10.5-knot crosswind component. In addition, the primary runway (i.e., Runway 17/35) alone satisfies the 95% wind coverage requirement for the 10.5-knot crosswind component at the Airport. The following table, entitled *ALL WEATHER WIND COVERAGE ANALYSIS*, quantifies the wind coverage provided by the individual runways and the combined runway ends during all weather conditions at the Airport.

Table C1

All Weather Wind Coverage Analysis

Runway	10.5-Knot	13-Knot	16-Knot
Runway 17/35	99.02%	99.63%	99.96%
Runway 17	90.50%	91.07%	91.39%
Runway 35	68.99%	69.16%	69.31%
Runway 08/26	93.49%	96.11%	---
Runway 08	87.38%	89.50%	---
Runway 26	91.80%	94.06%	---
Combined	99.82%	99.99%	99.96%

Source: MEAD & HUNT INC. analysis using the FAA Airport Design Software supplied with AC 150/5300-13, *Airport Design*. Wind data acquired from the National Oceanic and Atmospheric Administration, National Climatic Data Center. Station 72792, Olympia Washington. Period of Record: 2000-2009.

Note: It is important to note that a five-knot tailwind component was used for the individual runway end analysis.

It should also be noted that the determination of the FAA funding eligibility requirements of the crosswind runway are derived from the all weather wind coverage data presented above. Because Runway 17/35 alone satisfies the 95% wind coverage requirement for the Airport, the crosswind runway (i.e., Runway 08/26) is not eligible for FAA Airport Improvement Program (AIP) funding participation.

As stated previously, the Airport currently is equipped with four published Instrument Approach Procedures (IAPs), one of which provides visibility and ceiling minimums as low as ½-mile and 200 feet (AGL) to Runway 17. In an effort to analyze the effectiveness of the existing procedures and the need for and placement of improved or additional procedures, an Instrument Flight Rules (IFR) wind rose has been constructed and is presented in the following illustration entitled

IFR WIND ROSE. Again, wind data from the ASOS has been used for the construction of the wind rose and wind coverage analysis.

The following table, entitled *IFR WEATHER WIND COVERAGE ANALYSIS*, presents the wind coverage analysis provided during IFR meteorological conditions (i.e., weather conditions having a ceiling less than 1,000 feet, but equal to or greater than 200 feet and/or visibility is less than three miles, but equal to or greater than ½-mile). The table quantifies the wind coverage provided by the individual runway ends and the combined runway system. From this analysis, it can be concluded that Runway 17 provides the best wind coverage for all crosswind components. Runways 08 and 26 provide virtually identical wind coverage. Runway 35 actually provides the least favorable wind coverage during IFR weather conditions.

Figure C2
IFR Wind Rose

Source: National Oceanic and Atmospheric Administration, National Climatic Data Center. Station 72792, Olympia Washington.
Period of Record: 2000-2009.

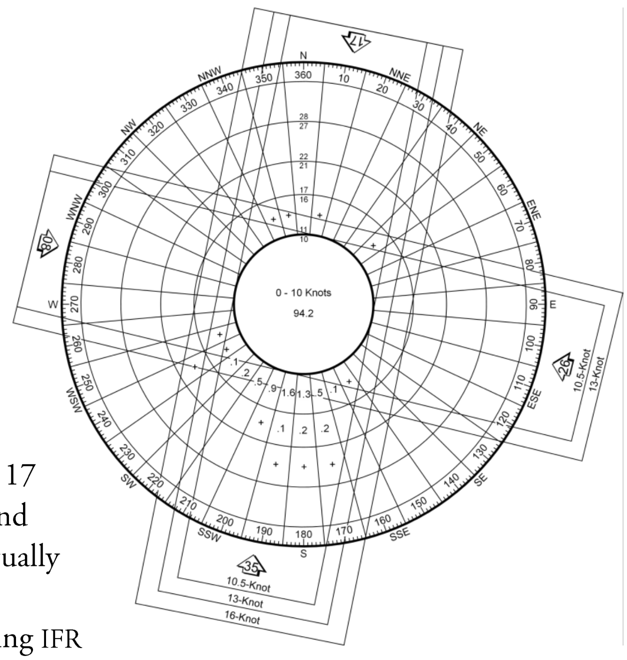


Table C2
IFR[1] Weather Wind Coverage Analysis

Runway	10.5-Knot	13-Knot	16-Knot
Runway 17/35	99.96%	99.98%	100.00%
Runway 17	94.01%	94.04%	94.05%
Runway 35	78.72%	78.72%	78.72%
Runway 08/26	94.52%	96.53%	---
Runway 08	93.10%	94.98%	---
Runway 26	93.16%	94.98%	---
Combined	99.97%	99.99%	100.00%

Source: MEAD & HUNT INC. analysis using the FAA Airport Design Software supplied with AC 150/5300-13, *Airport Design*. Wind data acquired from the National Oceanic and Atmospheric Administration, National Climatic Data Center. Station 72792, Olympia Washington. Period of Record: 2000-2009.

Notes: [1] Ceiling less than 1,000 feet, but equal to or greater than 200 feet and/or visibility less than three miles, but equal to or greater than ½-mile.
It is important to note that a five-knot tailwind component was used for the individual runway end analysis.

Conclusion. This analysis indicates that Runway 17/35 alone provides more than adequate wind coverage during all weather conditions, and thus Runway 08/26 is not eligible for FAA AIP funding participation on future maintenance or development projects. The IFR wind coverage analysis indicates that Runway 17/35 provides excellent wind coverage, and the previous ALP identified improved IAPs to Runway 35 with visibility minimums as low as ½-mile. The previous ALP also identified a future IAP to Runway 26 with visibility minimums as low as one mile. A more detailed examination of implementing new and/or improved IAPs to Runways 35 and 26 will be presented in the next chapter.

Ceiling and Visibility

FAA AC 150/5060-5, *Airport Capacity and Delay*, describes three categories of ceiling and visibility minimums for use in both capacity and delay calculations. Visual Flight Rules (VFR) conditions occur whenever ceiling levels are at least 1,000 feet AGL and visibility minimums are at least three statute miles. IFR conditions occur whenever reported ceilings are at least 500 feet AGL, but less than 1,000 feet AGL and/or visibility minimums are at least one statute mile, but less than three statute miles. Poor Visibility and Ceiling (PVC) conditions exist whenever reported ceilings are less than 500 feet AGL and/or the visibility minimums are less than one statute mile.

However, meteorological data obtained for Olympia Regional Airport from the NCDC for this study, have been categorized in terms that are more specific, which include:

VFR conditions: Ceiling equal to or greater than 1,000 feet AGL and visibility minimums equal to or greater than three statute miles. These conditions occur at the Airport approximately 87.5% of the time annually.

VFR minimums to existing Runway 17 GPS (LPV) approach minimums: Ceiling less than 1,000 feet AGL and/or visibility minimums less than three statute miles, but ceiling equal to or greater than 400 feet AGL and visibility minimums equal to or greater than ¾-statute mile. These conditions occur at the Airport approximately 6.3% of the time annually.

VFR minimums to existing Runway 35 GPS approach minimums: Ceiling less than 1,000 feet AGL and/or visibility minimums less than three statute miles, but ceiling equal to or greater than 600 feet AGL and visibility minimums equal to or greater than one statute mile. These conditions occur at the Airport approximately 4.7% of the time annually.

VFR minimums to existing Runway 17 ILS approach minimums: Ceiling less than 1,000 feet AGL and/or visibility minimums less than three statute miles, but ceiling equal to or greater than 200 feet AGL and visibility minimums equal to or greater than ½-statute mile. These conditions occur at the Airport roughly 8.3% of the time annually.

Below existing minimums: These conditions occur at the Airport about 4.2% of the time annually.

VFR minimums to future Runway 17 precision approach minimums: Ceiling less than 1,000 feet AGL and/or visibility minimums less than three statute miles, but ceiling equal to or greater than 200 feet AGL and visibility minimums equal to or greater than ¼-statute mile. These conditions occur at the Airport roughly 8.8% of the time annually.

Airfield Capacity

The ability of the airfield system (i.e., runways and taxiways) to accommodate both the existing and forecasted demand at an airport is known as airfield capacity. It is defined in the following terms:

- **Hourly Capacity of Runways:** The maximum number of aircraft that can be accommodated under conditions of continuous demand during a one-hour period.

- **Annual Service Volume (ASV):** A reasonable estimate of an airport's annual capacity (i.e., the level of annual aircraft operations that will result in an average annual aircraft delay of approximately one to four minutes).

The determination of capacity for long-range planning purposes at Olympia Regional Airport uses the methodology contained in FAA AC 150/5060-5, *Airport Capacity and Delay*. Certain site-specific factors influence airfield capacity, and include: aircraft mix, runway use, percent arrivals, touch-an-go activity, the location of exit taxiways, and local air traffic control rules and procedures. The following narrative describes these factors in detail.

Aircraft Mix. Aircraft mix is related to the type and size of the aircraft using an airport, and is categorized into four classes: Classes A and B consist of small single engine and twin-engine aircraft (both propeller and jet) weighing 12,500 pounds or less, which are representative of the general aviation fleet. Class C is large jet and propeller aircraft weighing between 12,500 pound and 300,000 pounds. Class D is large jet and propeller aircraft weighing in excess of 300,000 pounds. Class C and D are typical of those used by the airline industry and the military. Aircraft mix is defined as the relative percentage of operations conducted by each of these classes of aircraft. For Olympia Regional Airport, the existing aircraft mix has been estimated at 96% Classes A and B, and 4% Class C. The future 2030 aircraft mix is estimated at 95% Classes A and B, and 5% Class C. Examples of the various aircraft within each class are presented as follows:

- **Class A:** Cessna 172, Cessna 182, Beech Bonanza 35, Mooney M20, Piper PA-28
- **Class B:** Beech 55, Beech 95, Piper PA-23, Beech King Air B200, Pilatus PC-12, Piper PA-31
- **Class C:** Cessna Citation 550 and 650, Dassault Falcon 50 and 900 EX, Learjet 35 and 45, Raytheon Hawker 800, Gulfstream IV and V

Runway Use. The use configuration of the runway system is defined by the number, location, and orientation of the active runway(s) and relates to the distribution and frequency of aircraft operations to those facilities. Both the prevailing winds in the region and the existing runway facility at Olympia Regional Airport combine to dictate the utilization of the existing runway system. According to ATCT personnel, the estimated runway utilization pattern for the Airport is presented as follows:

Runway 17/35 @ 80%

- Runway 17 @ 70%
- Runway 35 @ 30%

Runway 08/26 @20%

- Runway 8 @ 5%
- Runway 26 @ 95%

Percent Arrivals. The percentage of aircraft arrivals influences the airfield capacity, because aircraft on approach are travelling at reduced speeds and are typically given priority over departures. Thus, higher percentages of arrivals during peak periods of activity tend to reduce the ability of the airfield system to accommodate the demand. It is estimated that a general balance of arrivals and departures exists at Olympia Regional Airport.

Touch-and-Go Operations. A touch-and-go operation refers to an aircraft maneuver in which the aircraft performs a normal landing touchdown followed by an immediate takeoff without stopping or taxiing clear of the runway. They are usually associated with training and are counted as local operations. As presented in the previous chapter, local operations comprise approximately 44% of all operations at the Airport, decreasing to approximately 42% by the end of the planning period (2030).

Exit Taxiways. Exit taxiways influence the airfield capacity by providing aircraft the ability to exit the runway as quickly and safely as possible. Therefore, the amount, spacing, and design of the exit taxiways affect runway occupancy times and the capacity of the airfield system. Olympia Regional Airport has a limited amount of exit taxiways to minimize runway occupancy times and maximize airfield capacity.

Air Traffic Control Rules. The FAA specifies separation criteria and operational procedures for aircraft in the vicinity of an airport contingent upon aircraft size, availability of radar, sequencing of operations, and noise abatement procedures (both advisory and/or regulatory) that may be in effect at an airport. The impact of air traffic control on airfield capacity is most influenced by aircraft separation requirements dictated by the mix of aircraft using an airport. Presently, there are no special air traffic control rules in effect at Olympia Regional Airport that significantly affect airfield capacity.

As specified in AC 150/5060-5, the determination of ASV and hourly capacity for long-range planning purposes involves several assumptions, which are: arrivals equal departures; the percentage of touch-and-go operations is between 0 and 50% of total operations; a full-length parallel taxiway and adequate exit taxiways are available and no taxiway crossing problems exist; there are no airspace limitations; the Airport has at least one runway equipped with an Instrument Landing System (ILS) and has the necessary air traffic control facilities and services to carry out operations in a radar environment; IFR weather conditions occur roughly 10% of the time; and, approximately 80% of the time the Airport is operated with the runway use configuration that produces the greatest hourly capacity.

Using these assumptions and AC 150/5060-5 guidelines, the existing and future ASV for Olympia Regional Airport has been calculated at approximately 230,000 operations, with a VFR capacity of 98 operations per hour and an IFR capacity of 59 operations per hour. It is recognized that the Airport does not conform to all of the assumptions stated above, which would result in a loss of capacity from the figures presented here. The primary difference between the Airport and the assumptions is the exit taxiway system, which is not fully optimized for maximum capacity.

Conclusion. As can be seen, the calculated ASV of 230,000 is significantly higher than the 67,195 operations expected at the end of the planning period. It should be noted that FAA planning standards indicate that when 60% of the ASV is reached (in this case, some 138,000 operations), an airport should begin planning ways to increase capacity, and when 80% of the ASV is reached (approximately 184,000 operations), then construction of facilities to increase capacity should be initiated. Although the Airport's actual ASV and hourly capacities would be reduced from those calculated, it is not anticipated that the Airport will exceed capacity during the planning period.

Dimensional Standards

Standard dimensional criteria for airport facilities are contained in FAA AC 150/5300-13, which are determined by the ARC and the designated or planned instrument approach procedure with the lowest visibility minimums. Because different aircraft types use the various runways at the Airport, each runway has a specific ARC.

Runway 17/35. Existing dimensions and the corresponding existing/potential design criteria applicable to Runway 17/35 are presented in the following table entitled *RUNWAY 17/35 DIMENSIONAL STANDARDS, IN FEET*. As identified, Runway 17/35 meets or exceeds all dimensional standards associated with ARC C-II with approach visibility minimums less than ¾-

statute mile. It should also be noted that the Runway 17/35 west side parallel taxiway system (i.e., Taxiway "W") is currently designed in accordance with Airplane Design Group (ADG) III dimensional criteria, which specifies a taxiway width requirement of 50 feet and additional taxiway object free area (TOFA) setback requirements. This existing ADG III taxiway capability allows the Airport to better accommodate those occasional large business jets, as well as preserves future opportunities to serve larger commercial service passenger aircraft (e.g., the Bombardier Q400 turboprop operated by Horizon Airlines). In addition, one of the commercial passenger service scenarios identified in the previous *Aviation Activity Demand Forecast* chapter (i.e., Scenario Two) reflected the potential use of ADG III aircraft. Again, it is understood that the FAA will only participate in funding based on the standard; the Port of Olympia will be responsible for anything exceeding demand at the time.

Table C3
Runway 17/35 Dimensional Standards, In Feet

Item	**Existing Dimension**	**ARC C-II w/ <3/4-Statute Mile Visibility Minimums**
Runway:		
Width	150	100
Safety Area Width	500	500
Safety Are Length (beyond runway end)		
Runway 17	1,000	1,000
Runway 35	1,000	1,000
Object Free Area Width	800	800
Object Free Area Length (beyond runway end)		
Runway 17	1,000	1,000
Runway 35	1,000	1,000
Precision Obstacle Free Zone Width		800
Precision Obstacle Free Zone Length (beyond runway end)		200
Obstacle Free Zone Width	400	400
Obstacle Free Zone Length (beyond runway end)		
Runway 17	2,685	2,685
Runway 35	200	200
Taxiway:		
Width	35, 40, 50	35
Runway Centerline to:		
Holdline	250	250
Parallel Taxiway Centerline	400	400
Aircraft Parking Area	600+	500

Source: FAA Advisory Circular 150/5300-13, *Airport Design*, and actual airport conditions as determined by MEAD & HUNT INC.

Runway 08/26. Existing dimensions and the corresponding existing/potential design criteria applicable to Runway 08/26 are presented in the following table entitled *RUNWAY 08/26 DIMENSIONAL STANDARDS, IN FEET*. As identified, Runway 08/26 meets or exceeds the identified dimensional standards associated with ARC B-II with approach visibility minimums greater than or equal to ¾-statute mile. It should be noted that the existing ALP identified a reduction of the runway width from 150 feet to 75 feet to meet the standard ARC B-II dimension. This recommendation will be retained in this MP Update to reduce the expenditure of funds required for pavement maintenance.

Table C4

Runway 08/26 Dimensional Standards, In Feet

Item	Existing Dimension	ARC B-II w/ ≥ 3/4-Statute Mile Visibility Minimums
Runway:		
Width	150	75
Safety Area Width	150	150
Safety Are Length (beyond runway end)		
Runway 08	300	300
Runway 26	300	300
Object Free Area Width	500	500
Object Free Area Length (beyond runway end)		
Runway 08	300	300
Runway 26	300	300
Obstacle Free Zone Width	400	400
Obstacle Free Zone Length (beyond runway end)		
Runway 08	200	200
Runway 26	200	200
Taxiway:		
Width	35, 50	35
Runway Centerline to:		
Holdline	200	200
Parallel Taxiway Centerline	N/A	240
Aircraft Parking Area	525	250

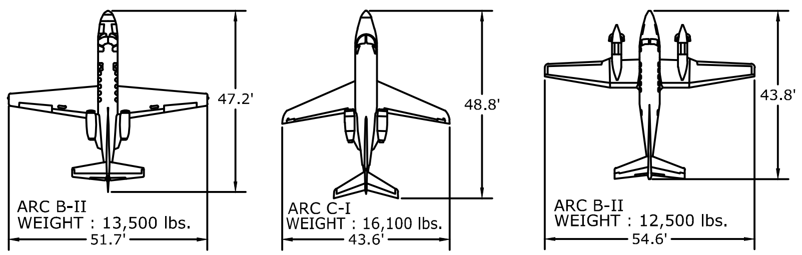
Source: FAA Advisory Circular 150/5300-13, *Airport Design*, and actual airport conditions as determined by MEAD & HUNT INC.

Note: No FAA funding is anticipated for Runway08/26 maintenance or improvement projects.

Mead & Hunt

Runway 17/35 | Runway 08/26

Cessna 550 | Beechjet 400A | Beech Super King Air B20



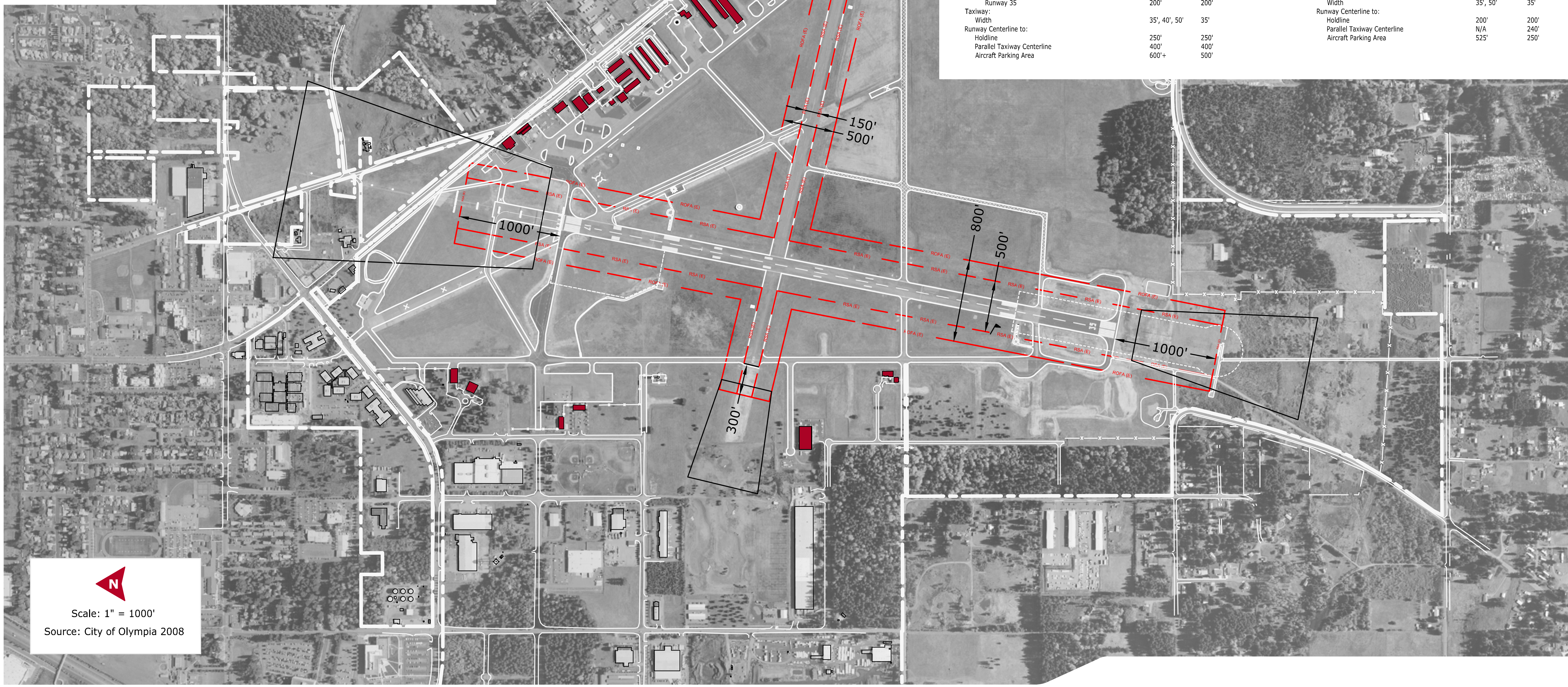
Runway Dimensional Standards

Runway 17/35

Item	Existing Dimension	ARC C-II w/ <3/4-Statute Mile Visibility Minimums
Runway:		
Width	150'	100'
Safety Area Width	500'	500'
Safety Area Length (beyond runway End)		
Runway 17	1000'	1000'
Runway 35	1000'	1000'
Object Free Area Width	800'	800'
Object Free Area Length (beyond runway end)		
Runway 17	1000'	1000'
Runway 35	1000'	1000'
Precision Obstacle Free Zone Width		800'
Precision Obstacle Free Zone Length (beyond runway end)	200'	200'
Obstacle Free Zone Width	400'	400'
Obstacle Free Zone Length (beyond runway end)		
Runway 17	2685'	2685'
Runway 35	200'	200'
Taxiway:		
Width	35', 40', 50'	35'
Runway Centerline to:		
Holdline	250'	250'
Parallel Taxiway Centerline	400'	400'
Aircraft Parking Area	600'+	500'

Runway 8/26

Item	Existing Dimension	ARC B-II w/ ≥3/4-Statute Mile Visibility Minimums
Runway:		
Width	150'	75'
Safety Area Width	150'	150'
Safety Area Length (beyond runway End)		
Runway 08	300'	300'
Runway 26	300'	300'
Object Free Area Width	500'	500'
Object Free Area Length (beyond runway end)		
Runway 08	300'	300'
Runway 26	300'	300'
Obstacle Free Zone Width	400'	400'
Obstacle Free Zone Length (beyond runway end)		
Runway 08	200'	200'
Runway 26	200'	200'
Taxiway:		
Width	35', 50'	35'
Runway Centerline to:		
Holdline	200'	200'
Parallel Taxiway Centerline	N/A	240'
Aircraft Parking Area	525'	250'



Scale: 1" = 1000'
Source: City of Olympia 2008

FIGURE C3
Existing Airport Dimensional Criteria

MASTER PLAN UPDATE
Port of Olympia/
Olympia Regional Airport

Conclusion. An illustration of the previously described dimensional criteria for each runway is presented in the following figure entitled *EXISTING AIRPORT DIMENSIONAL CRITERIA*. In consideration of the existing and forecast aircraft operational fleet, the dimensional standards analysis indicates that Runway 17/35 should be maintained to meet ARC C-II criteria, with the west side parallel taxiway system being maintained to ADG III standards, and Runway 08/26 should be maintained to meet ARC B-II criteria. The Runway 08/26 width can also be decreased to 75 feet in accordance with ARC B-II standards for pavement maintenance considerations.

Runway Length

The determination of runway length requirements is based on a combination of many factors. Generally, it is premised upon the most demanding aircraft within the general aviation fleet that are operating, or are projected to operate, at an airport, as well as airport elevation, mean maximum daily temperature of the hottest month, runway gradient, and stage length of the longest non-stop trip destination. Runway length requirements are derived from the FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*.

For Olympia Regional Airport, aircraft operations are dominated by small aircraft having a Maximum Takeoff Weight (MTOW) of 12,500 pounds or less, but include the operation of some turbojet-powered aircraft weighing less than 60,000 pounds. Using the airport elevation of 207.8 feet Above Mean Sea Level (AMSL), the mean maximum daily temperature of 77° Fahrenheit, the stage length of 500 NM, and the maximum difference in runway elevation at the centerline[1] (i.e., runway gradient) of 11.2 feet, the recommended runway length requirements can be generated and are presented in the following table, entitled *RUNWAY LENGTH REQUIREMENTS, IN FEET*. Additionally, an adjustment has been made in the length for wet and slippery conditions of runways expected to be used by turbojet-powered aircraft.

The table provides four lengths for small aircraft type runways. Each of these provides the required length to accommodate a certain type of small aircraft, ranging in length from 2,440 feet to 4,080 feet. There are also four lengths provided for large aircraft (i.e., aircraft weighing between 12,500 pounds and 60,000 pounds). The specified large aircraft runway lengths pertain to those general aviation aircraft, generally jet-powered, of 60,000 pounds or less MTOW. The runway length requirements for large aircraft range between 4,690 feet and 7,370 feet for

[1] The documentation of the runway centerline elevation differential, which is used to tabulate the effective runway gradient, is one of the runway length variables (i.e., for takeoff lengths only) specified for use in Advisory Circular (AC) 150/5325-4B, entitled *Runway Length Requirements for Airport Design*. An adjustment of 10 feet is added for each one foot of elevation difference between the high and low point of the runway centerline.

Olympia Regional Airport. The last row provides the runway length requirement for aircraft with MTOW greater than 60,000 pounds and a stage length of 500 NM.

The runway length requirements provided in the table for the large aircraft fleet with less than 60,000 pounds MTOW are dependent upon meeting the operational requirements of a certain percentage of the fleet at a certain percentage of the useful load, (i.e., 75% of the fleet at 60% useful load). The useful load of an aircraft is defined as the difference between the maximum allowable structural gross weight and the operating weight empty. In other words, it is the load that can be carried by the aircraft composed of passengers, fuel, and cargo. Generally, the following aircraft comprise 75% of the general aviation aircraft fleet having a MTOW less than 60,000 pounds: Learjets, Sabreliners, Citations, Falcons, Hawkers, and Westwinds.

Table C5
Runway Length Requirements, In Feet

Aircraft Category	Dry	Wet and Slippery
Existing Conditions		
Runway 17/35	5,501	5,501
Runway 08/26	4,157	4,157
Small aircraft[1] with less than ten seats		
75% of the fleet	2,440	2,440
95% of the fleet	2,980	2,980
100% of the fleet	3,540	3,540
Small aircraft[1] with more than ten seats	4,080	4,080
Aircraft greater than 12,500 pounds, but less than 60,000 pounds MTOW		
75% of the fleet at 60% useful load	4,690	5,270
100% of the fleet at 60% useful load	5,970	6,740
75% of the fleet at 90% useful load	5,090	5,500
100% of the fleet at 90% useful load	7.370	7,370
Aircraft greater than 60,000 pounds MTOW	5,090	5,090

Source: FAA AC 150/5325-4B, *Runway Length Requirement for Airport Design*. Lengths based on 207.8 feet AMSL, 77 degrees F NMT, 500 NM stage length, and a maximum difference in runway centerline elevation of 11.2 feet for Runway 17/35.
Note: [1] Under 12,500 pounds MTOW.

When analyzing the runway lengths presented in the preceding table, the actual runway length necessary for each individual aircraft to operate safely is a function of elevation, temperature, and aircraft weight (usually dependent upon the stage length). As temperatures change on a daily or hourly basis, the runway length requirements change accordingly (i.e., as the temperature increases, the runway length increases). Therefore, if a runway is designed to accommodate a certain aircraft under all conditions, it can also accommodate a larger aircraft, or one that requires a longer runway, when temperatures are cooler or when a shorter stage length is required. It should be noted that pilots operating at Olympia Regional Airport can adjust the operating weight of their aircraft based upon the specific payload requirements of their flight and their runway length available for takeoff. The specific performance capabilities of general aviation aircraft are documented through the aircraft certification process and defined by Federal Aviation Regulations (FAR) Part 23. Thus, both takeoff and landing procedures conducted at the Airport must comply with these regulations to ensure the safety of these operations. Based upon discussions with existing FBO representatives, some occasional business operators must take restricted fuel loadings when departing from Olympia, due to the existing runway length. However, these takeoff runway length limitations occur infrequently, and have not been identified as an aviation planning issue for this master plan update.

Runway 17/35. The data presented in the table indicates that Runway 17/35 can accommodate 75% of the large aircraft fleet with MTOW less than 60,000 pounds operating at 60% useful load and 75% of the large aircraft fleet with MTOW less than 60,000 pounds operating at 90% useful load during wet or slippery conditions. Also, with an existing 94,000 pounds dual wheel pavement strength, this runway can accommodate a variety of large aircraft weighing greater than 60,000 pounds MTOW.

Runway 08/26. With an existing length of 4,157 feet, this runway can accommodate the entire general aviation aircraft fleet with MTOW less than 12,500 pounds.

Conclusion. In consideration of the category of aircraft that regularly, or are expected to regularly operate at the Airport, it is recommended that no extensions to the either runway be proposed.

Pavement Strength

As identified in the *Inventory* chapter, Runway 17/35 has an existing gross weight bearing capacity of 75,000 pounds single wheel, 94,000 pounds dual wheel, and 142,000 pounds dual tandem wheel main landing gear configuration. During the design of the runway shift/line-of-sight construction project for Runway 17/35, it was determined that the runway should be strengthened to the 94,000 pounds dual wheel pavement strength to better accommodate existing operations by the larger business jet fleet and potential future operations by larger commercial service aircraft. Runway 08/26 has an existing gross weight bearing capacity of 30,000 pounds single wheel, 45,000 pounds dual wheel, and 90,000 pounds dual tandem wheel main landing gear configuration. According to the projected operational aircraft fleet mix, the existing runway pavement strengths coincide with the requirements expected to be placed on them.

Conclusion. It is recommended that the existing pavement strength for each runway be retained through a regular pavement maintenance program. In consideration of the existing/future design aircraft for each runway facility at the Airport, both runway pavement strengths will be reevaluated to confirm the required design strength at the next pavement reconstruction interval.

Runway Line of Sight

Line of sight standards provide pilots the ability to observe runway and taxiway surfaces for assurance that they are clear of aircraft, vehicles, wildlife, and other hazardous objects. According to the longitudinal (i.e., along the length of the runway) line of sight standards contained in AC 150/5300-13, any two points located five feet above the runway centerline must be mutually visible for the entire length of the runway. However, if the runway is served by a full-length parallel taxiway, the requirement is reduced to a distance of one-half the runway length.

Runway 17/35. A project that corrected a Runway 17/35 deficient line of sight standard was completed in 2008. At that time, the FAA determined that Taxiway "W" functions as a full-length parallel taxiway, even though it is not parallel for the entire runway length. Therefore, Runway 17/35 meets the existing longitudinal runway line of sight standards.

Runway 08/26. The FAA has not made a determination regarding Taxiway "G" functioning as a full-length parallel taxiway for Runway 08/26. Thus, this runway was analyzed for both criteria. This runway meets the longitudinal line of sight standards along one-half the distance of the runway, as well as along the entire length of the runway. Therefore, this runway complies with longitudinal runway line of sight standards.

Intersecting Runways. When airfield geometry includes intersecting runways, line of sight standards indicate there must be an unobstructed view from any point five feet above the runway centerline to any other point five feet above the intersecting runway within the visibility zone. At Olympia Regional Airport, the visibility zone is established by four points; three are located equidistant from the runway intersection to Runway ends 17, 35, and 26. The other point is located 750 feet west of the runway intersection along Runway 08/26. The intersecting runway line of sight standard within this visibility zone is currently met.

Conclusion. Since the longitudinal line of sight standards are met for both runways at Olympia Regional Airport, and the visibility zone requirements are attained, no additional analysis is required. However, should any improvements to the runway system be proposed, these standards will need to be reevaluated for compliance.

Runway Surface Gradients

A runway should be as level as practicable to facilitate smooth, comfortable, and safe landings and takeoffs. Longitudinal runway gradients (i.e., surface grades along the length of the runway) should be as flat as practicable to increase aircraft operational efficiency and safety while allowing design flexibility within local topographic constraints. Transverse surface gradients (i.e., surface grades across the runway and runway safety area), generally, should be kept to a minimum consistent with drainage requirements. Surface gradient standards are contained in FAA AC 150/5300-13 and are determined by the Aircraft Approach Category that a runway is designed to serve.

Runway 17/35. Existing and standard gradients for Runway 17/35 are presented in the following table entitled *RUNWAY 17/35 LONGITUDINAL SURFACE GRADIENTS*. This runway has a maximum longitudinal gradient of 0.3%, and has 0.07% and 0.2% within the north and south quarters of the runway, respectively. These gradients are within the standards for runways serving in approach categories C and D.

Table C6
Runway 17/35 Longitudinal Surface Gradients

Surface	Existing Gradient	Standard Gradient
Aircraft Approach Category C and D	0.3%	0% - 1.5%
Within first and last quarter of runway length		0% - 0.8%
Runway 17	0.07%	
Runway 35	0.2%	
200 feet beyond the end of the runway		0% - 3%
Runway 17	0.8%	
Runway 35	1.9%	

Source: FAA Advisory Circular 150/5300-13, *Airport Design*, and actual airport conditions as determined by MEAD & HUNT INC.

Runway 08/26. Existing and standard gradients for this runway are presented in the following table entitled *RUNWAY 08/26 LONGITUDINAL SURFACE GRADIENTS*. The maximum longitudinal gradient for this runway is 0.4%, which is within the standard for runways serving aircraft in approach categories A and B.

Table C7
Runway 08/26 Longitudinal Surface Gradients

Surface	Existing Gradient	Standard Gradient
Aircraft Approach Category A and B	0.4%	0% - 2%

Source: FAA Advisory Circular 150/5300-13, *Airport Design*, and actual airport conditions as determined by MEAD & HUNT INC.

Conclusion. Since the surface gradient standards are met by both runways, additional analysis is not required. Any proposed runway improvements or extensions will include further analysis to ensure that specified FAA engineering standards are maintained.

Runway Protection Zones

A Runway Protection Zone (RPZ) functions to enhance the protection of people and property on the ground beyond the end of the runway. This is achieved through airport control of the RPZ areas. The RPZ is trapezoidal in shape, centered on the extended runway centerline, and begins 200 feet beyond the end of the area usable for takeoff or landing. RPZ dimensions are a function of the ARC, aircraft size, and the lowest visibility minimums associated with a runway end.

As noted in the *Inventory* chapter, Runway 17 has two published IAPs, one providing visibility minimums as low as ½-mile. Runway 35 has two published IAPs, both having visibility minimums as low one mile. Runway 08/26 does not have any published IAPs. The following table, entitled *RUNWAY PROTECTION ZONE DIMENSIONS*, presents the RPZ dimensions as illustrated on the existing ALP and if the Airport owns or controls the entire area contained within the RPZ. The remainder of the table presents the RPZ dimensions for various instrument approach minimums and aircraft types.

Table C8
Runway Protection Zone Dimensions

Item	Width at Inner Edge	Length	Width at Outer Edge	Airport Controls Entire RPZ
Existing RPZ Dimensions				
Runway 17	1,000	2,500	1,750	Yes
Runway 35	500	1,700	1,010	Yes
Runway 08	500	1,000	700	Yes
Runway 26	500	1,000	700	No
Required RPZ Dimensions				
Visual and not lower than one mile, small aircraft only	250	1,000	450	
Visual and not lower than one mile, approach categories A and B	500	1,000	700	
Visual and not lower than one mile, approach categories C and D	500	1,700	1,010	
Not lower than ¾-mile, all aircraft	1,000	1,700	1,510	
Lower than ¾-mile, all aircraft	1,000	2,500	1,750	

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

Conclusion. The existing RPZs, as illustrated on the current ALP, are adequate in size based on the existing IAPs visibility minimums. Any changes in the visibility minimums or airfield layout will require a reevaluation of the requirements presented here.

Threshold Siting Requirements

FAA AC 150/5300-13 provides criteria for properly siting runway thresholds that meet approach and departure obstacle clearance requirements. Like the RPZ criteria, the threshold siting criteria are based on the type of aircraft and the IAP visibility minimums associated with each runway end. The existing criteria for Olympia Regional Airport is presented in the following table entitled *RUNWAY THRESHOLD SITING CRITERIA*.

Table C9
Runway Threshold Siting Criteria

Runway Type	Distance From Threshold	Width at Inner End	Width at Outer End	Length of First Segment	Length of Second Segment	Slope
1. Small aircraft only with approach speeds < 50 knots, visual approach	0	120	300	500	2,500	15:1
2. Small aircraft only with approach speeds > 50 knots, visual approach	0	250	700	2,250	2,750	20:1
3. Large aircraft, visual approach, or instrument minimums ≥ one mile, day only	0	400	1,000	1,500	8,500	20:1
4. Instrument night circling	200	400	3,400	10,000	0	20:1
5. Aircraft approach category A and B only, instrument straight in night operations	200	400	3,800	10,000	0	20:1
6. Aircraft approach category greater than B, instrument straight in night operations	200	800	3,800	10,000	0	20:1
7. Instrument approach with positive vertical guidance (GQS)	0	½ width RW +100′	760	10,000	0	30:1
8. Instrument approach with visibility minimums < one mile but ≥¾-mile, day or night	200	800	3,800	10,000	0	20:1
9. Instrument approach with visibility minimums < ¾-mile or precision approach, day or night	200	800	3,800	10,000	0	34:1

Source: FAA Advisory Circular 150/5300-13, *Airport Design*/Appendix 2.

Utilizing the above threshold siting standards for the existing runway ends (i.e., Runway Type 9 for Runway 17, Type 8 for Runway 35, and Type 3 for Runways 08 and 26), and the elevation data provided in both the June 1992 Olympia Regional Airport Obstruction Chart (OC) and the 2009 obstruction survey prepared by Reid Middleton, the Runways 17, 35, and 08 thresholds are currently sited to achieve adequate clearance over adjacent roadways, terrain, and other identified objects. However, the existing Runway 26 threshold siting surface is obstructed by a tree that is located on private property, on the east side of Old Highway 99.

Conclusion. This analysis indicates that the existing Runway 26 threshold has an obstruction to the specified threshold siting surface. The correction of this existing obstruction and the examination of future requirements in conjunction with any improvements or changes to the threshold locations or instrument approach capabilities will be examined in the next chapter.

Instrumentation, Lighting, and Marking

Electronic Landing Aids (Instrumentation). For many years, the FAA has been transitioning from ground-based navigational technology to satellite-based Global Positioning System (GPS) technology. GPS has the potential for providing a new or improved IAP to nearly every runway end in the country. The continued development of Wide Area Augmentation System (WAAS) further improves upon this technology by improving the GPS signal accuracy and allows for Localizer Performance with Vertical Guidance (LPV) approaches. Since WAAS does not require any ground-based navigational equipment, costs are reduced and approach capability is not affected by signal reflection from waiting or landing aircraft, hangars, or other structures.

Currently, Runway 17 is equipped with an ILS IAP providing visibility minimums of ½-mile, and a GPS (LPV) IAP having visibility minimums of ¾-mile. Runway 35 is equipped with a GPS IAP and a VOR/DME IAP, both providing visibility minimums as low as one mile. It is expected that Olympia Regional Airport will experience continued and increased use by more sophisticated general aviation aircraft during the planning period. Therefore, the ability to implement improved IAPs should be examined and preserved. The existing ALP indicates that Runway 35 is programmed for an IAP with visibility minimums of ½-mile, and Runway 26 is programmed for an IAP with visibility minimums of one mile. There are no IAPs programmed for Runway 8. These current IAP recommendations will be reevaluated and/or confirmed in the following section of this document. It should also be noted that future improvements to the IAPs, or the establishment of new procedures would require the implementation of more restrictive threshold siting criteria, which must be clear of all obstructions.

Visual Landing Aids (Lighting). Presently, Runway 17/35 is equipped with High Intensity Runway Lighting (HIRL) and four-light Precision Approach Path Indicators (PAPIs) located on the left-hand side of each runway end. Runway 17 is equipped with a Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR). The existing ALP indicates a future MALSR will be installed to Runway 35.

Appendix 16 of AC 150/5300-13 indicates that an Approach Procedure with Vertical Guidance (APV) having visibility minimums less than one mile requires, at a minimum, a Medium Intensity Approach Lighting System (MALS), an Omni-directional Approach Lighting System (ODALS), or a Simplified Short Approach Lighting System (SSALS). For runways with a precision IAP with visibility minimums less than ¾-mile, a MALSR, Short Simplified Approach Lighting System with Runway Alignment Indicator Lights (SSALSR), or an Approach Lighting System with Sequenced Flashers (ALSF) at a minimum are required. For runways with an IAP having visibility minimums not less than one mile, approach lighting systems are recommended but not required, but do require MIRL.

For Runway 35 to be equipped with the proposed precision IAP having visibility minimums of ½-mile, a MALSR is required. To implement the proposed Runway 26 IAP with visibility minimums of one mile, MIRL are required for night minimums. These lighting requirements will be evaluated in conjunction with the alternatives development analysis in the next chapter.

Marking. As presented in the Inventory chapter, Runway 17/35 currently has precision instrument runway markings on the north end and non-precision instrument runway markings on the south end. Runway 08/26 has basic runway markings. Appendix 16 of AC 150/5300-13 requires precision instrument runway markings for runways served by IAPs with visibility minimums of ½-mile, and non-precision instrument runway markings for runways with IAPs having visibility minimums as low as ¾-mile.

Runway 35 would require precision instrument runway markings for the implementation of the precision IAP with visibility minimums of ½-mile. Non-precision instrument runway markings would be required on Runway 26 for the implementation of the IAP having visibility minimums of one mile.

Conclusion. Based on the expected continued development and use of GPS navigation systems in general aviation aircraft and increasing the functional use of the airfield during adverse weather conditions, the IAP improvements indicated on the existing ALP will be re-examined in the next chapter. Marking and lighting requirements will be consistent with the requirements of Appendix 16 of AC 150/5300-13 and will be based on the desired visibility minimums proposed for future implementation.

Instrument Approach Screening Criteria

The instrument approach screening criteria that have been utilized for this evaluation are contained in FAA Order 8260.54A, *The United States Standard for Area Navigation (RNAV)* for procedures offering LPV minimums, and FAA AC 150/5300-13. The approach evaluation for each runway end proceeded using the following three criteria evaluations:

- **Glidepath Qualification Surface (GQS) Evaluation**
- **Final & Straight Missed Approach Segment Obstacle Assessment**
- **Turning Missed Approach Segment Obstacle Assessment**

In order to create an accurate representation of the obstacle assessment surfaces, three-dimensional wireframes were created in AutoCAD, which allowed for exact XYZ coordinates and measurements of the specified FAA evaluation criteria. These wireframes were then imported to Google SketchUp and placed on geodetically referenced aerial photography from Google Earth. The wireframes were then traced to create transparent surface models that could be overlaid on Google Earth topography and imagery to show approximate terrain penetrations. It should also be noted that Google Earth topography is based on USGS Digital Elevation Models (DEMs), which has an elevation accuracy of +/- 10 to 30 meters. In addition, an adverse assumption estimate of 150 feet was applied to the height of the larger trees, for which elevation data was unavailable, to assist with the evaluation of the obstacle evaluation surfaces.

Glidepath Qualification Surface (GQS) Evaluation. As specified in FAA Order 8260.54A, "the GQS extends from the runway threshold along the runway centerline extended to the decision altitude (DA) point. It limits the height of obstructions between the DA and runway threshold. When obstructions exceed the height of the GQS, an approach procedure with positive vertical guidance (ILS, MLS, TLS, LPV, Baro-VNAV, etc.) is not authorized". Therefore, the first level of instrument approach screening for this analysis applied the GQS criteria using a 3.0° glide path angle and a 200-foot DA. It should be noted that this GQS analysis includes existing obstruction data from both the 1992 Obstruction Chart and the 2009 obstruction survey, as well as the existing terrain model and tree locations from Google Earth for the obstacle evaluation.

In consideration of the existing runway end elevations at Olympia, the results of the GQS screening analysis are presented in the following table, entitled *GLIDEPATH QUALIFICATION SURFACE (GQS) EVALUATION* and delineated on the following illustrations, entitled *RUNWAY 35 GLIDEPATH QUALIFICATION SURFACE (GQS)* and *RUNWAYS 08 & 26 GLIDEPATH QUALIFICATION SURFACE (GQS)*.

Table C10
Glidepath Qualification Surface (GQS) Evaluation

Airport/Runway	3.0° Glide Path Angle GQS Clearance	Advance Runway to Initial TERPs Analysis
Runway 35 (202.8' MSL)	yes	yes
Runway 08 (197.4.0' MSL)	yes	yes
Runway 26 (207.5' MSL)	yes	yes

Source: GQS evaluation prepared by MEAD & HUNT INC.

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3° GPA/200' DA

Not To Scale
Source: Google Earth, 2011
FAA Order 8260.54a

FIGURE C4
Runway 35 Glide Path Qualification Surface (GQS)

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N
Not To Scale
Source: Google Earth, 2011
FAA Order 8260.54a

FIGURE C5
Runway 8/26 Glide Path Qualification Surface (GQS)

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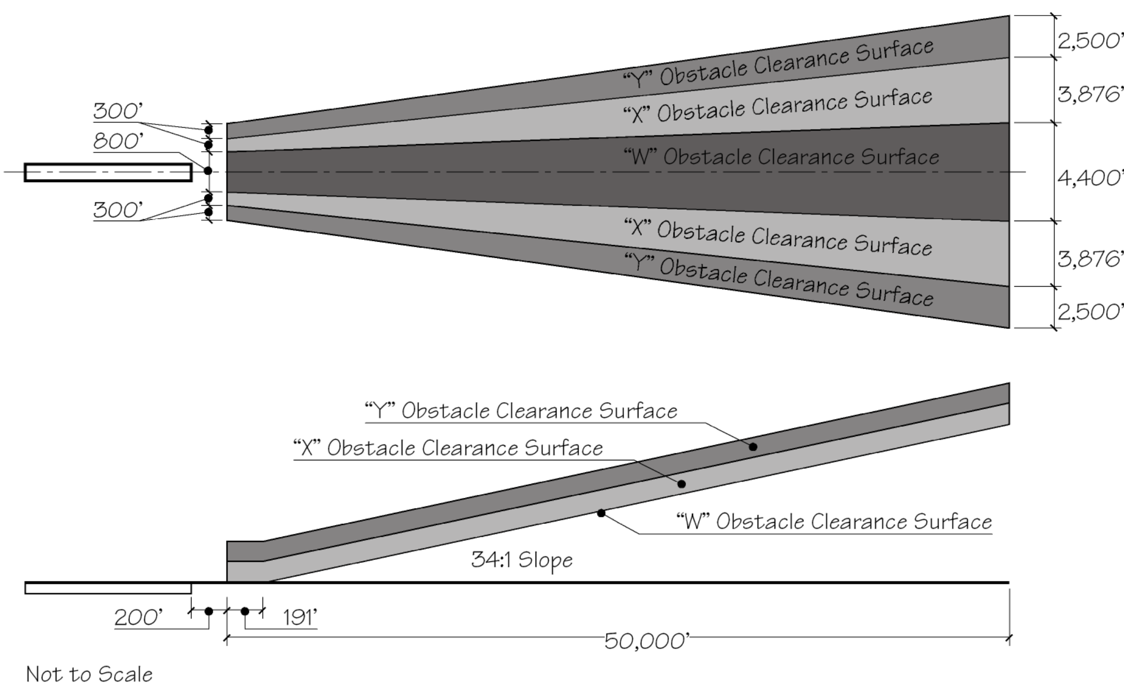
Final and Straight Missed Approach Segment Obstacle Assessment. The second level of screening for this instrument approach capability assessment includes the application of criteria for the LPV Final Approach Segment (FAS)/Obstruction Evaluation Area and Straight-Out Missed Approach Segment (MAS)/Obstruction Evaluation Area. The details of these criteria are also specified in FAA Order 8260.54A.

For the LPV Final Approach Segment, the primary area obstacle clearance surface (OCS) consists of the "W" and "X" surfaces, with the "Y" surface being an early missed approach transitional surface. The "W" surface slopes longitudinally at a slope ratio of 34:1 along the final approach track and is level perpendicular to the track. The "X" and "Y" surfaces slope upward from the edge of the W surface perpendicular to the final approach track at a slope ratio of 4:1 and 7:1, respectively. Obstacles located in the "X" and "Y" surfaces are adjusted in height to account for perpendicular surface rise and evaluated under the "W" surface. Figure C6 illustrates the FAS OCS in plan and profile view as used in this evaluation.

Figure C6
LPV FINAL APPROACH SEGMENT OBSTACLE CLEARANCE SURFACES



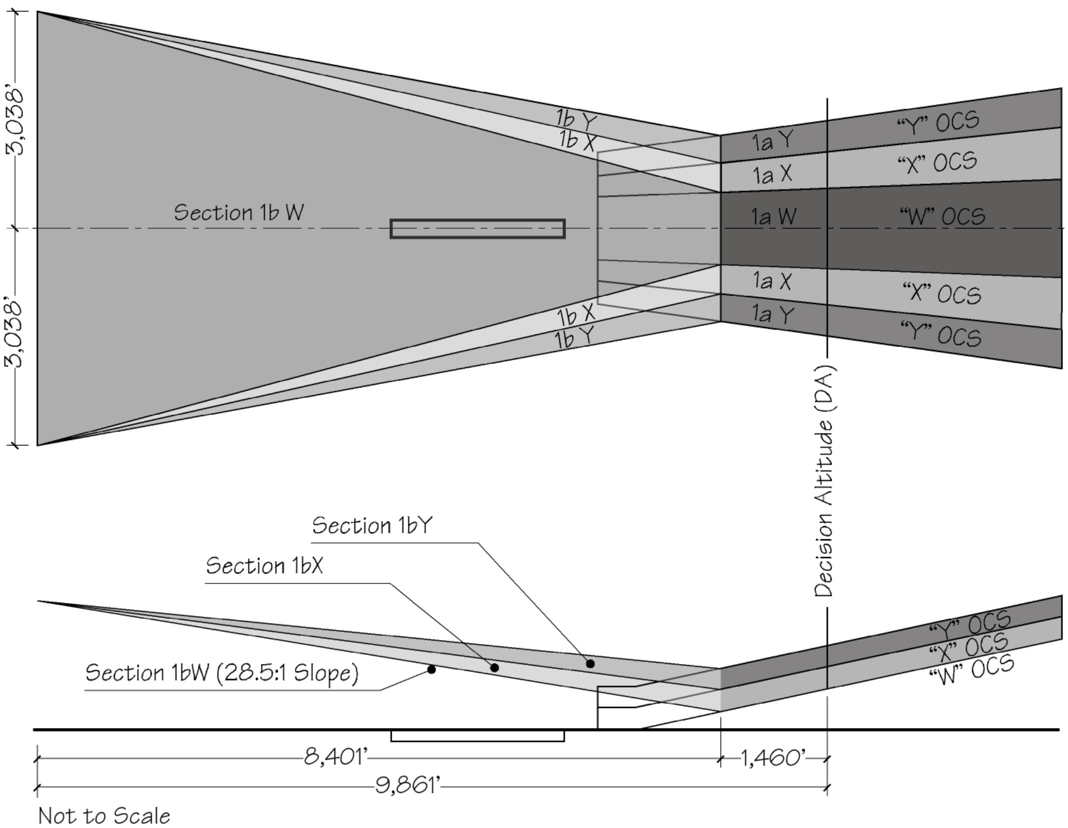
Source: Diagram prepared by MEAD & HUNT INC. using information obtained from FAA Order 8260.54A, *The United States Standard for Area Navigation (RNAV).*

In consideration of the Straight-Out MAS, Section 1a is a 1,460-foot continuation of the Final Approach Segment beginning at the DA point. Section 1b begins at the end of Section 1a and extends for a distance of approximately 8,400 feet and rises at a slope ratio of 28.5:1.

The following illustration, entitled *LPV SECTION 1 MISSED APPROACH SEGMENT OBSTACLE CLEARANCE SURFACES*, provides the specifics of the Section 1 MAS OCS.

Figure C7

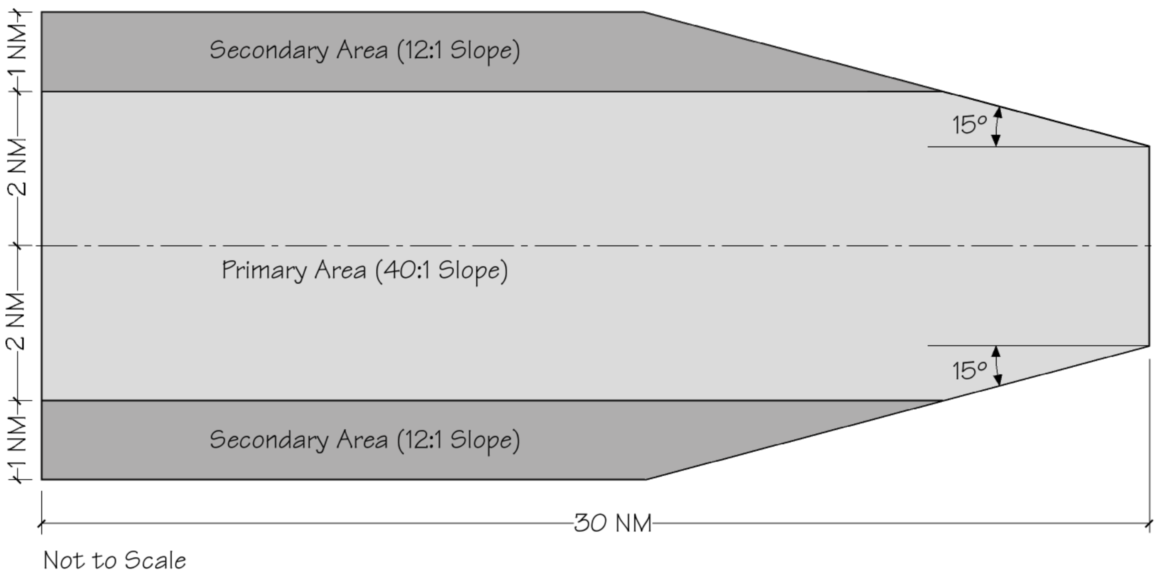
LPV SECTION 1 MISSED APPROACH SEGMENT OBSTACLE CLEARANCE SURFACES



Source: Diagram prepared by MEAD & HUNT INC. using information obtained from FAA Order 8260.54A, *The United States Standard for Area Navigation (RNAV).*

Section 2 of the MAS begins at the end of 1b, utilizing a splay of 15°, and extends with a slope ratio of 40:1 until reaching a full width of 6 NMs within a length of up to 30 NMs. Figure C8, entitled *LPV SECTION 2 MISSED APPROACH SEGMENT OBSTACLE CLEARANCE SURFACES*, illustrates the details of the Section 2 Missed Approach Segment OCS.

Figure C8
LPV SECTION 2 MISSED APPROACH SEGMENT OBSTACLE CLEARANCE SURFACES



Source: Diagram prepared by MEAD & HUNT INC. using information obtained from FAA Order 8260.54A, *The United States Standard for Area Navigation (RNAV).*

The results of the final approach and straight missed approach segment screening analysis are presented in the following table, entitled *FINAL & STRAIGHT MISSED APPROACH SEGMENT OBSTACLE ASSESSMENT (200-FOOT DA)*. It should also be noted that the evaluation of a 200-foot DA was selected based upon the potential LPV IAP minimums that could be achieved at the Airport. As can be determined from the table, Runway 35 and each end of Runway 08/26 was carried forward for this second level of screening and assessed independently for both the final approach and missed approach segments.

Table C11
FINAL & STRAIGHT MISSED APPROACH SEGMENT OBSTACLE ASSESSMENT (200-FOOT DA)

Airport/Runway	Final Approach Segment Obstacle Assessment (Terrain/Vegetation[1] Area)	Straight Missed Approach Segment Obstacle Assessment (Terrain/Vegetation[1] Area)
Runway 35	none/yes	none/none
Runway 08	yes/yes	none/none
Runway 26	none/none	yes[1]/yes[1]

Source: Final & straight-out missed approach evaluation prepared by MEAD & HUNT INC.
Note: [1] It is likely that a turning missed approach procedure could be developed to avoid the existing obstructing terrain and vegetation.

As depicted in the following illustrations, entitled *RUNWAY 35 W, X, & Y OBSTACLE CLEARANCE SURFACES* and *RUNWAY 35 MISSED APPROACH SURFACE (MAS)/SECTION 1B & SECTION 2,* there are existing tree obstructions located with the "W" surface of the final approach, while the straight missed approach segment appears to be clear and free of terrain/tree obstructions.

It is likely that these existing tree obstructions to the Runway 35 "W" surface are the controlling obstructions to the existing RNAV (GPS) approach to this runway end, and they would have to be removed to comply with the future threshold siting surface criteria that is associated with the improved IAP minima.

For Runway 08, there are existing tree and terrain obstructions located within the "W" surface of the final approach, while the straight missed approach segment appears to be clear and free of known terrain/tree obstructions. These surfaces and obstructions are presented on Figures C11 and C12, entitled *RUNWAY 08 W, X, & Y OBSTACLE CLEARANCE SURFACES* and *RUNWAY 08 MISSED APPROACH SURFACE (MAS)/SECTION 1B & SECTION 2.* Due to the elevation of the terrain and the associated tree cover, it is unlikely that the obstacles could be cleared to comply with the LPV final approach segment criteria.

For Runway 26, the final approach segment appears to be clear and free of known terrain/tree obstructions, while there are existing tree and terrain obstructions located within the straight missed approach segment. These surfaces and obstructions are presented on Figures C13 and C14, entitled *RUNWAY 26 W, X, & Y OBSTACLE CLEARANCE SURFACES* and *RUNWAY 26 MISSED APPROACH SURFACE (MAS)/SECTION 1B & SECTION 2.* Due to the location of the terrain/tree obstructions within Section 2 of the missed approach surface, it appears that a turning missed approach segment could likely be developed to avoid the obstacles. In consideration of the

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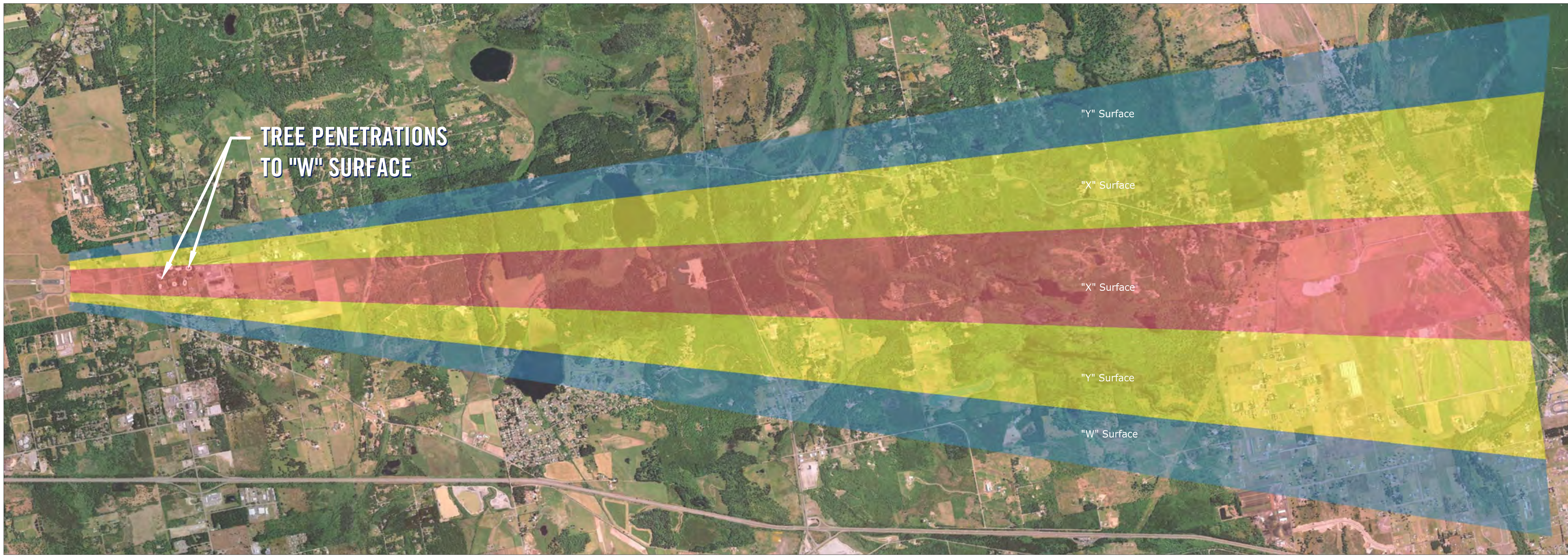

3° GPA

Not To Scale
Source: Google Earth, 2011
FAA Order 8260.54a

FIGURE C9
Runway 35 W, X, & Y Obstacle Clearance Surface (OCS)

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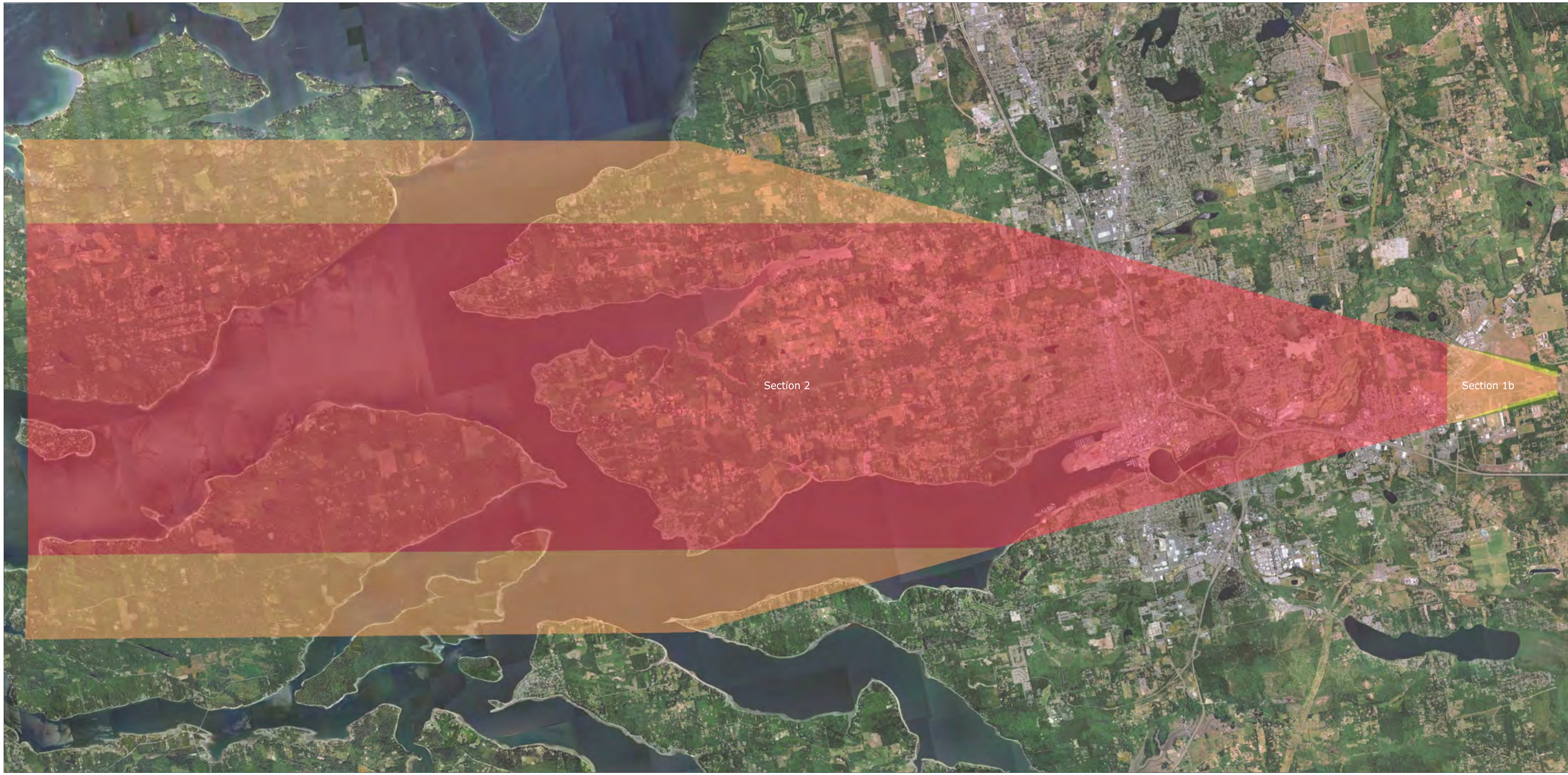

Not To Scale
Source: Google Earth, 2011
FAA Order 8260.54a

FIGURE C10
Runway 35 Missed Approach Surface (MAS) / Section 1b & Section 2

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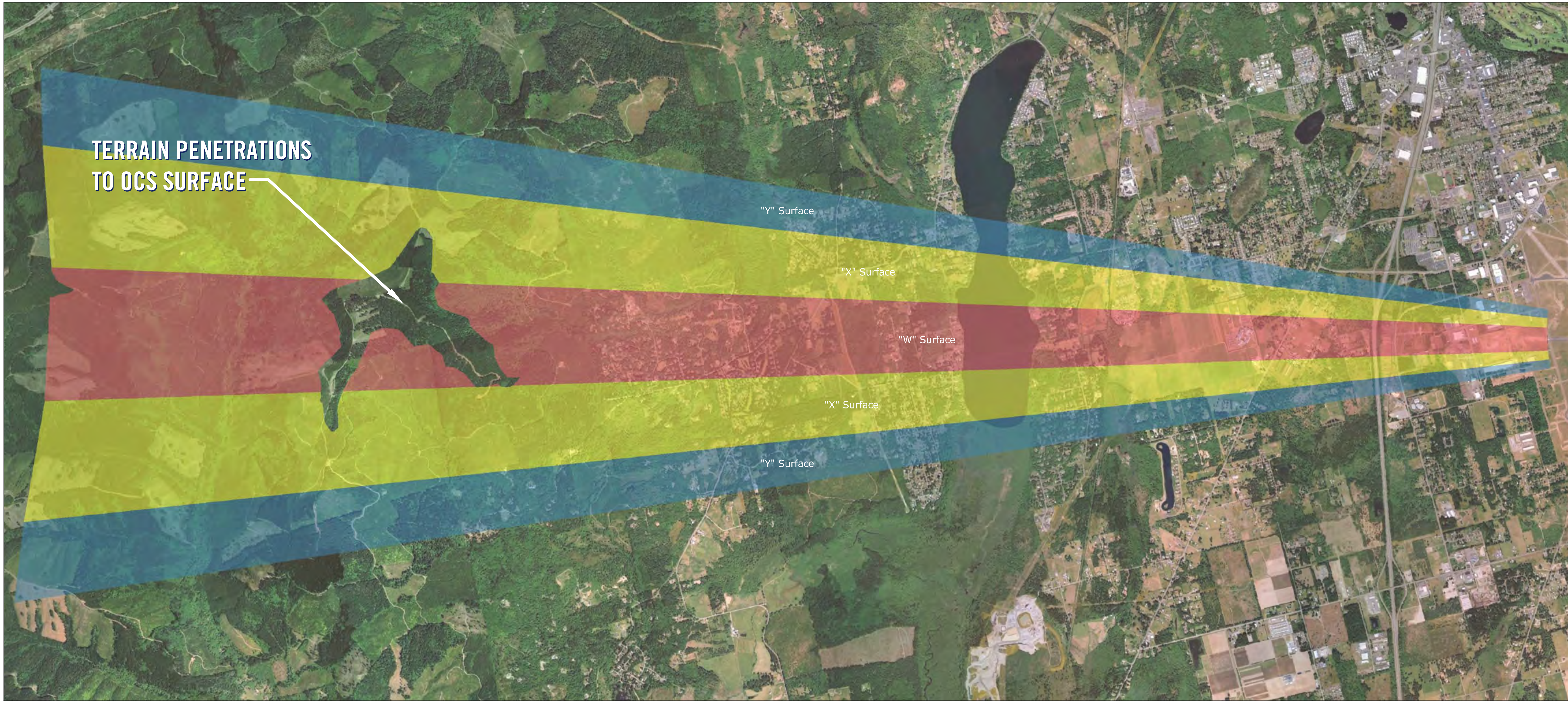

3° GPA

Not To Scale
Source: Google Earth, 2011
FAA Order 8260.54a

FIGURE C11
Runway 8 W, X, & Y Obstacle Clearance Surfaces (OCS)

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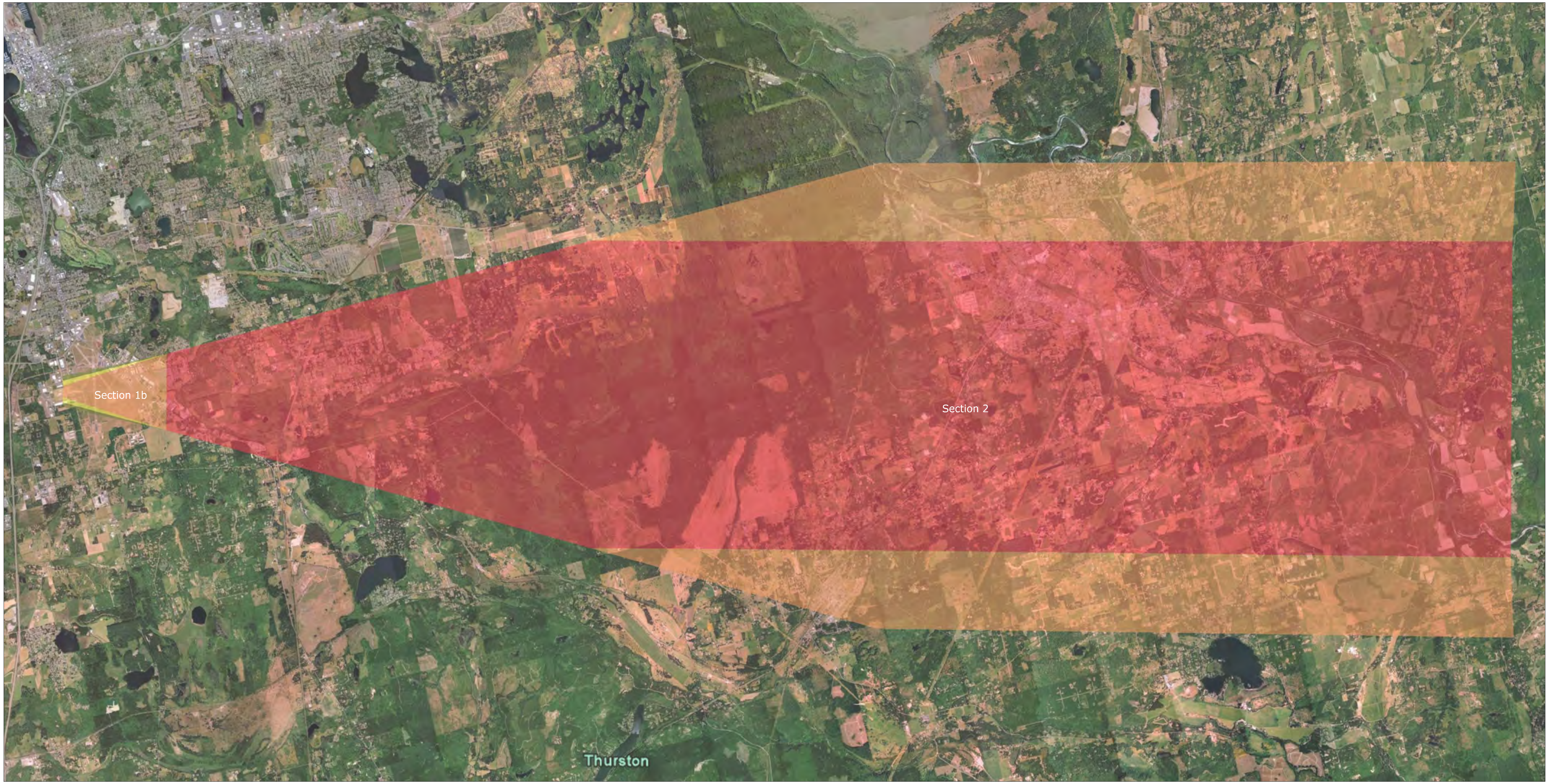

Not To Scale
Source: Google Earth, 2011
FAA Order 8260.54a

FIGURE C12
Runway 8 Missed Approach Surface (MAS) / Section 1b & Section 2

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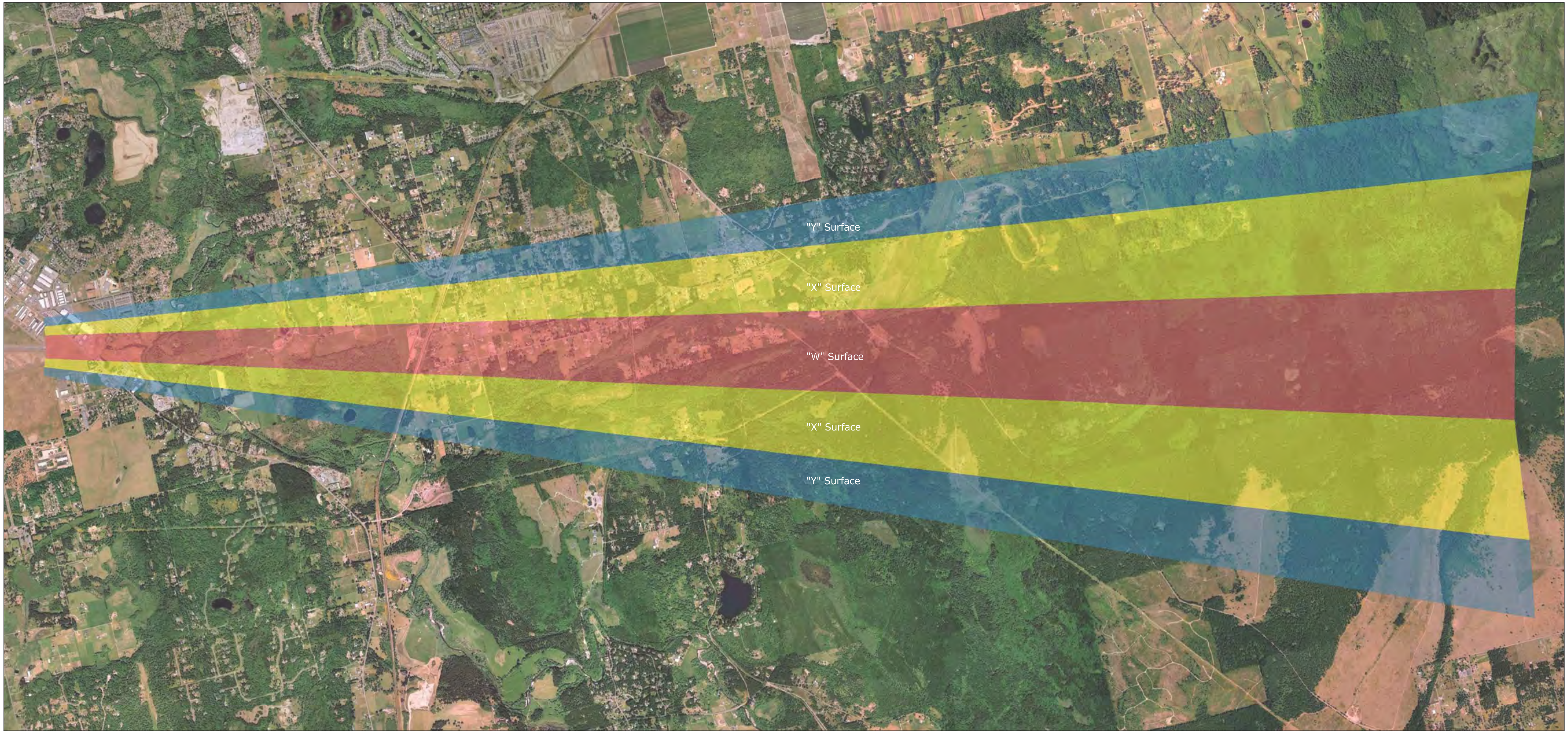

3° GPA

N

Not To Scale
Source: Google Earth, 2011
FAA Order 8260.54a

FIGURE C13
Runway 26 W, X, & Y Obstacle Clearance Surfaces (OCS)

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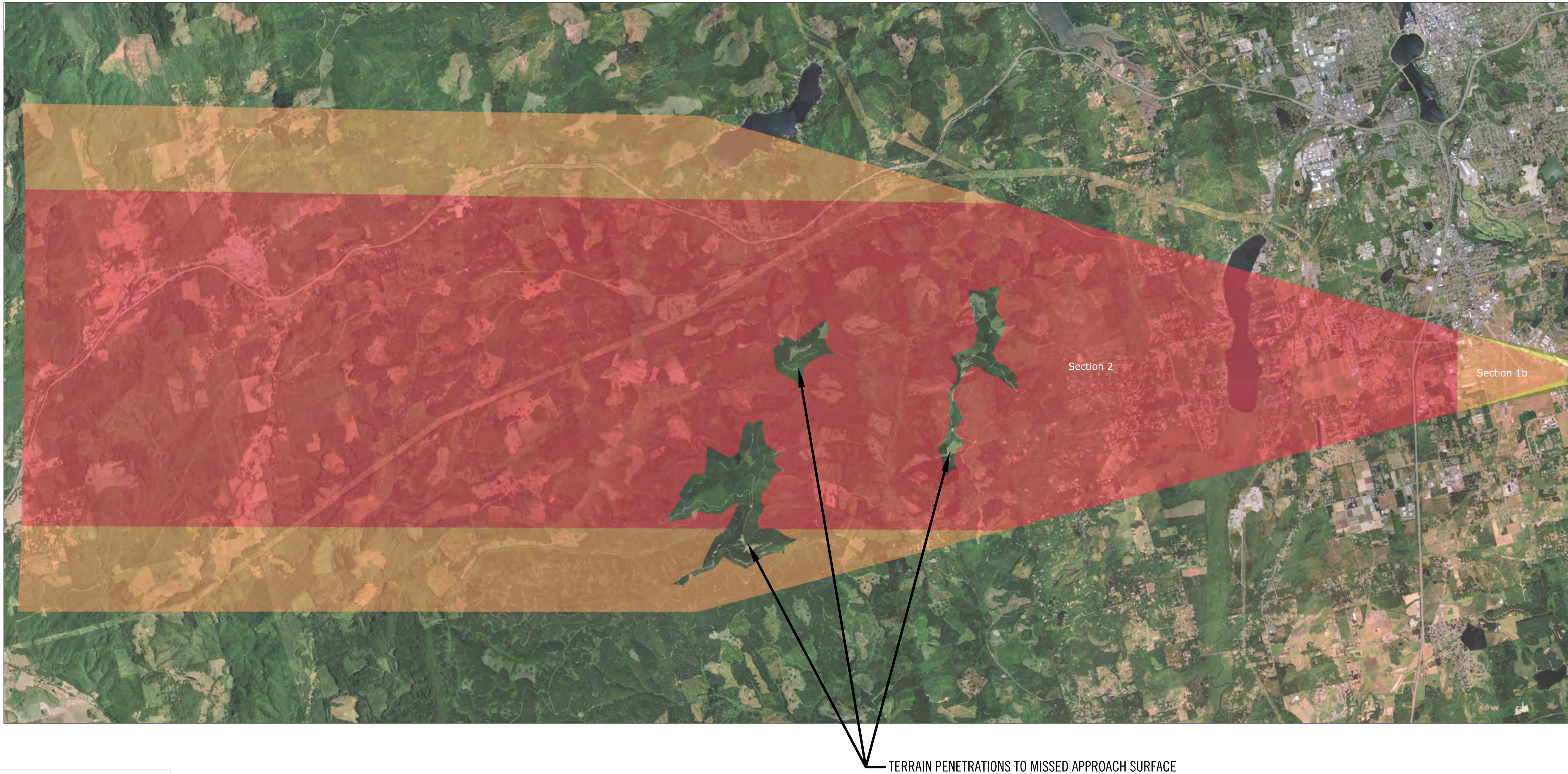

N
Not To Scale
Source: Google Earth, 2011
FAA Order 8260.54a

FIGURE C14
Runway 26 Missed Approach Surface (MAS) / Section 1b & Section 2

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Port of Olympia/
Olympia Regional Airport

Turning Missed Approach Segment, the Section 1a and 1b areas are the same as those described previously for the Straight-Out Missed Approach Segment. There is an additional straight segment of Section 2, which represents the balance of the Turn Initiation Area (TIA) that must be accommodated prior to the boundary of the turning portion of Section 2, and all obstacles within Section 2 are to be evaluated with a slope ratio of 40:1.

Conclusion. Options available to mitigate obstructions within the final and/or missed approach OCS include one or more of the following actions:

- **Remove or lower the obstruction.**
- **Raise the glide path angle.**
- **Increase the threshold crossing height.**
- **Increase the decision altitude.**
- **Turning missed approach procedure.**

The initial LPV instrument approach screening for Runway 35 indicates that there are tree obstructions located within the Runway 35 final approach surface. Any trees located on, or in close proximity to airport property would have to be trimmed or removed to accommodate the lower approach minimums. For Runways 08 and 26, the tree/terrain obstructions located within the Runway 08 final approach surface and within the Runway 26 missed approach surface would likely have to be avoided to mitigate the obstructions.

Therefore, as currently identified on the ALP, it is recommended that the Runway 35 airspace be protected for an APV providing ½-mile approach visibility minimums. According to Appendix 16 of AC 150/5300-13, an APV with these specified minimums would also require an Approach Lighting System (ALS), and, therefore, the siting requirements for a potential ALS should be protected for implementation on the ALP. In addition, the runway should comply with standard runway markings and standard holding position signs, provide clear obstacle free zones, and have imaginary surfaces free of obstructions. As noted in the previous section, Runway 17/35 does comply with current ARC C-II standards.

In addition, the Runway 26 airspace is to be protected for an APV providing one mile approach visibility minimums. Based upon the findings of this instrument approach screening evaluation, along with the existing runway utilization patterns, there will continue to be no future IAPs programmed for Runway 8.

Taxiways

Taxiways provide defined movement corridors for aircraft between the runway system and the various functional areas on an airport. Some taxiways are necessary simply to provide access between the runway and aprons, while others are necessary for more efficient and safer use of the airfield.

In general, the taxiway system configuration at Olympia Regional Airport is considered adequate. Each runway end is served by taxiway access from both directions, and each runway has exit taxiways at various locations along the runway. However, there are aspects of the taxiway geometry that could be improved upon, making the airfield safer and more efficient.

Runway 17/35 Taxiway System. As detailed earlier, Taxiway "W" was determined to function as a full-length parallel taxiway, even though it is not parallel for the entire length of the runway. A relocated Taxiway "W" positioned a consistent 400 feet west of the runway centerline, as indicated on the existing ALP, would alleviate this slight deficiency. Consequently, the provision of a full-length parallel Taxiway "F" 400 feet east of Runway 17/35, also indicated on the existing ALP, would increase efficient use of the airfield for aircraft accessing the development area east of this runway.

According to FAA Engineering Brief No. 75: *Incorporation of Runway Incursion Prevention into Taxiway and Apron Design*, right-angled taxiways are the recommended standard for all runway/taxiway intersections, except where there is a need for high-speed exit taxiways at congested airports. Using this guideline, there are several Runway 17/35 taxiway intersections with less than 90° angles, which are presented in the following table entitled *RUNWAY 17/35 NON-STANDARD EXIT TAXIWAYS*.

Table C12
Runway 17/35 Non-Standard Exit Taxiways

Taxiway	Intersection Angle
Taxiway "C"	36°
Taxiway "D"	39°
Taxiway "G"	79°
West Taxiway "L"	76°
East Taxiway "L"	82°

Source: MEAD & HUNT INC. analysis using existing ALP.

Optimally located exit taxiways minimize runway occupancy times and allow the airfield to be used more efficiently. Table A9-1 in Appendix 9 of AC 150/5300-13 provides the cumulative percentages of aircraft observed exiting runways at specific exit taxiway locations, given in 500-foot increments. Percentages for both wet and dry runway conditions are included, as are right-angled and acute-angled taxiway configurations. Acute-angled taxiways are generally only required when airport operations are expected to exceed the capacity of the airfield geometry, which is not the case at Olympia Regional Airport. It should be noted that since the percentages provided in Table A9-1 are based on 500-foot increments, analysis involving exit taxiways at other locations are provided as less than and/or greater than the percentage provided by the closest 500-foot increment.

As presented in the following table, entitled *RUNWAY 17/35 EXIT TAXIWAY ANALYSIS*, Runway 17/35 has four exit taxiways (i.e., Taxiways "C", "D", "G", "L"), but they are not located to provide sufficient percentages of landing aircraft with the ability to exit the runway in a safe and efficient manner. For instance, aircraft landing to Runway 35 technically have all four taxiways for exiting the runway. However, Taxiways "G" and "L" are located too close to the Runway 35 threshold to provide viable exit alternatives, especially for large aircraft weighing over 12,500 pounds. Landing aircraft must continue using the runway until reaching Taxiways "C" or "D" before exiting, which is virtually at the end of the runway. The provision of additional exit taxiways would allow greater percentages of aircraft the ability to exit the runway in a more efficient manner.

Table C13
Runway 17/35 Exit Taxiway Analysis

Taxiway	Distance From Landing Threshold (In Feet)	Percentage of Aircraft Exiting Runway – Dry Conditions A[1]	Dry Conditions B[2]	Dry Conditions C[3]	Wet Conditions A[1]	Wet Conditions B[2]	Wet Conditions C[3]
Runway 17							
Taxiway "G"	3,400	100%	<81%	<2%	<99%	<41%	0%
Taxiway "L"	4,700	100%	100%	>24%	100%	>97%	>4%
Runway 35							
East Taxiway "L"	700	<6%	0%	0%	<4%	0%	0%
West Taxiway "G"	2,100	>84%	>1%	0%	>60%	0%	0%
Taxiway "D"	5,000	100%	100%	49%	100%	100%	12%
Taxiway "C"	5,000	100%	100%	49%	100%	100%	12%

Source: MEAD & HUNT INC. analysis using existing ALP and AC 150/5300-13, *Airport Design*.
Notes: [1] Small, single engine aircraft weighing less than 12,500 pounds.
[2] Small, twin engine aircraft weighing less than 12,500 pounds.
[3] Large aircraft weighing between 12,500 pounds and 300,000 pounds.

Runway 08/26 Taxiway System. As with Runway 17/35, Runway 08/26 is not served by a true full-length parallel taxiway, although it is provided access to each runway end by Taxiways "E", "G", and "W". The current ALP illustrates two parallel taxiways, one on each side of the runway, located 240 feet from the runway centerline, which would increase efficient use of this runway for aircraft accessing the various development areas on the Airport.

Using the guidelines contained in FAA Engineering Brief No.75, there are several taxiways that intersect Runway 08/26 at less than 90° angles, which are presented in the following table entitled *RUNWAY 08/26 NON-STANDARD EXIT TAXIWAYS*.

Table C14
Runway 08/26 Non-Standard Exit Taxiways

Taxiway	Intersection Angle
Taxiway "W"	77°
South Taxiway "F"	88°
North Taxiway "F"	56°
North Taxiway "C"	52°
Taxiway "E"	38°
Taxiway "G"	77°

Source: MEAD & HUNT INC. analysis using existing ALP.

As presented in the following table, entitled *RUNWAY 08/26 EXIT TAXIWAY ANALYSIS*, Runway 08/26 is served by two exit taxiways (i.e., Taxiways "F" and "C"). However, they are not located to maximize the percentages of landing aircraft with the ability to exit the runway in a safe and efficient manner. Additionally, since both taxiways are not at right angles to the runway, the taxiway providing the longer landing distance would require aircraft to execute a greater than 90° exit from the runway, thus diminishing it's effectiveness as an exit taxiway. For instance, the table indicates that slightly less than 99% of small single engine aircraft and 10% of small twin engine aircraft could exit at Taxiway "C" when landing to Runway 08. However, since an aircraft would have to execute a turn of 128° to exit at Taxiway "C", the percentages of aircraft able to execute the exit maneuver safely would be diminished from what is provided in the table. The same is true for aircraft landing on Runway 26 and using Taxiway "F" for exiting the runway. As with Runway 17/35, the provision of additional exit taxiways would allow greater percentages of aircraft the ability to exit the runway in a more efficient manner.

Table C15
Runway 08/26 Exit Taxiway Analysis

Taxiway	Distance From Landing Threshold (In Feet)	Percentage of Aircraft Exiting Runway – Dry Conditions A[1]	Dry Conditions B[2]	Dry Conditions C[3]	Wet Conditions A[1]	Wet Conditions B[2]	Wet Conditions C[3]
Runway 08							
Taxiway "F"	2,000	84%	1%	0%	60%	0%	0%
Taxiway "C"	2,400	<99%	<10%	0%	<84%	>1%	0%
Runway 26							
Taxiway "C"	1,700	>39%	0%	0%	>23%	0%	0%
Taxiway "F"	2,100	>84%	<1%	0%	>60%	0%	0%

Source: MEAD & HUNT INC. analysis using existing ALP and AC 150/5300-13, *Airport Design*.
Notes: [1] Small, single engine aircraft weighing less than 12,500 pounds.
[2] Small, twin engine aircraft weighing less than 12,500 pounds.
[3] Large aircraft weighing between 12,500 pounds and 300,000 pounds.

Conclusion. Correction of the identified taxiway intersections causing potential runway incursion conditions and the provision of additional parallel and exit taxiways will be evaluated through the development alternatives contained in the next chapter. Other recommendations include the installation of lighting and signage on all taxiways not currently equipped or programmed for future development.

Landside Facility Requirements

Landside facilities are those facilities that support the airside facilities, but are not actually a part of the aircraft operating surfaces. They consist of such facilities as terminal buildings, hangars, aprons, access roads, and support facilities. Following a detailed analysis of these facilities, current deficiencies can be noted in terms of accommodating both existing and future aviation needs at the Airport.

Commercial Passenger Terminal Assessment

Components of the commercial passenger terminal complex include the terminal building, gate positions, apron area, automobile parking, access roadway, and curb length. The analysis is performed using FAA AC 150/5360-13, *Planning and Design Guidelines for Airport Terminal Facilities*, AC 150/5360-9, *Planning and Design of Terminal Building Facilities at Non-Hub Locations*, and the *Airport Curbside and Terminal Area Roadway Operations*, published by the Transportation Research Board, Airport Cooperative Research Program (ACRP) Project 07-02.

Terminal Building. The existing passenger terminal building at Olympia Regional Airport provides approximately 4,800 gross square feet of space. The methodology contained in AC 150/5360-13 is based on passenger activity during the peak hour and the demand that is placed on the facility. A rule-of-thumb guideline from AC 150/5360-13 indicates that for long-term passenger terminal planning purposes, the gross building area should provide approximately 150 square feet per peak-hour passenger. As noted in the *Aviation Activity Demand Forecast* chapter, two potential commercial passenger service scenarios were identified. The *Scenario One* option reflects a non-FAR Part 121 airline operating 9-passenger seat aircraft. The *Scenario Two* option reflects a regional airline operating 76-passenger seat aircraft. Utilizing the rule-of-thumb guideline noted above, the *Scenario One* commercial passenger service option would require a passenger terminal building with approximately 2,100 gross square feet. The *Scenario Two* commercial passenger service option would require a passenger terminal building with approximately 14,800 gross square feet.

Terminal Apron. The terminal apron is a defined area designed to accommodate the loading and unloading of passengers from the commercial service aircraft. The existing Olympia Regional Airport terminal apron provides approximately 19,500 square yards of space and two aircraft parking positions sized for Gate Type A aircraft (i.e., aircraft within ADG III with wingspans between 79 feet and 118 feet). The amount of apron space and aircraft parking positions provided appears adequate for either commercial passenger service option because the anticipated airline schedule will not have more than one aircraft occupying the apron at any one time.

Terminal Ground Access and Parking Requirements. Terminal area ground access facility requirements include the access roadway system, vehicle parking, and terminal curb frontage requirements.

Terminal Access Roadways. It is normally preferred that roadways operate below capacity to provide reasonable flow and minimize vehicle delay. Six operating conditions, known as levels-of-service (LOS), have been established, designated by letters A-F, providing for best to worst service in terms of driver satisfaction. LOS A defines a roadway with free flow characteristics at average speeds, while LOS F defines a roadway operating beyond its maximum capacity with traffic nearly at a standstill causing major delays. LOS C is generally the preferred operating condition for an urban road system, which is characterized as stable traffic flow and minimal delays. Using the quick-estimation method for uninterrupted flows on airport roadways contained in the ARCP Project 07-02, the lowest maximum flow (i.e., vehicles/hour/lane) for airport terminal area access and circulation roadways is 250 at a level-of-service A and design speed of 25 miles per hour. Terminal Street S.W. is a two-lane, two-way street providing access to the terminal building from Tumwater Boulevard. It is estimated that at the very least, this roadway has a capacity that exceeds 250 vehicles per hour operating at a level-of-service in the A.

For this analysis, the estimated peak-hour enplaned passenger vehicles in the peak direction are intended to be somewhat high based on 100% of enplaned passengers arriving at the Airport with average vehicle occupancy rates observed at airports similar to Olympia Regional Airport (i.e., 1.2 passengers per vehicle). For the *Scenario One* commercial passenger service option, this equals approximately 6 peak-hour vehicles in the peak direction; for the *Scenario Two* commercial passenger service option, this equals approximately 41 peak-hour vehicles in the peak direction. Clearly, Terminal Street S.W. has the capacity to accommodate the passenger vehicular traffic.

Terminal Curb Length. The terminal curb frontage is the interface between the terminal building and the ground access roadway system where passengers, baggage, and sometimes visitors are loaded and unloaded. The terminal curb length required for this loading and unloading is determined by the type and volume of ground vehicle traffic anticipated in the peak period on the design day. According to ACRP Project 07-02, curbside capacity is typically estimated in terms of the area that stopped vehicles may occupy while loading and unloading, measured in linear feet. The existing terminal curb length at Olympia Regional Airport is approximately 35 feet. The quick-estimation method indicates that the existing terminal curb length is sufficient to accommodate the *Scenario One* commercial passenger service option of 6 peak-hour vehicles. However, for the *Scenario Two* commercial passenger service option, a terminal curb length of 45 feet will be required.

Terminal Area Vehicle Parking. The existing parking facility at the terminal building accommodates 40 vehicles. Planning guidelines contained in AC 150/5360-9 indicate that vehicle parking requirements are closely related to annual enplanements. Additionally, AC 150/5360-13 indicates that an increase of 15% in the number of parking spaces should be provided to minimize the amount of time required to find a parking space. According to these guidelines, the Scenario One commercial passenger service option will require approximately 23 future vehicle parking spaces, and Scenario Two commercial passenger service option will require between 104 and 173 future vehicle parking spaces.

Conclusion. Based on this analysis, the existing passenger terminal building complex has adequate capacity to meet the projected commercial service demand associated with the *Scenario One* commercial passenger service option. However, if commercial service were operated by a regional airline as projected by the *Scenario Two* commercial passenger service option, then the terminal complex would be deficient in the areas of terminal building gross square footage, terminal curb length, and vehicle parking spaces.

Aircraft Storage Requirements

Aircraft based at Olympia Regional Airport are stored in one of four areas: T-hangars, executive hangars, large FBO storage hangars, or apron tiedowns. Currently, there are 165 aircraft based at the Airport, with the number expected to increase to 210 by 2030. This indicates that an increase in storage facilities accommodating approximately 45 new aircraft will be required throughout the planning period. It is assumed that future storage facilities will reflect many of the same characteristics as the current storage patterns.

Based Aircraft Apron Storage. Based aircraft tiedowns are usually provided for those aircraft owners and operators that do not require or desire to pay the cost for long-term hangar storage. Space calculations for these areas are based on 360 square yards of apron for each aircraft tiedown. This space allotment provides for aircraft parking and circulation between the rows of tiedowns. Trends indicate that, as more aircraft are based at an airport, hangar storage capacity is surpassed before additional hangar space is supplied.

Itinerant Aircraft Apron Storage. Itinerant apron storage is provided for transient aircraft owners and operators requiring short-term, temporary storage. Calculation of this storage requirement option allots 500 square yards per aircraft. There are a couple of reasons this space allotment is larger than the area required for based aircraft calculations. First, the users of the itinerant apron will not be as familiar with the layout and circulation patterns, and additional maneuvering space is essential. Second, whereas typically smaller, single engine aircraft are stored outside on based aircraft aprons, various sizes of transient aircraft will use temporary apron storage, so it is necessary to provide additional space to accommodate the larger aircraft.

Hangar Storage. Based on the high investment cost of owning an aircraft, hangars are, generally, the most desired option for both long-term and short-term aircraft storage. It should be noted that the Transportation Security Administration (TSA) has identified hangar storage as one of the most effective ways to secure general aviation aircraft from use by terrorist organizations. Therefore, the development plan for future hangars will focus on identifying potential parcels, in consideration of the ability to provide roadway and taxiway access in an efficient and secure manner.

Conclusion. The accompanying table, entitled *GENERAL AVIATION STORAGE REQUIREMENTS, 2010-2030*, presents the type of facilities and the number of units or acres needed in order to meet the forecast demand for each development phase. It is expected that most of the owners and operators of newly based aircraft at the Airport will desire hangar storage facilities. The actual type of hangar facilities has not been identified, but does include T-hangars, planeport hangars, and executive hangars. It should be noted that the actual number, size, and location of future hangars will depend on user needs and financial feasibility at the time demand occurs.

Table C16

General Aviation Storage Requirements, 2010-2030

Facility	2010	2015	2020	2025	2030
Apron Storage					
Itinerant GA Apron (tiedowns/acres)		35/3.6	40/4.1	42/4.3	44/4.5
Based GA Apron (tiedowns/acres)		7/0.6	9/0.7	10/0.8	10/0.8
Total Apron (tiedowns/acres)	36/3.3	42/4.2	49/4.8	52/5.1	54/5.3
Hangar Storage					
Hangar Spaces/acres	110/8.2	121/9.0	135/10.0	138/10.3	144/10.7

Source: MEAD & HUNT INC. projections based on AC 150/5300-13, *Airport Design*.

Helicopter Operations Area. AC 150/5390-2B, entitled *Heliport Design*, states, "The basic elements of a heliport are clear approach/departure paths, a clear area for ground maneuvers, and a wind sock". However, as helicopter activity increases at an airport, it is often determined that separate facilities dedicated for helicopter use should be developed. The design of these facilities, which include the dimensions of the touchdown and lift-off area (TLOF), the final approach and takeoff area (FATO), the taxi routes/taxiways, and parking positions with associated safety areas, is premised on the identified "design helicopter" for the facility.

As with most aviation facilities, "The optimum location for a heliport is in close proximity to the desired origination and/or destination of the end users". The existing helicopter activity at Olympia is primarily represented by a combination of medevac helicopter operations (i.e., the EC135 American Eurocopter operated by Airlift Northwest), helicopter pilot training provided by Glacier Aviation, Inc., utilizing a variety of helicopters (i.e., the Robinson R22 and R44, Hughes 500, and Bell 206), and the Washington State Department of Natural Resources who operate a fleet of Bell UH-1H Hueys. Each of these facilities is located on the east side of the Airport and operated from the adjacent apron and taxiway. In addition, the Airport accommodates some military helicopter training operations of CH-47 and UH-60 helicopters from Gray Army Air Field and the existing civilian helicopter activity counts recorded for the Airport include operations generated by Northwest Helicopters, which is located adjacent to airport property near the southeast quadrant of the Airport.

Based upon the dimensional requirements of the "design helicopters" for Olympia, the following design parameters have been identified:

- TLOF @ 40' square
- TLOF dynamic pavement load @ 10,000 lbs.
- FATO @ 65' square
- FATO C/L to RW C/L separation for VFR operations @ 500'
- Ground Taxi Paved Width @ 20'
- Ground Taxi Route Width @ 60-70' (depending on markings)
- Hover Taxi Route Width @ 80-100' (depending on markings)
- Safety Area Width @ 20-30' (depending on markings)
- Parking Position @ 40' square

Conclusion. The current ALP identifies the future location of a FATO and three helicopter parking positions southeast of the Runway 17 end. Following consultation with airport management and existing helicopter operators, it has been determined that the proposed helicopter development area, as depicted on the current ALP, will be re-examined in the following chapter.

Vehicular Access and Parking

The land requirements associated with airport roadways and vehicular parking are not included in the analysis presented in the preceding section because the amount of land necessary for these facilities will be a function of the location of other facilities, as well as the most effective routing of roadways. Sufficient automobile parking area should be provided at each hangar or building to meet the specific requirements of that facility.

Support Facilities

In addition to the aircraft storage and vehicular access and parking facilities described above, there are several support facilities that have quantifiable requirements, and which are vital components of a safe and efficient airport. The support facilities at Olympia Regional Airport that require further evaluation include the ATCT, the fuel storage facility, and the Aircraft Rescue and Fire Fighting (ARFF) Facility.

Airport Traffic Control Tower (ATCT). As identified in the *Inventory* chapter, the ATCT at Olympia Regional Airport is located on the west side of airport property, just north of the approach end of Runway 08. The ATCT is operated through the FAA Contract Tower (FCT) Program and is manned 12 hours daily, from 8:00 a.m. to 8:00 p.m.

According to mandatory siting requirements contained in Order 6480.4a *Airport Traffic Control Tower Siting Process* and AC 150/5300-13 *Airport Design*, a tower site must:

- Provide maximum visibility of airborne traffic patterns and runway approaches.
- Provide complete visibility to all airport surface areas utilized for movement of aircraft.
- Provide sufficient area to satisfy initial building/parking demands and future expansion requirements.
- Comply with FAR Part 77, *Objects Affecting Navigable Airspace,* and a Non Rule Making Airport Study (NRA) shall be conducted.
- The tower must not derogate the performance of existing or planned electronic facilities.
- Consider connectivity of all FAA cabling and utilities.
- Vehicular access to the ATCT shall avoid crossing areas of aircraft operations.
- Consider the impacts of security compliance of the ATCT development site.

In addition, it is preferable for the tower cab to be oriented to face north or alternatively east, west, or south in that order of preference within the northern hemisphere. Visibility and perception are also enhanced when the controller's line-of-sight (LOS) is perpendicular or oblique, and not parallel to the airport's runway/taxiway system. A Two-Point Lateral Discrimination Analysis can be performed to ensure that operations at critical points of the airport surface provide sufficient lateral discrimination.

Conclusion. As can be noted from the above listed siting criteria, the existing tower cab at Olympia Regional Airport, with an east facing orientation, is optimally positioned and complies with most, if not all of the specified siting criteria. Therefore, there are no plans to relocate the existing ATCT facilities at Olympia Regional; however, the Olympia ATCT is one of 149 federal contract towers that is currently being evaluated for closure (at the time of this printing) due to budgetary cuts related to federal sequestration legislation.

Fuel Storage Facility. According to fuel sale estimates provided by airport management, there has been an average of 134,355 gallons of AVGAS and 266,052 gallons of Jet A fuel sold per year at Olympia Regional Airport over the past six years. Based on 2010 total operation counts, this equates to just less than three gallons per operation for the piston engine aircraft and fifteen gallons per operation for turbine engine aircraft. Typically, as operations increase, fuel storage requirements can be expected to increase proportionately. By increasing the ratio of gallons sold per operation, an estimate of future fuel storage needs can be calculated as a two-week supply during the peak month of operations. As can be seen in the following table, entitled *FUEL STORAGE REQUIREMENTS, 2010-2030*, it appears that the Airport's AVGAS and Jet A fuel storage requirements can be accommodated through the year 2030 for a two-week supply utilizing existing storage facilities.

Conclusion. The Airport's existing fuel storage facilities are adequate to meet the anticipated demand throughout the planning period. However, adequate expansion area will be reserved near the existing fuel farms to accommodate long-term fuel storage requirements.

Table C17
Fuel Storage Requirements, 2010-2030

Fuel Type	2010	2015	2020	2025	2030
Jet A					
Average Day of Peak Month Operations	51	60	68	71	74
Two Weeks of Operations	721	844	946	991	1,037
Gallons Per Operation	15.0	15.0	15.2	15.4	15.5
Fuel Storage (gallons)	36,000(1)	12,662	14,377	15,254	16,072
AVGAS					
Average Day of Peak Month Operations	124	129	141	145	150
Two Weeks of Operations	1,737	1,802	1,968	2,031	2,099
Gallons Per Operation	2.7	2.9	3.1	3.4	3.7
Fuel Storage (gallons)	34,000(2)	5,227	6,102	6,905	7,766

Source: MEAD & HUNT INC. projections.
Notes: (1) Existing Jet A fuel storage.
(2) Existing AVGAS fuel storage.

Aircraft Rescue and Fire Fighting (ARFF) Facility. As identified in the *Inventory* chapter, the Airport does not presently have an ARFF facility on the field. Fire protection services are provided by the Thurston County Fire District No. 15, with the primary responder being the City of Tumwater Fire Department. However, the Port has previously maintained a "limited" Airport Operating Certificate (AOC) to provide FAR Part 139 Index A ARFF capabilities in support of previous commercial service passenger operations. Based upon the potential commercial passenger service reinstatement scenarios that were identified in the previous chapter, the following ARFF capabilities would be required.

For the *Scenario One* commercial passenger service option (i.e., reflecting a seating capacity of less than ten passenger seats), the Port would not need an AOC, and thus FAR Part 139 Airport Certification for ARFF facilities would not be required. For the *Scenario Two* commercial passenger service option (i.e., reflecting a seating capacity of greater than 30 passenger seats), the Port would be required to obtain a Class I AOC, and thus FAR Part 139 Airport Certification for ARFF facilities would be required. If the Airport were to accommodate passenger service with aircraft providing between 10 and 30 seats, in lieu of the greater than 30 passenger seat aircraft, the Port would be required to obtain a Class III AOC and implement the applicable FAR Part 139 ARFF criteria, which are less restrictive than the criteria for the Class I AOC.

The specified FAR Part 139 certification ARFF equipment and staff requirements are based on the length of the largest air carrier or commuter aircraft that serves the airport with an average of five or more daily departures. The following table, entitled *REPRESENTATIVE COMMUTER AIRCRAFT LENGTHS & ARFF INDEX*, presents the potential commercial aircraft fleet scenarios that were identified previously, along with their respective lengths and ARFF Index.

Table C18
Representative Commuter Aircraft Length & ARFF Index

Aircraft Type	Length (feet)	ARFF Index
Turboprop Aircraft		
Cessna 206 (6 seats)	31.8	A
Piper PA31 Navajo (8 seats)	32.6	A
Cessna 208 (9 seats)	37.6	A
Beech Airliner 1900 (19 seats)	57.8	A
Fairchild Metro III (19 seats)	59.3	A
Bombardier Q400 (76 seats)	1078	B
Regional Jet Aircraft		
Embraer ERJ 135 (37 seats)	86.4	A

Source: FAR Part 139 *Certification and Operations: Land Airports Serving CAB-Certificated Scheduled Air Carriers Operating Large Aircraft (Other Than Helicopters).*
FAA AC 150/5300-13 *Airport Design.*
Aviation Week & Space Technology, January 2011.

Conclusion. Until commercial service passenger operations are reinstated, no Part 139 certification ARFF requirements will be needed at Olympia Regional Airport.

Summary

The need for facilities, which has been identified in this MP Update, can now be utilized to help formulate the overall future Development Plan of the Airport. These projects will only be constructed if there is actual demand demonstrated for the facility, the project is financially feasible, and any potential environment impacts can be mitigated.

The following table summarizes the projected facility requirements necessary to accommodate the projected operational demands through 2030. The formulation of this plan will begin by establishing goals for future airport development and an analysis of development alternatives, whereby demand for future airport facilities can be accommodated. These alternatives will be presented in the following chapter, entitled *Development Concepts and Alternatives Analysis*.

Table C19
FACILITY REQUIREMENTS SUMMARY, 2010-2030

Facility	2010 [1]	2015	2020	2025	2030
Dimensional Standards (ARC)					
Runway 17/35	C-II[2]	same	same	same	same
Runway 08/26[3]	B-II	same	same	same	same
Runway Length/Width					
Runway 17/35	150' x 5,501'	same	same	same	same
Runway 08/26[3]	150' x 4,157'	75' x 4,157'	same	same	same
Instrument Approach Enhancement					
Runway 17 ILS	½ Mile Vis. Mins.	same	same	same	same
Runway 17 ILS	---	---	1,800 RVR	same	same
Runway 17 GPS WAAS LPV	¾ Mile Vis. Mins.	same	same	same	same
Runway 35 GPS, VOR/DME	1 Mile Vis. Mins.	same	same	same	same
Runway 35 GPS WAAS LPV	---	---	½ Mile Vis. Mins.	same	same
Runway 26 GPS	none	same	1 Mile Vis. Mins.	same	same
Approach Lighting System					
Runway 17	MALSR	same	same	same	same
Runway 35	none	MALSR	same	same	same
Runway 08	none	same	same	same	same
Runway 26	none	same	same	same	same
General Aviation Apron Requirements					
Itinerant GA Apron (tiedowns/acres)	---	35/3.6	40/4.1	42/4.3	44/4.5
Based GA Apron (tiedowns/acres)	---	7/0.6	9/0.7	10/0.8	10/0.8
Total Apron (tiedowns/acres)	36/3.3	42/4.2	49/4.8	52/5.1	54/5.3
General Aviation Aircraft Storage Facilities					
Hangar Spaces/acres	110/8.2	121/9.0	135/10.0	138/10.3	144/10.7
Support Facilities					
ATCT (Contract) [4]	yes	same	same	same	same
Fuel Storage (In Gallons)[5]					
AVGAS	36,000	5,227	6,102	6,905	7,766
Jet A	36,000	12,662	14,377	15,254	16,072
ARFF	none	same	same	same	same

Source: MEAD & HUNT INC. Projections.
Notes: [1] Actual.
[2] ADG III criteria apply to west side parallel taxiway system (i.e., Taxiway "W"). No FAA funding is anticipated for maintenance or improvement projects exceeding standards as indicated by the demand at the time.
[3] No FAA funding is anticipated for Runway08/26 maintenance or improvement projects.
[4] The Olympia ATCT is one of 149 federal contract towers that is currently being evaluated for closure due to budgetary cuts related federal sequestration legislation.
[5] Projections reflect typical two-week storage requirements for the peak month operation counts.