CHAPTER 4.

CAPACITY ANALYSIS AND FACILITY REQUIREMENTS

Introduction

A key step in the master planning process is determining the requirements of airport facilities that are needed to accommodate airside and landside needs throughout the planning period. By comparing the existing conditions at Northern Colorado Regional Airport (FNL or the Airport), which were presented in **Chapter 2 – Inventory** in conjunction with the predicted growth patterns developed in **Chapter 3 – Aviation Activity Forecasts**, this chapter defines the future requirements for airside, landside, and terminal facilities to accommodate FNL's forecasted aviation demand related to the existing and forecasted fleet through 2038.

Determining FNL's current capacity and ability to accommodate future airport capacity is an essential step in estimating future airport needs. The capacity of an airfield is primarily a function of the major aircraft operating surfaces that compose the facility and the configuration of those surfaces (runways and taxiways). Airfield capacity is also affected by wind coverage, airfield layout, and aircraft mix. A capacity analysis is used to identify deficiencies, surpluses, and opportunities for future development, and ultimately inform the design of the Airport Layout Plan (ALP) and future facility development.

This chapter describes the capacity analysis methodology and findings; airside and landside facility requirements; passenger terminal requirements; and remote tower operational considerations. The findings of this Airfield Capacity & Facility Requirements chapter will be used to inform the following chapter, which presents and evaluates a range of development alternatives to meet the current and projected aviation activity at the Airport.

The capacity analysis and facility requirements review presented in this chapter resulted in the recommendations summarized in **Table 4-1**, which are necessary to meet FAA design standards and accommodate forecasted aviation activity.

The analysis in this chapter was done for the critical (design) aircraft identified in **Chapter 3 – Aviation Activity Forecasts**. Airbus A319/A320 is the critical (design) aircraft for Runway 15/33. The B-I-Small criteria was used for Runway 6/24. Refer to **Figure 4-1** for a representation of critical (design) aircraft and aircraft from other Runway Design Codes (RDC).

Table 4-1: Capacity Analysis and Facility Requirements Recommendations Summary

Item	Recommendation
Airfield Capacity	It is recommended that the Airport continue planning for a parallel runway and initiate design/construction of parallel runway when annual operations reach 164,000.
Runway Length	It is recommended that the Airport continue to plan for a 1,000-feet runway extension to better accommodate the current business jet fleet as well as Allegiant's A319 and A320, and other narrow body aircraft anticipated to operate at FNL. It is recommended that Runway 6/24 remain at current length.
Runway Width	It is recommended that the Airport consider widening of both runways in accordance with FAA standards to safely accommodate future commercial service aircraft.
Runway Shoulder	The Airport should consider runway shoulder improvements in accordance with FAA standards.
Holding Position Markings	It is recommended that the Airport adjust holding position markings on Taxiway A at Runway End 6.
Taxiway Shoulder	The Airport should consider taxiway shoulder improvements per FAA standards. The quantity of exit taxiways at FNL is adequate for existing and future operations; no action is recommended.
Runway Object Free Area (ROFA)	The Airport meets ROFA criteria for Runway 15/33 and 6/24. No action is recommended.
Runway Protection Zone (RPZ)	The Airport does not have complete ownership of RPZs for Runways 15, 33, and 24. It is recommended that the Airport attain sufficient interest in Runway Protection Zones.
Runway Safety Area (RSA)	The Airport meets RSA criteria for Runway 15/33 and 6/24. No action is recommended.
Airport Access and Circulation	It is recommended that current airport access be maintained in the existing location for the future use. Widening of Earhart road from Lindbergh Drive to the terminal parking lot should be considered as well as expansion as a terminal loop road. The Airport should investigate the need for a dedicated access road to GA facilities.

SOURCE: Mead & Hunt, 2018.

SOURCE | Mead & Hunt Analysis, 2019.

RDC A-I
Single-Engine Aircraft - 2 to 6 Seats
Cessna-172
Beech Bonanza
Cirrus SR22

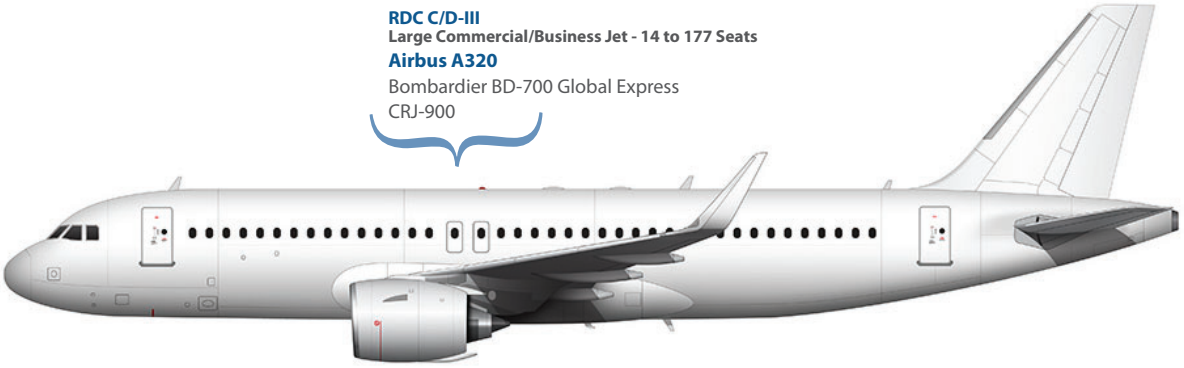
RDC B-I
Twin-Piston Aircraft - 4 to 10 Seats
Piper 31-310 Navajo
Beech Baron 58
Cessna 414

RDC B-II
Twin-Turboprop/Business Jet/Small Cabin Aircraft
6 to 12 Seats - *Includes most commercial turboprop aircraft.*
Citation Excel/XLS
Beach King Air 200
Pilatus PC-12

RDC C/D-I
Business Jets - 6 to 12 Seats
Lear 45
1124 Westwind
Hawker 400

RDC C/D-II
Commercial/Business Jet - 6 to 70 Seats
Bombardier CRJ-200
Bombardier CL-600 Challenger
Embraer ERJ-145

RDC C/D-III
Large Commercial/Business Jet - 14 to 177 Seats
Airbus A320
Bombardier BD-700 Global Express
CRJ-900



Representative Aircraft not to scale.

FIGURE 4-1 **Representative Aircraft by Runway Design Code (RDC)**

4.1 Airfield Capacity Methodology

As FAA capacity methodology has not changed since the completion of the 2007 Master Plan, the following sections summarize analysis completed as part of 2007 Master Plan. Many characteristics identified in the previous Master Plan still apply. Where applicable, updated data such as wind data, was used in the demand-capacity analysis presented in this chapter. The individual factors that influence airfield capacity are described below.

4.1.1 Airfield Layout

The arrangement and interaction of airfield components (runways, taxiways, and ramp entrances) refers to the layout or "design" of an airfield. FNL's airfield system consists of primary Runway 15/33 and Runway 6/24. Runway 15/33 is supported by full parallel Taxiway A. Runway 6/24 serves as a taxiway for though the fence (TTF) tenants located east of airport property. Taxiway C, B, and D provide access between Taxiway A and terminal/hangar area. Airport hangars, aprons, Fixed Based Operator (FBO), and other facilities are located east of Runway 15/33. The existing landside facilities at FNL have adequate access to the airfield with the current airfield layout. Future development that may be required to accommodate forecasted demand may require additional taxiways or other airfield components.

4.1.2 Climatological Conditions

The climatological conditions specific to the location of an airport influence both the layout or design of the airfield, and the use of the runway system. Variations in the weather, resulting in limited cloud ceilings and reduced visibility, typically lower airfield capacity, while changes in wind direction and velocity dictate runway usage and affect runway capacity.

Ceiling and Visibility. FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*, describes three categories of ceiling and visibility minimums for use in both capacity and delay calculations. Conditions needed to meet cloud ceiling and/or visibility criteria under the three approach visibility conditions are summarized in **Table 4-2**.

Table 4-2: Visibility and Ceiling Criteria

Visibility Category	Cloud Ceiling	Visibility
Visual Flight Rules (VFR)	At least 1,000′ above ground level	At least 3 statute miles
Instrument Flight Rules (IFR)	At least 500′, but less than 1,000′	At least 1, but less than 3 statute miles
Poor Visibility and Ceiling (PCV)	Less than 500′	Less than 1 statute mile

SOURCE: FAA Advisory Circular 150/5060-5, Airport Capacity and Delay.

Current National Climatic Data Center data was collected to analyze approach visibility minimums at FNL and summarized in **Table 4-3**.

Table 4-3: National Climatic Data Center Approach Visibility Minimums

Visibility Category	Cloud Ceiling	Visibility	Annual occurrence at FNL
VFR Conditions (all runways)	At least 1,000′ above ground level	At least 3 statute miles	95.2%
VFR minimums to existing Runway 33 approach minimums (Category I ILS)	At least 200′, but less than 1,000′	At least 1/2, but less than 3 statute miles	3.7%
Below Category I ILS minimums	Less than 200′	Less than 1/2 statute mile	1.1%

SOURCE: National Climatic Data Center.

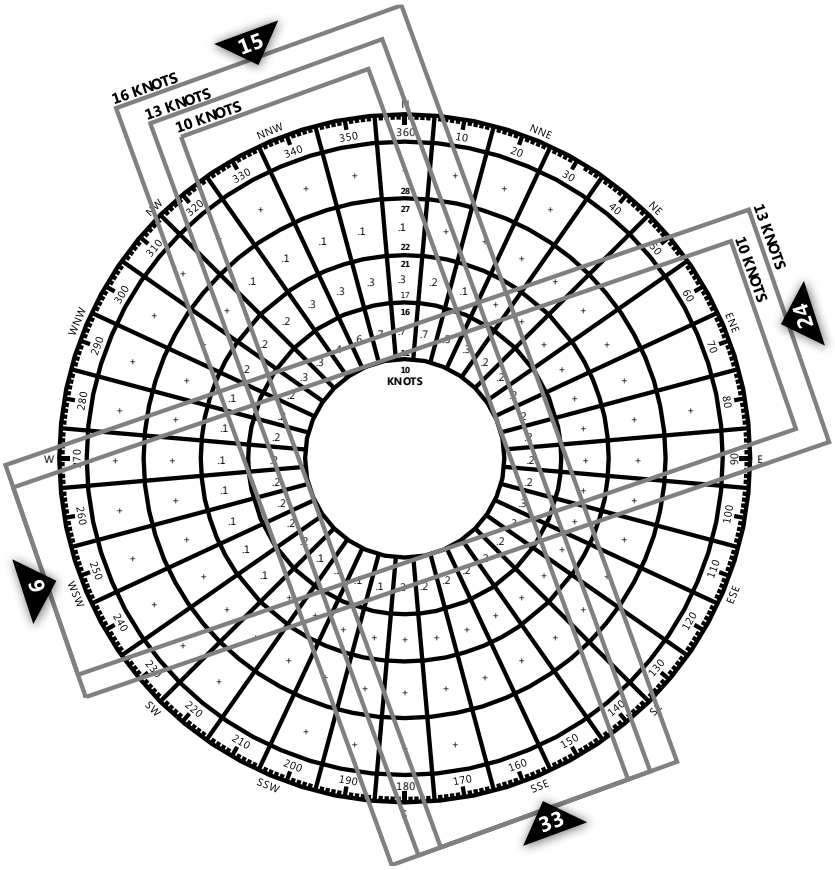
Wind Coverage. Surface wind conditions (direction and speed) generally dictate optimal runway alignment and configuration. Ideally aircraft will land and take off into the wind to take advantage of wind resistance. Runways, which are not oriented to take advantage of prevailing winds, will restrict the capacity of the Airport. Wind conditions affect all airplanes to varying degrees; however, the ability to land and takeoff in crosswind conditions varies according to pilot proficiency and aircraft type. Generally, the smaller the aircraft, the more it is affected by crosswind velocity.

Wind data was collected through FAA's portal for FNL's AWOS station Direction and velocity data were collected from year 2008 to 2017.

Based on the all-weather wind analysis for FNL, illustrated in **Figure 4-2** and summarized in **Table 4-4**, the existing runway configuration of the primary runway (Runway 15/33) provides more than 95 percent wind coverage under the allowable crosswind components for aircraft up to C/D-III (16 knots), which are expected to continue to operate at FNL throughout the planning period, under all meteorological conditions.[1] In addition, since it is known that the Airport will continue to also serve small single and twin-engine aircraft for which the allowable crosswind component is 10.5 knots, this crosswind component was also analyzed. For comparison purposes, the 13-knot crosswind component has been included as well.

[1] The allowable crosswind component is dependent upon the Airport Reference Code (ARC) for the type of aircraft that utilize the Airport on a regular basis. The current Airport Reference Code (ARC) for Runway 15/33 is ARC C/D-III.

Figure 4-2: All Weather Windrose



SOURCE: FAA Airport Design Tools, 2008 to 2017.

Table 4-4: All Weather Wind Coverage Summary

Runway	10.5 knots	13 knots	16 knots
All Weather			
Runway 15/33	95.24%	97.26%	98.93%
Runway 6/24	91.57%	94.51%	N/A
Runway 15/33 & 6/24 Combined	98.95%	99.68%	99.93%

SOURCE: Wind analysis tabulation provided by Mead & Hunt utilizing the FAA Airport Design Tools, Wind Analysis. Wind data obtained from AWOS Station 724769, Fort Collins Loveland. Period of Record: 2008-2017.

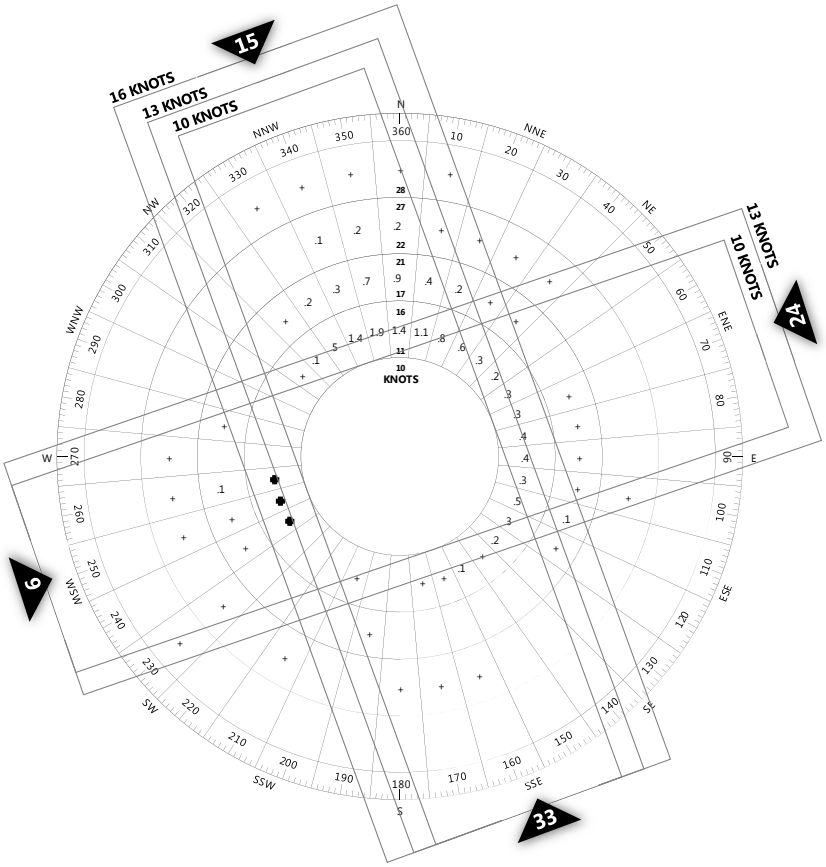
NOTES: Runway 15/33 true bearing is 160 degrees. Runway 6/24 true bearing is 71 degrees. Wind data period of record is 2008 to 2017. All Weather observations – 233,128. A 60-knot tailwind component was used for bidirectional runway wind analysis.

The desired wind coverage for an airport's runway is 95 percent, meaning that the runway orientation and configuration should be developed so that the maximum crosswind component is not exceeded more than 5 percent of the time annually. The FAA may recommend a crosswind if runway if wind coverage for the primary runway is below 95 percent.

As summarized in **Table 4-4**, Runway 15/33 provides more than 95 percent wind coverage with 16-knot, 13-knot, and 10.5-knot crosswind components under all-weather conditions. The combined wind coverage of Runway 15/33 and Runway 6/24 under each crosswind component exceeds 98 percent. This analysis indicates that the existing runway configuration provides adequate wind coverage for the 16-knot, 13-knot, and 10.5-knot crosswind components. Since Runway 15/33 meets the desirable wind coverage criteria (95 percent) without consideration of the crosswind runway, and the type of aircraft operating at the airport is not expected to change, a crosswind runway is not required at FNL to minimize adverse wind conditions.

Figure 4-3 and **Table 4-5** illustrate that runway 15/33 provides over 95 percent coverage for all presented crosswind categories, and thus can accommodate FNL operations independently. Runway 6/24 is not designed for instrument approach procedures.

Figure 4-3: IFR Windrose



SOURCE: FAA Airport Design Tools, 2008-2017.

Table 4-5: IFR Wind Coverage Summary

Runway	10.5 knots	13 knots	16 knots
Instrumental Flight Rules (IFR)			
Runway 15/33	96.29%	98.22%	99.52%
Runway 6/24	89.41%	92.84%	N/A
Runway 15/33 & 6/24 Combined	99.21%	99.82%	99.97%

SOURCE: Wind analysis tabulation provided by Mead & Hunt utilizing the FAA Airport Design Tools, Wind Analysis. Wind data obtained from AWOS Station 724769, Fort Collins Loveland. Period of Record: 2008-2017.

NOTES: Runway 15/33 true bearing is 160 degrees. Runway 6/24 true bearing is 71 degrees. Wind data period of record is 2008 to 2017. IFR observations – 12,541. A 60-knot tailwind component was used for bidirectional runway wind analysis.

Table 4-6 shows that Runway 15/33 is adequate for VFR conditions during all presented crosswind conditions and that Runway 6/24 does not provide sufficient coverage for its users as it provides less than 95 percent coverage.

Table 4-6: VFR Wind Coverage Summary

Runway	10.5 knots	13 knots	16 knots
Visual Flight Rules (VFR)			
Runway 15/33	95.22%	97.23%	98.91%
Runway 6/24	91.77%	94.65%	N/A
Runway 15/33 & 6/24 Combined	98.95%	99.68%	99.93%

1. **SOURCE:** Wind analysis tabulation provided by Mead & Hunt utilizing the FAA Airport Design Tools, Wind Analysis. Wind data obtained from AWOS Station 724769, Fort Collins Loveland. Period of Record: 2008-2017.
2. **NOTES:** Runway 15/33 true bearing is 160 degrees. Runway 6/24 true bearing is 71 degrees. Wind data period of record is 2008 to 2017. VFR observations – 222,857. A 60-knot tailwind component was used for bidirectional runway wind analysis.

No additional runways are necessary for the purpose of providing additional wind coverage throughout the planning period.

4.1.3 Characteristics of Demand

Certain site-specific characteristics related to aviation use and aircraft fleet makeup impact the capacity of the airfield. These characteristics include aircraft mix, runway use, percent arrivals, touch-and-go operations, exit taxiways, and air traffic control rules. Since these characteristics have not changed significantly since the last Master Plan was completed in 2007, this section summarizes the characteristics of demand identified in that study.

Since Runway 6/24 is used less frequently than Runway 15/33, it is not included in the following analysis.

Aircraft Mix. Aircraft mix refers to the variety of aircraft operating at an airport according to maximum take-off weight categories, as described in FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay*. Aircraft mix is defined as the relative percentage of operations conducted by each of the four classes of aircraft summarized in **Table 4-7**. There have not been any significant changes in the aircraft mix at FNL since the 2007 Master Plan, which identified an approximate split of 60 percent class A & B aircraft and 40 percent class C aircraft. Currently, there are no class D operations at FNL with no class D operations forecasted throughout the planning period.

Table 4-7: Aircraft Weight Classifications

Aircraft Class	Max Certified Take-off Weight (pounds)	Number of Engines	Wake Turbulence Classification
A	12,500 or less	Single	Small
B	12,500 or less	Multi	Small
C	12,500 to 300,000	Multi	Large
D	Over 300,000	Multi	Heavy

SOURCE: FAA Advisory Circular 150/5060-5, Airport Capacity and Delay.

Runway Use. The use configuration of a 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 at those facilities. The prevailing winds in the region and the existing runway facilities at FNL dictate the utilization of the existing runway system. Runway 33, the calm-wind runway, remains the most utilized runway, although wind data indicates that prevailing winds only favor it slightly. It is still estimated that approximately 60 percent of the Airport's operations utilize Runway 33, and Runway 15 is used for the remaining 40 percent.

Percent Arrivals. Runway capacity is also significantly influenced by the percentage of all operations that are arrivals. Higher percentages of arrivals during peak periods reduce the Annual Service Volume (ASV) since aircraft on final approach are typically given absolute priority over departing aircraft. The assumption that arrivals equal departures during the peak period at FNL remains valid.

Touch and Go Operations. Touch-and-go operations refer to aircraft maneuvers in which aircraft perform a normal landing touchdown followed by an immediate takeoff without stopping or taxiing clear of the runway. These operations are normally associated with training and are included in local operations figures. Local operations often include touch-and-go operations, which are conducted almost exclusively on Runway 15/33 and comprise approximately 37 percent of all operations at the Airport (according to the FAA's Form 5010, Airport Master Record). By the end of the 20-year planning period, local operations are expected to increase to approximately 47 percent of the total aircraft operations at the Airport. This increase is associated with the Aims Community College (ACC) flight operations program relocating to FNL in 2019.

Exit Taxiways. The quantity and design of the exit taxiways directly influences aircraft runway occupancy time and capacity based on the ability of an aircraft to exit the runway as quickly and safely as possible.

Air Traffic Control (ATC) Rules. The FAA specifies separation criteria and operational procedures for aircraft in the vicinity of an airport contingent upon aircraft size, availability of radar, and sequencing of operations, both advisory and/or regulatory, which may be in effect at the Airport. The impact of ATC on runway capacity is most influenced by aircraft separation requirements dictated by the mix of aircraft utilizing the Airport. Presently, there are no special ATC rules in effect at FNL that significantly impact operational capacity.

4.2 Airfield Capacity Analysis

The airfield capacity analysis performed in the 2007 Master Plan used the following assumptions: arrivals equal departures, the percent of touch-and-go operations is between 0 percent and 50 percent of total operations, there is a full-length parallel taxiway with ample exits and no taxiway crossing issues, there are no airspace limitations, the Airport has at least one (1) runway equipped with an ILS, IFR weather conditions occur roughly 5 percent of the time, and approximately 95 percent of the time the Airport is operated with the runway use configuration that produces the greatest hourly capacity. The optimized capacity for Runway 15/33 is formulated in terms of:

- **Hourly Capacity of Runways (VFR and IFR):** The maximum number of aircraft that can be accommodated under conditions of continuous demand during a one-hour period; and
- **Annual Service Volume (ASV):** A reasonable estimate of an airport's annual capacity.

A single runway airport, with a fleet mix like that at FNL, can have an ASV as high as 205,000 operations, with a VFR capacity of roughly 63 operations per hour, and an IFR capacity of approximately 56 operations per hour. FAA's Airport Improvement Program Handbook recommends planning for additional runway when 60 percent of ASV is reached and constructing additional runways when 80 percent of ASV is reached. The optimized ASV of 205,000 is greater than the number of annual operations (142,324) forecast through the 20-year planning period.

However, from a long-term planning perspective, the forecasted operations are nearly 70 percent of the ASV capacity are close enough that the planning of a significant capacity enhancement (i.e., a new parallel runway) should still be considered in the formulation of the ultimate development plan for the Airport. Adding a parallel runway could potentially increase the Airport's ASV as high as 260,000 operations.

It is recommended that the Airport continue planning for a parallel runway and initiate construction of parallel runway when annual operations reach 164,000.

4.3 Facility Requirements

This section provides an analysis of airside and landside facility requirements necessary to meet forecasted aviation demand at FNL over the 20-year planning period. Airside facilities include the runways, taxiways, runway protection zones, thresholds, and navigational aids. Landside facilities include hangars, aircraft apron areas, and airport support facilities. When existing facilities do not meet the current or future demand, the type and size of facilities required to meet future demand are identified.

This analysis is based on the preferred growth scenario identified in **Chapter 3 - Aviation Activity Forecasts**. This is not intended to dismiss the possibility that, due to the unique circumstances in the region, either accelerated growth or consistently higher or lower levels of activity may occur. Aviation activity levels should be monitored for consistency with the forecasts. In the event of changes, the schedule of development should be adjusted to correspond to the demand for facilities rather than be set to predetermined dates of development. By doing this, over-building or under-building can be avoided.

4.3.1 Airside Facilities

Dimensional Criteria. Runway and taxiway design standards established by FAA AC 150/5300-13A – Change 1 and are based upon the critical aircraft. See **Figure 4-1** for representation of critical (design) aircraft and aircraft from other RDC. See **Table 4-4** for representation of airfield design surfaces.

Runway dimensional design standards define the widths and clearances required to optimize safe operations in the landing and takeoff area. These dimensional standards vary depending upon the RDC for the runway and the type of approach that is provided. C/D-III aircraft still represent the most demanding, or critical aircraft, operating at FNL.

In accordance with previous FAA airport design standards, Runway 15/33 is designated with a RDC of C/D-III; however, it does not currently meet all C/D-III design standards. Runway 15/33 does not meet runway width standard of 150 feet and runway shoulder recommendation of 25 feet wide. Existing Runway 15/33 dimensions and current C/D-III design standards are summarized in **Table 4-8**.

Table 4-8: RDC C/D-III Runway Design Standards – Runway 15/33

Item	Existing Runway Dimension (feet)	C/D-III Design Standard (feet)	Standard Met
Runway 15/33			
Runway Width	*100*	*150*	*No*
Runway Shoulder Width	*N/A*	*25 (recommended)*	*No (25 feet recommended)*
Runway Safety Area (RSA) Width	*500*	*500*	*Yes*
RSA Beyond Runway End	*1,000*	*1,000*	*Yes*
Runway Object Free Area (ROFA) Width	*800*	*800*	*Yes*
ROFA Beyond Runway End	*1,000*	*1,000*	*Yes*
Obstacle Free Zone Width	*400*	*400*	*Yes*
Runway Centerline to:			
Parallel Taxiway Centerline	*400*	*400*	*Yes*
Aircraft Parking	*658*	*500*	*Yes*
Runway Holding Position Markings	*250*	*250*	*Yes*

SOURCE: FAA Advisory Circular 150/5300-13A-Change 1, Airport Design; and existing conditions at FNL.
NOTES: **Runway Safety Area (RSA):** An area adjacent to the runway that is cleared and graded and that has no potentially hazardous ruts, humps, depressions, or other surface variations. Under dry conditions, the safety area shall be capable of supporting aircraft rescue equipment, snow removal equipment, and the occasional passage of aircraft without causing structural damage.
Runway Object Free Area (OFA): A two-dimensional ground area surrounding a runway that is clear of objects protruding above the safety area edge elevation. Objects are acceptable within the OFA if the location is required for the purpose of air navigation or aircraft ground maneuvering purposes.
Bold/Italic Numbers: Indicate existing non-standard condition.
N/A: Not applicable.
--- Data not available.

Associated with Runway 15/33, Taxiway A has a TDG 3 designation. As illustrated in **Table 4-9,** the existing dimensions meet the current TDG 3 standards, which are necessary to accommodate aircraft such as the A320.

Table 4-9: Taxiway Design Group (TDG) 3 Standards

Item	Existing Runway Dimension (feet)	TDG 3 Standards	Standard Met
Taxiway Width	50	50	Yes
Taxiway Safety Area Width	118	118	Yes
Taxiway Object Free Area (TOFA) Width	186	186	Yes

SOURCE: FAA Advisory Circular 150/5300-13A-Change 1, Airport Design

Runway 6/24 is designated with a RDC of B-I Small Aircraft. As summarized in **Table 4-10**, it also does not meet some of the current RDC B-I Small Aircraft design standards outlined in FAA AC 150/5300-13A – Change 1. Runway 6/24 does not meet the runway width standard, shoulder recommendation, and holding position marking standard.

Table 4-10: RDC B-I Small Aircraft Runway Design Standards – Runway 6/24

Item	Existing Runway Dimension (feet)	B-I Small Aircraft Design Standard (feet)	Standard Met
Runway 6/24			
Runway Width	*40*	*60*	*No*
Runway Shoulder Width	*N/A*	*10 (recommended)*	*No (10 ft recommended)*
Runway Safety Area (RSA) Width	*120*	*120*	*Yes*
RSA Beyond Runway End	*240*	*240*	*Yes*
Runway Object Free Area (ROFA) Width	*250*	*250*	*Yes*
ROFA Beyond Runway End	*240*	*240*	*Yes*
Obstacle Free Zone Width	*250*	*250*	*Yes*
Runway Centerline to:			
Parallel Taxiway Centerline	*N/A*	*150*	*N/A*
Aircraft Parking	*1,045*	*125*	*Yes*
Runway Holding Position Markings	*150 & 120*	*150*	*No (Runway 6: -30 ft)*

SOURCE: FAA Advisory Circular 150/5300-13A-Change 1, Airport Design; and existing conditions at FNL.

NOTES: **Runway Safety Area (RSA):** An area adjacent to the runway that is cleared and graded and that has no potentially hazardous ruts, humps, depressions, or other surface variations. Under dry conditions, the safety area shall be capable of supporting aircraft rescue equipment, snow removal equipment, and the occasional passage of aircraft without causing structural damage.
Runway Object Free Area (ROFA): A two-dimensional ground area surrounding a runway that is clear of objects protruding above the safety area edge elevation. Objects are acceptable within the ROFA if the location is required for the purpose of air navigation or aircraft ground maneuvering purposes.
Bold/Italic Numbers: Indicate existing non-standard condition.
N/A: Not applicable.
--- Data not available.

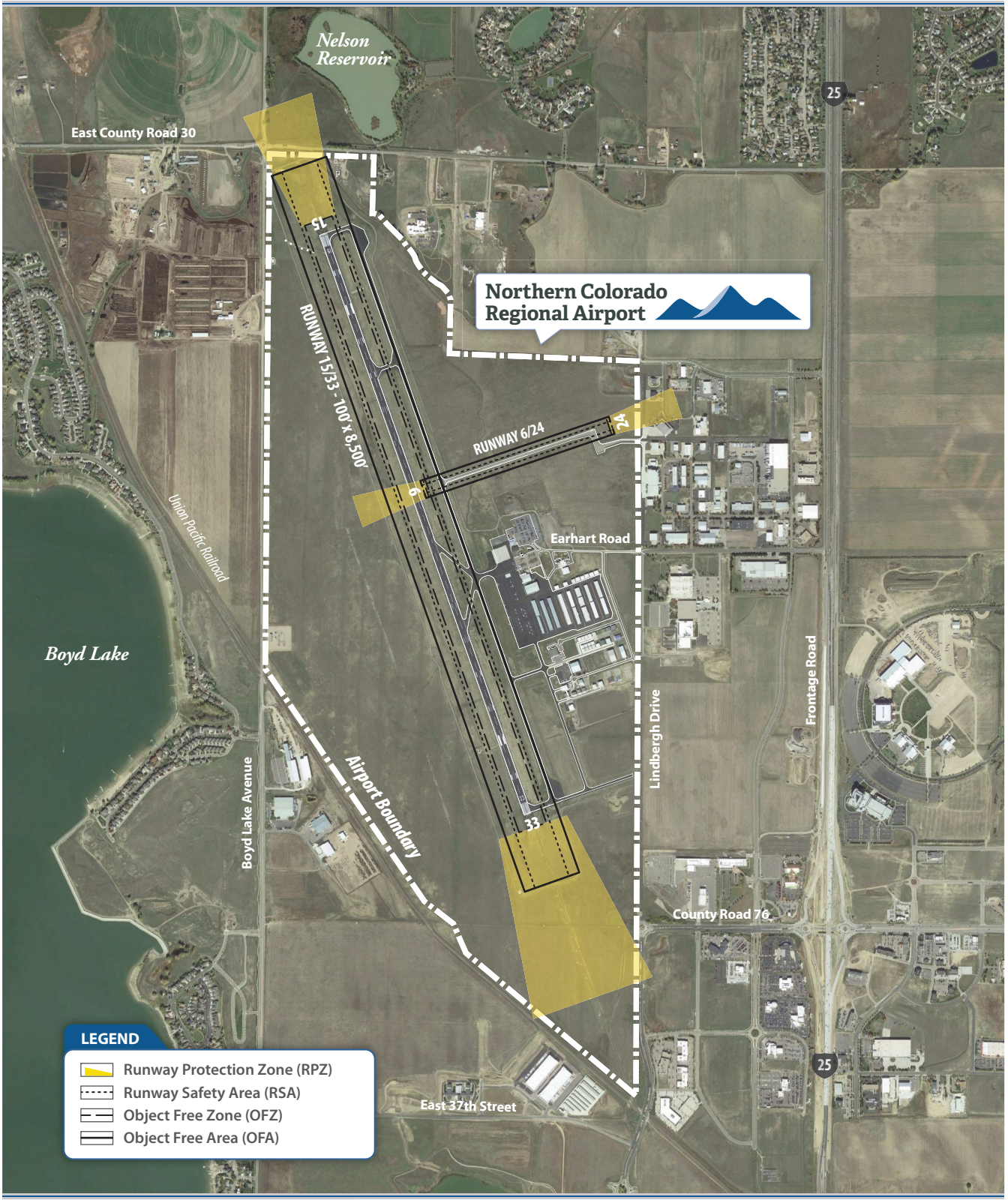
It is recommended that the Airport consider runway width improvements for Runway 15/33 and 6/24, along with correcting holding position markings for Runway 6. The Airport may consider runway shoulder improvements to meet the FAA recommended shoulder width criteria.

Runway Pavement Strength. According to a 2014 report by CH2M HILL, the primary runway at FNL, Runway 15/33, has a Pavement Classification Number of 49 meaning it can support operations by narrow-body aircraft like the Boeing 737 series and the Airbus A319 and A320 family of aircraft. The published pavement strength in the FAA 5010 should be updated to reflect this analysis and these numbers should also be reflected on the ALP that results from this Master Plan Study.

As previously described in **Chapter 3**, while Runway 6/24 is important to the operation of the Airport, it is classified as a secondary runway because wind coverage conditions at FNL do not necessitate a crosswind runway. Runway 6/24 was designed with a pavement strength to serve primarily smaller aircraft weighting up to 12,500 pounds. The 2016 CDOT inspection of Runway 6/24 indicates that this runway has a PCI of 44, which is considered fair condition on the PCI rating scale. The Airport also independently monitors the condition of Runway 6/24; maintenance and capital improvement projects are funded by owners of properties within the adjacent Centrepoint Business Park.

Both runways have adequate pavement strength to accommodate existing and project future aircraft operations.

SOURCE | **AERIAL:** Google Maps, 2018. **SAFETY AREAS DATE:** Mead & Hunt, 2018.



North | Approximate Scale: 1" = 2,000'

FIGURE 4-4 **Airfield Design Surfaces**

Runway Length. FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design,* identifies a step-by-step process for determining recommended runway length. The first step is to determine a critical aircraft for runway length. As determined in the previous chapter, FNL is already designed to accommodate C/D-III aircraft. While there are less than 500 operations of this family grouping of aircraft, it was recommended that RDC C/D-III criteria continue to be maintained so as not to prohibit commercial service aircraft from operating on a regular basis at FNL in the future. The AC notes that if the critical aircraft has a Maximum Take-Off Weight (MTOW) of over 60,000 pounds, the process is to follow the instructions in Chapter 4 of the AC and utilize the Airport Planning Manuals (APMs) published by the aircraft manufacturers.

The 2007 Master Plan recommended that a 1,000-foot extension would provide significant benefit in consideration of Allegiant's Las Vegas service provided at that time and the anticipated Phoenix-Mesa route. The 2007 Master Plan also determined that the business jet fleet, which is similar to the business jet fleet operating at FNL today, would benefit from a 1,000-foot extension, and that a 1,500-foot extension would be optimal (accommodating 100 percent of the fleet at 60 percent useful load).

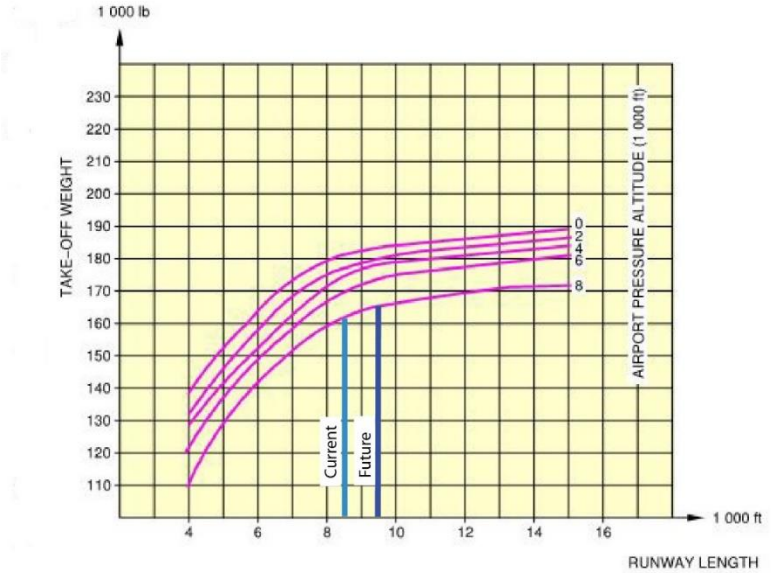
The 1,000-foot extension for Runway 15/33 was based on the design criteria for Allegiant's MD-80 Aircraft. While Allegiant no longer operates the MD-80, the new Allegiant fleet consists of the A319 and A320, which would also significantly benefit from extending the runway based on the runway length analysis presented in this section.

Figure 4-5 displays take-off weight limitations for the A320 aircraft. The Y-axis represents the aircraft's MTOW and the X-axis represents runway length, while the curves inside the graph represent a constant density altitude, which is based on airport's elevation and climate characteristics. The A320's MTOW is 171,961 pounds, and FNL's density altitude is 8,000. Density altitude comes from adjusting the airfield elevation (5,016 feet) to non-standard temperature that occurs during summertime. Air density decreases as temperature and altitude increase. Essentially, aircraft don't perform as well at higher density altitude since there is less air available and require more runway length for takeoffs and landings.

Figure 4-5 also shows that at the current length of 8,500 feet, Runway 15/33 does not provide adequate runway length to accommodate the A320 aircraft at its MTOW. At the current length of Runway 15/33, the A320 could only depart at approximately 163,000 pounds, taking roughly a five percent reduction from the MTOW. Weight reductions are typically accomplished by reducing fuel amounts or reduction in passengers.

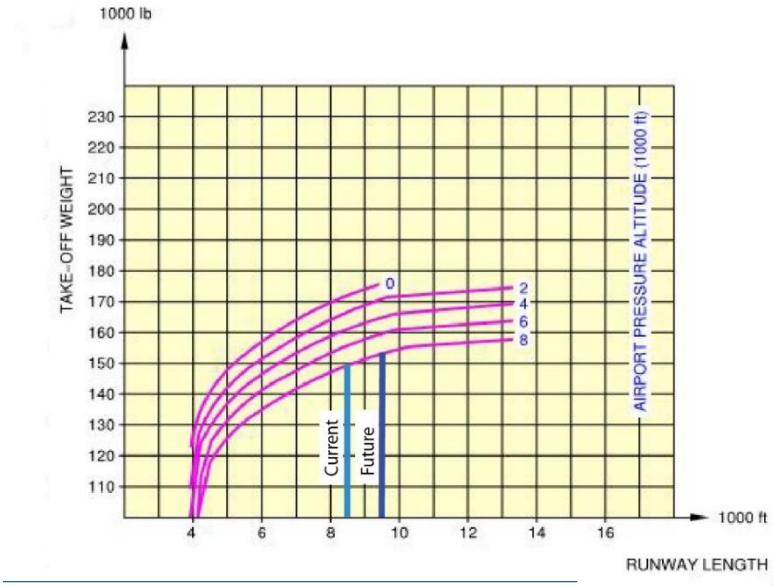
Figure 4-6 represents take-off weight limitations for the Airbus A319, which has a MTOW of 166,000 pounds. To operate at FNL, the A319 would need to reduce its weight to approximately 150,000 pounds, a 10 percent weight reduction.

Figure 4-5: Airbus A320 Take-Off Weight Limitations



SOURCE: Airbus A320 Aircraft Characteristics Airport and Maintenance Planning AC.

Figure 4-6: Airbus A319 Take-Off Weight Limitations



SOURCE: Airbus A319 Aircraft Characteristics Airport and Maintenance Planning AC.

The 2007 Master Plan also cited payload restriction challenges experienced by Allegiant between April 1 and October 31 (a seven-month period), with loads on the 162-seat MD-83 restricted to a maximum of 148 passengers due to takeoff runway length-imposed weight restrictions.[2] Allegiant personnel had also indicated that a 1,000-foot extension (providing a runway length of 9,500 feet), would likely eliminate the weight restrictions on the Las Vegas route, except for very hot days, adding that limitations on other potential routes (i.e., Los Angeles, San Francisco, and Seattle) would be significantly reduced.

Based on the information provided above and the anticipated return of commercial service, a 1,000-foot runway extension would still benefit the existing business jet fleet utilizing the Airport as well as the low-cost air carrier fleet expected to operate at FNL. **Table 4-11** provides a comparison of the runway length requirements for the 2007 Master Plan aircraft fleet and the current fleet using the Airport (or anticipated to use the Airport).

From a long-term planning perspective, the information provided above was substantial enough to provide the impetus to investigate a detailed alternative analysis related to how a runway extension of between 1,000 feet and 1,500 feet might be implemented in the 2007 Master Plan. An extension of 1,000 feet to the south was the preferred alternative and shown on the current ALP.

Based on the existing and anticipated fleet of aircraft that serve FNL, the existing Runway 15/33 length (8,500 feet) could be extended by 1,000 feet to allow some operators to depart FNL at higher takeoff weights, particularly during the summer months. This would increase Allegiant's ability to carry even more useful load, which would further increase FNL's attractiveness as an origin and destination (O&D) passenger market, which may present an opportunity to serve new, longer haul routes to FNL's top 10 markets (identified in **Appendix C – Passenger Demand Analysis)**, such as Los Angeles, San Francisco, and Seattle.

[2] This information was supported by a letter from Allegiant Air provided in the 2007 Master Plan Appendix. Under the 2007 operating practices, the payload restriction represented 4,247 departing seats that could not be sold (14 seats on 10 flights per week for the seven-month period).

Table 4-11: 2007/2018 Aircraft Fleet Runway Length Requirements Comparison

2007 Master Plan Aircraft	Runway Length Requirement (feet) at MTOW	2018 Master Plan Aircraft	Runway Length Requirement (feet) at MTOW
Business Jet Fleet			
Challenger 600	10,659′	Challenger 350	8,240′
G-IV	10,500′	G-450	10,800′
Cessna Citation 650	8,731′	Cessna Citation Sovereign	6,258′
Commercial Fleet			
MD-80	Greater than 13,000′ or limited to 130,000 lbs (10,000 lbs off MTOW) at current length of 8,500′	A319	Greater than 14,000′ or limited to 155,000 lbs (13,653 lbs off MTOW) at current length of 8,500′
MD-83	Greater than 13,000′ or limited to 144,000 lbs (8,000 lbs off MTOW) at current length of 8,500′	A320	11,500′ or limited to 167,000 lbs (4,900 lbs off MTOW) at current length of 8,500′

SOURCE: FAA Advisory Circular 150/5325-4B, and Individual Aircraft Airport Planning Manuals.

Analysis for Runway 6/24 revealed that to capture 100 percent of the B-I-Small fleet, the runway needs to be 6,300 feet long and 6,200 feet to capture 95 percent of the fleet. Runway 6/24's current length of 2,273 feet greatly restricts the type of aircraft that may operate on the runway; however, the B-I-Small aircraft that require a longer runway currently operate on 15/33.

It is recommended that the Airport continue to plan for a 1,000-feet runway extension to better accommodate the current business jet fleet as well as Allegiant's A319 and A320 aircraft and other narrow body aircraft anticipated to operate at FNL.

It is recommended that Runway 6/24 remain at current length.

Taxiways. Taxiways are constructed primarily to enable the movement of aircraft between the various functional areas on the Airport and the runway system. Some taxiways are necessary simply to provide access between aircraft parking aprons and runways; whereas, other taxiways become necessary to provide more efficient and safer use of the airfield. The Taxiway A system, which serves aircraft on Runway 15/33, is 50 feet wide and designed to meet TDG 3 aircraft. Taxiway A meets the current design criteria for TDG 3 aircraft, which includes the A320.

Taxiway A does not have shoulders. Current FAA design standards recommends that taxiways accommodating ADG-III aircraft have 25-foot paved shoulders.

When serving as a taxiway, Runway 6/24 meets TDG 2 width and Taxiway Edge Safety Margin (TESM) design standards and may accommodate aircraft with main gear width of up to 20 feet and cockpit to main gear distance of up to 65 feet, which characterizes the aircraft currently using Runway 6/24 as taxiway. Runway 6/24 does not have shoulders. Current FAA design standards recommend that TDG 2 taxiways have 15-foot shoulders, which could be constructed of turf, aggregate-turf, soil cement, lime, or bituminous stabilized soil.

In addition, the need for additional exit taxiways will be studied as part of the alternatives analysis in the following chapter to determine if improvements might be implemented to reduce runway occupancy times for arriving aircraft.

It is recommended that the Airport consider taxiway shoulder improvements per FAA standards. The quantity of exit taxiways at FNL is adequate for existing and future operations, no action is recommended.

Runway Protection Zones. The function of the RPZ is to enhance the protection of people and property on the ground beyond the runway ends. This is achieved through airport control of the RPZ areas. The RPZ is trapezoidal in shape and centered about the extended runway centerline. It begins 200 feet beyond the end of the area usable for takeoff or landing. The RPZ dimensions are functions of the type of aircraft operating at the Airport and the approach visibility minimums associated with each runway end. FNL RPZ dimensions are listed in **Table 4-12**. Per FAA guidance the Airport is recommended to purchase RPZ areas in fee simple, if ownership is not attainable, airports may acquire an easement or rely on appropriate zoning.

It is recommended that FNL attain sufficient interest in Runway Protection Zones.

Table 4-12: Runway Protection Zones

Runway End	Width at Runway End	Length	Width at Outer End	Airport Controls Entire RPZ	Percent Owned	Existing Easement
Runway 15	500′	1,700′	1,010′	No	55	No
Runway 33	1,000′	2,500′	1,750′	No	99	No
Runway 6	250′	1,000′	450′	Yes	100	N/A
Runway 24	250′	1,000′	450′	No	46	Yes

SOURCE: FAA AC 150/5300-13A – Change 1.

Electronic Landing Aids. Electronic landing aids, including instrument approach capabilities and associated equipment, airport lighting, and weather/airspace services, which were detailed in **Chapter 2 – Inventory of Existing Conditions**. The Airport is currently equipped with an ILS instrument approach to Runway 33 and RNAV(GPS) instrument approaches serving Runway 15 and Runway 33. The Airport also has a VOR instrument approach procedure.

No new instrument approaches are expected to be developed during the planning period.

Visual Landing Aids (Lights). Presently, the primary runway, Runway 15/33, has a high intensity runway lighting system (HIRL) and the taxiway system is equipped with a medium intensity edge lighting system (MITL). Runway 33 has a medium intensity approach lighting system with runway alignment indicator lights (MALSR), as well as Precision Approach Path Indicator (PAPI) lights west of the runway. Runway 15 has PAPI lights east of the runway and runway end identifier lights (REIL). Runway 6/24 has full-length runway edge reflector lights.

No new visual landing aids are considered necessary during the planning period.

Holding Position Markings. At airports without operating airport traffic control towers (ATCT), runway holdlines identify the location where a pilot should ensure there is adequate separation from other aircraft before proceeding onto the runway. Runway 15/33 meets holding position marking standards with holding positions 250 feet from runway centerline. Runway 6/24 does not meet the 150-foot holding position marking standard at Runway End 6. Holding position markings at Runway End 6 are 120 feet away from runway centerline.

It is recommended that holding position markings at Runway End 6 be relocated to 150 feet away from runway centerline.

Runway Object Free Area (ROFA)

"To the extent practicable, objects in the ROFA should meet the same frangibility requirements as the RSA. Objects non-essential for air navigation or aircraft ground maneuvering purposes must not be placed in the ROFA." *(FAA Advisory Circular 150/5300-13A-Change 1, Airport Design)*

The Airport meets ROFA criteria for Runway 15/33 and 6/24. No action is recommended.

Runway Obstacle Free Zone (ROFZ)

The (ROFZ) is a three-dimensional airspace centered above the runway, above a surface whose elevation at any point is the same as the elevation of the nearest point on the runway centerline, and extended runway centerline that is required to be clear of obstacles for protection to aircraft landing or taking off from the runway and for missed approaches.

The Airport meets ROFZ criteria for Runway 15/33 and 6/24. No action is recommended.

Runway Safety Area (RSA)

Centered on the runway, this area must be cleared and graded to have no potentially hazardous ruts, humps, depressions, or other surface variations; drained by grading or storm sewers to prevent water accumulation; capable, under dry conditions, of supporting snow removal equipment, Aircraft Rescue and Fire Fighting (ARFF) equipment, and the occasional passage of aircraft without causing damage to the aircraft; and be free of objects, except those functionally required to be in the RSA. Objects higher than 3 inches above grade must be constructed, to the extent practical, on frangible mounted structures.

The Airport meets RSA criteria for Runway 15/33 and 6/24. No action is recommended.

4.3.2 Landside Facilities

Landside facilities are those facilities that are supported by the airside facilities but are not actually part of the aircraft operating surfaces. These consist of such facilities as passenger terminal facilities, aprons, access roads, hangars, and support facilities. Following an analysis of these existing facilities, current deficiencies can be noted in terms of accommodating both existing and future needs. Passenger terminal facilities will be discussed in the **Passenger Terminal Facility Requirements** section.

Commercial Aeronautical Development. There are a number of commercial enterprises currently located at the Airport that can be classified as aeronautical development given the operators use of and access to the airfield. These operators include the FBO at the Airport as well as aircraft maintenance operators, helicopter operators, avionics specialists and flight schools.

It is recommended that the Airport continue to reserve space for both expansion of commercial aeronautical development as well as new commercial aeronautical development. Additional detail is provided in the Operator Facility Needs Assessment included in Appendix E.

Non-Aeronautical Development. Generating increased revenue from land assets to help fund airport operations and future improvements continues to be a strategic goal of the Airport. This Master Plan Study and associated ALP will help further establish the conditions and criteria needed to obtain FAA approvals to release portions of the property for non-aeronautical uses. The Airport is ideally situated at the "crossroads" of Northern Colorado with good accessibility to Interstate 25, the primary transportation link within the region.

Strong population and job growth throughout Northern Colorado continue to result from a desirable quality of life, well-educated labor base, high-quality public institutions, a strengthening network of positive social and financial capital, and a strong entrepreneurial spirit. These competitive strengths and assets provide the opportunity to accommodate a variety of non-aeronautical land use needs on portions of the property, to the benefit of both the Airport and communities and region of Northern Colorado.

Non-aeronautical land uses that represent leading opportunities to expand and diversify Airport revenue sources include Light Industrial/Flex uses and Public/Institutional uses:

- **Light Industrial/Flex Uses** - The industrial real estate market continues to be extremely tight with favorable demand-supply fundamentals. The market area has a limited inventory of available, modern industrial building space to accommodate future growth. Developable land sites for traditional Light Industrial/Flex uses within Loveland and Fort Collins are also increasingly scarce.

  The Airport property is situated in the preferred industrial submarket of the region and both near- and long-term opportunities for non-aeronautical industrial use are likely to arise. Prevailing market rents for existing Light Industrial/Flex buildings are typically high enough (and continually increasing) to encourage and reward the speculative development of new industrial building space, provided land with appropriate entitlements/zoning and reasonable pricing is available. Some of the Airport property could be released for non-aeronautical use to provide these industrial land opportunities.

- **Public/Institutional Uses** – Given the FNL's centrality within the region, its property represents an ideal location to serve municipal/public functions, especially multi-jurisdictional land or facility requirements that can be co-located or combined into one location to reduce costs and improve efficiencies. The approximately 43-acre Northern Colorado Law Enforcement Training Center on the west side of the Airport is an example of this opportunity.

  Similar opportunities to generate non-aeronautical land lease revenues while accommodating public land and facility needs may arise over time. A consolidated base for regional emergency and disaster/fire response operations, for example, would derive advantages from an Airport location (given access to airside infrastructure to serve aircraft used in such operations) but may require some non-aeronautical land.

The near-term market is currently stronger for Light Industrial/Flex use than it is for Office uses. Office market conditions are not currently as robust, and the existing inventory has more capacity to accommodate future growth.

East Loveland is not generally a "preferred" location for office space users in the Northern Colorado region, and land supply competition is also much deeper for Office uses. The viability of Airport property as an Office use location can be expected to improve over time as contemporary office parks in Fort Collins, Loveland, and Johnstown build-out and the region continues to grow.

As commercial passenger services at FNL are cultivated over time, this could also stimulate some non-aeronautical land use needs related to ancillary travel services (e.g., hotel, rental cars, and food service). The foreseeable scale of such demands outside of the terminal area, however, would likely be very small (less than five acres). The surrounding environs already contain a relatively complete array of hospitality and travel-related services and amenities.

Non-aeronautical development could be accommodated in a variety of locations on Airport property. However, the two opportunities to create large, contiguous sites for non-aeronautical use are likely to be on the south and west sides of the property. If both areas north and south of the 6/24 runway are not required for future General Aviation facilities, the currently unutilized land south of the runway (east of the Terminal Area) would be desirable to non-aeronautical industrial users. It adjoins existing off-airport Light Industrial uses, provides existing roadway access via Earhart Road, and could effectively develop as a combination of aeronautical and non-aeronautical uses similar to the business park/airpark adjoining the Airport property to the east.

It is recommended that a minimum of 100 acres of the Airport property be identified and planned for future non-aeronautical land uses.

General Aviation Aircraft Storage. General aviation aircraft that are based at FNL are stored on the east side of the Airport, in the area south of the crosswind runway. Over the course of the 20-year planning period, the number of based aircraft at the Airport is forecast to increase from 2018 count of 256 aircraft to 325 aircraft by 2038. In addition, there is a known existing demand for additional indoor aircraft storage facilities. All Airport-owned hangars (963 square feet to 1,000 square feet T-Hangars) are presently occupied. there is a total of 65 slots on the paid waiting lists (by hangar type), which require a $25 deposit. The trend of increasing general aviation aircraft size also plays a role in defining future development needs.

Perhaps the most important influence contributing to the need for a comprehensive analysis of the future development needs for general aviation is the configuration of the existing facilities in consideration of space currently available for development, the goals identified in the Airport's Strategic Plan, and identifying highest and best use in available development areas.

Considerations in the future development plan for the configuration of future general aviation facilities at FNL include:

- The existing general aviation area can accommodate additional development with expansion to the east and to the south; however, a lease agreement was recently executed for a proposed development south of the existing general aviation area, which may include construction of corporate aircraft hangars and associated office space, a second FBO, a restaurant, and an aerial cable transportation system to transport passengers across I-25 to the Brands, which is proposed as a live, work, play development.
- The area north of the existing GA development area will be reserved for expanded passenger terminal facilities.
- General aviation demand during the next 20 years will likely be larger than can be accommodated in the currently developed GA area.
- The areas on either side of the Runway 6/24 can accommodate general aviation facilities development.
- Additional general aviation facility development areas could be captured with land acquisition on the east side of the existing development area (across Lindbergh Drive). Programming the integration of the available development parcels into the long-term development plan is a key component of the overall future development recommendation of this Airport Master Plan Update.

Tie-down Storage Requirements/Based Aircraft. Aircraft tie-downs are provided for those aircraft that do not require, or do not desire to pay the cost for hangar storage. Because of the great value of even small, unsophisticated general aviation aircraft, most aircraft owners prefer some type of indoor storage. There will continue to be some demand for based aircraft tie-down areas; however, it is anticipated that the Airport has enough area on existing aprons to accommodate future demand.

Tie-Down Storage Requirements/Itinerant Aircraft. In addition to the needs of the based aircraft tie-down areas addressed in the preceding section, transient aircraft also require apron parking areas at the Airport. This storage is provided in the form of transient aircraft tie-down space. In calculating the area requirements for these tie-downs, an area of 400 square yards per aircraft is used. As the plan for future general aviation development is formulated, adequate space will be provided for transient aircraft parking areas, especially in those areas that cater to transient aircraft needs (i.e., FBO services).

Hangars. The development plan for future general aviation hangars on the east side of the Airport will focus on identifying potential parcels, in consideration of the ability to provide roadway and taxiway access in a manner that is efficient and secure. The number of based aircraft at the Airport is forecast to increase by almost 70 during the next 20 years; therefore, the proposed plan will accommodate indoor storage space for a minimum of 70 additional aircraft. The breakdown of these aircraft per the previous chapter includes approximately 50 future single engine aircraft, eight jets, eight helicopters and 4 glider/ultralight type aircraft.

It is recommended that the Airport continue to plan for additional tie-down storage for itinerant aircraft and additional hangar storage for future based aircraft.

Air Cargo. Currently, air cargo is not a significant component of the activity at FNL. Air cargo activity which does occur is not scheduled and is provided by contract carriers, operating general aviation aircraft that utilize the general aviation ramp area. Given the local area's proximity to DIA and the fact that the area is considered primarily a consumer importer area, significant increases in cargo activity are not anticipated. Furthermore, without one of the "big three" air cargo operators (FedEx, UPS, or DHL), the cargo activity that takes place at FNL will likely remain general aviation related with smaller cargo aircraft offloading to trucks on the ramp.

New air cargo specific facilities are not recommended.

Support Facilities. In addition to the facilities described above, there are several airport support facilities that have requirements and that are vital to the efficient and safe operation of the Airport.

Aircraft Rescue and Fire Fighting (ARFF) Facility. The ARFF facility serving the Airport is located east of the FBO/Terminal complex, on the south side of Earhart Road. According to Code of Federal Regulations (CFR) Part 139.317, ARFF equipment and staff requirements are based upon the length of the largest air carrier aircraft that serves the Airport with an average of five (5) or more daily departures. **Table 4-13** presents the ARFF Index, length criteria, and representative air carrier aircraft.

Table 4-13: ARFF Support Requirements

ARFF Index	Aircraft Length	Representative Aircraft
A	Less than 90'	RJ-85
B	Between 90' and 126'	Bombardier Q400; Airbus A319/A320
C	Between 126' and 159'	MD-80; 737-800
D	Between 159' and 200'	B757; B767; Airbus A330
E	Greater than 200'	B747-400; B777

Source: FAA Part 139.315 ARFF Index Determination.

The Airport does not have current scheduled air carrier service, but still maintains an ARFF Index B classification, which would adequately serve Airbus A320, the forecasted critical aircraft.

It is recommended that the Airport maintain their ARFF Index B classification and ARFF facilities.

Fuel Storage Facility. The Airport's fuel storage facility is located adjacent to the main remote air traffic control camera tower, north of the FBO facility and south of passenger terminal. The site provides adequate access for delivery trucks from Earhart Road, and for aircraft fueling trucks to the airfield via a gated entrance leading to the aircraft parking apron. The size of the existing site provides the capacity to accommodate expansion needs that can reasonably be anticipated during the next 20 years; however, development considerations related to the passenger terminal and general aviation facilities, along with landside access and parking could potentially require the relocation of the fuel storage tanks.

It is recommended that the Airport monitor fuel demand and make appropriate accommodations if supplies become insufficient. If necessary, relocate fuel to an alternate location.

Service Roads. Airport's service roads are provided on airport and essentially follow the perimeter fence line. These roads give operations staff and emergency vehicles access to the entire Airport. The current service roads are in good condition and adequate for current and forecasted activity. The roads provide appropriate width and access for vehicle serving the Airport.

It is recommended that the Airport maintain current service roads and construct additional roads if demand arises.

Utilities.

The Airport has an existing Utility Master Plan that was completed in 2015. The information in the plan is still relevant and should be referenced for future planning considerations. Additional fiber optic cable has since been added for the remote tower facility, which should be incorporated into future updates of the Utility Master Plan.

It is recommended that the 2015 Utility Master Plan continue to be updated and incorporated into future airport planning decisions.

Airport Access and Circulation.

The existing Airport access roads provide easy landside access to the existing passenger terminal building; however, passenger terminal alternatives will be evaluated in the following chapter. With construction of new commercial terminal and vehicle parking facilities, additional access roads may be required. Wayfinding from Interstate 25 is clear and simple, and it is recommended that future terminal facilities be constructed in place of or adjacent to existing terminal facilities. The Airport Commission selected a future site for the Passenger Terminal which will be incorporated into the alternatives analysis in the following chapter. With expansion of GA facilities there may be a need for an additional access point to GA area.

It is recommended that current airport access be maintained in the existing location for the future use. Widening of Earhart road from Lindbergh Drive to the commercial terminal parking lot should be considered.

Remote ATCT Facilities

The remote tower control facility is located inside of a mobile structure located adjacent to the passenger terminal holding room. It is likely that the control facility could either be located off site in the future, onsite in a standalone facility, or onsite within the new terminal building. However, in the short term the Airport should continue to plan for this facility on airport property.

According to the Colorado Remote Tower Project website, the remote tower project includes leading-edge technology that will be the first of its kind to mesh both ground-based visual/camera data with aircraft radar/track-based data. This high-tech array will provide an enhanced level of efficiency and safety, while dramatically reducing the costs associated with the construction and staffing of a traditional air traffic control tower. There are three tower masts located along the runway. The center tower mast has a 360-degree view plane while the two masts near the end of Runway 15/33 have 180-degree view planes. Consideration of these view planes and line-of-sight for the cameras is an important consideration in future airfield and landside planning.

4.3.3 Passenger Terminal Facility Requirements

Based on the forecasts included in the previous chapter, it is recommended that the Airport plan for a future replacement terminal building. The existing terminal and modular building, at a total of 7,500 square feet, are not adequate for the anticipated number of annual enplanements. The layout of the two buildings is also not considered conducive for expansion. In accordance with the FAA approved forecasts, a future replacement airport terminal building has been programmed as a two-gate, two-airline facility capable of accommodating the A320 as the design aircraft.

This section contains information relevant to the terminal building space program. The facility program was developed using the FAA Advisory Circular 150/5360-13A, *Airport Terminal Planning,* and the *IATA Airport Development Reference Manual, 10th Edition*. The first document contains references to other publications used in the development of this program. For planning purposes, the program design aircraft holds 177 passenger seats. This has been factored by an 85% design load factor, an industry standard, to yield 150 peak hour originating or terminating passengers. This number is factored further according to the activity being measured. The formulas are derived from and compared to the references noted above and are a compilation of different methodologies. The space generated from this process is then modified as appropriate, in this case, a single aircraft/airline operation served as the driver of space for both arrivals and departures operations and a dual operation was considered in increasing sizes of certain components over others.

Further, facilities that would be expensive to expand were given additional consideration to determine what would be needed for an initial building development phase. Finally, component areas, such as corresponding ticket hall concourse, were programmed by calculating the size of the area. Circulation was included mainly for back of house space. The terminal passenger and aircraft profiles and program summary are shown in **Table 4-14**.

Airline Ticket Counter. Airline ticket counter check-in distributions were created to determine a model for the percentage and number of passengers who will check in with bags, and passengers who will use kiosks to obtain boarding passes only. These figures along with the design population noted above, are applied to the worksheets found in Airport Cooperative Research Program (ACRP) Report 25, v. 2, *Airport Passenger Terminal Planning and Design*, and other sources to determine both number of positions and area required for the ticket hall.

Space for ticketing operations has been built upon industry standard ticket counter arrangements. The number of positions required serve two airlines, providing space to each to operate separately. This serves to cover different operating scenarios, including off-schedule operations.

Airline Offices. Airline ticket offices are smaller at destination airports, providing space for the station manager and agents. Break rooms are typically shared space with ramp agents, many of whom often serve dual functions. This is the case with this program component at FNL. There is also a potential for this function to have moved on to an alternative that is more self-directed, requiring less space and personnel in the future. This may include self-service baggage check in use in larger airports or options for remote baggage check-in.

Baggage Claim Area. The baggage claim area has been programmed for one flight using approximately 78 percent of passengers claiming bags and 80 percent of these passengers claiming bags within twenty minutes of a flight's arrival. These figures have been derived based on planning experience at other airports to provide a baggage claim device that will provide approximately 115-feet of claim device frontage. The baggage claim device recommended is a flat-plate device, with the off-load belt located on the secure side of the terminal.

There remains a possibility that these devices will be modified such that bags delivered to the non-secure, public area of the claim hall will not be allowed to return into the off-load space. The public space for this function includes the claim device, queuing and waiting areas, and airline baggage service offices as well as the adjacent concourse.

Baggage Claim Off-Load. The inbound baggage claim off-load device is recommended to be housed within and enclosed structure as part of the terminal building. It provides the baggage claim drop belt with tug and cart maneuvering and equipment storage space for overnight and weather events. An odd/ oversized baggage drop-off area is also recommended in this space. This can be a sloped tray or a run-out baggage belt into the claim hall.

Baggage Make-up. The airline outbound baggage make-up area includes the baggage run-out belt(s) from TSA's checked baggage inspection room. A small baggage make-up device is recommended in this program to assist with sorting of baggage into carts. The make-up area includes circulation are for tug and cart maneuvering and staging. It is programmed as a shared airline space but with separate operations areas for the outbound operation, small equipment, and storage. This can also be configured to enclose airline operations to house aircraft ground service equipment.

Baggage Service Office. An airline baggage service office that is sized to accommodate two airlines is recommended in the claim hall program. However, the airlines serving FNL may prefer to maintain this operation at their ticket offices to better utilize staff and keep the bags secure.

Checked Baggage Screening. Checked baggage security screening has been programmed for one mini-inline system with Computer Tomography X-ray (CTX) and two Explosive Trace Detection (ETD) machines. TSA personnel will manage this operation within space behind or to one side of the ticket counters.

Concessions. Concessions for a two-gate operation are anticipated to be mainly food and beverage with a small retail and personal items. It's assumed that much of the food will be pre-packaged, possibly from a local vendor. The space will likely contain a small kiosk, similar to a coffee stand that has a refrigerated case for beverages and supplemented with vending machines.

Gate Departure Lounge. The gate departure lounge area for a two-gate operation has been programmed so that passengers from two flights could share a lounge area. Instead of building out to a demand for two departures equal to two full flights, the departure lounge will provide a larger area that will support two overlapping but separated operations where one flight may be boarding passengers as others are in the middle of arriving at the terminal. This will allow airlines more schedule flexibility over the long term. This figure was determined to be 150 percent of the total area required for one flight. It acknowledges the lower probability of two closely spaced departures yet recognizes the need for room to accommodate growth.

Rental Car Counters. Car rental companies will operate at this terminal on a limited basis just before and after a flight. Their counter and office space are programmed to their industry standard for three vendors.

Ticket Hall. The ticket hall ticket area has been programmed for two airlines, each having two four-position counters each, and five kiosks apportioned between the two airlines. Supporting queues, concourse, and waiting areas are included in this space.

Public Seating. Public seating is included in the ticket and baggage claim halls as well as outside the terminal. Seating in the departures lounge was apportioned at a higher area per passenger to allow for non-standard seating options, such as tables that can be used as work surfaces and softer furnishings for group gatherings.

Restrooms. Restrooms are limited to one fixture per gender per 25 passengers based on the design aircraft for both secure and non-secure areas of the terminal. Family restrooms, one at both the secure and non-secure areas, are also included.

Security Screening Check Point. In the recommended Security Screening Check Point (SSCP), there is more than enough capacity to process one flight during the period prior to a departure. Allowance for an additional future checkpoint lane may be appropriate if the main checkpoint is located with an area that isn't easily expanded. TSA office and breakroom/training room are located within this area as well.

General Public Circulation. A main hall area has been included in the program to provide a central entrance, gathering, and waiting area as well as focal point for wayfinding in the non-secure area of the terminal. This space includes other general public circulation, such as buffer space between functional components.

Airport Administration. Airport administration includes airport offices, break areas, small public conference space, and police office. Back of house space includes facilities services equipment and supply storeroom and office/break room. It is also recognized that the repurposing of the existing terminal for airport administration space is a possibly.

Transportation Security Administration. TSA offices will be housed adjacent to and with direct access to the checked baggage security screening room and the public.

Mechanical/Electrical/Utility. Program area for building systems has been developed to allow for a combination of mechanical, electrical, water and emergency generator.

Structure/Non-Net Areas. A percentage of the programmed space for building structure, walls, cavities and building systems has been included in the terminal building program.

Automobile Parking. The number of auto parking spaces required for this terminal considers both the future airline use as well as continued sports and casino charter use of the parking area. While the existing parking area with 336 spaces is adequate to accommodate current use of charter flights and employees, it is recommended that FNL consider reservation space to essentially double the size of the existing vehicle parking to accommodate the return of commercial service.

The recommended number of spaces dedicated to commercial service is approximately 50 short-term spaces and 350 long-term spaces based on the anticipated design aircraft.

Conclusion - Passenger Terminal Facility Planning. The planning and programming for this passenger terminal for FNL requires allowing for some uncertainty in where the industry will be when the terminal is designed and built. This includes how baggage will be managed from the ticket counter to the aircraft and if there will be a traditional ticket hall with agents at counters or if agents will be in a space to guide passengers who require assistance.

This passenger engagement will take many forms until it becomes mostly virtual and highly mobile. This may have a great impact on terminal space, even at a smaller commercial service airport. In preparing for the future, it will likely to require areas for passengers to work and relax in a larger secure area that provides services to meet passenger needs and can be obtained within the secure environment, no matter how many people are awaiting their flight.

This recommended terminal facility program provides an outline for the future, with options for accommodating expansion within the programmed space. The program also allows for the Master Plan Study to plan for an appropriate reservation of space for such facilities. The airport layout plan (ALP) and financial implementation components of this master plan will consider the general phasing for construction and general budgeting purposes.

Table 4-14: Future Terminal Program

Terminal Demand Profiles and Program Summary	Future Terminal
Departure & Arrivals Demand Profiles	
Design Aircraft	A320
Design Aircraft Seats	177
Peak Hour Design Load Factor	85%
Peak Hour Originating Passengers (PHOP)	150
Peak Ten-Minute Percent of Originating Passengers	20%
Peak Ten-Minute Originating Passengers	30
Peak Hour Terminating Passengers (PHTP)	150
Peak Hour Terminating Passengers w/Bags Percent	78%
Peak Hour Terminating Passengers w/Bags	117
Peak Twenty Minute Terminating Passengers w/Bags	117
Peak Twenty Minute Terminating Passengers w/Bags %	100%
Terminal Component Program Summary	
Main Hall Circulation	1,640 sf
Airport Administration	1,163 sf
Ticketing Positions (Kiosks and Counters)	*13*
Ticketing Check-In / Baggage Check-In Area	3,140 sf
Outbound Checked Baggage Screening	
Total Positions (one Inline EDS and two ETD)	*3*
Total Inline Checked Baggage Screening Area Rqd	928 sf
Airline Operations Outbound Baggage Make-Up Device	2,303 sf
Departing Passenger Security Screening & TSA Offices	
Total SSCP Lanes Required	*1*
Total SSCP Area Required	2,535 sf
Total Recommended Aircraft Gates	*2*
Total Passenger Departure Lounge Area Required	4,753 sf
Baggage Claim Hall	
Recommended Number of Baggage Claim Devices	*1*
Total Baggage Claim Area Recommended	3,547 sf
Car Rental Counters & Offices	450 sf
Inbound Baggage Claim Drop-Off	2,304 sf
Concessions Retail	744 sf
Restrooms	2,400 sf
Total Functional Component Area Requirements	**25,907 sf**
Building Administration & Support Space	1.250 sf
Building Structure, Walls, Cavities, & Building Systems	3,345 sf
Total Building	**30,502 sf**

SOURCE: Mead & Hunt, 2018.

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