Asheville Regional Airport Master Plan Update

Working Paper #3 - Demand/Capacity and Facility Requirements

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4 DEMAND/CAPACITY AND FACILITY REQUIREMENTS

To ensure that Asheville Regional Airport (AVL) can support the increase in forecasted aviation activity, evaluations were conducted to verify that the recommendations of this Master Plan adequately accommodate existing and anticipated activity levels. The purpose of this Chapter is to identify the Airport's facility development needs over the 20-year planning horizon. Using the preferred aviation activity forecast presented in **Chapter 3**, the airport facility needs were determined, which forms the basis of the development concepts discussed in **Chapter 5**.

The airport demand, capacity, design standards, and the overall facility requirements at AVL were evaluated using guidance contained in several FAA publications, including:

- Advisory Circular 150/5060-5, *Airport Capacity and Delay*
- AC 150/5190-4B, *Airport Land Use Compatibility Planning*
- AC 150/5300-13B, *Airport Design*
- AC 150/5325-4B*, Runway Length Requirements for Airport Design*
- AC 150/5360-13A, *Airport Terminal Planning*
- Title 14 Code of Federal Regulations (CFR) Part 77*, Safe, Efficient Use, and Preservation of the Navigable Airspace*
- Order 5090.5, *Formulation of the National Plan of Integrated Airport Systems (NPIAS) and the Airports Capital Improvement Plan (ACIP)*
- Airport Cooperative Research Program (ACRP), *Report 25: Airport Passenger Terminal Planning and Design*
- ACRP, *Report 25 – Airport Passenger Terminal Planning and Design, Volume 1: Guidebook*
- ACRP, *Report 25 – Airport Passenger Terminal Planning and Design, Volume 2: Spreadsheet Models and User's Guide*
- ACRP, *Report 130 - Guidebook for Airport Terminal Restroom Planning and Design*
- ACRP, *Report 54 – Resource Manual for In-Terminal Concessions 2011*
- International Air Transportation Association (IATA*), Airport Development Reference Manual (ADRM), 12th Edition*
- U.S. Department of Transportation, Federal Aviation Administration, Systems Research & Development Service *Report No. FAA-RD-75-191 – The Apron & Terminal Building Planning Manual July 1975*

The following elements of the Airport were addressed in this assessment:

- Airfield Capacity

- Airfield Facility Requirements
- Support Facilities (General Aviation, Airfield Maintenance, etc.)
- Passenger Terminal Facilities
- Surface Transportation & Parking Facilities

4.1 PLANNING FACTORS

Before the facility requirements for AVL could be determined, it was first necessary to establish the Planning Activity Levels (PALs) based on the preferred forecasts, the design aircraft family, and the appropriate airport, runway, and taxiway classifications that are associated with FAA design standards. These parameters are discussed in the following subsections.

4.1.1 Planning Activity Levels (PALs)

Since aviation activity is highly susceptible to fluctuations in economic conditions and industry trends, identifying recommended facility improvements based solely on specific years can be a challenge. The timeline associated with the preferred forecast is representative of the anticipated timing of demand (in 5-year increments – 2026, 2031, 2036, and 2041). The actual timing of demand can vary; therefore, Planning Activity Levels (PALs), rather than calendar years, were established.

The PALs represent the activity levels believed to trigger the need for additional capacity or other development at the Airport, thus identifying significant demand thresholds for implementing recommended facility improvements and providing the Greater Asheville Regional Airport Authority (GARAA) with the flexibility to advance or slow the rate of development in response to actualized demand. In other words, if the preferred forecast proves conservative (i.e. the alternate forecast scenarios are realized because of successful airport marketing and route development initiatives, etc.), some recommended improvements may be advanced in schedule. In contrast, if demand occurs at a rate that is slower than the preferred forecast projects, the improvements should be deferred accordingly. As actual activity levels approach a PAL and trigger the need for a facility improvement, sufficient lead time for planning, design, and construction must be also given to ensure that the facilities are available for the impending demand.

Table 4-1 identifies the Base Year and PALs used for this Study. The Base Year and PALs 1 through 4 correspond with the preferred aviation activity forecast for the Base Year of 2021 and the planning horizon years 2026, 2031, 2036, and 2041. To further provide a range of potential activity levels in addition to the preferred forecast, PALs 5 and 6 were established to provide alternate (I.e., higher) passenger and commercial operations activity levels, which will further serve as a basis for future facility planning should potential air service developments occur (i.e., a new entrant airline, service to new markets, etc.) or should activity increase beyond the preferred forecast's projections.

Note, general aviation and military operations were assumed to remain static in PALs 5 and 6.

Table 4-1 – Planning Activity Levels (PALs)

Passenger Activity								
Enplanements		**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**	**PAL 5**	**PAL 6**
Annual		716,015	1,038,576	1,162,182	1,300,499	1,455,279	1,649,002	1,841,354
Peak Month		91,609	132,878	148,693	166,390	186,192	210,978	235,588
Peak Month Average Day		2,955	4,277	4,787	5,356	5,994	6,792	7,584
Peak Hour		616	910	1,019	1,140	1,276	1,446	1,614
Operations								
Category	**Activity**	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**	**PAL 5**	**PAL 6**
Commercial Aviation	Annual	20,328	26,054	28,292	30,723	33,363	37,804	42,214
	Peak Month	2,361	3,026	3,286	3,568	3,875	4,391	4,903
	Peak Month Average Day	76	100	109	118	128	146	163
	Peak Hour	11	19	20	22	24	27	30
General Aviation	Annual	51,008	53,256	55,475	57,694	60,230	60,230	60,230
Military Aviation	Annual	4,402	4,402	4,402	4,402	4,402	4,402	4,402
Total Operations	**Annual**	**75,738**	**83,712**	**88,169**	**92,819**	**97,995**	**102,436**	**106,846**
	Peak Month	**7,737**	**8,552**	**9,007**	**9,482**	**10,011**	**10,464**	**10,915**
	Peak Month Average Day	**250**	**276**	**291**	**306**	**323**	**338**	**352**
	Peak Hour	**28**	**31**	**33**	**34**	**36**	**38**	**40**

Source: FAA 2021 TAF, FAA OPSNET, Bureau of Transportation Statistics, Woods & Poole Economics, Airport Master Record (Form 5010), GARAA, CHA, 2023.

4.1.2 Aircraft Classification

The FAA has established aircraft classification systems that group aircraft types based on their performance and geometric characteristics. These classification systems were used to determine the appropriate airport design standards for specific runway, taxiway, taxilane, apron, or other facilities at AVL, as described in FAA AC 150/5300-13B, *Airport Design*.

As discussed in **Chapter 3**, the standard classifications are the Aircraft Approach Category (AAC), the Airplane Design Group (ADG), and the Taxiway Design Group (TDG). **Table 4-2** presents the applicability of these classification systems to the FAA airport design standards for individual airport components (such as runways, taxiways, or aprons).

Table 4-2 – Applicability of Aircraft Classifications

Aircraft Classification	Related Design Components
Aircraft Approach Category (AAC)	Runway Safety Area (RSA), Runway Object Free Area (ROFA), Runway Protection Zone (RPZ), runway width, runway-to-taxiway separation, runway-to-fixed object
Airplane Design Group (ADG)	Runway, Taxiway, and apron Object Free Areas (OFAs), parking configuration, taxiway-to-taxiway separation, runway-to-taxiway separation
Taxiway Design Group (TDG)	Taxiway width, radius, fillet design, apron area, parking layout

Source: FAA AC 150/5300-13B, CHA, 2023.

4.1.3 Design Aircraft Family

The "critical aircraft" or "design aircraft family" represents the most demanding aircraft, or grouping of aircraft, with similar characteristics (relative to AAC, ADG, TDG) that are currently using or are anticipated to use an airport on a regular basis. The design aircraft family was identified for AVL (see **Table 4-3**) after review of the FAA's Traffic Flow Management System Counts (TFMSC) data, T100 data[1], airport-reported data, and forecast fleet mix assumptions (as described in **Chapter 3**). This grouping represents the typical commercial aircraft anticipated to operate at AVL over the planning horizon. These aircraft generally have higher AAC, ADG, and TDG classifications than the other regularly scheduled commercial aircraft. Determining the critical aircraft is important when planning airfield and landside facilities as they may require specific facility design accommodations within their designated areas of operation.

Table 4-3 – Commercial Fleet Mix

AAC & ADG		Base	PAL 1	PAL 2	PAL 3	PAL 4	PAL 5	PAL 6
Subtotal by AAC	A	0	0	0	0	0	0	0
	B	0	0	0	0	0	0	0
	C	20,278	25,644	27,807	30,152	32,695	37,047	41,369
	D	50	410	486	571	668	757	845
Subtotal by ADG	I	0	0	0	0	0	0	0
	II	6,656	3,412	3,705	4,024	4,370	4,952	5,529
	III	13,672	22,642	24,587	26,699	28,993	32,852	36,684
	IV	0	0	0	0	0	0	0

Note 1: AAC: Group C (i.e., A220, A319, B717-200, B737-700, ERJ-145/175, etc.); Group D (i.e., B737-800/900, etc.)
Note 2: ADG: Group II (i.e., CRJ-200/700, ERJ 145, etc.); Group III (i.e., A220, A319/320, B737-700/800/900, etc.)
Source: GARAA, CHA 2023.

4.1.4 Airport & Runway Classification

The FAA classifies airports and runways based on their current and planned operational capabilities. These classifications, described below, combined with the aircraft classifications defined previously, were used to determine the appropriate FAA standards (as per AC 150/5300-13B) for airfield facilities.

Airport Reference Code (ARC)

ARC is an airport designation that represents the AAC and ADG of the aircraft that the airfield is intended to accommodate on a regular basis. The ARC is used for planning and design only and does not limit the aircraft that may be able to operate safely on the airport. The Airport's previous 2013 Airport Layout Plan (ALP) identified the Boeing 737-700 as the critical aircraft for airfield and pavement design.

[1] The Bureau of Transportation Statistics (BTS) uses a form (Form T-100) to gather monthly traffic reports from certificated air carriers in the United States. These traffic reports provide information regarding domestic and international markets, as well as domestic and international segments. The data collected is then made available to the public via BTS's Air Carrier Statistics Database, also known as the T-100 data bank.

Based on changes to the fleet mix in the years following the previous ALP, the current critical aircraft has been identified as the Boeing 737-800. Allegiant Air, the largest carrier operating at AVL, will be phasing out their Airbus A319 and A320 aircraft during the planning period, in favor of Boeing 737 MAX 7 and 737 MAX 8-200 aircraft. Given this, and characteristic similarities to the existing design aircraft, it is recommended the future design aircraft be maintained as the Boeing 737-800. Although the specific critical aircraft model has changed since the previous Master Plan and ALP, the past, present, and future models consist of ARC C/D-III. As such, the overall airfield classification will remain consistent over time.

4.2 AIRFIELD CAPACITY REQUIREMENTS

Airfield capacity refers to the maximum number of aircraft operations (takeoffs or landings) an airfield can accommodate in a specified amount of time. Assessments of AVL's airfield's current and future capacity were performed using common methods described in FAA AC 150/5060-5, *Airport Capacity and Delay*.

4.2.1 FAA AC 150/5060-5, Airport Capacity and Delay

FAA AC 150/5060-5, *Airport Capacity and Delay*, explains how to compute airfield capacity for the purposes of airport planning and design. This evaluation helped to determine any capacity-related improvements or expansions that may be needed to support flight activity levels. The estimated capacity of the airfield at AVL was expressed in the following measurements:

- Hourly Capacity – The maximum number of aircraft operations an airfield can safely accommodate under continuous demand in a one-hour period. This expression accounts for Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) conditions and is used to identify any peak-period constraints on a given day.
- Annual Service Volume (ASV) – The maximum number of aircraft operations an airfield can accommodate in a one-year period without excessive delay. This calculation is typically used in long-range planning and referenced for capacity-related improvement.

AC 150/5060-5 provides estimated hourly airfield capacity for VFR and IFR operations, as well as the ASV based on runway configurations and the type of aircraft operating (or projected to operate) at an airport. The runway configuration and aircraft fleet mix, as they pertain to AVL, are further examined in the subsequent sections.

Calculating Hourly Capacity and Air Service Volume

<u>Runway Use Configuration</u>

The principal determinants of an airfield's layout or configuration are the number and orientation of runways. The efficiency and functionality of the runways used in conjunction with the taxiways and aprons during the various levels of aviation activity directly affects an airport's operational capacity.

AVL has one runway, Runway 17/35, which has a generally north/south orientation. Thus, a single runway configuration was assumed throughout the planning horizon when using the methodologies presented in AC 150/5060-5.

Runway-use Configuration No. 1 from AC 150/5060-5 *Figure 2-1, Capacity and ASV for Long Range Planning*, was chosen to represent the runway configuration at AVL, which is presented in **Table 4-4.**

Table 4-4 – Capacity and ASV for Long Range Planning

Mix Index	Hourly Capacity (Ops/Hr)		Annual Service Volume (Ops/Yr)
% (C+3D)	VFR	IFR	
0 to 20	98	59	230,000
21 to 50	74	57	195,000
51 to 80	63	56	205,000
81 to 120	55	53	210,000
121 to 130	51	50	240,000

Source: FAA AC 150/5060-5 [*Figure 2-1*], CHA, 2023.

Aircraft Fleet Mix Index

After identifying the runway-use configuration, it was necessary to determine the aircraft fleet mix index. An airport's fleet mix index is determined by the size of typical aircraft and the frequency of their operations. To identify the aircraft mix index, AC 150/5060-5, *Airport Capacity and Delay*, establishes four categories in classifying an aircraft by its maximum takeoff weight (MTOW), as depicted in **Table 4-5**.

Table 4-5 – Aircraft Capacity Classifications

Aircraft Class	MTOW (lbs)	Number of Engines	Wake Turbulence
A	<12,500	Single	Small (S)
B		Multi	
C	12,500 – 300,000	Multi	Large (L)
D	>300,000	Multi	Heavy (H)

Source: FAA AC 150/5060-5, CHA, 2023.

The aircraft mix index is calculated using the formula *% (C + 3D)*, the letters corresponding with the aircraft class. This product falls into one of the FAA-established mix index ranges listed below and is used in capacity calculations herein:

- 0 to 20
- 21 to 50
- 51 to 80
- 81 to 120
- 121 to 180

The current facilities at the Airport can accommodate all four aircraft classes. The following operations percentages for aircraft categories C and D were gathered from a review of operations that occurred in 2021 (Base Year):

- Class C = 31.0 percent of the Airport's operations
- Class D = 0.9 percent of the Airport's operations

As such, the Base Year aircraft mix index is 33.6 [31.0 + 3(0.9) = 33.6], which falls within the 21 to 50 mix index range.

The projected operation percentages by aircraft class depicted in **Table 4-6** were utilized to project the future aircraft fleet mix index for each PAL.

Table 4-6 – Projected Operations by Aircraft Class (%)

Aircraft Class	PAL 1	PAL 2	PAL 3	PAL 4	PAL 5	PAL 6
A	25.8%	25.5%	25.2%	24.9%	23.8%	22.9%
B	33.2%	32.7%	32.2%	31.7%	30.4%	29.1%
C	38.5%	39.3%	40.2%	40.9%	43.4%	45.6%
D	2.4%	2.4%	2.4%	2.4%	2.4%	2.4%

Source: FAA TFMSC, Bureau of Transportation Statistics (T-100 Data), GARAA, CHA, 2023.

Based on the fleet mix changes described in **Chapter 3**, specifically related to commercial activity, the aircraft fleet mix index is anticipated to slightly increase from the Base Year mix index of 33.6, with the projected mix indexes continuing to fall within the 21 to 50 mix index range through PAL 5; however, in PAL 6, the mix index is projected to fall within the 51 to 80 mix index range. The projected fleet mix indexes by PAL are depicted in **Table 4-7** and are identified in **Table 4-8**.

Table 4-7 – Aircraft Mix Index

Timeframe	Aircraft Fleet Mix Index
Base	33.6
PAL 1	45.7
PAL 2	46.5
PAL 3	47.4
PAL 4	48.1
PAL 5	50.6
PAL 6	52.8

Source: FAA AC 150/5060-5, CHA 2023.

Table 4-8 – Capacity and ASV for Long Range Planning (AVL Aircraft Mix Index)

Mix Index	Hourly Capacity (Ops/Hr)		Annual Service Volume (Ops/Yr)
% (C+3D)	VFR	IFR	
0 to 20	98	59	230,000
21 to 50	74	57	195,000
51 to 80	63	56	205,000
81 to 120	55	53	210,000
121 to 130	51	50	240,000

Source: FAA AC 150/5060-5 [*Figure 2-1]*.

<u>Hourly Capacity</u>

As outlined in AC 150/5060-5, *Chapter 2: Capacity and Delay Calculations for Long Range Planning,* hourly capacity estimates were made under the following assumptions:

- Percent Arrivals: Arrival operations equal departure operations.
- Percent Touch and Goes: Percent of touch and goes is within the ranges shown in AC 150/5060-5, *Table 2-1*. Based on AVL's Aircraft Mix Index, the percent of touch and go operations were assumed between 0 and 40 percent through PAL 5 and between 0 and 20 percent in PAL 6, which aligns with projected activity levels at AVL (between 17.8 and 20.5 percent through PAL 5 and approximately 17.0 percent in PAL 6).
- Taxiways: Full-length parallel taxiway, ample runway entrance/exit taxiways, and no taxiway crossing problems. These assumptions accurately represent the taxiway layout at AVL.
- Airspace Limitations: There are no airspace limitations which would adversely impact flight operations or otherwise restrict aircraft which could operate at the Airport.
- Runway Instrumentation: The airport has at least one runway end equipped with an Instrument Landing System (ILS) and has the necessary Air Traffic Control (ATC) facilities and services to carry out operations in a radar environment. This assumption is true for AVL, as Runways 17 and 35 are both equipped with an ILS, and the Airport has the necessary ATC facilities and services.

Based on the runway-way use configuration and aircraft mix index at AVL, and in accordance with FAA AC 150/5060-5, current and future hourly capacity (or operations per hour) through PAL 5 under VFR and IFR conditions are approximately 74 and 57 operations, respectively. In PAL 6, hourly capacity under VFR and IFR conditions is projected at approximately 63 and 56 operations, respectively. See **Table 4-9**.

Table 4-9 – Capacity and ASV for Long Range Planning (AVL Hourly Capacity)

Mix Index	Hourly Capacity (Ops/Hr)		Annual Service Volume (Ops/Yr)
% (C+3D)	VFR	IFR	
0 to 20	98	59	230,000
21 to 50	**74**	**57**	195,000
51 to 80	**63**	**56**	205,000
81 to 120	55	53	210,000
121 to 130	51	50	240,000

Source: FAA AC 150/5060-5 [*Figure 2-1]*.

When evaluating AVL's ability to accommodate hourly activity levels, average hourly activity and peak hour activity levels were independently examined. Per TFMSC data, from 2019 through 2022, AVL averaged approximately 10 hourly operations. As previously shown in **Table 4-1**, AVL had approximately 28 operations during the Airport's peak hour in the Base Year, which is projected to increase to approximately 36 operations by PAL 4, extending to 40 operations by PAL 6. Based on the hourly capacity parameters presented in **Table 4-9**, AVL is anticipated to accommodate average hourly operations and peak hourly operations throughout the forecast horizon.

Annual Service Volume

Annual Service Volume (ASV) is an expression of the total number of aircraft operations that an airfield can support per annum. As outlined in AC 150/5060-5, *Chapter 2: Capacity and Delay Calculations for Long Range Planning,* air service volume estimates were made under the following assumptions:

- VFR weather conditions occur roughly 10 percent of the time
- Runway-Use Configuration: Roughly 80 percent of the time the airport is operated with the runway-use configuration which produces the greatest capacity

Based on the runway-use configuration and mix index, and as shown in **Table 4-10**, annual air service volume at AVL is expected to remain approximately 195,000 operations per year through PAL 5. In PAL 6, ASV is expected to be approximately 205,000 operations.

Table 4-10 – Capacity and ASV for Long Range Planning (AVL ASV)

Mix Index	Hourly Capacity (Ops/Hr)		Annual Service Volume (Ops/Yr)
% (C+3D)	VFR	IFR	
0 to 20	98	59	230,000
21 to 50	74	57	195,000
51 to 80	63	56	205,000
81 to 120	55	53	210,000
121 to 130	51	50	240,000

Source: FAA AC 150/5060-5 [*Figure 2-1]*.

If the annual aircraft operations exceed the ASV, the airport is likely to see significant delays; however, an airport can still experience delays before capacity is reached. Activity levels that may trigger capacity planning and development are discussed in FAA Order 5090.5, *Formulation of the National Plan of Integrated Airport Systems (NPIAS) and the Airports Capital Improvement Plan (ACIP)*, which indicates (via Table 4-4 of Order 5090.5). This allows an airport to make necessary improvements and avoid delays before they are anticipated to occur.

Per the previously discussed FAA Order, 60 percent ASV is the trigger for planning a new runway or extended runway to increase hourly capacity and the trigger for development is being within five years of the ASV reaching 80 percent.

As shown in **Table 4-11**, airfield capacity at AVL is expected to range from 38.8 percent in the Base Year to 52.5 percent in PAL 5 and only reaching 52.1 percent by PAL 6.

Table 4-11 – Annual Service Volume

Factor	Base	PAL 1	PAL 2	PAL 3	PAL 4	PAL 5	PAL 6
Annual Operations	75,738	83,712	88,169	92,819	97,995	102,436	106,846
Annual Service Volume	195,000	195,000	195,000	195,000	195,000	195,000	205,000
Capacity Level	**38.8%**	**42.9%**	**45.2%**	**47.6%**	**50.3%**	**52.5%**	**52.1%**

Source: FAA AC 150/5060-5, CHA, 2023.

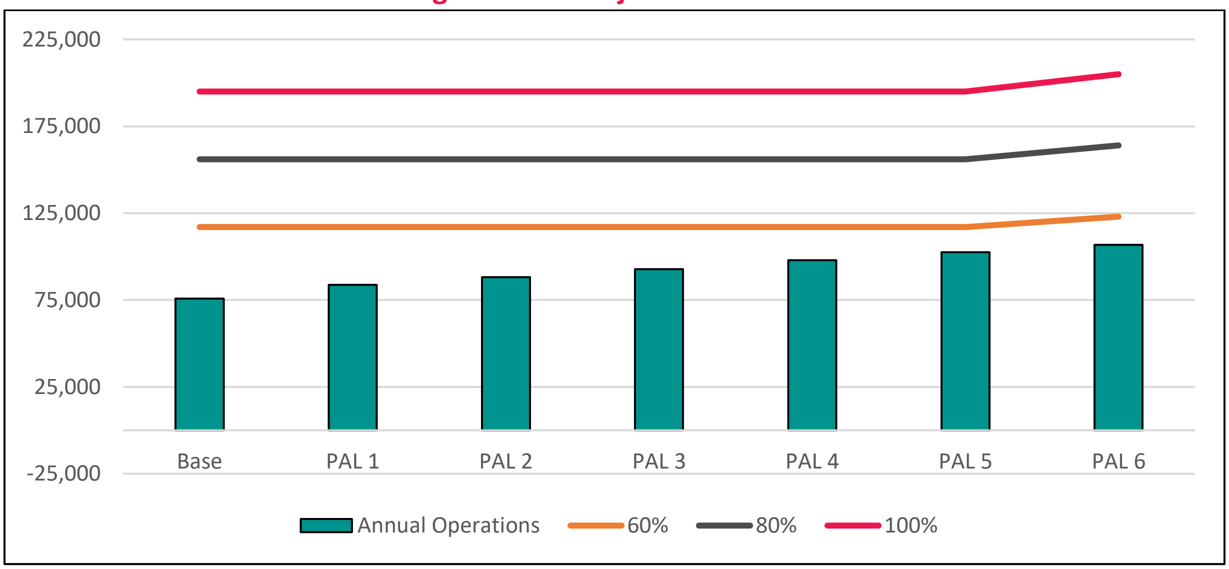
Table 4-12 presents the forecasted operational limits at specific capacity levels to trigger future planning for another runway at AVL. As shown, the current runway capacity should be adequate to serve the Airport's activity well beyond the planning horizon. As activity at AVL is forecast to reach a maximum of approximately 50 percent capacity, improvements in airfield capacity are not necessary. Projected demand and capacity levels are further depicted in **Figure 4-1**.

Table 4-12 – Capacity Levels

Capacity Level	Base Year – PAL 5	PAL 6
60%	117,000	123,000
80%	156,000	164,000
100%	195,000	205,000

Source: FAA AC 150/5060-5, CHA, 2023.

Figure 4-1 – Projected Demand



Source: FAA AC 150/5060-5, CHA, 2023

4.3 RUNWAY AND TAXIWAY REQUIREMENTS

Airfield improvements are planned and developed according to the established ARC, ADG, and TDG for an airport. The associated design criteria are applied when planning upgrades or improvements for a runway or taxiway. An airport's ARC is determined by the critical aircraft (aircraft with the longest wingspan, highest tail, and fastest approach speeds) that makes "regular use" of the airport or a specific runway. FAA AC 150/5000-17, defines "regular use" as 500 annual operations, including both itinerant and local operations, but excluding touch-and-go operations (an operation is either an arrival or departure).

4.3.1 Runway Requirements

In 2020, AVL completed a runway reconstruction project--replacing Runway 16/34 with Runway 17/35. The newly constructed runway is 8,002 feet by 150 feet and can accommodate up to C-IV aircraft. While the new runway is the same dimensions, the centerline was shifted 75 feet west to provide a standard 400 feet of separation between the runway and the parallel taxiway (Taxiway A).

Airfield Configuration & Wind Coverage

The general configuration of the airfield, including the number of runways along with their location/orientation, should allow the airport to meet anticipated air traffic demands and maximize wind coverage and operational utility for all types of aircraft. It is a FAA recommendation that the runway system at an airport be oriented to provide at least 95 percent wind coverage. This means that 95 percent of the time in a given year, the crosswind coverage at an airport is within acceptable limits for the types of aircraft operating on the runways. As shown in **Table 4-13**, the current single runway configuration at AVL provides wind coverage greater than the FAA recommended 95 percent for the design aircraft. Furthermore, Runway 17/35 alone provides well over 95 percent wind coverage for all crosswind components. **Table 4-13** also includes the annual wind coverage separately during both IFR and VFR conditions. That evaluation also demonstrates nearly 100 precent wind coverage at AVL under all conditions. **Figure 4-2** provides a depiction of the average wind speed and direction at AVL. The graph illustrates that the predominant of wind from the north-northwest and south-southwest is in direct alignment of Runway 17/35.

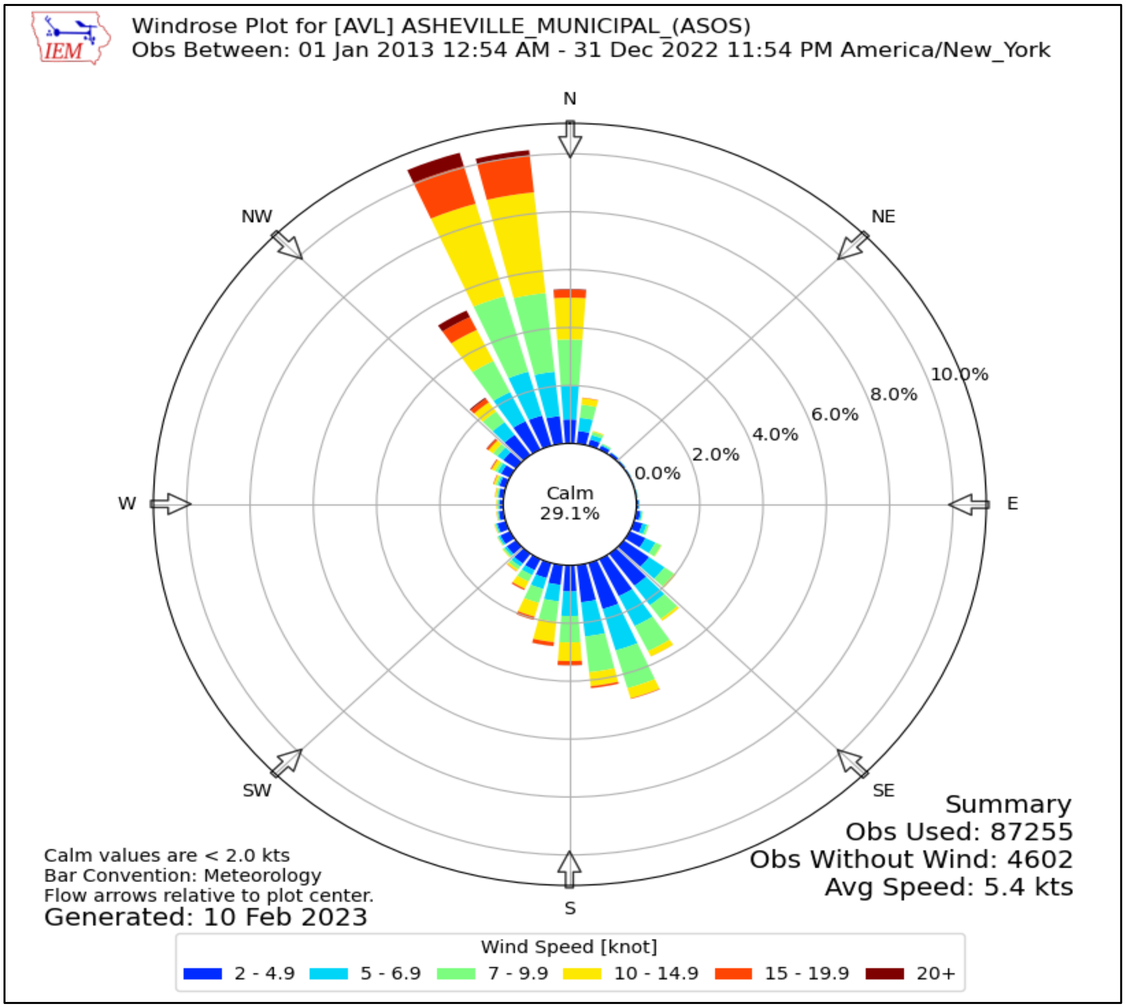
Table 4-13 – AVL Wind Coverage (Runway 17/35)

Weather Condition	10.5 Knots	13 Knots	16 Knots	20 Knots
All Weather	99.60%	99.89%	99.98%	100%
IFR	99.69%	99.87%	99.96%	100%
VFR	99.55%	99.89%	99.99%	100%

Note: Data is provided by NOAA's Integrated Surface Database (ISD). Data available from 2013 through 2022. Data accessed 14 September 2022 via FAA's Airport Data and Information Portal (ADIP).
Source: NOAA, FAA, CHA, 2023.

As such, it was concluded that no changes to the runway configuration are recommended during the planning horizon to accommodate wind conditions.

Figure 4-2 – All-Weather Windrose



Source: Iowa State University Environmental Mesonet, 2023.[2]

Runway Designations

Due to the changes in the earth's magnetic declination over time, the compass heading of a runway and its associated runway end number designations can change. Current magnetic declination information was derived from the National Oceanic and Atmosphere Administration (NOAA). The current headings and declinations[3] of the runway ends at AVL are as follows:

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[2] Iowa State University. *Environmental Mesonet*. https://mesonet.agron.iastate.edu/sites/dyn_windrose.phtml?station=AVL&network=NC_ASOS&bin0=2&bin1=5&bin2=7&bin3=10&bin4=15&bin5=20&conv=from&units=kts&nsector=36&fmt=png&dpi=100&year1=2013&month1=1&day1=1&hour1=0&minute1=0&year2=2023&month2=12&day2=31&hour2=23&minute2=59. Accessed 09 February 2023.

[3] National Oceanic and Atmospheric Administration (NOAA) / National Centers for Environmental Information. "Magnetic Field Calculators." 19 January 2023. https://www.ngdc.noaa.gov/geomag/calculators/magcalc.shtml#igrfwmm

- Runway 17
  - Current headings: 167° magnetic (rounds and truncates to 17), 160° true
  - Declination: 6° 51' 25'' W ± 0° 22' changing by 0° 3' 6'' W per year
- Runway 35
  - Current headings: 347° magnetic (rounds and truncates to 35), 340° true
  - Declination: 6° 51' 38'' W ± 0° 22' changing by 0° 3' 7'' W per year

Currently, no changes in the runway designations of 17/35 are needed; however, since magnetic declination changes slowly over time, the runway numbers may need to be reevaluated by PAL 4, at which time the magnetic declination may have changed more significantly.

Runway Design Standards

During this master planning effort, FAA design and safety standards related to the airfield facilities were identified so that the airport may review and work to achieve compliance where needed. The standards include dimensions, separation distances, protection zones, clearance requirements, etc., which are based on the critical aircraft.

Runways are assigned a Runway Design Code (RDC), which signifies the required design standards that the runway must satisfy. As detailed in **Chapter 3, *Forecasts of Aviation Demand,*** D-III represents the current and future critical aircraft grouping at AVL, with a B737-800 being an example of a D-III aircraft operating at AVL. When constructed, Runway 17/35 was built to D-IV standards, thus accommodating the Airport's critical aircraft.

The key FAA design and safety standards related to Runway 17/35 at AVL (as defined in AC 150/5300-13B, *Airport Design*) are described below. Refer to **Figure 4-3**.

<u>Runway Width</u> – Runway width requirements are based on the critical aircraft associated with the runway. ARC D-III runways are required to have a runway width of 150 feet when the critical aircraft has a maximum certified takeoff weight greater than 150,000 pounds, such as the B737-800.

Runway 17/35 is 150 feet wide, thereby meeting this design requirement.

<u>Runway Shoulders</u> – Shoulders provide resistance to blast erosion and accommodate the passage of maintenance and emergency equipment and the occasional passage of an airplane veering from the runway. The FAA recommends paved shoulders for runways accommodating Group C/D-III aircraft and higher. FAA AC 150/5300-13B indicates the required shoulder width to be 25 feet on either side of a Group C/D-III runway.

Runway 17/35 is equipped with paved shoulders that are 25 feet in width, thus meeting the runway shoulder requirements.

<u>Runway Safety Area (RSA)</u> – The RSA is a rectangular area bordering a runway that is intended to reduce the risk of damage to aircraft in the event of an undershoot, overrun, or excursion from

the runway. The RSA is required to be cleared and graded such that it is void of potentially hazardous ruts, depressions, or other surface variations. Additionally, the RSA must be drained by grading or storm sewers to prevent water accumulation, be able to support snow removal and firefighting equipment, and be free of objects except those required because of their function.

The RSA for a Group C/D-III or Group C/D-IV runway is required to be 500 feet wide and extend 1,000 feet beyond the runway end. The longitudinal grade beyond the end of the runway should be between 0.0 percent to -3.0 percent for the first 200 feet and no more than -5.0 percent for the remaining 800 feet of the RSA. Transverse grades should be -1.5 percent to -3.0 percent away from the runway shoulder edge and beyond the runway ends.

The RSAs for Runway 17/35 meet the required design standards.

Runway Object Free Area (ROFA) – The ROFA is a rectangular area bordering a runway intended to provide enhanced safety for aircraft operations. This is accomplished by ensuring the area remains clear of parked aircraft or other equipment not required to support air navigation or the ground maneuvering of aircraft. The ROFA design standard for Group C/D-III and Group C/D-IV runways is 800 feet wide, centered about the runway centerline, and extends 1,000 feet beyond each runway end.

The ROFA for Runway 17/35 meets FAA design standards; however, for both runway ends the FAA ILS glideslope antenna and equipment building are located within the ROFA. The FAA may consider relocating the equipment buildings outside the ROFA.

Runway Object Free Zone (ROFZ) – The ROFZ is a volume of airspace centered above the runway that is required to be clear of all objects, except for frangible navigational aids that need to be in the ROFZ because of their function. The ROFZ provides clearance protection for aircraft landing or taking off from the runway. The ROFZ is the airspace above a surface whose elevation at any point is the same as the elevation of the nearest point on the runway centerline.

As required per FAA standards, the Runway 17/35 ROFZ extends 200 feet beyond each end of the runway, and its width is based on visibility minimums and aircraft size, with a 400-foot width requirement. AVL satisfies the ROFZ standards.

Runway Blast Pads - Like runway shoulders, blast pads are intended to provide erosion protection at the runway ends. Conformance to FAA design criteria for C/D-III runways consists of a blast pad having a width of 200 feet and length of 200 feet, placed symmetrically at each of the runway.

Runway 17/35 has a blast pad at each runway end providing the required dimensions.

Building Restriction Line (BRL) – Though not a specific FAA design standard, the BRL is a reference line which provides generalized guidance on building location and height restrictions. The BRL is typically established with consideration to OFAs and RPZs, as well airspace protection by identifying areas of allowable building heights (e.g., 35 feet above ground level). It should be noted that site-specific terrain considerations (i.e., grade/elevation changes) may allow buildings taller than indicated by the generalized BRL to be developed within the limits of the BRL. These height restrictions are based on FAR Part 77 parameters and are evaluated for each specific site development plan. The facilities at AVL do not penetrate the existing BRL.

Table 4-14 identifies the existing conditions at AVL and the geometric requirements of the above standards relative to ARC D-III.

Table 4-14 – FAA Runway Design Standards

Design Standard	FAA Runway Design Standards D-III * (< ¾ mile visibility)	AVL Runway 17/35: Meet or Exceed (Yes / No)
Runway Width	150'	Yes
RSA Width	500'	Yes
RSA Length Beyond Runway End	1,000'	Yes
ROFA Width	800'	Yes
ROFA Length Past Runway End	1,000'	Yes
Runway OFZ Width	400'	Yes
Separation Between:		
Runway Centerline to Parallel Taxiway Centerline	400'	Yes
Runway Centerline to Hold line	250'	Yes
Approach Runway Protection Zone (RPZ):		
Length	2,500'	Yes
Inner Width	1,000	Yes
Outer Width	1,750	Yes
Departure Runway Protection Zone (RPZ):		
Length	1,700	Yes
Inner Width	500	Yes
Outer Width	1,010	Yes

*With a critical aircraft over 150,000 pounds MTOW.
Source: FAA AC 150/5300-13B, CHA 2023.

Runway Protection Zone (RPZ)

The RPZ is a land use control that is primarily meant to enhance the protection of people and property on the ground through airport control. Such control includes clearing of RPZ areas of incompatible objects and activities.

RPZ Dimensions

Runways may have two types of RPZs, the Approach RPZ and Departure RPZ, which have varying dimensions based on the design aircraft's AAC and ADG, as well as the runways' visibility minimums. The RPZ is a trapezoidal area located 200 feet beyond the runway end and centered on the extended runway centerline.

The Approach RPZ under Group C/D-III and -IV design standards when the visibility is less than ¾ miles requires an inner width of 1,000 feet, outer width of 1,750 feet, and a length of 2,500 feet. The Departure RPZ under these same conditions are an inner width of 500 feet, outer width of

1,010 feet, and length of 1,700 feet. Departure RPZs are used if and when a runway displaced threshold is in place. Currently the runway ends at AVL do not contain a displaced threshold.

The RPZs for Runway 17/35 meet the RPZ dimensions. See **Figure 4-4**.

<u>Incompatible Land Use Within the RPZs</u>

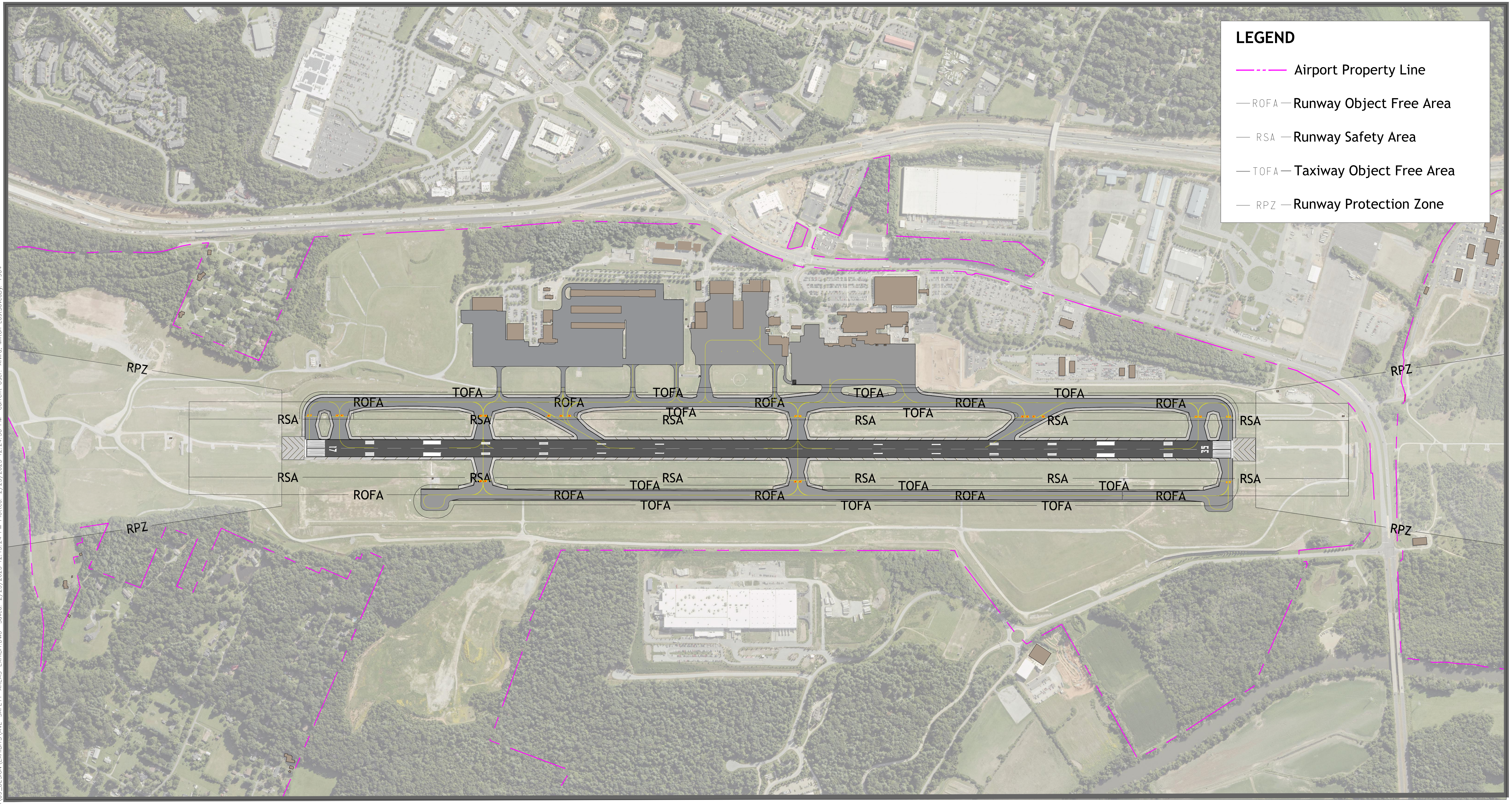
Incompatible land uses consist of homes, or any other development that contains a concentration of people such as occupied buildings of any type. Incompatible land uses can also consist of physical obstructions, visual distractions, or wildlife attractants which can threaten the safety of aircraft operations. According to AC 150/5190-4B, *Airport Land Use Compatibility Planning,* compatible land uses consist of "those that can coexist with a nearby airport without constraining the safe and efficient operation of the airport or exposing people living and/or working nearby to significant environmental impacts." The primary characteristics that are typically considered when determining land use compatibility include:

- Noise
- Airspace
- Visual/Atmospheric Interference
- Wildlife
- Protection of People and Property
- Development Density

Each of the previously defined RPZs were evaluated at a high-level for incompatible land uses, with an emphasis given to airspace and protection of people and property. Land use within the existing RPZs at AVL were determined to satisfy the key FAA standards.

The Runway 17 RPZ contains portions of State Road 3496 and Pinner Road. Runway 35 RPZ contains portions of New Airport Road and State Highway 280, portions of Hunter Airport Drive, French Broad Lane, and areas operated by Broadmoor Golf and Event Center (i.e., public parking, private roadways, etc.).

It is recommended that GARAA seek opportunities to eliminate, reduce, or mitigate existing incompatible land uses; however, it is acknowledged that roadways and parking exist in most airport RPZs. While not ideal, such land uses are not prohibited unless traffic lights and intersections result in standing traffic and associated concentrations of people. Options to address incompatible land uses within the RPZ will be further discussed during the Alternatives evaluation.



GRAPHIC SCALE (FEET)

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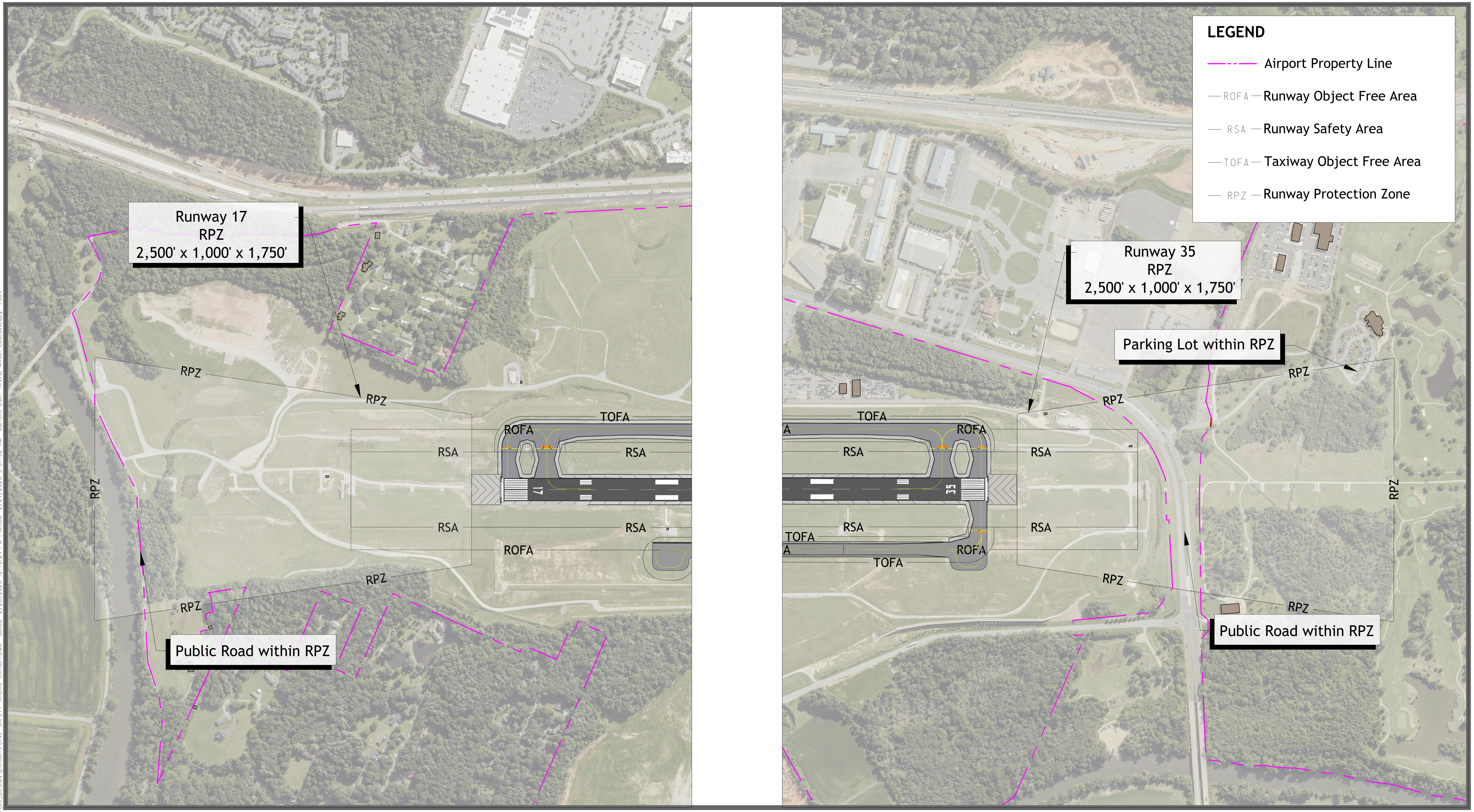
Figure 4-3

Airfield Design Standards

Asheville REGIONAL AIRPORT

MASTER PLAN UPDATE



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Asheville REGIONAL AIRPORT

MASTER PLAN UPDATE

Figure 4-4

Runway Protection Zones (RPZs)

Runway Length Requirements

To ensure that AVL can support existing and anticipated aircraft and airline operational demands, a detailed runway length analysis was performed based on specific aircraft performance characteristics as documented in the manufacturer's Aircraft Planning Manuals (APMs). Inadequate runway length can limit the operational capability of an airport, including the aircraft types that can operate and the destinations that the airport serves. Runway lengths can place restrictions on the allowable takeoff weight of the aircraft, which then reduces the amount of fuel, passengers, or cargo that can be carried. The runway analysis herein was conducted using the guidance provided in AC 150/5325-4B, *Runway Length Requirements for Airport Design*.

Aircraft Specifics

Factors specific to aircraft operating at AVL that were included within the runway length calculations were as follows:

- Model and Engine Type – the calculations specified herein represent the takeoff & landing length requirements for the Airbus A320-200, Boeing B737-800 and the B737 MAX 8 during the hottest mean day temperature (85.9°F) at a 2,000-foot Airport Altitude for AVL. Note, for calculation purposes, aircraft takeoff and landing performance charts with International Standard Atmosphere/Standard (ISA/STD) plus 15°C were utilized to represent the hottest mean day temperature of 85.9°F.
- Payload – represents the carrying capacity of the aircraft, including passengers, baggage, and cargo. For this analysis, both 90 percent and 100 percent were chosen as the payload for planning purposes.[4]
- Estimated Takeoff Weight – the estimated weight at takeoff, which includes the payload and the fuel required to reach the intended destination (with reserve fuel). The estimated takeoff weight varies by aircraft, payload, and destination.
- Estimated Landing Weight – the estimated weight at landing. For this analysis, maximum landing weight was used to determine runway landing requirements.

Airport Specifics

- Temperature – the atmospheric temperature at the airport. Warmer air requires longer runway lengths because the air is less dense, thus generating less lift on the aircraft. The average temperature (85.9°F) of the hottest month (July) at AVL was used in the calculations.[5]

[4] It should be noted that fuel burn was not accounted for within the evaluations; therefore, the calculations presented herein would need reassessed to include fuel burn prior to any runway reconstruction.

[5] Source: https://www.ncei.noaa.gov/access/us-climate-normals/#dataset=normals-monthly&timeframe=30&location=NC&station=USW00013872

- Elevation – the elevation above sea level at the airport. As elevation increases, air density decreases, making takeoffs longer and landings faster. The elevation at AVL is established at 2,163.9 feet above mean sea level (MSL).
- Effective Runway Gradient – the difference between the highest and lowest elevations along the runway centerline, divided by the runway length.[6]
- Stage Length (flight distance) – the length in nautical miles (nm) to the intended destination. The stage length determines the amount of fuel an aircraft will require on takeoff to complete its flight, thus impacting aircraft weight and runway length requirements. For this Study, the length analysis was evaluated for the farthest destination currently served [Harry Reid International/Las Vegas Airport (LAS) – stage length: approximately 1,580.8 nautical miles], as well the farthest potential destination [Seattle-Tacoma International Airport (SEA) – stage length: approximately 1,908 nautical miles].
- Obstacles impacting departure climb were not included.

The runway length analysis was conducted to indicate current and the worst-case scenario, thus providing GARAA with the capability to plan long-term. The calculations discussed herein represent the takeoff and landing length requirements for the A320-200, B737-800, and the B737 MAX 8 during the hottest mean day temperature (approximately 85.9°F) at a 2,000-foot Airport Pressure Altitude.[7] These aircraft were chosen because they are the largest and most demanding aircraft currently and forecast to use AVL.

Takeoff Length Calculations

Table 4-15 depicts the aircraft takeoff weight for LAS, the current longest non-stop flight, and SEA, the longest anticipated future non-stop destination per the activity forecasts. These values were used along with the associated aircraft manufacturer performance charts (relevant to each aircraft/engine) to calculate the takeoff length requirements shown in **Table 4-16**.

It is pertinent to note, these calculations represent the worst-case scenario, which may only occur during peak activity levels, not daily. The runway's current length supports existing activity on an average day. Also, manufacturer data herein is generalized. Detailed discussions would need to occur with airlines operating at AVL, as airlines often have specific operations data to consider.

Based on the analysis for LAS, the aircraft with the most demanding takeoff length is the Boeing 737-800 at 8,666 feet. With adjustments for effective runway gradient (ERG), the determined

[6] Runway 17 Elevation (2,163.9 feet); Runway 35 Elevation (2,117.4 feet).

[7] Note: For calculation purposes, aircraft takeoff and landing performance charts with ISA/STD plus 15 degrees Celsius were utilized to represent the hottest mean day temperature of 86 degrees Fahrenheit.

takeoff length requirements for AVL based on a 2,000-foot pressure altitude and an ISA/STD of plus 15°C is 9,131 feet.

Based on the analysis for SEA, the aircraft with the most demanding takeoff length is the Boeing 737-800 at 9,087 feet. With adjustments for effective runway gradient (ERG), the determined takeoff length requirements for AVL based on a 2,000-foot pressure altitude and an ISA/STD of plus 15°C is 9,552 feet.

Calculations were performed for takeoff length requirements at field elevation (2,163.9 feet MSL). Although the calculations focused on values based on a 2,000-foot pressure altitude, the field elevation takeoff lengths were slightly greater than the values calculated at a 2,000-foot pressure altitude. The maximum potential takeoff length requirement for AVL, based on the airport's field elevation (2,163.9 feet MSL) and an ISA/STD of plus 15°C is 9,296 feet when traveling to LAS and 9,892 feet for SEA.

Table 4-15 – Takeoff Weight to Destination (At 90% Max Payload)

Aircraft	Takeoff Weight to LAS (Pounds)	Takeoff Weight to SEA* (Pounds)
Airbus A320-200 (V2500 Engines)	156,405	161,969
Airbus A320-200 (CFM56 Engines)	155,494	161,000
Boeing 737-800 (CFM56-7 Engines)	170,087	177,522
Boeing 737 Max 8 (LEAP 1B Series Engines)	168,450	174,085

Source: Aircraft Performance Manuals (A320, B737-800, B737 MAX 8), CHA, 2023.

Table 4-16 – Takeoff Length Requirement (At 90% Max Payload)

Aircraft	Takeoff Length Requirement to LAS (Feet)*	Takeoff Length Requirement to SEA (Feet)*
Airbus A320-200 (V2500 Engines)	6,115	6,599
Airbus A320-200 (CFM56 Engines)	6,180	6,727
Boeing 737-800 (CFM56-7 Engines)	8,666	9,087
Boeing 737 Max 8 (LEAP 1B Series Engines)	8,066	9,000

Note: *Values have not been adjusted for effective runway gradient or wet runway conditions.
Source: Aircraft Performance Manuals (A320, B737-800, B737 MAX 8), CHA, 2023.

Landing Length Calculations

Landing length requirements were derived from the specific maximum landing weight values, both of which are presented in **Table 4-17**. The emergency landing weight, or the approximate landing weight for an aircraft needed to return to the airfield immediately after takeoff, was also determined.

Table 4-17 – Maximum Landing Weight & Landing Length Requirements

Aircraft	Maximum Landing Weight (Pounds)	Landing Length Requirements (Feet)	Emergency Landing Weight From LAS (Pounds)*	Emergency Landing Weight From SEA (Pounds)*
Airbus A320-200 (V2,500 Engines)	145,505	5,079	156,405	161,969
Airbus A320-200 (CFM56 Engines)	145,505	5,218	155,494	161,000
Boeing 737-800 (CFM56-7 Engines)	146,300	6,081	170,087	177,522
Boeing 737 Max 8 (LEAP 1B Series Engines)	152,800	6,128	168,450	174,085

Note: * The emergency landing length requirement values are a scenario-based calculation and does not represent actual operating procedures or manufacturer weight limitations during emergency return landings.
Source: Aircraft Performance Manuals (A320, B737-800, B737 MAX 8), CHA, 2023.

With the exception of the Airbus A320-200, the landing length requirement values for the B737-800 and B737 MAX 8 were calculated using only the maximum landing weight identified in the specific aircraft manufacturer APM. The calculated emergency landing weight for both Boeing aircraft exceeds the landing performance chart parameters and could not be used to calculate landing length requirements. Even so, the aircraft with the most demanding landing length is the B737 MAX 8 at 6,128 feet. With adjustments for wet runway conditions, the determined landing length requirement for AVL based on a 2,000-foot pressure altitude and an ISA/STD of plus 15°C is 7,047 feet for LAS and SEA.

Calculations were performed for landing length requirements at field elevation (2,163.9 feet MSL). Although the calculations focused on values based on a 2,000-foot pressure altitude, the field elevation takeoff lengths were slightly greater than the values calculated at a 2,000-foot pressure altitude. The determined landing length requirement for AVL is 7,077 feet if traveling from LAS and SEA. As such, it is concluded that the existing runway provides adequate length for landing throughout the planning period.

Runway Length Recommendation

To accommodate the future potential runway takeoff length requirements presented herein, a runway extension of approximately 1,000 feet is recommended to achieve a runway length of 9,000 feet, thus supporting farther stage lengths on hot days and/or with 90%+ payloads. This should be considered a future goal for AVL, but not a facility requirement. More detailed evaluations for specific airline requirements would be presented prior to advancing a runway extension.

4.3.2 Taxiway Requirements

The overall goal of airfield planning and design is to enhance efficiency and the margin of safety for operational activities. Per FAA guidance, and consultation with the airport operations and air traffic control personnel, the following specific goals were identified for the taxiway system at AVL:

- Accommodate all existing and projected users (commercial and general aviation)
- Reduce risk of pilot confusion

- Complexity of the taxiway system can lead to pilot confusion, which can lead to human error and the increased potential for runway incursions. Reducing the risk for pilot confusion includes:
  - Reducing the number of taxiways intersecting at a single location
  - Increasing the pilot's situational awareness (i.e., through proper signage and marking)
  - Avoiding wide expanses of pavement
  - Avoid potential "hot spots" (no current hot spots at AVL)
  - Increasing visibility

- Allow for expandability
  - The taxiway system should be designed to enable the long-term expansion of other aviation facilities and the ability to provide efficient airside access to developable parcels of the airport.

- Adhere to all FAA design standards (based on ADG and TDG).
  - Taxiways should be developed to the appropriate FAA standards associated with the ADG and TDG of the design aircraft

During construction of the new runway (Runway 17/35), a temporary runway was constructed on the west side of the airfield to allow the Airport to remain operational. After the new runway opened, the temporary runway was decommissioned and converted to a permanent parallel taxiway, designated as Taxiway B. For the purpose of this Study, all taxiways and connectors were evaluated against FAA design standards based on the Airport's design aircraft (B737-800, ADG D-III and TDG-3). Design standards are addressed below.

Taxiway Design Standards

Similar to runways, taxiways are subject to FAA design requirements such as pavement width, edge safety margins, shoulder width, and safety and object free area dimensions. The taxiway design standards are based on the Airport's Taxiway Design Group (TDG), which is TDG-3 for the critical aircraft.

The FAA standards in relation to taxiways (as defined in AC 150/5300-13A, *Airport Design*) are described below. See **Figure 4-3**.

Table 4-18 – Taxiway Design Standards based on Airplane Design Group (ADG)

Design Standard	ADG-III
Protection Standards	
Taxiway Safety Area (TSA) Width	118 feet
Taxiway Object Free Area (TOFA) Width	171 feet
Taxiway Wingtip Clearance	26.5 feet
Separation Standards	
Taxiway Centerline to Parallel Taxiway	144.5 feet
Taxiway Centerline to Fixed or Moveable Object	85.5 feet

Source: FAA AC 150/5300-13B, CHA 2023.

Table 4-19 – Taxiway Design Standards based on Taxiway Design Group (TDG)

Design Standard	TDG-3
Taxiway Width	50 feet
Taxiway Edge Safety Margin	10 feet
Taxiway Shoulder Width	20 feet

Source: FAA AC 150/5300-13B, CHA 2023.

Taxiway Width – Taxiway widths and standards are based on the Airport's TDG, which is TDG-3. Based on FAA design standards, the recommended taxiway width for TDG-3 is 50 feet for the taxiways that serve the critical aircraft. For corporate/general aviation taxiways, TDG-2A/2B is appropriate at a width of 35 feet to accommodate large corporate jets (i.e., Gulfstreams, Global Express). Presently, all taxiways meet required design standard width of 50 feet, or 35 feet for general aviation taxiways (Taxiways G, H, J, and K).

Taxiway Shoulders – Airports, such as AVL, with a critical aircraft of ADG-III should provide stabilized or paved taxiway shoulders. AVL has a mix of paved and turf taxiway shoulders, all of which meet FAA standards.

Taxiway Safety Area (TSA) and Taxiway Object Free Area (TOFA) – TSAs are designed to support the occasional passage of aircraft, as well as ARFF equipment. Per FAA AC 150/5030-13B, TOFAs are the "area adjacent to the TSA that is clear of objects not fixed-by-function to provide a vertical and horizontal wingtip clearance." Based on the critical aircraft grouping (ADG-III), the taxiway safety area (TSA) and taxiway object free area (TOFA) width requirements are required to be 118 feet and 171 feet, respectively, centered about the taxiway. The taxiway TSAs and TOFAs at AVL comply with FAA standards.

Taxiway Fillets – For taxiway turns onto runways, aprons, or additional taxiways, there are FAA design standards for the geometry of the fillets, based on the ADG and the angle of the turn. In conjunction with the runway reconstruction and the new taxiway, taxiway fillets at AVL have been updated to adhere to current FAA standards.

Parallel Taxiway Lengths – Per FAA standards, a parallel taxiway is "a continuous taxiway path located laterally to the runway it serves, providing access to one or both runway ends without entering the RSA or OFZ."

Two parallel taxiways exist at AVL. Taxiway A, located on the east side of Runway 17/35, is a full-length parallel taxiway and provides access to both runway ends. Taxiway B, located on the west side of Runway 17/35, is a partial length parallel taxiway, meaning access is only provided to the Runway 35 approach end. It is recommended that Taxiway B be extended to a full-length taxiway, thus providing greater accessibility to the west side of the airfield, and eliminating the need to cross the runway to access the north end of the runway.

4.4 AIRFIELD LIGHTING AND NAVIGATIONAL AIDS REQUIREMENTS

Airfield lighting allows for the safe operation of aircraft during nighttime hours and low visibility conditions. Lighting on the airfield includes runway and taxiway lighting systems, approach lighting and navigational aids, and the rotating beacon.

4.4.1 Runway and Taxiway Lighting

Runway & Taxiway Edge Lighting

Edge lighting systems assist pilots in defining the edge of the runway and taxiway pavements during times of limited or low visibility.

Runway 17/35 is a precision runway. Thus, in accordance with FAA standards for precision runways, is equipped with High Intensity Runway Lights (HIRL). At AVL, the runway edge lights are white for the first 6,002 feet in either direction, with the last 2,000 feet being amber. The amber lights provide caution to pilots after landing that the runway end is approaching. Runway edge lighting must be positioned between 2 and 10 feet from the edge of full-strength pavement, and not more than 200 feet apart. The Runway 17/35 edge lighting is currently positioned 10 feet from the edge of full-strength pavement, with each unit having 200 feet of separation.

All taxiways at the Airport are equipped with Medium-Intensity Taxiway Light (MITL) systems, which is the standard used for taxiways. To provide a distinct difference between runway and taxiway edges, taxiway edge lights are blue. Like runway edge lights, taxiway edge lights are required to be positioned between 2 and 10 feet from the edge of full-strength pavement; however, spacing between the lights is dependent upon taxiway section lengths.

All runway and taxiway edge lights at AVL adhere to FAA standards.

Runway Centerline Lighting

Runway 17/35 is equipped with bi-directional runway centerline lights, equally spaced 50 feet apart. Per FAA design standards, the centerline lights are white except for the last 3,000 feet. The centerline lights located between 3,0000 and 1,000 feet from the runway ends are alternately placed white and red, with the final 1,000 feet being all red to provide an additional visual aid that the end of the runway is approaching.

Touchdown Zone Lighting

The TDZLs indicate the touchdown zone when landing under adverse visibility conditions. Runway 35 is equipped with touchdown zone lights, as it is the predominately used runway end at AVL. Per FAA standards, the touchdown zone lights consist of three lights grouped perpendicular to the centerline, with lights on either side of the centerline. The lights are placed starting 100 feet from the runway threshold, extending to 3,000 feet. The lights are only visible from the Runway 35 approach end.

Threshold Lighting

At AVL, Runways 17 and 35 have standard runway threshold lighting. As required by FAA for precision runways with HIRL, the threshold lighting system are grouped in fours on both sides of the runway thresholds, with each light spaced 10 feet (center to center). Since each runway has a blast pad, the threshold lights are placed between the threshold and blast pad. The threshold lights are red/green, with red lights being visible from departure and green lights being visible upon approach.

PAPIs

A PAPI is a system of lights, located near a runway end, that provides pilots with visual glide slope guidance information during an approach to the runway. PAPIs typically have an effective visual range of at least three miles during the day and up to 20 miles at night and inform pilots if they are high, low, or on the correct approach descent path for the threshold. A 4-box PAPI system (PAPI-4) is provided at the ends of Runway 17 and Runway 35 and are set at the standard 3-degree angle.

4.4.2 Approach Procedures and Navigational Aid (NAVIAD) Requirements

Based on current FAA classifications, there are three types of approach categories: visual, non-precision, and precision.

- Visual (V) – Approaches performed under visual flight rules only when meteorological conditions include a cloud ceiling height of 1,000 feet or greater and visibility of 3 miles or greater.
- Precision Approach (PA) – Instrument approach procedures providing both horizontal and vertical guidance less than 250 feet above the threshold and visibility minimums lower than ¾ mile.
- Non-Precision Approach (NPA) – Instrument approach procedures providing only lateral guidance with a ceiling minimum of 400 feet above the threshold.

Runway 17 and 35 each provide a precision approach using an ILS and one non-precision approach using RNAV GPS.

Precision Approach – ILS

The ILS systems each consists of three components: a localizer (LOC), a glideslope (GS), and the approach lighting system (ALS).

A localizer is situated 1,000 feet past the departure-end of each runway approach and provides lateral positioning guidance to pilots. The system uses radio frequencies (RF) to transmit signals to aircraft by focusing the RF beam down the centerline of the runway toward the approach end of the runway for approximately 10 miles, focused within 35 degrees to the left or right of the runway centerline.

The glide slope is located near the runway approach end (each on the west side of Runway 17/35) at a distance from the threshold to provide optimum crossing height. The glide slopes transmit a signal for approximately 10 nautical miles, with a horizontal coverage of eight degrees on each side of the localizer course, measured from the origin of the glide slope beam.

The ALS provides a lighted approach path along the extended centerline of the runway to provide a visual alignment, height perception, roll guidance, and horizontal reference for the pilot. At AVL, the ALS consists of a Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR). The MALSR at AVL adheres to FAA design standards.

Non-Precision Approaches: RNAV (GPS)

The Global Positioning System (GPS) based technology for Runway 17 and Runway 35 enables vertically guided approach procedures with approach capabilities similar to ILS approaches, without the need for the traditional ground-based ILS NAVAID components. The RNAV (GPS) systems follow FAA standards.

Table 4-20 – Airfield Lighting & Instrumentation

Runway	Runway Markings	Lighting	Minimum Ceiling (AGL)/ Visibility	Instrument Approach Types
17	Precision	HIRL, PAPI-4, MALSR	200 ft. / ½ mile	ILS or LOC, RNAV (GPS)
35	Precision	HIRL, PAPI-4, MALSR	200 ft. / ½ mile	ILS or LOC, RNAV (GPS)

Source: FAA Airport Master Record (Form 5010), Accessed 2021.

GPS – Global Positioning System
HIRL – High Intensity Runway Lights
ILS – Instrument Landing System
MALSR – Medium-Intensity Approach Lighting System with Runway Alignment Indicator Lights
PAPI-4 – Four-Box Precision Approach Path Indicator
RNAV – Area Navigation

4.4.3 Other Airfield Lighting Requirements

Rotating Beacon

The rotating beacon at AVL is currently located atop the existing Air Traffic Control Tower (ATCT). Relocation of the ATCT will require that the rotating beacon also be relocated. Possible areas for relocation will be identified during the Alternatives analysis in **Chapter 5**.

4.5 SUPPORT FACILITY REQUIREMENTS

Support facilities provide vital functions related to the overall operation of the Airport and include facilities related to general aviation operations, aircraft fueling and deicing, Aircraft Rescue and Firefighting (ARFF), Airport maintenance, Air Traffic Control Tower (ATCT), and Urban Air Mobility (UAM). As airport operations increase, the use of these facilities and infrastructures increases, creating greater demand and less available capacity to meet this demand over the 20-year planning horizon. The following sections detail the current capacity and projected demand for the previously mentioned facilities.

4.5.1 General Aviation Facility Requirements

Hangar requirements are generally a function of the number and type of based aircraft, owner preferences, hangar rental costs, and area climate. In the winter, snowstorms, frost, ice, and intense wind can cause damage to parked aircraft. Additionally, during warmer months, heat and sun exposure can damage avionics and fade paint. Thunderstorms and hailstorms also occur, with the potential to cause considerable amounts of damage. All these factors make hangars desirable.

Aircraft Storage Facilities

Locally based operators and private owners at AVL employ use of hangar space. These hangars are fully enclosed and secured. **Table 4-21** lists each storage hangar at the Airport, as well as the approximate storage capacity.

Table 4-21 – Existing Aircraft Storage Facilities

Building Number	Hangar Type	Hangar Size (SF)
North Apron		
Building 240	Corporate Hangar	31,980
Building 30	Corporate Hangar	19,600
Building 20	Corporate Hangar	8,480
Building 40	Corporate Hangar	15,220
Total Storage		**75,280**
Middle Apron		
T-Hangar 20	T-Hangar (30 Bays)	22,830
T-Hangar 40	T-Hangar (18 Bays)	26,490
T-Hangar 60	T-Hangar (22 Bays)	39,370
Total Storage		**88,690**
South GA Apron		
Building 104 – Hangar 1	Bulk Hangar	10,920
Building 104 – Hangar 2	Bulk Hangar	10,920
Building 31	Bulk Hangar	7,130
Building 35	Bulk Hangar	14,730
Building 168	Bulk Hangar	28,648
Building 120	Bulk Hangar	14,430
Building 122	Bulk Hangar	6,090
Total Storage		**92,868**
All Hangars (Total)		
Total Hangar Storage Capacity		**256,838**

Note: Square Feet (SF) – not adjusted for office space; Reference **Chapter 2**, **Figure 2-11**.

Source: GARAA, CHA, 2023.

All hangars at AVL are controlled by Signature Flight Support, with Signature leasing hangars to numerous tenants [e.g., Allegiant Air, Belle Aircraft Maintenance, and Western North Carolina (WNC) Aviation]. Based on the Inventory of Existing Conditions, all hangars are currently under lease, thus there is currently no excess capacity.

Over the forecast horizon, the Airport is projected to experience an increase in based aircraft, consisting predominately of single-engine aircraft (see **Table 4-22**). Additional hangars will be required to accommodate projected demand.

To develop a projection of required hangar space, assumptions were made based on average square feet of space required to store each type of aircraft and the forecasted fleet mix during the planning horizon. **Table 4-23** provides an overview of anticipated hangar space requirements based on the following assumptions:

- 1,100 SF (single- and multi-engine aircraft)
- 4,700 SF (jet aircraft)

Table 4-22 – Based Aircraft Forecast

Period	Base	PAL 1	PAL 2	PAL 3	PAL 4
Single-Engine	144	147	150	154	157
Multi-Engine	9	9	10	10	11
Jet	5	9	12	15	19
Helicopter	3	3	3	3	3
Total	**161**	**168**	**175**	**182**	**190**

Source: FAA 2021 TAF (National), Airport Master Record (Form 5010), CHA, 2023.

Table 4-23 – Projected Hangar Space Requirements

Aircraft Type	Base	PAL 1	PAL 2	PAL 3	PAL 4
Current & Projected Based Aircraft					
Single- & Multi Engine Aircraft	153	156	160	164	168
Jet Aircraft	5	9	12	15	19
Total	158	165	172	179	187
Additional Based Aircraft to Be Accommodated Each Planning Period					
Single- & Multi Engine Aircraft	-	3	4	4	4
Jet Aircraft	-	4	3	3	4
Total	-	7	7	7	8
Additional Hangar Storage Required (SF)					
Single- & Multi Engine Aircraft	-	3,300	4,400	4,400	4,400
Jet Aircraft	-	18,800	14,100	14,100	18,800
Total	-	22,100	18,500	18,500	23,200
Total Additional Hangar Space Through PAL 4		**82,300**			

Source: CHA, 2023.

Based on these assumptions and starting with current conditions, AVL is expected to need approximately 82,300 SF of additional hangar space by PAL 4: 16,500 SF for single- and multi-engine aircraft and 65,800 SF for jet aircraft. The single- and multi-engine aircraft could be accommodated within 15 T-hangar bays at 1,100 SF each, while bulk hangars could be constructed to accommodate jet aircraft.

Per conversations with Signature, over 75 additional aircraft, ranging from TBM 900 to the Challenger 300, frequent AVL. Depending on the need and length of stay, these aircraft require hangar storage or tie-down locations, as well as fuel. These additional aircraft further constrain current capacity. For the purposes of this Study, it was assumed that 20 percent of these additional aircraft will require accommodation at any given time, or approximately 15 aircraft. For these aircraft, an assumption of 2,500 SF per aircraft was assumed, for a total demand of 37,500 SF of storage.

In total, the projection for hangar space to accommodate future aircraft demand is approximately 119,800 (82,300 SF for based aircraft + 37,500 SF for transient aircraft), by PAL 4.

Note, as hangars are developed, this may result in a loss of tie-down parking. Locations for future hangar development will be further examined in the Alternatives Chapter.

Helipad Facility Requirements

The demand for helipads was also evaluated. Currently, the Airport has two helipads: one adjacent to the Middle Apron and one adjacent to the South GA Apron. Three helicopters are currently based at the Airport, with no more than three anticipated to be based at the Airport throughout the forecast period. To accommodate current and future demand, one additional helipad is recommended.

Locations for an additional helipad will be further examined in the Alternatives Chapter.

4.5.2 Aviation Fueling Facilities

Signature Flight Support is responsible for operating the Airport's fuel storage and dispensing facilities. As stated in **Chapter 2**, the fueling area consists of six above-ground fuel tanks:

- Four 20,000-gallon Jet-A tanks
- One 12,000-gallon 100LL AvGas tank
- One 1,000-gallon self-serve tank for light piston aircraft (adjacent to the FBO facility)

This analysis focuses on Jet-A fuel storage. Presently, the existing fuel storage capacity provides less than two days of reserve fuel, which is less than the industry's standard of five to seven days reserve. For an airport like AVL, the minimum for current capacity would be around a three-day fuel reserve. An analysis was conducted to project the number of 40,000-gallon Jet-A storage tanks required to accommodate projected demand while maintaining a three-day reserve. See **Table 4-24**.

Current plans include installation of two additional 40,000-gallon Jet-A tanks, thus doubling fuel storage capacity as capacity would increase from 80,000 gallons to 160,000 gallons. This increase in capacity would provide three days reserve in the Base Year. Two more tanks would be required by PAL 1 (for a total of four new tanks), with one more additional tank needed in PAL 3 (for a total of five new tanks), and one final additional tank in PAL 5 (for a total of six new tanks) which will satisfy demand through PAL 6.

Table 4-24 – Fuel Requirements

	Base	PAL 1	PAL 2	PAL 3	PAL 4	PAL 5	PAL 6
Commercial Operations (Annually)	20,328	26,054	28,292	30,723	33,363	37,804	42,214
Commercial Operations (Daily Average) *	55	71	77	83	91	98	107
Approximate Daily Jet-A Fuel Usage (In gallons)	53,333	68,356	74,228	80,606	87,532	95,054	103,222
Jet-A Fuel Storage Capacity (In gallons)	80,000	80,000	80,000	80,000	80,000	80,000	80,000
Approximate Days Fuel Reserve at Current Capacity	1.5	1.2	1.1	1.0	0.9	0.8	0.8
3-Day Reserve							
Fuel Storage Capacity Required (In gallons)	160,000	205,069	222,684	241,818	262,597	285,162	309,666
Fuel Storage Capacity Deficit (In gallons)	(80,000)	(125,069)	(142,684)	(161,818)	(182,597)	(205,162)	(229,666)
Recommended Additional Tanks (At 40,000 gallons each)	2	4	4	5	5	6	6

*Note: Daily average was used, not peak day.
Source: FAA OPSNET, CHA, 2023.

4.5.3 Aircraft Rescue and Firefighting Facilities (ARFF)

ARFF Building

AVL's Aircraft Rescue and Firefighting (ARFF) facility is located between the South GA Apron and the Terminal Apron, with direct access to a taxiway and the terminal building. The facility was constructed in 2014, replacing the former 30-year-old public safety building. This facility was constructed in accordance with building design requirements found in AC 150/5210-15A, *Aircraft Rescue and Firefighting (ARFF) Station Building Design.*

ARFF Equipment

AVL currently operates as an ARFF Index B. To transition to an Index C, five or more average daily departures of aircraft measuring at least 126 feet, but less than 159 feet would be required. Based on projected activity levels throughout the forecast horizon and airlines' operating schedules, AVL is anticipated to receive more than five commercial departures in a day via aircraft measuring between 126 feet and 159 feet (i.e., B737-800, B737-900). Thus, it is anticipated that AVL will transition to an ARFF Index C.

4.5.4 GARAA Maintenance Facilities

The Greater Asheville Regional Airport Authority (GARAA) presently owns and operates the four buildings that houses the Maintenance and vehicle storage. This space includes an adjoining shop and office for AVL's needs. A map and details of the land-use intentions of the GARAA facilities can be found in **Chapter 2**. Current facilities can accommodate the Airport's needs.

4.5.5 Air Traffic Control Facilities

Currently, at AVL, the Air Traffic Control Tower (ATCT) is located on the terminal building. The location of the ATCT tower has been a convenient and resourceful placement for the airport's operations. However, going forward with Asheville's ongoing terminal development and improvement plans, AVL is relocating the tower to the west side of the airfield. This relocation is necessary as part of the Terminal Building Improvement Program.

4.5.6 Urban Air Mobility

In recent years, many advancements have been made in the Unmanned Aerial Vehicle (UAV) sector of the aviation industry, bringing more focus on planning for Urban Air Mobility (UAM) within major metropolitan areas. AVL serves the Asheville Metropolitan Statistical Area (MSA), thus it is important to look ahead at how the potential for UAM activity will impact the Airport and basic facility requirements to accommodate demand.

In June 2020, the FAA released the *UAM Concept of Operations (ConOps), Version 1.0*. That publication described "the envisioned operational environment that supports the expected growth of flight operations in and around urban areas." The advancement of UAM will eventually aide in supporting passenger and cargo operations in hard to reach or underserved areas. Per the FAA, UAM advancement will take place in series of increasing levels of autonomy and operational tempo.

The initial phases of implementing UAM will utilize existing helicopter routes, helipads, rules and regulations, and air traffic control (ATC) services. As previously discussed, the Airport currently has two helipads, which could be utilized. As demand for UAM activity increases, so should the demand on infrastructure and procedures. Over time, the FAA will establish and define UAM Corridors from specific aerodromes[8] based on performance requirements. This will also trigger changes to and enforcement of new UAM regulations. As the state of operations mature to become more advanced, and as frequency increases throughout the UAM sector, the previously formed UAM Corridors may form a new network, thus optimizing paths between aerodromes. The number of aerodromes would also increase as demand increases. One primary difference between the stages of activity is that once operations have increased to be considered 'Mature,' the UAM vehicles will be piloted remotely or autonomously rather than having an onboard pilot in control.

As the previously discussed advancements are made, the FAA will continue to define, maintain, and make publicly available the standards and regulations regarding the UAM system; therefore, it is important that GARAA review and apply the standards to ensure accommodations of this newly emerging technology. Advancements to current infrastructure at AVL could include, but is not limited to:

[8] Per the FAA an aerodrome is "a location from which UAM flight operations depart or arrive."

- Installing charging stations in the GA areas for the aircrafts' electric motors and batteries
- Construction of new hangars to accommodate the new aircraft

These advancements will be further evaluated in the subsequent Alternatives Chapter.

Sections 4.6, 4.7, and 4.8 are in progress and will updated upon completion.

4.6 PASSENGER TERMINAL FACILITY BUILDING AND GATE REQUIREMENTS

4.6.1 Terminal Apron

4.6.2 Remain Overnight (RON) and Diversion Parking

4.7 SURFACE TRANSPORTATION AND PARKING REQUIREMENTS

4.8 ACCESS ROADWAYS AND CIRCULATION