Reno-Tahoe Airport Authority

Reno-Tahoe International Airport MASTER PLAN

DECEMBER 2018

CHAPTER 3:

Facility Requirements

FACILITY REQUIREMENTS

Introduction

This chapter presents requirements for airside, landside, terminal, and support facilities to meet aviation demand at Reno-Tahoe International Airport (RNO) over the next 20 years. Facilities are evaluated to determine adequacy for existing and future operations. The chapter identifies facilities determined to be deficient, as well as the type and size of facility required to meet future demand.

These facility analyses use the preferred Master Plan forecasts presented in **Chapter 2 – Aviation Activity Analysis and Forecast**. Aviation activity levels should be monitored to check consistency with the forecasts. If levels show changes inconsistent with the timing of the activity forecasts, the recommendation is to adjust the development schedule to correspond to the demand for facilities rather than set the schedule to pre-determined dates of development. This strategy avoids over- or under-building.

Components of Facility Requirements

This chapter is organized in the following components:

- Airside Facility Requirements
  - Fundamentals of Airfield Design
  - Airfield Capacity
  - Runway System
  - Taxiway System
  - Terminal Aircraft Aprons
- Landside Facility Requirements
  - Federal Inspection Services (FIS) and Customs and Border Protection (CBP)
  - Passenger Terminal Roadway Demand and Capacity Analysis
  - Vehicular Parking and Rental Car Demand and Capacity Analysis
- Terminal Facility Requirements
  - Fundamentals of Terminal Design
  - Demand Factors
  - Terminal Building Capacity Analysis
- Support Facility Requirements
  - Fixed Base Operator (FBO) and Corporate Facilities
  - General Aviation (GA) Facilities
  - Military
  - Air Cargo Facilities
  - Support and Maintenance Facilities
- Executive and Tenant Workshops
- Conclusions and Recommendations

Overview of Facility Requirements

This chapter provides the basis for understanding what facility improvements at RNO are likely needed to accommodate future Airport demands efficiently and safely. The facility needs, summarized here and presented in greater detail throughout the chapter, will be used to develop layout alternatives to configure future airport facilities. This chapter assesses improvement alternatives to evaluate priorities for airside, landside, terminal, and support facilities.

Overall on the airside, the runway and taxiway systems are in good condition and comply with Federal Aviation Administration (FAA) standards in most instances. The runway safety areas (RSA) are graded and meet obstruction clearance standards. The recommendations outlined in this chapter cover approach surface clearance, non-standard taxiway geometry as identified by the FAA, runway object free area (ROFA) and runway visibility zone (RVZ) clear areas, hold lines, and efforts to manage RPZs that are currently off RNO property.

Some landside facilities should be priorities for upgrades or relocation at RNO. The CBP building should be studied for improvements and possible relocation, along with increasing space for rental car facilities and storage, and public parking in response to increasing passenger demand.

One of the primary sources of information used in the preparation of RNO's passenger terminal facilities is the Transportation Research Boards' Airport Cooperative Research Program (ACRP) Report 25: *Airport Passenger Terminal Planning and Design* (ACRP Report 25). ACRP Report 25 serves as the industry standard for guidance in planning and developing airport passenger terminals and assists users in analyzing common issues related to airport terminal planning and design. At RNO, the passenger terminal facilities are generally adequate for existing and near-term passenger and commercial use as determined in the preferred forecasts. Long-term passenger use will cause demand to exceed capacity in certain areas, leading to the following priorities: the check-in and ticketing hall, especially in response to emerging trends and technology; the security checkpoint, also related to evolving technology; the size of the gate lounges; and concessions and public spaces.

Existing and future demand suggested the following priorities for support facilities: cargo facility expansion or relocation; airfield maintenance facility relocation or consolidation into a new facility; GA hangar location, focusing on GA East in the northeast quadrant; and deicing areas, specifically at the end of Runways 16R/L and 34L/R.

Recommendations for improvements in all four areas are listed in order of priority at the end of the chapter.

Airside Facility Requirements

Fundamentals of Airfield Design

The intent is for Airport improvement projects to meet facility needs and comply with the current FAA design standards in Advisory Circular 150/5300-13A, Change 1, *Airport Design* (AC-13A). Participating in FAA funding for eligible improvement projects requires that the Airport meet FAA standards, or demonstrate why meeting such standards is impractical or unfeasible. This section summarizes the design standards that apply and identifies the conditions unique to RNO that influence airfield design recommendations.

Design Standards Concepts and Terminology

The FAA is responsible for the overall safety of civil aviation in the United States (U.S.); therefore, safety is what primarily drives FAA design standards. FAA standards and policy also reflect secondary goals including efficiency and utility. As the aviation industry continues to develop rapidly, changes affecting safety and efficiency constantly evolve. This means industry professionals can expect design standards will continue to evolve as well, especially with technologies and procedures.

Critical Aircraft and Airport Reference Code (ARC)

Use of a coding system determines FAA design standards for an airport. The coding system is shorthand for the physical and operational characteristics of the most demanding aircraft that routinely use the airport. These aircraft, called critical aircraft or design aircraft, operate, or are projected to operate, at least 500 times per year at the airport. Because of the demand they place on the infrastructure, facility design and safety setback distances depend on the critical aircraft characteristics. Characteristics of the critical aircraft used in facility planning include approach speed, wingspan, tail height, main gear width, cockpit to main gear length, aircraft weight, and takeoff and landing distances. Dimensions of airfield facilities determined by the critical aircraft include: runways, taxiways, taxilanes, aprons, and associated obstacle/obstruction setbacks and clearances. The critical aircraft, which may be a specific aircraft type or a composite of aircraft critical characteristics, determines the ARC.

Runway Design Code (RDC)

The RDC is a three-component code that defines the design standards that apply to a specific runway. A letter, A-E, depicts the first component and stands for the Aircraft Approach Category (AAC). The AAC relates to the approach speed of the critical aircraft. A Roman numeral, I-VI, depicts the second component, which is the Airplane Design Group (ADG). The ADG relates to the greatest wingspan or tail height of the critical aircraft. The third component relates to runway approach visibility minimums as expressed in Runway Visual Range (RVR) equipment measurements. RVR-derived values represent feet of forward visibility that have statute mile equivalents, for example, 2400 RVR is equal to one-half mile. **Table 3-1** summarizes the RDC classifications. The critical aircraft and RDC will determine the scale and setbacks of airfield facilities.

Table 3-1: Runway Design Code System

	Aircraft Approach Category (AAC)	
AAC	**Approach Speed**	
A	Approach Speed less than 91 knots	
B	Approach speed 91 knots or more, but less than 121 knots	
C	Approach speed 121 knots or more, but less than 141 knots	
D	Approach speed 141 knots or more, but less than 166 knots	
E	Approach speed 166 knots or more	
	Airplane Design Group (ADG)	
Group #	**Tail height (ft)**	**Wingspan (ft)**
I	< 20’	< 49’
II	20’ - < 30’	49’ - < 79’
III	30’ - < 45’	79’ - < 118’
IV	45’ - < 60’	118’ - < 171’
V	60’ - < 66’	171’ - < 214’
IV	66’ - < 80’	214’ - < 262’
	Approach Visibility Minimums	
RVR[1] (feet)	**Flight Visibility Category (statute mile)**	
VIS	Visual approach use only	
4000	Lower than 1 mile, but not lower than ¾ mile (APV[2] ¾ but<1 mile)	
2400	Lower than ¾ mile but not lower than ½ mile (CAT-I PA)	
1600	Lower than ½ mile but not lower than ¼ mile (CAT-II PA)	
1200	Lower than ¼ mile (CAT-III PA)	

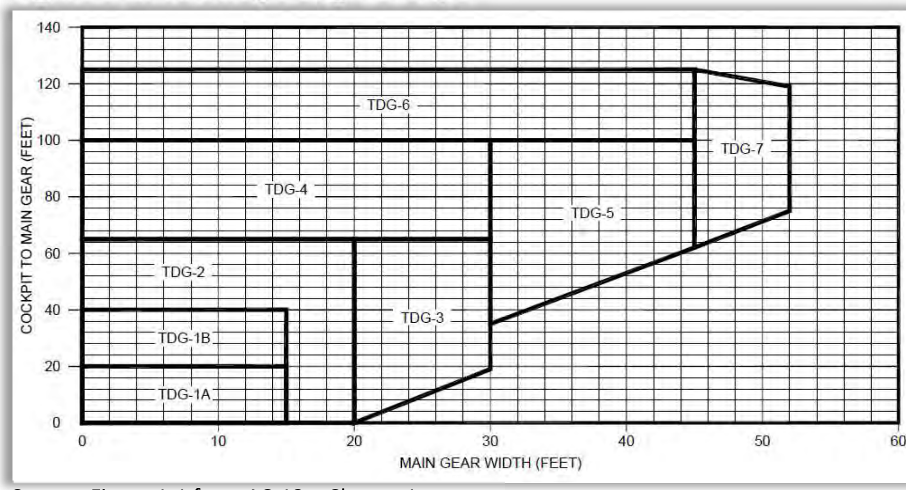
Source: AC-13A, Change 1, *Airport Design*

1. Runway Visual Range (RVR) is the approximate visibility (in feet) as measured by the RVR light transmission/reception equipment or equivalent weather observer report. RVR values are not exact equivalents.
2. APV stands for Approach with Vertical Guidance.

Taxiway Design Group (TDG)

The TDG considers the dimensions of the aircraft landing gear to determine taxiway widths and pavement fillets, which accommodate the inner wheel of the airplane as it turns at taxiway intersections. The width of the main gear and wheel base, or the distance from nose gear to main gear, determine the seven TDG classifications. **Figure 3-1** presents the TDG classifications.

Figure 3-1: Taxiway Design Groups



Source: Figure 1-1 from AC-13a, Change 1

Wind Coverage and Weather Conditions

One of the primary factors influencing runway orientation is wind. The preferred design for runways is to align them so that airplanes may take off and land into a headwind. This minimizes the challenges associated with crosswinds, which affect small, light aircraft more than larger, heavier ones. FAA runway design criteria states that runway orientation must satisfy 95 percent wind coverage based on annual wind conditions.

Table 1-3 in **Chapter 1 – Inventory of Existing Conditions** shows annual average wind coverage for each runway direction during three weather conditions: all weather, visual flight rules, and instrument flight rules (IFR). When calculated individually, neither runway alignment by itself provides 95 percent coverage for operations during 10.5 or 13 knots in the three weather conditions. However, the combined alignment provides over 98 percent coverage during each weather condition, justifying the need for continued FAA investment in Runway 7/25 to maintain the required wind coverage.

Other Airfield Design Considerations

In addition to RDC and TDG, the following design considerations affect airport geometry and development patterns.

- **Independent versus dependent operating streams:** Runways that intersect or have intersecting approach and departure corridors depend on each other. During high levels of activity, these dependencies cause delay by reducing capacity. As delays increase, an independent operating stream may be necessary. However, at RNO this may not be possible due to physical limitations from terrain and safety discrepancies.
- **Critical areas:** Electronic equipment used for navigation, communication, security, and surveillance is commonly found throughout airport property. To function properly, most of these items require clear and graded areas, setbacks from certain objects and construction materials, and a clear corridor between transmitters and receivers. These areas create restrictions for development and the types of activities permitted nearby.
- **Airfield line of sight:** Intersecting runways cannot operate simultaneously without adequate safety measures. The RVZ, which is an area within which a pilot must be able to see aircraft on the intersecting runway, must be clear of obstructions. Runway grading standards also must provide line of sight between aircraft operating at opposite ends of the same runway.
- **Approach and departure protection:** Obstacle clearance determines instrument flight procedure minimum descent altitudes, glide paths, and climb gradients. Obstacle clearance protection surfaces typically travel along the extended runway centerline. Tall objects and terrain can impose restrictions on aircraft operations if they inhibit the ability for aircraft to safely arrive and depart. Airports typically work with nearby communities to adopt land use planning techniques to minimize incompatible development.
- **Visual aids to navigation:** Certain visual aids, including the airport beacon, runway approach lighting, and runway glide path indicator lights, require unobstructed line of sight with aircraft in flight.
- **Controller line of sight:** Air traffic **controllers** require an uninterrupted line of sight between the air traffic control tower (ATCT) and approach and departure corridors, runways, taxiways, and aprons.

Critical Aircraft and Airport Reference Code

The first step in airside facility planning is to select the critical aircraft. When the airport has one common user type, one critical aircraft is appropriate. When the airport serves various user types, planning efforts will use a combination of aircraft types, or aircraft characteristics, for the critical aircraft. Operations records define the existing critical aircraft while projections from **Chapter 2** forecasts determine the future critical aircraft.

Existing (2016) Critical Aircraft

Table 3-2 shows operations by scheduled commercial passenger aircraft in 2016, and **Table 3-3** shows operations by cargo aircraft. Cargo and commercial aircraft are the largest civilian aircraft, by wingspan and weight, regularly operating at RNO and are evaluated first since these will determine the critical aircraft. GA operations are evaluated later in this section. Military aircraft, such as the Lockheed C130 used by the Nevada Air National Guard, use airfield facilities at RNO; however, their characteristics cannot be used to justify FAA investment in improvement projects because the Department of Defense operates those aircraft.

Table 3-2: Existing (2016) Operations – Commercial Passenger Carriers

Aircraft Model	Approach Speed (knots)	Wingspan (feet)	AAC	ADG	TDG	MTOW (lbs.)	2016 Operations
Airbus A319	138	111.9	C	III	3	166,449	**3,068**
Airbus A320	136	111.9	C	III	3	171,961	**4,022**
Boeing 737-800	142	117.5	**D**	III	3	174,200	**2,822**
Boeing 737-700	141	117.4	**D**	III	3	174,200	**13,652**
CRJ-200 (Canadair)	140	69.6	C	II	3	53,000	**2,122**
CRJ-700 (Canadair)	140*	76.3	C	II	3	77,000	**1,128**
CRJ-900 (Canadair)	140*	81.5	C	III	3	84,500	**332**
CRJ (Canadair CRJ)	140	69.6	C	II	3	53,000	**120**
DHC-8-400 (DeHavilland Q400)	129	93.3	C	III	**5**	65,200	**7,510**
Embraer E-175	124*	85.3	C	III	1A	82,673	**3,360**
McDonnell Douglas MD-80	132	107.8	C	III	**5**	140,000	**708**
McDonnell Douglas MD-82	135	107.8	C	III	**5**	149,500	**298**
Total Operations – Commercial Passenger Carriers (2016)							**39,142**

Source: Reno-Tahoe Airport Authority (RTAA) Detail Landing Report, 2016
MTOW= Maximum Takeoff Weight
*Approach speed estimated

Table 3-3: Existing (2016) Operations – Cargo Operators

Aircraft Model		Approach Speed (knots)	Wingspan (feet)	AAC	ADG	TDG	MTOW (lbs)	2016 Operations
FedEx	**Airbus 300-600**	137	147.1	C	**IV**	**5**	375,888	**28**
	Boeing 757/200	137	135.0	C	**IV**	4	255,000	**1,168**
	MD-11/ER	153	170.5	**D**	**IV**	6	630,500	**66**
	MD-10/30	151	165.3	**D**	**IV**	**5**	590,000	**976**
UPS	Airbus 300-600	137	147.1	C	**IV**	**5**	375,888	**788**
	Boeing 757/200	137	135.0	C	**IV**	4	255,000	**948**
	Boeing 767/300ER	145	156.2	**D**	**IV**	**5**	412,000	**68**
DHL	Boeing 737-400F	139	94.8	C	III	3	133,500	**526**
	Cessna 208/B + Caravans	86	52.1	A	III	1	8,000	**472**
							Total Operations – Cargo Operators (2016)	**5,040**

Source: Reno-Tahoe Airport Authority (RTAA) Detail Landing Report, 2016
MTOW= Maximum Takeoff Weight

For the 2016 critical aircraft and ARC:

- The most demanding AAC aircraft models using RNO are within category D, such as the Boeing 737-700 and 800 series, which are commercial passenger carriers, and the MD-10/30 and Boeing 767/300ER, which serve cargo operations.
- The most demanding ADG aircraft using RNO are within group IV. These include cargo aircraft, such as the Airbus 300-600, MD-10/30, Boeing 757/200, and the Boeing 767/300ER.
- Aggregate operations determine the ARC for RNO is D-IV. The most demanding aircraft regularly using RNO within the D-IV category is the MD-10/30 used by FedEx.

Identification of Future Critical Aircraft

The master plan forecasts, found in **Chapter 2**, are used to determine the future critical aircraft at RNO. It is estimated that in 2036, 59 percent of scheduled commercial passenger operations will be narrow-body jets, and the other 41 percent will be regional jets. Aircraft such as the MD-80 series and the Dash-8 (Q400) turboprop are in the process of being retired and will be removed from service over the next 20 years. Alaska Airlines has indicated the Q-400 will be replaced by a regional jet with similar range and seating capacity, such as the CRJ-700 or the E-175. Aircraft like the MD-80 will likely be replaced by the Airbus 319/320 series and the Boeing 737 series. **Table 3-4** shows the estimated breakdown of aircraft types operating at RNO in the future and separates narrow-body jets and regional jets.

Table 3-4: Future Operations – Commercial Passenger Carriers

Aircraft Type	Aircraft Model	AAC	ADG	TDG	Future Operations[1] 2021	2026	2036	
Regional Jets	CRJ-200	C	II	3	5,447	4,124	1,695	**22,399**
	CRJ-700	C	II	3				
	CRJ-900	C	III	3				
	Embraer 175	C	III	1A	8,412	15,382	20,704	
Narrow Body Jets	Airbus 319	C	III	3	7,472	7,536	8,261	**32,699**
	Airbus 320	C	III	3				
	Boeing 737-700	**D**	III	3	20,205	22,142	24,438	
	Boeing 737-800	**D**	III	3				
Phased Out	DeHavilland Dash-8	C	III	5	4,074	0	0	**0**
	MD-80	C	III	5	263	0	0	
	Misc Aircraft	-	-	-	16	0	0	
Total Operations - Commercial Passenger Carriers (MP Forecast)					**45,889**	**49,183**		**55,098**

Sources: OAG Schedules Analyzer and Unison Consulting, Inc.
1. Matches total and splits for commercial aircraft. See Figure 2-33 in Chapter 2 for more information.

While cargo volume is forecast to grow, cargo operators are expected to maintain the same relative share of cargo volume in the future. Cargo operators typically use aircraft over a longer lifespan than passenger airlines, occasionally operating aircraft more than 30 years after delivery. FedEx Fourth Quarter Fiscal 2015 Statistics indicate that operations by the MD-10 and MD-11 series will be phased out of service by 2021 to be replaced by 62 Boeing 767 from 2014 to 2019.

UPS is expected to maintain the current fleet, but also expected to add 14 747-8 cargo carriers in the short-term, primarily for trunk routes connecting Europe to Asia, and Asia to the U.S. It is not expected these aircraft will use RNO regularly. **Table 3-5** shows future cargo operations by aircraft model**.**

Table 3-5: Future Operations – Cargo Operators

Carrier	Aircraft Model	AAC	ADG	TDG	Share of Cargo Ops[1]	Operations 2021	2026	2036
FedEx	Airbus 300-600	C	**IV**	**5**	44.4%	29	30	**32**
	Boeing 757/200	C	**IV**	4		1,208	1,251	**1,342**
	Boeing 767/300ER (NEW)	**D**	**IV**	**5**		539	1,116	**1,197**
	MD-10/11/ER (phased out)	D	IV	6		539	0	**0**
UPS	Airbus 300-600	C	**IV**	**5**	35.8%	815	844	**905**
	Boeing 757/200	C	**IV**	4		981	1,016	**1,089**
	Boeing 767/300ER	**D**	**IV**	**5**		70	73	**78**
DHL	Boeing 737-400F	C	III	3	19.9%	544	564	**604**
	Cessna 208/B + Caravans	A	III	1		494	512	**549**
Total Operations – Cargo Operators (MP Forecast)						**5,220**	**5,406**	**5,798**

Source: Preferred Master Plan Forecasts
1. Indicates share of cargo operations only, not landed weights or market share. Operations share based on 2016 landings. Share Source: RTAA Includes RTAA Detail Landing Report, 2016

GA Operations

Commercial passenger and cargo airlines operated the largest non-military aircraft at RNO in 2016 and are expected to do so throughout the planning period. These aircraft drive the ARC and RDC for each runway. However, commercial and cargo operations only makeup 65 percent of total operations at RNO. GA aircraft make up 33 percent, and military aircraft, the remaining two percent. GA aircraft range from small single-engine piston aircraft, which are less than or equal to 12,500 pounds maximum take-off weight (MTOW), to large corporate aircraft, such as the Gulfstream V. GA aircraft are smaller than the most demanding passenger and cargo aircraft; therefore, they are not used as the critical aircraft at RNO to plan and design facilities that the larger aircraft also use.

GA aircraft are used as critical aircraft at RNO for facilities that the larger passenger and cargo aircraft do not use. These facilities include the GA West, Atlantic Aviation, and GA East areas. **Table 3-6** presents existing and forecasted GA operations. **Table 3-6** only details operations by jets, turboprops and larger propeller aircraft with more than 150 operations in 2016. A line is included for remaining GA operations that are by various aircraft types but primarily by aircraft within the B-II RDC and less than 12,500 pounds MTOW.

Table 3-6: Existing (2016) and Future Operations – GA

Aircraft Model	Type	Approach Speed (kits)	Wingspan (feet)	AAC	ADG	TDG	MTOW (lbs)	Operations			
								2016	2021	2026	2036
Pilatus PC-12	Prop	98.8	53.2	B	II	*	10,500	1,187	1,243	1,363	1,513
Cessna Citation Excel	Jet	121	56.3	C	II	2	20,200	911	954	1,046	1,161
Beechcraft 1990	T-prop	113	58.0	B	II	*	17,120	758	794	870	966
Super King Air 200	T-prop	103	54.5	B	II	2	12,500	603	631	692	769
Cessna Citation II	Jet	117	51.8	B	I	2	13,300	558	584	641	711
Beechcraft King Air 90	Prop	100	50.2	B	II	1	10,100	479	502	550	611
Cessna Citation X	Jet	129	63.9	C	II	2	36,100	392	410	450	500
Cessna Citation CJ3	Jet	113	53.3	B	II	2	13,870	354	371	407	451
Embraer Phenom 100	Jet	100	40.4	B	I	*	10,582	346	362	397	441
Raytheon Hawker 800	Jet	130	54.3	C	II	3	28,000	332	348	381	423
Cessna Citation V	Jet	114	54.8	B	II	1	16,630	294	308	338	375
Dassault Falcon 900	Jet	100	63.4	B	II	3	45,500	292	306	335	372
Dassault Falcon 2000	Jet	130	63.4	C	II	2	35,800	276	289	317	352
Embraer Phenom 300	Jet	110	53.2	B	II	*	17,968	268	281	308	342
Canadair Challenger	Prop	125	63.8	C	II	*	47,600	256	268	294	326
Raytheon Premier 1	Jet	*	44.0	B	I	2	12,500	232	243	266	296
Cessna Citation Sovereign	Jet	110	63.3	B	II	3	30,300	206	216	237	263
Gulfstream V	Jet	156	93.5	D	III	3	91,000	201	210	231	256
Cessna Citation Mustang	Jet	*	43.2	B	I	2	8,645	195	204	224	249
Cessna Citation CJ1	Jet	115	46.9	B	I	2	10,600	194	203	223	247
Learjet	Jet	143	39.5	D	I	1	18,300	180	188	207	229
Gulfstream IV	Jet	145	77.8	D	II	3	74,600	171	179	196	218
Cessna 421	Piston	96	41.7	B	I	*	7,450	159	166	183	203
Beechcraft Beechjet	Jet	121	43.5	C	I	1	16,100	152	159	175	194
REMAINING GA OPS	Varies	<121	<49.0	A to B	I to II	1	<12,500	17,779	18,615	20,416	22,662
Military											
C-130	T-prop	138	132.6	C	IV	*	155,000	2,220	2,220	2,220	2,220

Sources: OAG Schedules Analyzer and Unison Consulting, Inc.
*Data is not published with aircraft specification data.

Critical Aircraft and ARC

For the future critical aircraft and the ARC:

- The most demanding AAC aircraft models expected at RNO are within the D category, such as the Boeing 737-700 and 800 series, which are commercial passenger carriers, and Boeing 767/300ER, which serves cargo operations.
- The most demanding ADG aircraft expected to use RNO in the future are within group IV. These include cargo aircraft, such as the Airbus 300-600, Boeing 757/200, and the Boeing 767/300ER.
- Future aggregate operations determine the future ARC is D-IV. The most demanding aircraft expected to operate regularly at RNO within the D-IV category is the Boeing 767/300ER, which is used by cargo operators.

The potential for activity at RNO by aircraft in larger design groups, such as the Boeing 747 or 787, is possible. However, due to limited projected demand, regular scheduled operations by these aircraft are unlikely. **Table 3-7** summarizes the existing and future ARC for RNO.

Table 3-7: Airport Reference Code

	AAC	ADG	Approach Visibility Minimums	Design Aircraft
Existing	D	IV	½ mile (2,400’)	MD-10/30
Future	No Change	No Change	No Change	B-767/300ER

Airfield Capacity

The focus area of facility requirements is RNO’s annual service volume (ASV), which will be calculated using the FAA methodology contained in AC 150/5060-5, *Airport Capacity and Delay* (AC-5060), Airport Cooperative Research Program (ACRP) Report 79: *Evaluating Airfield* Capacity, and Report 104: *Defining and Measuring Aircraft Delay and Airport Capacity Thresholds.* The ACRP released Report 79 in 2012 and Report 104 in 2014 to provide updated guidance while the FAA continues to revise AC-5060. ACRP Report 79 states that, despite the age of AC-5060, “it is still widely used in the United States and Worldwide.”

AC 5060 contains two model types to assess capacity. ACRP Report 79 classified these models as Level One, *Table Lookup*, for determining capacity based on runway configuration, and Level Two, *Charts, Monographs, and Spreadsheets,* for capacity that factors in hourly peak operations and weather conditions.

AC-5060 is conservative in that it was written before the FAA began the transition to global positioning system (GPS)-based navigation, which has improved traffic flow at more congested airports. GPS-based navigation technology, also known as NextGen, provides air traffic control and pilots with additional tools that help improve traffic flow and airfield capacity without requiring infrastructure improvements. AC-5060 bases maximum airfield capacity on 19 types of runway configurations. Some modern airports, such as Denver (DEN) and Chicago (ORD) are so large and complex they cannot be assessed using the methods described in AC-5060. In comparison, the airfield at RNO fits within the AC-5060 models; therefore, this method can still be applied to assess capacity.

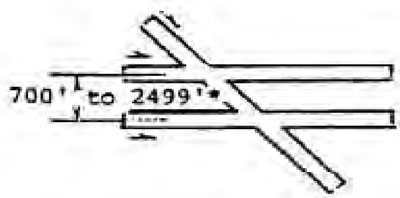
Factors That Influence Capacity

Several variables influence airfield capacity: the type of aircraft operating, the weather and visibility conditions, separation of parallel runways, traffic patterns, and location and type of taxiway exits. Increasing the number of runways adds capacity, provided new runways are oriented to support traffic flow, which generally means parallel to the primary runway. AC-13A identifies that runway separation determines whether parallel runways add additional capacity in visual conditions only, or during both instrument and visual conditions. Runways 16R/34L and 16L/34R are 700 feet apart. That distance supports simultaneous operation during visual conditions but is too close to be considered separate runways during instrument meteorological conditions (IMC). IMC at RNO occur when cloud ceilings fall below 1,000 feet above ground level and visibility is less than three statue miles.

Based on the airfield layouts in AC-5060, RNO is a Type 10 airfield, characterized by two parallel runways separated between 700 feet and 2,499 feet, plus a crosswind runway. Type 10 airports have a capacity between 260,000 and 355,000 annual operations. The percent of operations performed by Type C and D aircraft determines the range. Type C aircraft are those that weigh more than 12,500 pounds but less than 300,000 pounds, and Type D aircraft are those that weigh more than 300,000 pounds. A diverse fleet mix reduces capacity and a homogenous fleet mix (either few C and D aircraft, or many C and D aircraft) increases capacity. The airfield model is shown in **Figure 3-2**.

Figure 3-2: **RNO Airfield Capacity Model**

12/1/95 AC 150/5060-5 CHG 2

No.	Runway-use Configuration	Mix Index %(C+3D)	Hourly Capacity Ops/Hr VFR	Hourly Capacity Ops/Hr IFR	Annual Service Volume Ops/Yr
10.		0 to 20	197	59	355,000
		21 to so	14s	57	275,000
		51 to 80	121	56	260,000
		81 to 120	105	59	285,000
		121 to 180	94	60	340,000

Source: FAA AC-5060

Capacity and Delay Measures

Quantifying airport capacity and delay can be simplified by averaging the variables to create typical operating conditions experienced annually. FAA AC-5060 refers to an airport's annual capacity as the ASV. The ASV is the number of operations an airfield can accommodate annually. The comparison of annual demand, existing and forecast, with the ASV determines at what percent of capacity the airport is operating. This comparison also gauges the timing of airfield capacity improvements. As annual demand approaches ASV, average delays will increase. Existing data for 2016, and the preferred Master Plan forecasts from **Chapter 2** are the basis for calculating the ASV.

Peak Hour Characteristics

The preferred Master Plan forecasts looked at peaking characteristics for 2016 and beyond. **Table 3-8** shows peak month average day (PMAD) operations, and the peak hour during the PMAD for cargo, commercial passenger and GA operations.

Table 3-8: RNO Peak Operation Characteristics

Passenger Airline	2016	2021	2026	2036
Peak Month Average Day (PMAD) (PM Subtotal/31 days)	117	137	147	165
PMAD Peak Hour (7.5% of PMAD Subtotal)	9	10	11	12
Cargo				
PMAD (PM Subtotal/31 days)	19	20	21	22
PMAD Peak Hour (14.3% of PMAD Subtotal)	3	3	3	3
General Aviation				
PMAD (PM Subtotal/31 days)	114	119	130	143
PMAD Peak Hour	11	12	13	14
Totals				
Total PMAD	250	276	297	330
Total Peak Hour	23	25	27	30
Source: Unison Consulting and Selected Master Plan Forecast PMAD: Peak month average day				

Airfield Capacity

Both ASV calculation methods in AC-5060 are applied in this analysis. The Level 1 method uses the chart in **Figure 3-2** and the mix of C and D aircraft from operations records, which was 69 percent in 2016. The hourly capacity during visual conditions is 121 operations and the hourly capacity during instrument conditions is 56 operations. Based on this formula, the ASV for RNO is 260,000 annual operations.

The Level 1 method provides a rough order of magnitude estimate for airfield capacity; however, it does not consider the reduced capacity that occurs during instrument operations, which is addressed by the Level 2 method.

The Level 2 method has a formula for calculating ASV that contains three variables: weighted hourly capacity (CW); the ratio of annual demand to average daily demand in the peak month (D); and the ratio of average daily demand to average peak hour demand during the peak month (H).
CW is calculated based on the amount of time RNO is operating under visual conditions (95 percent) and the amount of time it is operating under instrument conditions (5 percent). Following the formula contained in AC-5060, C_W for RNO is 84.07 operations per hour. The daily demand ratio (D) and Hourly Demand ratios (H) are calculated based on the percentage of activity that occurs during peak periods, as defined in **Table 3-8** above. The Level 2 ASV calculation is shown in **Table 3-9**.

Table 3-9: RNO Peak Operation Characteristics

	Variable$_1$	Variable$_2$
Flight Conditions	Instrument	Visual
AC-5060 Configuration	Type 1	Type 10
Hourly Capacity (C_1 and C_2)	56	121
Percent of Year (P_1 and P_2)	5%	95%
Hourly Capacity/Max Capacity	0.46	1.00
Weighing Factor (W_1 and W_2)	25.00	1.00
Weighted Hourly Capacity (C_W)	$((C_1{*}P_1{*}W_1) + (C_2{*}P_2{*}W_2))/((P_1{*}W_1) + (P_2{*}W_2))$	
Weighted Hourly Capacity (C_W)	**84.07**	
Annual Demand (AD)	81,800	
Peak Month Average Daily Demand (PMAD)	250	
Daily Demand Ratio (AD/PMAD=D)	**327.20**	
Peak Hour Demand (PDH)	23.00	
Hourly Demand Ratio (PMAD/PHD=H)	**10.87**	
Annual Service Volume (C_W*D*H=ASV)	**299,000 (rounded)**	

Source: AC-5060 and Mead & Hunt.
Notes: Calculations based on peak hour operations as described in Forecast Chapter.
Instrument versus visual condition split based on wind data over the past 10 years, acquired for wind coverage calculations. Wind data is separated based on instrument and visual conditions.

Planning guidelines recommend initiating additional runway planning when actual aircraft operations reach 60 percent of ASV. Runway construction should begin when aircraft operations reach 80 percent of the ASV. **Table 3-10** shows the ASVs produced by the Level 1 and Level 2 methodologies and compares these to 2016 operations and 2036 operations forecasted in **Chapter 2**.

Table 3-10: RNO Capacity Assessment

Method Level	ASV	60 Percent of Capacity (Planning)	80 Percent of Capacity (Construction)	2016 Operations (Percent Capacity)	2036 Operations (Percent Capacity)
Level 1	**260,000**	156,000	208,000	81,800 **(31 percent)**	109,465 **(42 percent)**
Level 2	**299,000**	179,400	239,200	81,800 **(27 percent)**	109,465 **(37 percent)**

Source: AC-5060

Based on the two methods of ASV assessment, the existing runway capacity at RNO is expected to be sufficient to meet the expected level of demand throughout the forecast period.

Runway System

This section identifies the various FAA design standards associated with the runway system and analyzes how each runway at RNO complies with these standards.

Runway Design Code (RDC)

A pilot's request to land or depart on a specific runway is based on several factors including prevailing winds, runway length and width, terrain and obstructions, available instrument procedures, and navigational aids (NAVAIDs). ATCT and operations staff indicate that 99 percent of total aircraft operations occur on Runways 16R/34L and 16L/34R. Therefore, each of these runways accommodate the most demanding aircraft at RNO and are classified as RDC D-IV.

Aircraft use Runway 7/25 when high winds from the east or west make operations on the primary north-south runways difficult for smaller aircraft. ATCT and operations staff indicate that Boeing 737 aircraft do use Runway 7/25 when necessary, but this practice is not common. To accommodate the Boeing 737, Runway 7/25 is classified as RDC C-III. **Table 3-11** summarizes existing and future RDC for each runway at RNO.

Table 3-11: Runway Design Code

Runway		AAC	ADG	Approach Visibility Minimums	Design Aircraft
16R/34L	Existing	D	IV	½ mile (2,400')	B-767/300ER
	Future	No Change	No Change	No Change	No Change
16L/34R	Existing	D	IV	>1 mile (5,000')	B-767/300ER
	Future	No Change	No Change	No Change	No Change
7/25	Existing	C	III	VIS	B-737-800
	Future	No Change	No Change	No Change	No Change

Runway 16R/34L Design Standards

Table 3-12 is the design standards matrix for Runway 16R/34L based on a critical aircraft of D-IV composite, which at RNO is the Boeing 767/300ER. No change is proposed for future RDC.

Table 3-12: Runway 16R/34L Design Standards Matrix

Runway 16R/34L RDC		D-IV-2400		
Item	Existing Conditions	FAA Design Standards	Meets Standards?	Disposition
Runway Design				
Width	150 ft.	150 ft.	Yes	No Action
Shoulder Width	40 ft.	25 ft.	Exceeds	No Action
Blast Pad Width	220 ft.	200 ft.	Exceeds	No Action
Blast Pad Length	400 ft. / 1000 ft.	200 ft.	Exceeds	No Action
Crosswind Component	97.3% @ 20 knots	95% @ 20 knots	Yes	No Action
Gradient (maximum)	0.1%	1.5%	Yes	No Action
Runway Protection				
Runway Safety Area (RSA)				
Length beyond departure end	1000 ft.	1000 ft.	Yes	No Action
Length prior to threshold	600 ft.	600 ft.	Yes	No Action
Width	500 ft.	500 ft.	Yes	No Action
Runway Object Free Area (ROFA)				
Length beyond departure end	1000 ft.	1000 ft.	Yes	No Action
Length prior to threshold	600 ft.	600 ft.	Yes	No Action
Width	800 ft.	800 ft.	Yes	No Action
Runway Obstacle Free Zone (OFZ)				
Width	400 ft.	400 ft.	Yes	No Action
Length beyond departure end	200 ft.	200 ft.	Yes	No Action
Inner Approach OFZ – Both Approach Ends				
Length prior to landing threshold	2,600 ft.	2,600 ft.	Yes	No Action
Inner Transitional OFZ – Both Approach Ends				
Vertical (H) above runway elevation	31.7 ft.	31.7 ft.	Yes	No Action
6:1 final segment height above runway	150 ft.	150 ft.	Yes	No Action
Precision Obstacle Free Zone (POFZ) – Both Approach Ends				
Length	200 ft.	200 ft.	Yes	No Action
Width	800 ft.	800 ft.	Yes	No Action
Approach Runway Protection Zone (RPZ) – Both Approach Ends				
Length	2,500 ft.	2,500 ft.	Off Property: 12 ac: 16R aprch 3 ac: 34L aprch	Airport Control[1]
Inner Width	1,000 ft.	1,000 ft.		
Outer Width	1,750 ft.	1,750 ft.		
Departure Runway Protection Zone (RPZ) – Both Departure Ends				
Length	1,700 ft.	1,700 ft.	Off Property: 2 ac: 16R dprt 5 ac: 34L dprt	Airport Control[1]
Inner Width	500 ft.	500 ft.		
Outer Width	1,010 ft.	1,010 ft.		
Runway Separation				
From Runway Centerline to:				
Parallel Runway Centerline	700 ft.	700 ft.	Yes	No Action
Hold Line[2]	262 ft.	294 ft.	No: +1’ for every 100’ above sea level[2]	
Parallel Taxiway Centerline (Twy B)	400 ft.	400 ft.	Yes	No Action
Aircraft Parking Area	760 ft.	500 ft.	Yes	No Action

Source: FAA Advisory Circular 150/5300-13A, Change 1 Airport Design (February 2014)
1. See RPZ discussion below for recommendations.; See Hold Line discussion below for more information.

Runway 16L/34R Design Standards

Table 3-13 is the design standards matrix for Runway 16L/34R, based on a critical aircraft of D-IV composite, which at RNO is the Boeing 767/300ER. No change is proposed for future RDC.

Table 3-13: Runway 16L/34R Design Standards Matrix

Runway 16L/34R RDC		D-IV-2400		
Item	Existing Conditions	FAA Design Standards[1]	Meets Standards?	Disposition
Runway Design				
Width	150 ft.	150 ft.	Yes	No Action
Shoulder Width	35 ft.	25 ft.	Exceeds	No Action
Blast Pad Width	220 ft.	200 ft.	Exceeds	No Action
Blast Pad Length	400 ft.	200 ft.	Exceeds	No Action
Crosswind Component	97.3% @ 20 knots	95% @ 20 knots	Yes	No Action
Gradient (maximum)	0.1%	1.5%	Yes	No Action
Runway Protection				
Runway Safety Area (RSA)				
Length beyond departure end	1,000 ft.	1,000 ft.	Yes	No Action
Length prior to threshold	600 ft.	600 ft.	Yes	No Action
Width	500 ft.	500 ft.	Yes	No Action
Runway Object Free Area (ROFA)				
Length beyond departure end	1,000 ft.	1,000 ft.	No: Not Clear of Service Road	See ROFA discussion
Length prior to threshold	600 ft.	600 ft.		
Width	800 ft.	800 ft.		
Runway Obstacle Free Zone (OFZ)				
Length prior to threshold	200 ft.	200 ft.	Yes	No Action
Width	400 ft.	400 ft.	Yes	No Action
Inner Approach OFZ	N/A	N/A	N/A	N/A
Inner Transitional OFZ	N/A	N/A	N/A	N/A
Precision Obstacle Free Zone (POFZ)	N/A	N/A	N/A	N/A
Approach Runway Protection Zone (RPZ)				
Length	1,700 ft.	1,700 ft.	Off Property: 2 ac: 16L aprch 6 ac: 34R aprch	Airport Control[1]
Inner Width	500 ft.	500 ft.		
Outer Width	1,010 ft.	1,010 ft.		
Departure Runway Protection Zone (RPZ)				
Length	1,700 ft.	1,700 ft.	Off Property: 6 ac: 16L dprt 2 ac: 34R dprt	Airport Control[1]
Inner Width	500 ft.	500 ft.		
Outer Width	1,010 ft.	1,010 ft.		
Runway Separation				
From Runway Centerline to:				
Parallel Runway Centerline	700 ft.	700 ft.	Yes	No Action
Hold Line[2]	262 ft.	294 ft.	No: +1' for every 100' above sea level[2]	
Parallel Taxiway Centerline (Twy C)	450 ft. / 300 ft.	400 ft.	Yes	No Action
Aircraft Parking Area	400 ft.	500 ft.	Recommendation	No Action

Source: FAA Advisory Circular 150/5300-13A, Change 1 Airport Design (February 2014)
1. See RPZ discussion below for recommendations.
2. See Hold Line discussion below for more information.

Runway 7/25 Design Standards

Table 3-14 is the design standards matrix for Runway 7/25, based on a critical aircraft of C-III, which at RNO is the Boeing 737/800. No change is proposed for future RDC.

Table 3-14: Runway 7/25 Design Standards Matrix

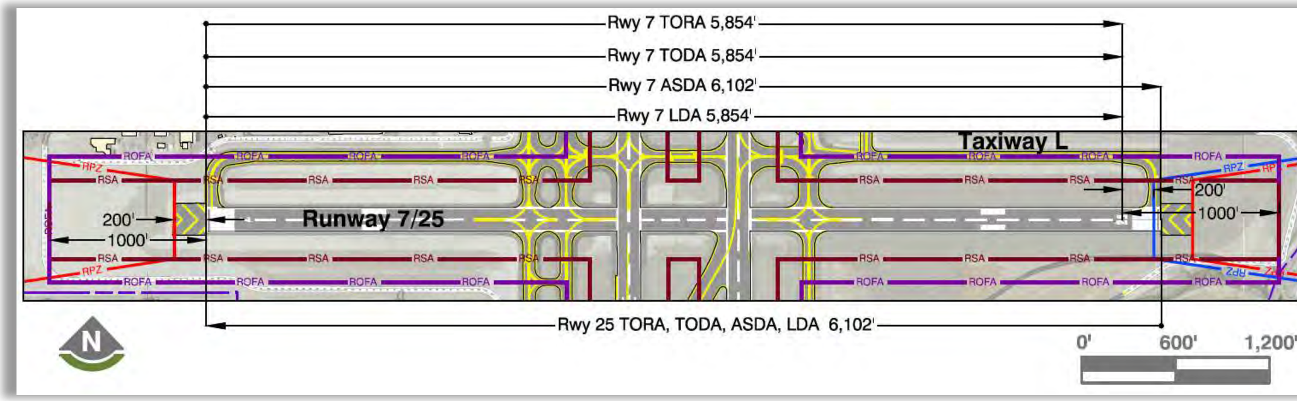
Runway 7/25 Design Code	C-III-VIS			
Item **Runway Design**	Existing Conditions	FAA Design Standards	Meets Standards?	Disposition
Width	150 ft.	150 ft.	Yes	No Action
Shoulder Width	25 ft.	25 ft.	Yes	No Action
Blast Pad Width	200 ft.	200 ft.	Yes	No Action
Blast Pad Length	200 ft.	200 ft.	Yes	No Action
Crosswind Component	97.3% @ 16 kts	95% @ 16 kts	Yes	No Action
Gradient (maximum)	0.2%	1.5%	Yes	No Action
Runway Protection				
Runway Safety Area (RSA)				
Length beyond departure end[1]	1,000 ft.[1]	1,000 ft.	Yes	No Action
Length prior to threshold[1]	600 ft.[1]	600 ft.	Yes	No Action
Width	500 ft.	500 ft.	Yes	No Action
Runway Object Free Area (ROFA)				
Length beyond departure end[1]	1,000 ft.[1]	1,000 ft.	No: Not Clear of Service Road	See ROFA discussion
Length prior to threshold[1]	600 ft.[1]	600 ft.		
Width	800 ft.	800 ft.		
Runway Obstacle Free Zone (OFZ)				
Length prior to threshold	200 ft.	200 ft.	Yes	No Action
Width	400 ft.	400 ft.	Yes	No Action
Inner Approach OFZ	N/A	N/A	N/A	N/A
Inner Transitional OFZ	N/A	N/A	N/A	N/A
Precision Obstacle Free Zone (POFZ)	N/A	N/A	N/A	N/A
Approach Runway Protection Zone (RPZ)				
Length	1,700 ft.	1,700 ft.	Off Property: 12 ac: 7 aprch 9 ac: 25 aprch	Airport Control[2]
Inner Width	500 ft.	500 ft.		
Outer Width	1,010 ft.	1,010 ft.		
Departure Runway Protection Zone (RPZ)				
Length	1,700 ft.	1,700 ft.	Off Property: 9 ac: 7 dprt 12 ac: 25 dprt	Airport Control[2]
Inner Width	500 ft.	500 ft.		
Outer Width	1,010 ft.	1,010 ft.		
Runway Separation				
From Runway Centerline to:				
Parallel Runway Centerline	N/A	N/A	N/A	N/A
Hold Line[3]	262 ft.	294 ft.	No: +1' for every 100' above sea level[3]	
Parallel Taxiway Centerline (Twy L)	400 ft.	400 ft.	Yes	No Action
Aircraft Parking Area (GA West)	600 ft.	500 ft.	Yes	No Action

Source: FAA Advisory Circular 150/5300-13A, Change 1 Airport Design (February 2014)
1. RSA and ROFA dimensions for operations on Runway 7 attained through declared distances. See discussion below.
2. See RPZ discussion below for recommendations.
3. See Hold Line discussion below for more information.

Runway 7/25 has FAA approved declared distances, which are distances available for an aircraft's takeoff run, takeoff distance, accelerate-stop distance, and landing distance. Declared distances are in effect on Runway 7/25 to obtain the required RSA and ROFA for operations on Runway 7. **Figure 3-3** illustrates the published declared distances on Runway 7 with the RSA, ROFA, and runway protection zones (RPZs).

Since Runway 7 has established declared distances, Runway 25 also shows published distance figures. However, RSA and ROFA requirements are met for operations on Runway 25 based on the current runway configuration, and declared distances are not required for RSA and ROFA. The dimensions for each declared distance on Runway 25 is equal to the physical length of the runway – 6,102 feet. For operations on Runway 25, each declared distance begins at the landing threshold and ends at the opposite end of the runway.

Figure 3-3: **Runway 7 Declared Distances with RSA, OFA and RPZs**



Runway Design Standards Compliance

The matrices in **Tables 3-12, 3-13 and 3-14** above detail criteria for design surfaces for each runway, as stipulated by FAA requirements in AC-13A. The design surfaces dimensions are based upon the critical aircraft and ARC plus the type of approach instrumentation. Brief explanations of each design surface follow here with references to any non-standard conditions in **Tables 3-12, 3-13 and 3-14** above. **Figure 3-4** illustrates all runway design surfaces and instrument landing system (ILS) critical areas, with non-standard conditions highlighted in orange.

Runway Safety Area (RSA)

The RSA provides a graded, clear area for aircraft in case of a runway excursion and gives fire-fighting and rescue equipment greater accessibility during such incidents. The RSA must be clear of all objects and capable of supporting aircraft, maintenance vehicles, and rescue vehicles. The FAA does not grant modifications to RSA standards, meaning that non-standard RSAs must be corrected when funding is in place and it can be coordinated with an airport improvement program (AIP) project. RSAs are labeled with a red line in **Figure 3-4**.

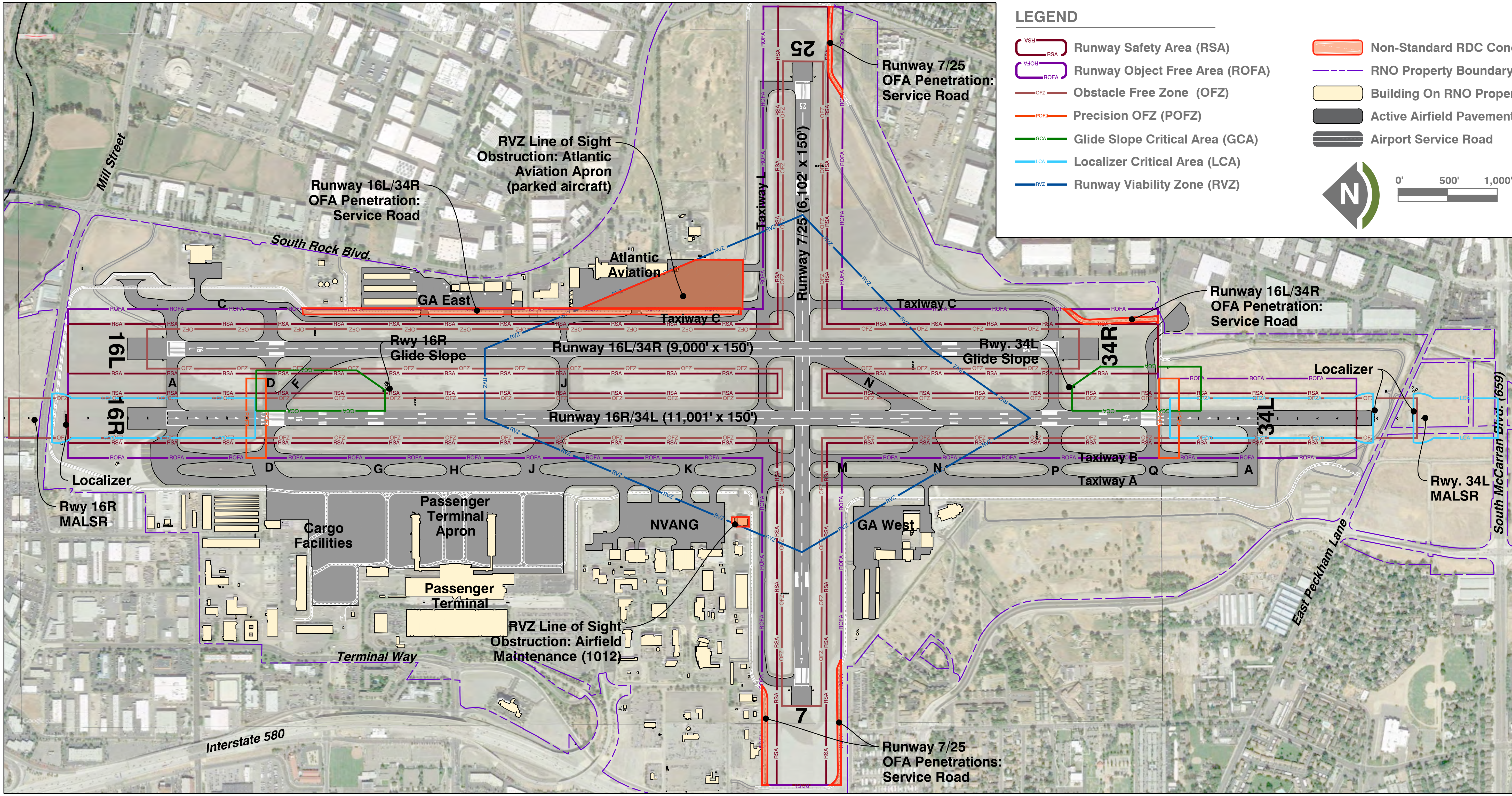


Figure 3-4
Runway and ILS Design Surfaces

The RSA for each runway meets FAA design standards for existing and future runway configuration. The recommendation is that RNO should continue to maintain a clear and graded area for each RSA lateral to and beyond the runway end. RNO should promptly respond to any comments from FAA RSA Team inspections to help maintain required grading, if needed.

Runway Object Free Area (ROFA)

ROFA standards require clearing of above-ground objects protruding above the nearest point of the RSA. Objects non-essential for air navigation must not be placed in the ROFA. Except where prevented by other standards, it is acceptable for objects that need to be in the ROFA for air navigation or aircraft ground maneuvering to protrude above the nearest point of the RSA, and for aircraft to taxi and hold in the ROFA. ROFAs are identified with a purple line in **Figure 3-4**.

The perimeter service road crosses into the ROFA at each approach end of Runway 7/25, east of Runway 16L/34R near GA East, and at the approach end of Runway 34R, as shown in **Figure 3-4**. Although service roads and vehicles are prohibited from ROFAs, relocation of these existing service roads is not recommended. The existing condition is not an operational issue at RNO, because the 24-hour ATCT staff provide operational guidance to drivers on the service roads. Relocating the northeast quadrant service road would require a shift in GA East facilities (hangars and aprons). Other relocations would require significant environmental and construction costs. It is recommended that RTAA continue to coordinate with the ATCT on any operational procedures for movement inside an existing service road. Additionally, it is further recommended that the RTAA consider adding more signage alerting vehicle operators that they are entering a ROFA, and that no new service roads are constructed within ROFAs.

Obstacle Free Zones (OFZ)

Several types of OFZs are possible, but regardless of type, all are operational surfaces that must be kept clear during aircraft operations. The shape and size of the OFZ depends on the approach minimums for the runway end. The Runway OFZ (ROFZ) is a defined three-dimensional volume of airspace centered above the runway centerline. The ROFZ extends 200 feet beyond each end of the runway, and the size of the aircraft operating on the runway determines its width. OFZs are identified with a pink line **Figure 3-4**. The OFZ for each runway is clear of penetrations, and therefore no improvements are necessary.

Inner-Approach OFZ

An inner-approach OFZ is a defined three-dimensional volume of airspace centered on the runway approach area and applies only to runways with an approach lighting system (ALS). At RNO, the inner-approach OFZ is in effect at the approach ends of Runway 16R and 34L. The inner-approach OFZ begins 200 feet from the runway threshold and extends 200 feet beyond the last light unit in the ALS. Its width is the same as the ROFZ and rises at a slope of 50:1 from its starting point. OFZs are identified with a pink line and labeled in **Figure 3-4** at the end of Runway 16R and 34L.

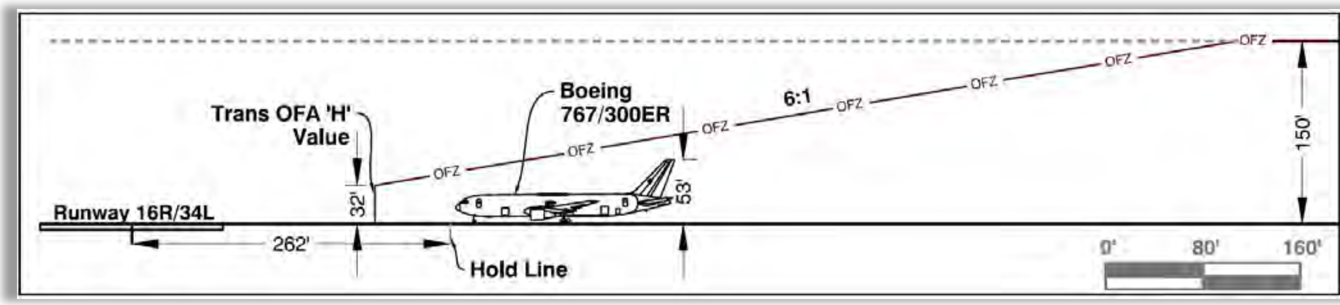
The inner-approach OFZ is clear of penetrations at each end of Runways 16R and 34L. This includes vehicles on roads within the inner-approach OFZ: Mill Street, at the approach end of Runway 16R, and East Peckham Lane, at the approach end of Runway 34L. The recommendation is that RTAA continue to maintain this area clear of vegetation that could penetrate the 50:1 surface.

Inner-Transitional OFZ

The inner-transitional OFZ is a defined volume of airspace along the sides of the OFZ, lateral to the runway. This applies only to runways with lower than 3/4-statute-mile approach visibility minimums, which at RNO is just Runway 16R/34L. Tails of parked and taxiing aircraft may not penetrate the inner-transitional OFZ.

For runways serving large airplanes with Category I approach minimums, the inner-transitional OFZ rises a value of "H" vertically where the runway OFZ stops, 200 feet from the runway centerline. The H value is determined based on the critical aircraft dimensions and the airport elevation, and as a result is 32 feet at RNO. From H the inner-transitional OFZ rises at a slope of 6:1 to a point 150 feet above the airport elevation. **Figure 3-5** shows the profile view of the inner-transitional OFZ and illustrates the rise of the H value. The tail height of the Boeing 767/300ER is 53 feet and is clear of the inner-transitional OFZ, and therefore no modifications are necessary.

Figure 3-5: Runway 16R/34L Inner-Transitional OFZ (Profile)



Precision Obstacle Free Zone (POFZ)

A POFZ is located at the approach ends of Runways 16R and 34L. The POFZ is defined as a volume of airspace above an area beginning at the landing threshold, at the elevation of the landing threshold, and centered on the extended runway centerline. The POFZ is 200 feet long by 800 feet wide and illustrated on **Figure 3-4** in orange. This surface is only in effect when all three of the following criteria are met:

- The approach includes vertical guidance;
- The reported ceiling is below 250 feet or visibility is less than 3/4 statute miles (or RVR is below 4,000 feet); and
- An aircraft is on final approach within two miles of the runway threshold.

When the POFZ is in effect, the wing of an aircraft on a taxiway waiting for runway clearance may penetrate the POFZ, but the fuselage or tail may not. The POFZ markings and signs at RNO comply with FAA standards.

Runway Protection Zone (RPZ)

The RPZ is a trapezoidal area at the end of the runway designed to enhance safety for aircraft operations and for people and objects on the ground. The FAA recommends that incompatible land uses, objects, and activities that would compromise the RPZ be located outside it. The FAA also recommends that an airport operator take reasonable measures to control an RPZ, ideally through fee simple property acquisition. If acquisition is not feasible, then land use control measures or cooperative interagency planning is recommended to prevent the expansion of existing non-compatible development or the addition of new non-compatible development within an RPZ.

Portions of RPZs at each runway end are located off airport. To the north, or the approach to Runway 16R and 16L, the majority of RPZ is owned by the RTAA except for Mill Street. Mill Street bisects each RPZ and several existing developments on the west corner of the RPZ. To the south, or the approach to Runway 34L and 34R, most of the RPZ is owned by the RTAA except for East Peckham Lane. East Peckham Lane bisects the RPZ to Runway 34L and a six-acre parcel within the Runway 34R RPZ, which was formerly a through-the-fence operation.

To the west, about 11 acres of the RPZ to Runway 7 is located off airport, including Terminal Way, Interstate 580, and primarily residential development. To the east, about 8 acres of the RPZ to Runway 25 is located off airport, including Longley Lane and some light industrial land use.

Figure 3-6 shows the total acres for the RPZs located both on and off RNO property, and **Tables 3-12, 3-13 and 3-14** above document RPZ land use. The figure identifies the RPZs within the existing airport property with green shading, and the portions not owned by the RTAA, in yellow.

The FAA provides guidance on RPZ land use compatibility in the 2012 memorandum *Interim Guidance on Land Uses within a Runway Protection Zone*. Land uses and structures not inherently compatible in the RPZ include: buildings, especially those for assembly such as churches or schools; fuel facilities; hazardous material storage; recreational land uses; and transportation facilities and roads. The FAA does not have the authority to regulate local land use, so it relies on the airport sponsor to work with local jurisdictions to promote compatible development within the RPZ. Airport actions that introduce incompatible land uses into the RPZ, either by moving a runway end or increasing the size of the RPZ, require coordination with FAA headquarters. This coordination is not needed for existing incompatible land uses if the RPZ does not move or change size.

The FAA is currently grandfathering non-standard RPZ land uses, until a change to an RPZ size or location is required (usually triggered by an RDC change, lower instrument approach minimums, or a runway shift or extension). Since no changes to runway length, RDC, or approach minimums are initially recommended, no changes to the RPZs will occur and acquisition is not required. Although it is recommended that the RTAA study long-term RPZ acquisition, initial analysis indicates that RPZ property acquisition is not reasonable due to lengthy acquisition procedures, cost-prohibitive relocation costs, and minimal return-on-investment as all acquired properties would require demolition with minimal potential of future revenue generation.

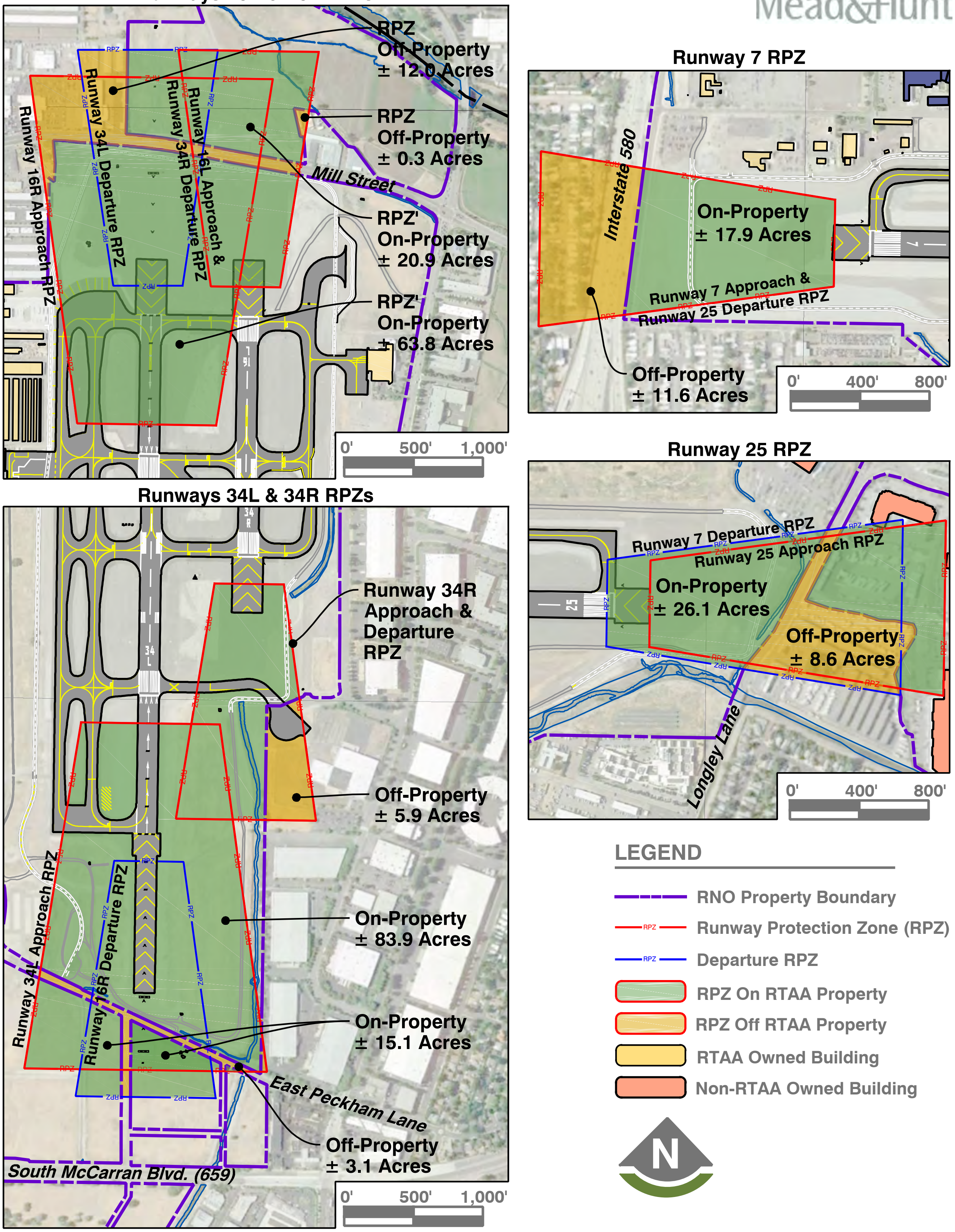


Figure 3-6
RPZ Off Airport Control

Runway Visibility Zone (RVZ)

Runway line-of-sight standards indicate intersecting runways must maintain an unobstructed line of sight from any point five feet above the runway centerline to any other point five feet above the intersecting runway centerline within the visibility zone. The RVZ at RNO is established by points equidistant from the intersection points and the runway ends. The RVZ prohibits any fixed or movable objects that may limit line of sight between the runways. **Figure 3-4** shows the RVZ as a blue line and identifies existing line of sight obstructions.

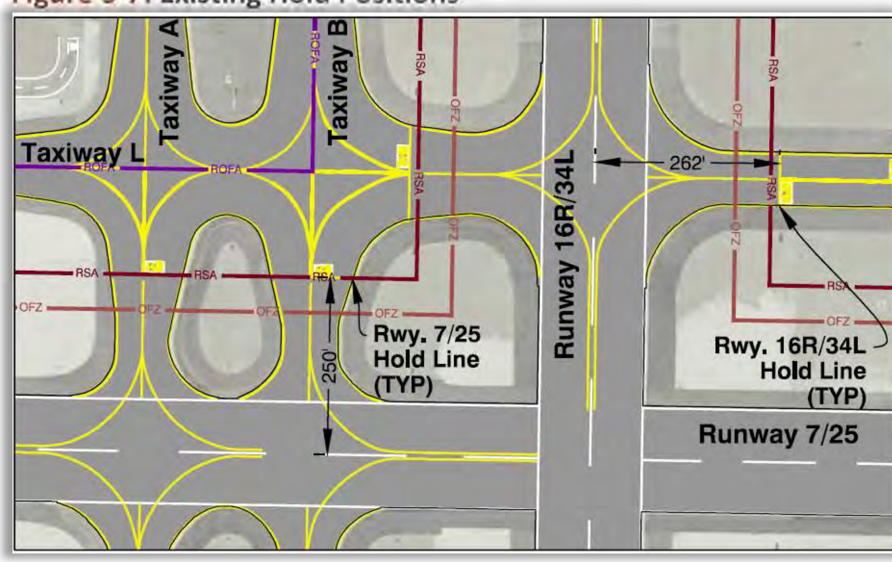
The line of sight obstructions occur in two places. The first is 525,000 square feet of the Atlantic Aviation apron where aircraft park and tie down. This section of the apron only includes aircraft parking areas, no permanent structures. RNO has made efforts to limit permanent structures within the RVZ on the Atlantic Aviation apron. The fuel farm contains the last structure to be built, which was intentionally located outside the RVZ. However, parked aircraft are considered an obstruction to RVZ clearing standards. The airfield maintenance facility (building # 1012), south of the NVANG apron also obstructs the RVZ.

The recommendation is that RNO continue to limit permanent structures within the RVZ and to consider relocating or removing the airfield maintenance facility. Another option that has merit for RNO is to look at a modification to standards for RVZ obstructions. The FAA has shown favorable response to modifying RVZ standards when airports have an ATCT. Since RNO has an ATCT, the FAA may approve such a modification.

Hold Positions

RDC determines the holding position distance on each connector taxiway from the runway centerline. AC-13A shows that for C-III and D-IV RDC runways, the holding position is 250 feet from the runway centerline. In addition, the required distance increases 1 foot for each 100 feet the airport is above sea level. Using this formula, at 4,400 feet mean sea level (MSL), the required distance for hold positions from all runway centerlines is 294 feet.

Figure 3-7: Existing Hold Positions



Currently, the hold lines for Runways 16R/34L and 16L34R are located 262 feet from the runway centerline, and for Runway 7/25 the distance is 250 feet from centerline, as **Figure 3-7** illustrates. These hold lines do not meet the standard outlined in AC-13A.

The FAA updated guidance in AC-13A regarding holding positions in 2014. RNO has updated holding positions (and associated signs and marking) based on the prior guidance. Moving hold lines and requirements will be analyzed in alternatives, including looking at the impact that holding aircraft further from the runway would have on taxiway movement.

NAVAID Critical Areas

Runway 16R/34L has a glide slope and localizer as part of the instrument landing system at each runway end. An antenna array radiates from each of these facilities. These components are explained in more detail in **Chapter 1**. For NAVAIDs, the FAA requires that a critical area remain clear of objects to ensure the integrity of the signal received by aircraft using the equipment.

Figure 3-4 shows the glide slope critical area in green. The dimensions of the glide slope critical area are based on dimensions for a "sideband reference and capture effect'" type glide slope, as defined in FAA Order 6750.16D, *Siting Criteria for ILS*. Order 6750.16D outlines dimension for the localizer critical area, which **Figure 3-4** illustrates in light blue**.** The localizer critical area at the approach end of Runway 34L is divided into two sections for each localizer component, which is divided by East Peckham Lane. There are no penetrations to the glide slope critical area and localizer critical area.

The recommendation is that RNO keeps the ILS critical areas clear of objects that would cause interference to the antenna array. Vegetation should not exceed 12 inches in height.

Blast Pads

Paved runway blast pads provide erosion protection beyond runway ends during jet aircraft operations. The blast pads for each runway meet or exceed design standards. The blast pad at the approach end of Runway 34L is 1,000 feet long. The blast pads at the approach ends of Runways 16R, 16L and 34R are 400 feet long, and the blast pads on Runway 7/25 are 200 feet long.

A paved area beyond the runway end may be designated as a stopway for use with declared distances. A stopway increases the declared distance of the accelerate-stop distance available to departure operations on a runway. No stopways are designated at RNO. Maintaining the extra pavement on the Runway 34L approach is advantageous in the event of an overrun; however, other options, such as a standard RSA, require less maintenance and marking.

Runway Length

This assessment is to verify that the available runway length meets the needs of existing users, and whether additional length would open the Airport to additional users. Runway 16R/34L is 11,001 feet long, Runway 16L/34R is 9,000 feet long, and Runway 7/25 is 6,102 feet long. As explained above, Runway 7/25 has declared distances, which means the full length is not usable in both directions. At their existing lengths, these runways serve the range of GA piston engine aircraft and jets, turbo-prop, regional, and narrow-body passenger jets, and narrow- and wide-body cargo aircraft that operate from RNO. RNO connects to airline hubs across the country, putting travelers within one stop of many key cities in the U.S. and the world. Runway length is generally sufficient for aircraft serving domestic and North American destinations from RNO; however, long-haul international destinations to South America, Asia, and Europe face challenges.

These challenges are due to the elevation and environment in which RNO is located. Temperature, elevation, and obstructions impact aircraft ability to perform at RNO on the existing runway length. This section summarizes these challenges, which are explored in detail in **Appendix E**.

Several factors drive required runway length: aircraft weight; engine type; runway contamination, for example, water and ice; and density altitude, which is a product of elevation and temperature. Obstructions in the approach and departure path factor into the equation as the aircraft must be able to clear them even in the event of an engine failure. The following paragraphs explain the terminology and variables used in the runway length assessment.

Elevation

RNO has six runway ends from which aircraft can operate, and the elevation of these runway ends ranges from 4,400 feet above MSL to 4,415 feet MSL.

International Standard Atmosphere (ISA)

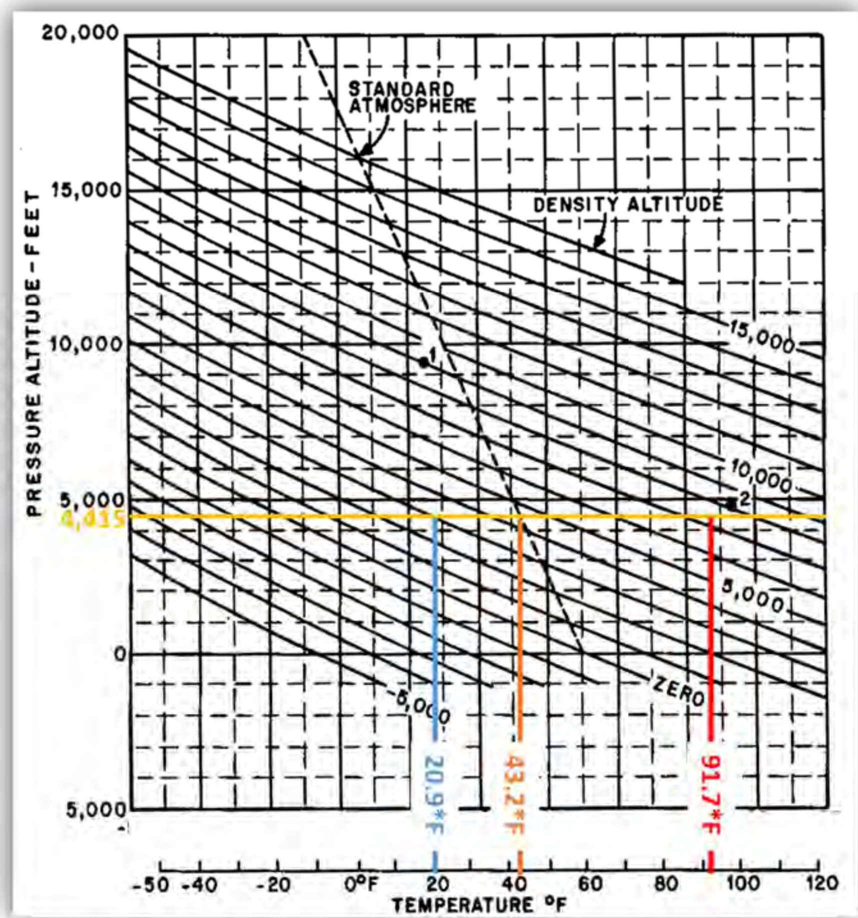
This mathematical model describes how the earth’s atmosphere, or air pressure and density, change depending on altitude. The atmosphere is less dense at higher elevations. ISA is frequently used in aircraft performance calculations because deviation from ISA will change how an aircraft performs. ISA at sea level occurs when the temperature is 59°F. ISA at 4,415 feet MSL occurs when the temperature is 43°F.

Density Altitude (DA)

This measurement compares air density at a point in time and specific location to ISA that is a critical component of aircraft performance calculations. DA is used to understand how aircraft performance differs from the performance that would be expected under ISA. DA is primarily influenced by elevation and air temperature, essentially the higher and hotter it is impacts aircraft performance. To examine the effect of changes to either variable, this calculation holds the other variable constant. **Figure 3-8** shows the DA for RNO at the average low and average high temperatures.

- At constant elevation: When air temperature increases, DA increases. When air temperature decreases, DA decreases. This comparison is often used when analyzing aircraft performance at an airport during different times of the day, and different days of the year.
- At constant temperature: When elevation increases, DA increases. When elevation decreases, DA decreases. This comparison, which is not often used, can be employed to compare aircraft performance at different airports under identical climate conditions.

Figure 3-8: Density Altitude Calculation



Source: Federal Aviation Administration

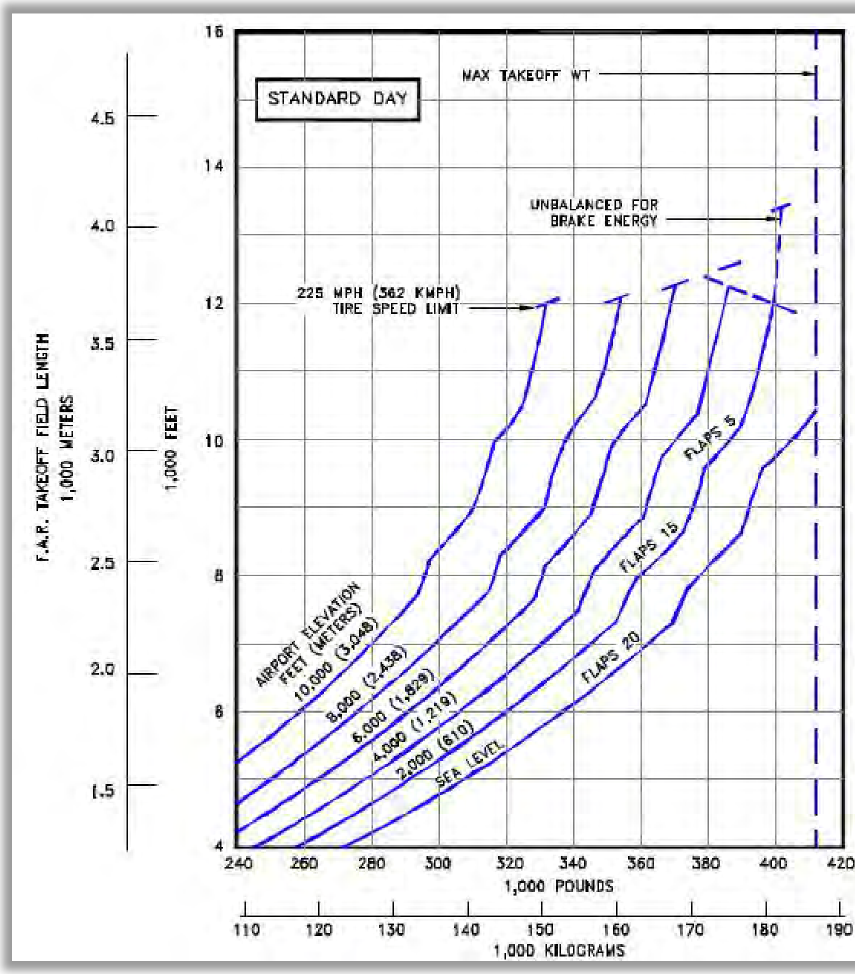
As shown in **Figure 3-8**, DA for RNO at the average minimum temperature, which is 20.9°F, is 4,000 feet and the DA at the average maximum temperature, which is 91.7°F, is over 7,000 feet. National Oceanic and Atmospheric Administration (NOAA) climate data from 1981 to 2010 shows the average maximum temperature at RNO exceeds ISA, or 43.2°F, every day of the year. There are 133 days where the average temperature range exceeds 43.2°F during daylight hours. The DA at RNO is generally greater than airport elevation, which reduces aircraft and engine performance, requiring additional runway length. As a result, the reduction in performance is most pronounced in the summer when DA can be equivalent to over 7,000 feet above MSL.

As DA approaches 7,000 feet above MSL, aircraft performance declines. The effect of increasing DA is compounded by a reduction in engine performance as temperatures approach 100°F. Runway length requirements increase in this situation and may exceed the 11,001 feet available at RNO. To remedy this situation, airlines must lower takeoff weight by reducing the number of passengers and cargo on the flight. This disrupts the travelers and impacts the airlines financial performance on the route, as they offer compensation and alternate travel arrangements to the inconvenienced passengers.

Airlines at RNO report that airline fleet modernization, such as the replacement of the MD-80 aircraft with more powerful Boeing and Airbus narrow-bodies, has reduced some of the impact of hot days on operations.

The effect of DA on aircraft performance is shown in **Figure 3-9**. The blue lines represent runway length required at a given elevation at ISA. The Boeing 767-300ER was selected for this demonstration because it is the critical aircraft for primary runway 16R/34L. The Boeing 767-300ER, at a constant takeoff weight of 380,000 pounds and in ISA, requires 8,000 feet of runway at sea level, 9,500 feet of runway at 1,000 feet above MSL, and 11,000 feet of runway at 4,000 feet above MSL. These lengths increase as temperature exceeds the ISA level for that altitude. At a certain point, the aircraft is unable to take off due to the limits of its tires and brakes.
Takeoff from RNO on a hot day, where DA is near 7,000 feet, is not possible unless payload is reduced to a takeoff weight under 360,000 pounds, in this example. Extending a runway beyond 12,000 feet at 4,000 feet AMSL will not have much impact on the Boeing 767-300ER's ability to take on additional payload.

Figure 3-9: **Takeoff Runway Requirements for a Boeing 767-300ER**



Source: 767 Airplane Characteristics for Airport Planning, 2005 (Boeing)

As demonstrated in **Figure 3-9**, the 767-300ER cannot take off at MTOW, except at sea level, meaning that the aircraft must operate below its MTOW regardless of what runway length is available at RNO. The slope of the blue line is nearly vertical beyond Runway 16R/34L's length of 11,001 feet, meaning that at any given DA, adding another 1,000 feet of runway length will enable only a few thousand pounds of additional payload. **Appendix E** includes analysis on how DA, aircraft performance capabilities, and obstructions can be addressed to provide additional runway length. This appendix includes discussion on the benefits and drawbacks associated with extending the runway.

Pavement Strength

The FAA provides guidance for classifying and reporting pavement strength in AC 150/5335-5C, *Standardized Method of Reporting Airport Pavement Strength – PCN*. A value called the Pavement Classification Number (PCN) represents the pavement strength. The PCN is a factor of the pavement section, combined aircraft operations, and the most demanding aircraft anticipated to use the pavement.

The results from a PCN evaluation for RNO performed in 2014 are shown in **Tables 1-7** and **1-9** in **Chapter 1**. This section includes a re-calculation of the pavement strength based on existing and forecast aircraft operations. A model derived from pavement data from the 2014 report input with the operations shown above in **Tables 3-2** through **Table 3-6** determined the current and future PCN values. **Table 3-15** presents the pavement strength results for 2016 operations and forecast operations for 2026 on each runway. The critical aircraft for PCN calculation is shown and may differ from the critical aircraft that determines airfield design standards (767-300ER); however, the full fleet mix is included in PCN analysis. To help streamline the PCN discussion, the taxiway PCNs are also presented here. Further taxiway analysis is provided in the following **Taxiway System Section**. Only data for 2016 and 2026 is presented. PCN calculation is based on most demanding aircraft in the projected fleet mix. The fleet mix is not projected to change proportionally from 2026-2036 as much as projected between 2016-2026.

Table 3-15: PCN Analysis for 2016 and 2026 Operations

Section	2016 Operations			2026 Operations		
	PCN	Critical Aircraft ACN	CDF	PCN	Critical Aircraft ACN	CDF
Runway 16R/34L	89/R/B/W/T	69 (MD-11/ER)	0.14	70/R/B/W/T	59 (Airbus 300-600)	0.18
Runway 16L/34R	89/R/B/W/T	69 (MD-11/ER)	0.07	72/R/B/W/T	59 (Airbus 300-600)	0.09
Runway 7/25	68/R/B/W/T	52 (Boeing 737-800)	0.03	68/R/B/W/T	52 (Boeing 737-800)	0.03
Taxiway A	66/R/B/W/T	52 (Boeing 737-800)	0.06	66/R/B/W/T	52 (Boeing 737-800)	0.07
Taxiway B	71/R/B/W/T	69 (MD-11/ER)	0.84	58/R/B/W/T	59 (Airbus 300-600)	1.06
Taxiway C (North)	73/R/B/W/T	15 (Falcon 900)*	0.00	60/R/B/W/T	15 (Falcon 900)*	0.00
Taxiway C (Central)	34/R/B/W/T	15 (Falcon 900)*	0.00	34/R/B/W/T	15 (Falcon 900)*	0.00
Taxiway C (South)	73/R/B/W/T	31 (Gulfstream V)*	0.00	60/R/B/W/T	31 (Gulfstream V)*	0.00
Taxiway D	73/R/B/W/T	69 (MD-11/ER)	0.71	60/R/B/W/T	59 (Airbus 300-600)	0.88
Taxiway F	89/R/B/W/T	69 (MD-11/ER)	0.01	72/R/B/W/T	59 (Airbus 300-600)	0.01
Taxiway G	89/R/B/W/T	69 (MD-11/ER)	0.06	72/R/B/W/T	59 (Airbus 300-600)	0.07
Taxiway H	69/R/C/W/T	54 (Boeing 737-800)	0.12	68/R/C/W/T	54 (Boeing 737-800)	0.16
Taxiway J	77/R/B/W/T	69 (MD-11/ER)	0.49	62/R/B/W/T	59 (Airbus 300-600)	0.61
Taxiway L	68/R/B/W/T	52 (Boeing 737-800)	0.03	68/R/B/W/T	52 (Boeing 737-800)	0.03
Taxiway N	89/R/B/W/T	69 (MD-11/ER)	0.09	72/R/B/W/T	59 (Airbus 300-600)	0.11
Taxiway P	89/R/B/W/T	69 (MD-11/ER)	0.05	72/R/B/W/T	59 (Airbus 300-600)	0.07
Taxiway Q	90/R/B/W/T	69 (MD-11/ER)	0.04	74/R/B/W/T	59 (Airbus 300-600)	0.05
Terminal Aprons	87/R/B/W/T	69 (MD-11/ER)	0.05	71/R/B/W/T	59 (Airbus 300-600)	0.07

Source: Mead & Hunt. Note: Critical aircraft for weight and PCN calculation is shown; however, the full fleet mix as shown in Tables 3-2 through 3-6 above are included in PCN analysis.
* The Falcon 900 and the Gulfstream V were assumed to be the most demanding aircraft currently using Taxiway C, although the pavement can support heavier aircraft, as indicated by the PCN value.

The letters shown within the PCN columns represent the following:

- **First Column (R):** Indicates the pavement type: "R" for rigid pavement (Portland cement concrete).
- **Second Column (B or C):** Indicates the subgrade strength category. "A" is strongest, "D" is weakest.
- **Third Column (W):** Indicates allowable tire pressure. "W" represents unlimited tire pressure, which is typical for rigid pavement.
- **Fourth Column (T):** Indicates the analysis method used. "T" for technical evaluation method, which uses pavement data and the FAA program COMFAA.

Also shown in the table are the Aircraft Classification Numbers (ACN) for the critical aircraft that use each pavement section, and the Cumulative Damage Factor (CDF). The CDF is an indicator of the damage done to the pavement by the fleet mix. When the CDF is less than one, the pavement section is structurally adequate to support the operations. Additionally, when the pavement section is adequate, the PCN value is higher than the critical aircraft ACN value.

The results show that all runways and taxiways, as well as the terminal aprons, can support the existing operations. In 2026, if operations continue as projected, the pavement should still be structurally adequate, except for Taxiway B, which is projected to have a CDF of 1.06. This value is very close to one and operations may change from what is anticipated. If operations are fewer than expected, then the CDF may not exceed 1.0 by 2026. Pavement condition should still be monitored regularly to determine the appropriate maintenance schedule.

Instrument Approaches

Table 1-18 in the **Chapter 1** fully details the instrument approaches in effect at RNO**. Table 3-16** shows the approaches with the lowest minimums to each runway.

Table 3-16: Lowest Instrument Approach Procedures

Runway	Procedure	Minimums	
		Decision Height (AGL)	Visibility (Statute Miles)
16R	ILS X OR LOC X	200 feet	½ mile
	ILS Z OR LOC Z	200 feet	½ mile
16L	RNAV (RNP) Z	381 feet	1-1/8 mile
34R	RNAV (GPS) X	892 feet	1-1/4 mile
34L	RNAV (RNP) Z	361 feet	1 mile
Circle-to-Land	VOR-D	1,585 feet	1-1/4 mile
Source: FAA Digital Terminal Procedures (d-TPP) publication and Airport 5010			

The glide slopes, localizers, and medium intensity approach lighting systems make up the ILS for either end of Runway 16R/34L. The ILS allows for precision instrument approaches. More discussion on these facilities is provided in the **Chapter 1** in the **Airside Facilities Section**.

The instrument approach and departure procedures determine the size and slope of the "imaginary" airspace surfaces that protect the flight corridors to and from the airport. Multiple standards apply to the runway, including those described in Title 14 of the Code of Federal Regulation (CFR), Part 77, Safe, Efficient Use, and Preservation of Navigable Airspace (Part 77); FAA Order 8260.3C, *United States Standard for Terminal Instrument Procedures (TERPS);* and threshold siting surfaces (TSS), also known as obstacle clearance surfaces, described in AC-13A. Part 77 and TSS deal with runway location and compatible land use and are used in general airport planning. TERPS surfaces deal with instrument procedure development, and airport planning exercises do not commonly use TERPS. The TERPS instrument departure surface is cross-referenced as a TSS.

The runway type and the type of instrument approach procedure, for example, visual, non-precision, and precision, determine the Part 77 surface dimensioning. Part 77 surfaces are notification surfaces designed to identify and determine obstructions to air navigation. They are advisory, not regulatory. Penetrations to Part 77 surfaces, however, can make it difficult for airports to extend or relocate runways, and to add new instrument procedures.

The type of instrument approach procedure, for example, ILS, GPS, and VHF Omnidirectional Range, determines TERPS surface dimensions. TERPS surfaces are regulatory, and penetrations to TERPS surfaces will result in modified or cancelled instrument procedures.

The type of instrument procedure, critical aircraft on each runway, and the visibility minimums of the lowest instrument approach determine TSS. TSS apply to both approach and departure ends of the runway and determine the location of the runway thresholds. Penetration of TSS will require modification of departure climb gradient for penetrations to departure TSS, and relocation of landing thresholds or reduction in approach procedure capability for penetrations to approach TSS.

Figures 3-10, 3-11 and 3-12 show the Part 77 and TSS surfaces for each runway. These figures also illustrate obstructions from the 2014 Airports Geographic Information System (AGIS) survey that penetrate these airspace surfaces. Green objects are clear of the Part 77 and TSS. Yellow objects penetrate the Part 77 approach but are clear of the TSS. A single, red object penetrates the TSS to Runway 7. Only objects captured during the 2014 AGIS survey were analyzed here against current runways and approaches.

Additional options for improving the approaches to Runways 7/25, 16L/34R and 16R/34L are addressed in the next section.

NAVAIDs and Instrumentation

Existing NAVAID facilities at RNO are documented in the **Chapter 1** in **Table 1-10**. NAVAIDs to each runway are adequate for the type of existing instrument approach to each runway. The combination of the ASV and peak hour operations during IFR conditions do not warrant the need for installation of an ILS to Runways 34L and 34R. Total operations during IFR conditions are not significant such that an additional ILS would increase airfield capacity. However, several airport stakeholders have expressed interest in exploring a CAT-II ILS approach to Runway 16R and the addition of an ILS approach to Runway 16L. Both approaches would reduce visibility minimums to their respective runways; however, several factors must be considered. These include the preparation of an updated aeronautical obstruction survey, coordination with FAA, and the installation of additional ILS equipment.

To accommodate a CAT-II approach on Runway 16R, RNO would need additional facilities including: RVR sensors at touchdown, midpoint, and rollout points; increased OFZ requirements; and meeting the TERPS missed approach segment. It is important to note that a CAT-II approach would not change the runway or taxiway design surface requirements, or the Part 77 and TSS for Runway 16R. In addition, a CAT-II approach would not have any significant impact on airfield capacity since RNO operates under IFR conditions approximately five percent of the time. The primary benefits of a CAT-II approach on Runway 16R are a lower decision height for the pilot in command and decreased visibility minimums for aircraft arrivals conducted during periods of inclement weather.

The addition of an ILS approach to Runway 16L would also operate as a potential backup system should the Runway 16R ILS become inoperable or during times of repair. An ILS to Runway 16L would also require additional facilities including: glide slope; RVR sensors at touchdown; increased Part 77, threshold siting, and OFZ requirements; meeting the TERPS missed approach segment; and an increase in RPZ area north of the runway. The RPZ increase may trigger the FAA to require property acquisition. Due to the benefits associated with having a redundant ILS capability, it is recommended that an ILS on Runway 16L be considered in the alternatives analysis.

Apart from a potential CAT-II to Runway 16R and exploring the possibility of an ILS on Runway 16L, no additional NAVAIDs are proposed for the runway system. Runway 7/25 is constrained by obstructions located to the west and terrain located further east. The primary obstruction to Runway 7 appears to be a tree located in a nearby residential area. There also appear to be other trees near the Runway 7 approach surfaces. It is recommended that RNO take steps to clear vegetation west of Runway 7 near the approach surfaces, including trees or other vegetation that may have grown since the 2014 AGIS survey, depending on the species and the time of year to avoid impacts to natural habitat. Future improvements resulting from the FAA NextGen are being implemented across the Country. NextGen shifts away from on-airport navigational facilities to satellite-based aircraft guidance. In the future, NextGen may offer the possibility for lower instrument approach minimums without the need for new NAVAIDs for Runways 7/25, 16R/34L and 16L/34R.

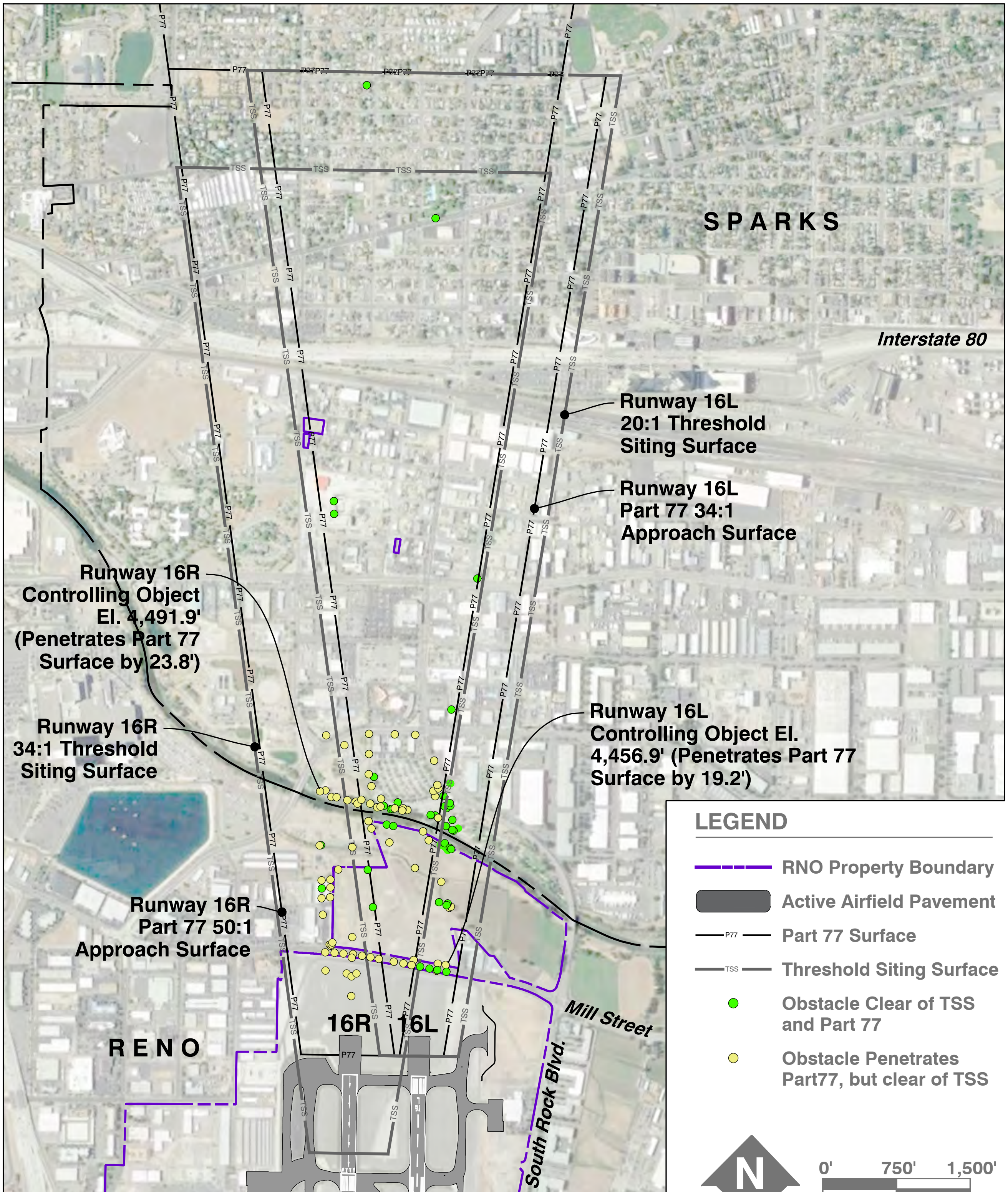
Overall, it is recommended that RNO maintain their existing NAVAIDs and consider the implementation of a CAT-II approach to Runway 16R and an ILS approach to Runway 16L. CAT II operations on Runway 16R would require the addition of these facilities:

- A rollout RVR sensor in addition to the existing touchdown RVR sensor. When the runway is more than 8,000 feet long, a midpoint RVR sensor is required in addition to the touchdown and rollout sensors for CAT II operations below RVR 1,600.
- Touchdown zone lights.

Runway Lighting and Marking

Runway lighting, signage, and markings are in generally good condition, but should be reoriented if any hold line is relocated. The changes to taxiways, as proposed in the **Taxiway Section** below, will also require the airport to relocate signs.

Based on gradual changes in magnetic declination, Runways 16R&L/34R&L will need to be re-designated as 17R&L/35R&L. Calculations indicated the magnetic bearing will reach 166.9/346.9 degrees in 2020. As a result, it is advised that re-designation of the runways be included during a runway rehab or reconstruction project scheduled for 2019-2020. This will require the re-painting of the runway end designators to the new numbers, plus changing the placards associated with Runways 16R/34L and 16L/34R. Coordination with FAA to update the airports facility directory and published instrument approaches should be coordinated a year prior to implementing any physical changes to the runways.



Reno-Tahoe INTERNATIONAL AIRPORT MASTER PLAN

Figure 3-10
Obstacles - Runway 16L & 16R Approaches

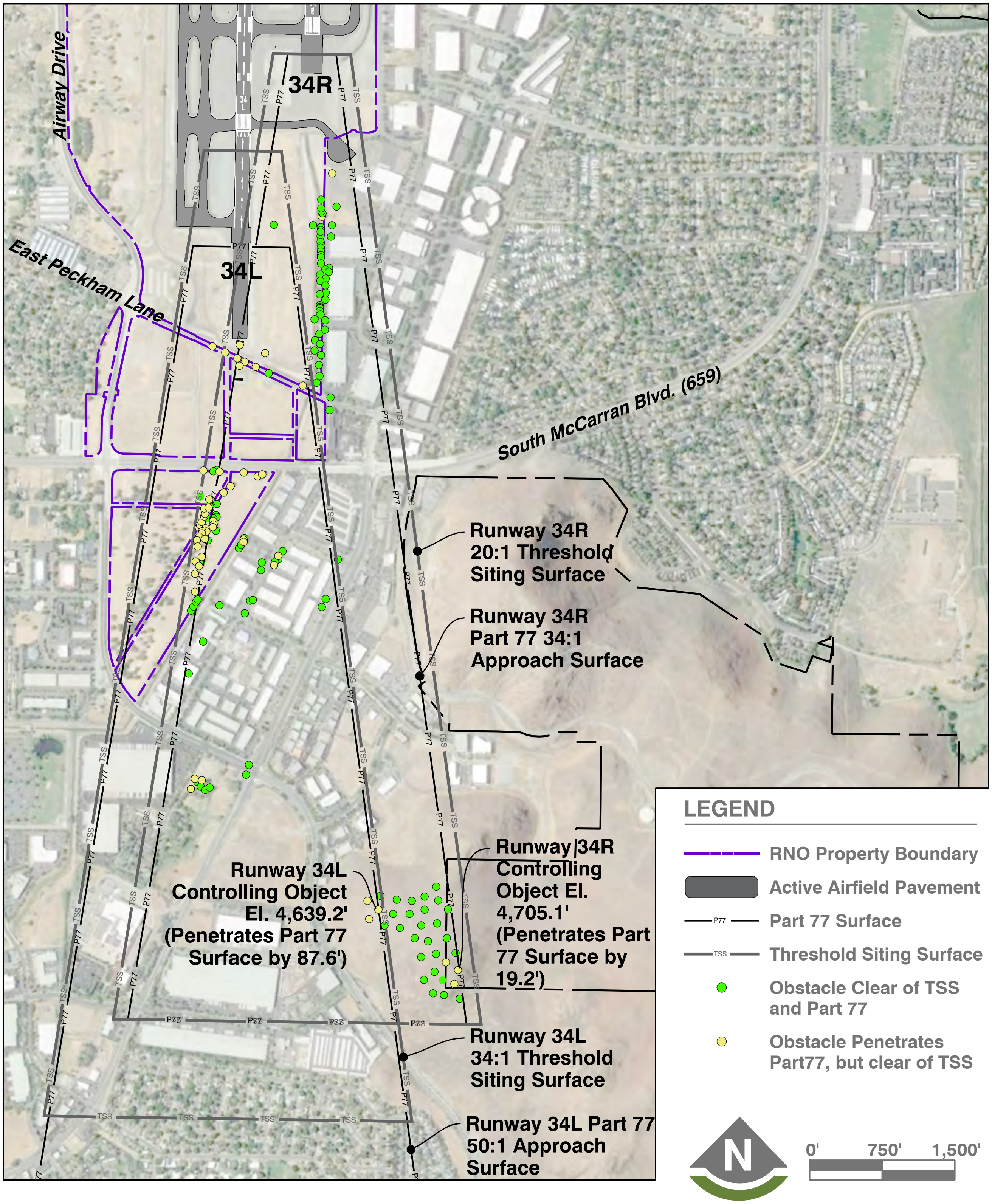


Figure 3-11
Obstacles - Runway 34L & 34R Approaches

Reno-Tahoe
INTERNATIONAL AIRPORT MASTER PLAN

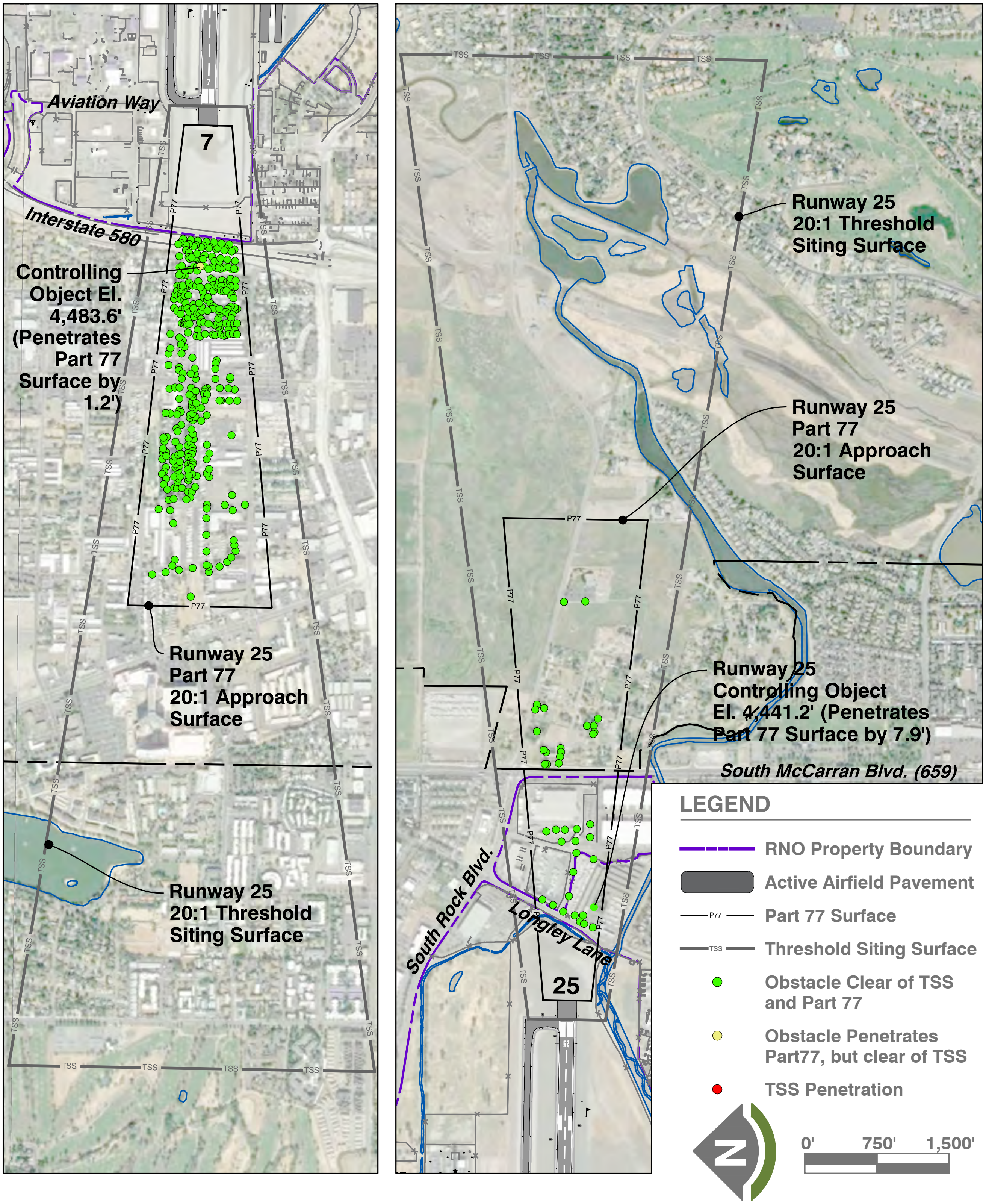


Figure 3-12
Obstacles - Runway 7-25 Approach

Runway System Conclusions and Recommendations

The previous section outlined major runway design factors and surfaces. Overall, the runway system is well designed per design standards in AC-13a. The RSAs are clear of obstructions and there are no modifications to standards on the runway design surfaces. The recommended disposition for the non-standard conditions are summarized in **Table 3-17** matrix below.

Table 3-17: Runway Design Standards Summary

Design Surface	Runway	Location	Issue	Recommendation
ROFA	16L/34R	GA East	Service Road within ROFA	Note as non-standard condition and mitigate with 24-hour ATCT and signage.
		Runway 34R approach end		
	7/25	Runway 7 approach end		
		Runway 25 approach end		
RVZ	16L/34R & 7/25	GA East – Atlantic Aviation apron	Parked aircraft block RVZ line of sight	Note as non-standard condition.
	16R/34L & 7/25	Airfield maintenance building #1012 (old ARFF)	Structure blocks RVZ line of sight	Note as non-standard condition and/or remove.
Blast Pad	16L/34R	Runway 34R approach end	Exceeds requirements	Remove (do not rehab) excess pavement or consider as a potential stopway.
RPZ	All runway approach ends	Off Airport property	Not Airport controlled	No change. Study long-term potential acquisition.
Hold Positions	16L/34R	Each connector taxiway	262 ft. (294 ft. required)	Shift hold positions (sign and marking) to 294 feet from runway centerline.
	16R/34L		262 ft. (294 ft. required)	
	7/25		250 ft. (294 ft. required)	

The following list contains additional recommendations for RNO for the runway system:

- Mitigate the obstruction to Runway 7 TSS approach, and investigate other potential obstructions, such as trees, to airspace in the Runway 7 approach.
- Explore the possibility of a CAT-II approach to Runway 16R. This will be completed as part of a separate study.
- Evaluate the implementation of ILS facilities to Runway 16L for purposes of redundancy in case of equipment failure or repair on Runway 16R ILS.
- Continue to maintain runways to FAA design standards, with attention to continued RSA compliance.

Taxiway System

Taxiways enable the aircraft to move between the various functional areas. The taxiway system at RNO is assessed in terms of design standards and guidelines intended to enhance safety and pilot situational awareness; the efficiency of the system and its effects on airfield capacity; and taxiway design standards that apply to setbacks. Taxiway pavement strength was evaluated in the **Pavement Strength Section** above.

Taxiway Design Standards

Similar to runways, in taxiway design the ADG determines separation between runways, taxiways, taxilanes, and objects. Unlike runways, taxiway design is also dependent on the landing gear configuration, and considers the gear type, width, length, and relation to the cockpit.

Each taxiway at RNO is designated with a different ADG depending on aircraft typically using that taxiway. For the most part, taxiways at RNO are designed for ADG IV, which includes the design aircraft Boeing 767/300ER plus other air carrier aircraft and cargo operators shown previously in **Tables 3-4** and **3-5**. Ancillary taxiways that serve Runway 7/25 and GA East and West are designed for smaller aircraft.

Like the ADG, the TDG for different taxiways varies by the aircraft using it. Tables 3-4 and 3-5, show TDG for each aircraft model. Most air carrier and cargo use is TDG 4 or 5. Other taxiways that serve GA areas and Runway 7/25 are designed for smaller TDG. GA operations are detailed in **Table 3-6.**

Table 3-18 details the ADG and TDG for each taxiway. The ADG determines the required taxiway object free area (TOFA), which is the setback from the taxiway centerline to fixed or moveable objects. The TDG determines the taxiway width. **Table 3-18** shows the required and actual TOFA and taxiway widths, with notes on limited use for some taxiways. The TDG and ADG for each taxiway is expected to remain the same throughout the planning period. This is based on the preferred Master Plan Forecast and shown in **Tables 3-4** and **3-5** above and the critical aircraft at RNO remaining the Boeing 767/300ER throughout the planning period.

Figure 3-13 illustrates the north airfield taxiways, and **Figure 3-14** illustrates the south airfield taxiways. Both figures show each taxiway with a color-coded TDG, and the TOFAs, which are based on the ADG. Both figures also detail non-standard conditions, which are explained below.

Parallel Taxiway Separation

Taxiways A and B are parallel. ADG determines the separation for parallel taxiways, and Taxiway B is designated ADG IV. The required separation for an ADG-IV taxiway is 215 feet. The existing separation between Taxiway A and B is 245 feet, which exceeds ADG-IV standards.

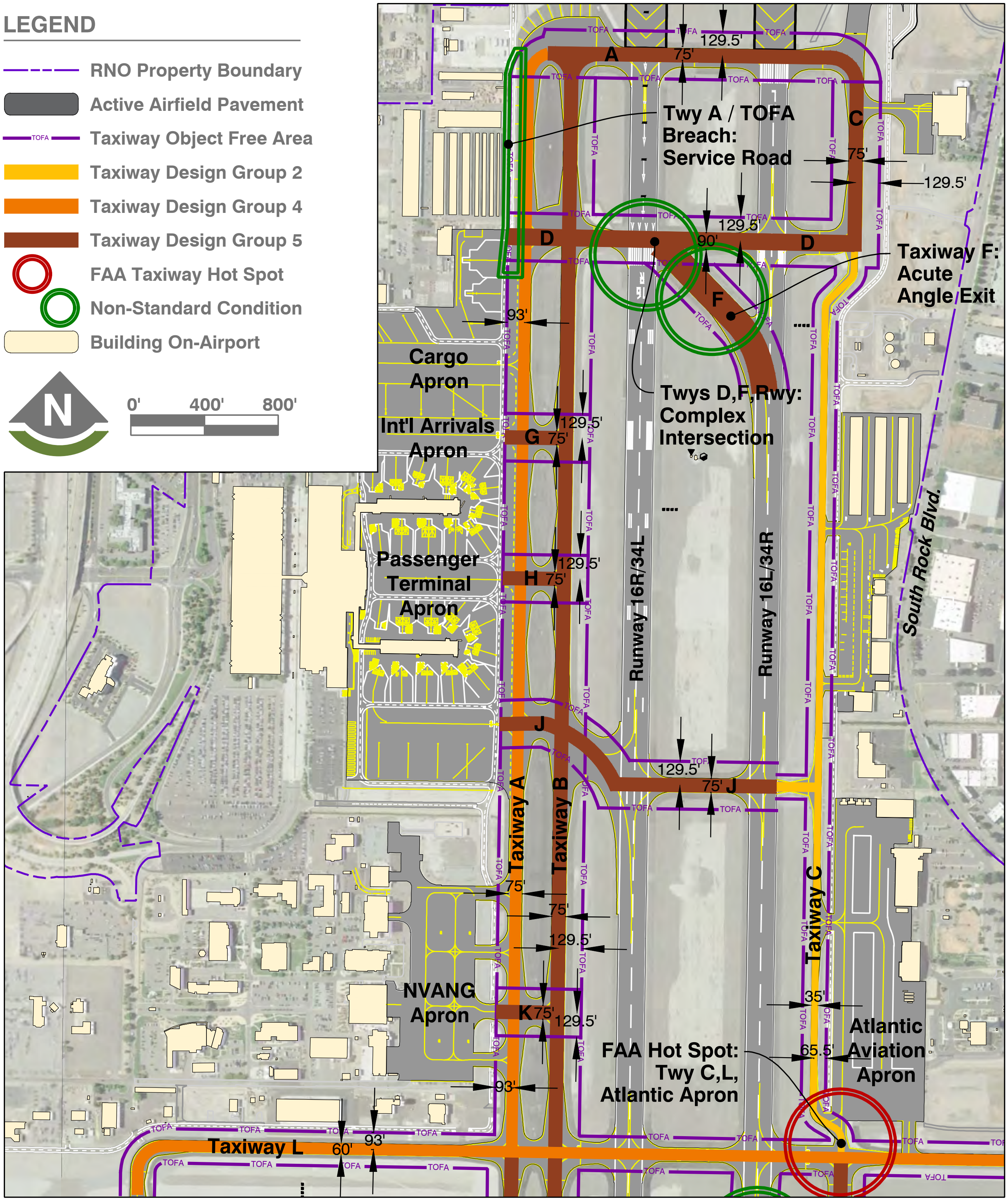


Figure 3-13
Taxiway Design - North Airfield

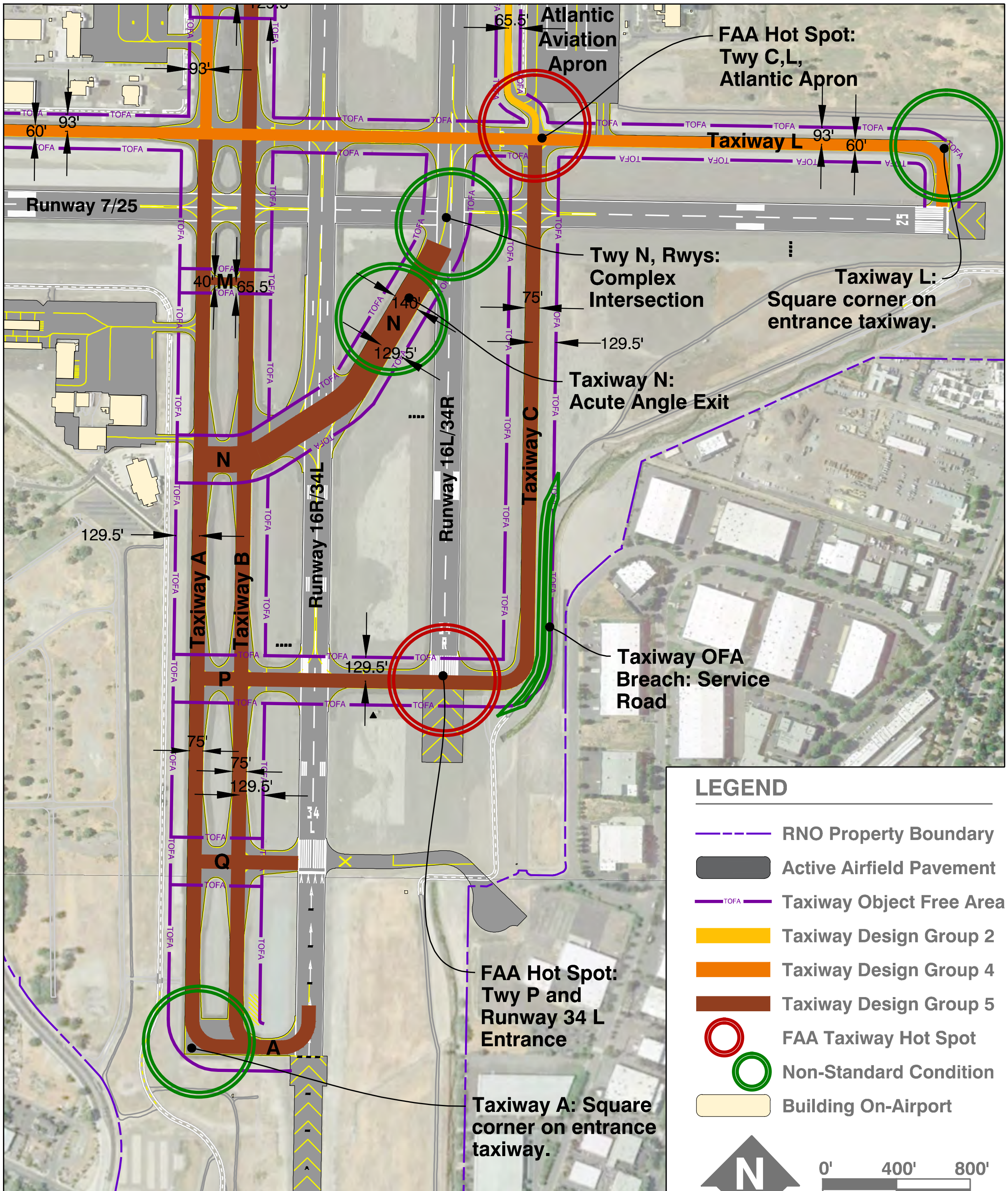


Figure 3-14
Taxiway Design - South Airfield

Table 3-18: Taxiway Design Standards

	Taxiway		ADG	TOFA (from CL)		TDG	Width		Notes
				Req.	Actual		Req.	Actual[1]	
Parallels	A	N of Twy L	III	93 ft.	93 ft.	5	75 ft.	75 ft.	Closed to air carrier >149' wingspan, N of Twy D
Parallels	A	S of Twy L	IV	129.5 ft.	129.5 ft.	5	75 ft.	75 ft.	
Parallels	B		IV	129.5 ft.	129.5 ft.	5	75 ft.	75 ft.	
Parallels	C	N of Twy D	IV	129.5 ft.	129.5 ft.	5	75 ft.	75 ft.	
Parallels	C	Twy L to Twy D	II	65.5 ft.	65.5 ft.	2	35 ft.	35 ft.	Closed to air carrier & > 60,000 lbs aircraft
Parallels	C	S of Twy L	IV	129.5 ft.	129.5 ft.	5	75 ft.	75 ft.	
Parallels	L		III	93 ft.	93 ft.	4	50 ft.	60 ft.	
Connectors	D		IV	129.5 ft.	129.5 ft.	5	75 ft.	90 ft.	
Connectors	F		IV	129.5 ft.	129.5 ft.	5	75 ft.	140 ft.	Acute angle exit
Connectors	G		IV	129.5 ft.	129.5 ft.	5	75 ft.	75 ft.	
Connectors	H		IV	129.5 ft.	129.5 ft.	5	75 ft.	75 ft.	
Connectors	J	W of 16L/34R	IV	129.5 ft.	129.5 ft.	5	75 ft.	75 ft.	
Connectors	J	E of 16L/34R	II	65.5 ft.	65.5 ft.	2	35 ft.	50 ft.	Closed to air carrier aircraft
Connectors	K		IV	129.5 ft.	129.5 ft.	5	75 ft.	75 ft.	Access to NVANG
Connectors	M		II	65.5 ft.	65.5 ft.	2	35 ft.	40 ft.	Closed to air carrier aircraft
Connectors	N		IV	129.5 ft.	129.5 ft.	5	75 ft.	140 ft.	Acute angle exit
Connectors	P		IV	129.5 ft.	129.5 ft.	5	75 ft.	75 ft.	
Connectors	Q		IV	129.5 ft.	129.5 ft.	5	75 ft.	75 ft.	

Source: RTAA GIS and record drawings for pavement edges.
1. Taxiway widths may appear larger than listed because of required turn fillets, which were defined earlier in the TDG section.

Taxiway Design Method

Design guidelines in AC-13A recommend taxiway layouts that enhance safety by discouraging runway incursions. Six connector and exit taxiways at RNO were found to not conform with the following design recommendations:

- **Three-Node Concept:** The three-node concept maintains simple taxiway intersections by reducing the number of taxiways intersecting at a single location. The three-node concept means a pilot is presented with no more than three choices at an intersection, ideally, left, right, and straight ahead. Complex intersections with more than three nodes increase the possibility of pilot error. The three-node concept allows for suitable placement of airfield markings, signs, and lighting.
- **Acute-Angle Exit and Increasing Visibility:** Right-angle intersections between taxiways and runways provide the best visibility to the left and right for a pilot. At airports with large jet activity, acute-angle, or high-speed, runway exits enhance airport capacity and increase efficiency in runway use but should not be used as runway entrance or as crossing points. A right-angle turn at the end of a parallel taxiway is a clear indication of approaching a runway. When the design peak hour is less than 30 operations, a right-angled exit taxiway in the proper location will achieve an efficient flow of traffic. As discussed in the **Airfield Capacity Section**, the future peak hour operations at RNO is 30 operations in 2036.

- **Complex Intersections:** Taxiways must never coincide with the intersection of two runways. Taxiways configured with multiple taxiway and runway intersections in a single area create large expanses of pavement. These expanses make it difficult to provide proper signs, marking, and lighting.
- **Squared Entrance Taxiway:** The outer edge of an entrance taxiway must be curved. A squared corner may be confused for a runway end.
- **Indirect Access:** Do not design taxiways to lead directly from an apron to a runway without requiring a turn.
- **Service Roads:** TOFA clearing standards prohibit service vehicle roads, parked aircraft, and other objects, except for objects that need to be in the OFA for air navigation or aircraft ground maneuvering.

Non-Standard Taxiways

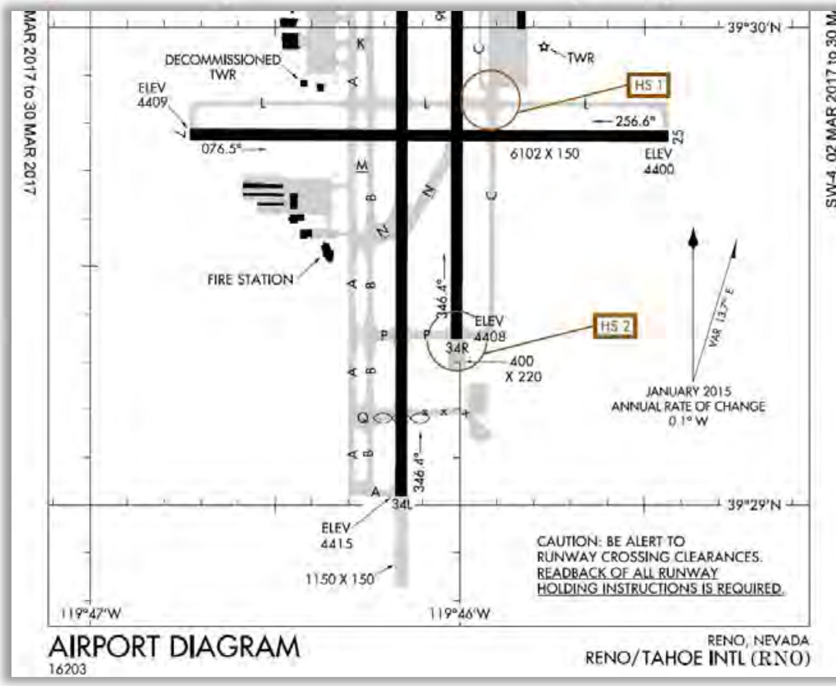
Based on ADG dimensions and taxiway design methods above, the following areas are found to be non-standard. These are highlighted on **Figures 3-13** and **3-14**.

- **Taxiway A TOFA Breach:** The perimeter service road penetrates the TOFA north of Taxiway D. There is an FAA modification to standards for this condition.
- **Taxiways D, F, and Runway 16R/34L:** This is a complex intersection with more than three-nodes.
- **Taxiway F:** This has an acute-angle taxiway exit.
- **Taxiway N, Runway 16L/34R, and Runway 7/25:** This is a complex intersection with more than three-nodes.
- **Taxiway N:** This has an acute-angle taxiway exit.
- **Taxiway L at Runway 25 Approach:** The outer edge of the entrance taxiway is currently designed with a square corner.
- **Taxiway A at Runway 34L Approach:** The outer edge of the entrance taxiway is currently designed with a square corner.
- **Taxiway C TOFA Breach:** The perimeter service road penetrates the TOFA east of the approach end of Runway 34R near Boynton Slough.

FAA Designated Hot Spots

The FAA has designated two taxiway hot spots at RNO. A hot spot is a location in an airport movement area with a history of potential risk of collision or runway incursion, and where heightened attention by pilots and drivers is necessary. The FAA designates hot spots, and these are published in the Airports Facility Directory for RNO. **Figures 3-13 and 3-14** illustrate the hot spots, and **Figure 3-15** shows the currently published FAA Airport Diagram.

Figure 3-15: Airport Diagram: FAA Taxiway Hot Spots



- **Hot Spot 1: Intersection of Taxiways C and L and Atlantic Aviation Apron.** This location has been identified for the sharp turn on Taxiway C and the taxilane entrance to Atlantic Aviation, combined with the complex intersection of Taxiways C and L. The apron exit also provides direct apron to Runway 7/25 access. ATCT personal have indicated these conditions create a potentially confusing environment for pilots.
- **Hot Spot 2: Taxiway P and the approach ends of Runway 34L and 34R.** Past instances have found pilots mistaking Taxiway P as the connector to the takeoff end for both Runways 34R and 34L increasing the potential for intersection departures on Runway 34L. Pilots have also mistaken landings on Runway 34R for Runway 34L.

Other Taxiway Design Concerns

Taxiway C is constrained to the east by existing apron and buildings and is not designed for aircraft in ADG III with wingspans greater than 79 feet; however, some business jets that use Atlantic Aviation fit this category. As a result, the ADG III business jets that use Atlantic Aviation must cross Runway 16R/34L and 16L/34R on Taxiway L, then taxi north on Taxiway A or B to depart on Runways 16L or 16R. ATCT staff indicated that Runways 16L and 16R account for 80 percent of operations. Aircraft leaving Atlantic Aviation and crossing the runways to depart is not an FAA-recommended operating procedure.

Taxiway Design Recommendations

The recommendation is for **Chapter 4 – Airport Alternatives** to consider taxiway designs that:

- Explore an improved design alternative for Hot Spot 1 at the intersection of Taxiways C and L and the Atlantic Aviation Apron. Proper marking and sign locations are advised to be used to help direct traffic.
- Eliminate the two acute-angle exit taxiways. Eliminating the acute-angle taxiway exits would also correct the complex intersections at Taxiways D, F, and Runway 16R/34L, and Taxiway N, Runway 16L/34R, and Runway 7/25. Right-angle taxiway location should consider runway occupancy times and locating right-angle taxiways within the first and last third of the runway is advised.
- Eliminate the squared corners on Taxiway A entrance to Runway 34L and Taxiway L entrance to Runway 25.
- Consider correcting the Taxiway A TOFA service road breach by relocating facilities, fence, and service road to the west.
- Consider correcting the Taxiway C TOFA service road breach at the Runway 34R approach end by considering a culvert over Boynton Slough.

Terminal Aircraft Aprons

Terminal Apron Size

Gate parking size is adequate for the projected fleet mix. The projected fleet mix for commercial operators is shown in **Table 3-19** below.

Table 3-19: Future Operations – Commercial Passenger Carriers

Aircraft Type	Aircraft Model	AAC	ADG	TDG	Future Operations[1]			
					2021	2026	2036	
Regional Jets	CRJ-200	C	II	3	5,447	4,124	1,695	22,399
	CRJ-700	C	II	3				
	CRJ-900	C	III	3				
	Embraer 175	C	III	1A	8,412	15,382	20,704	
Narrow Body Jets	Airbus 319	C	III	3	7,472	7,536	8,261	32,699
	Airbus 320	C	III	3				
	Boeing 737-700	**D**	III	3	20,205	22,142	24,438	
	Boeing 737-800	**D**	III	3				
Phased Out	DeHavilland Dash-8	C	III	5	4,074	0	0	0
	MD-80	C	III	5	263	0	0	
	Misc Aircraft	-	-	-	16	0	0	
Total Operations - Commercial Passenger Carriers (MP Forecast)					**45,889**	**49,183**		**55,098**

Sources: OAG Schedules Analyzer and Unison Consulting, Inc.
1. Matches total and splits for commercial aircraft. See Figure 2-33 in **Chapter 2** for more information.

Reno-Tahoe International Airport Master Plan

The terminal apron parking positions are adequate for the current operations and selected master plan forecasts. The available gates with ADG and dimensions are shown in **Figure 3-16**. Seven gates are designed for ADG III aircraft, and the remaining are designed for various ADG IV aircraft. The projected commercial mix shows all projected operations by ADG III aircraft. The existing layout allows for larger ADG aircraft to use the existing parking positions and gates.

Location and Connectivity to Runway/Taxiway System

The location of the airfield terminal is ideal for operations on Runway 16R/34L. This being the primary runway of use for commercial operators, aircraft do not have to cross the parallel to reach the terminal area. Three connector taxiways allow access from the terminal aprons to the parallel taxiways, which lead directly to the departure ends of Runways 16R and 34L. Multiple connectors allow for multiple aircraft to enter and leave the terminal area during peak activity.

The single central taxilane between the concourses only allows for one aircraft at a time. This could become a delay issue if an aircraft is entering the central taxilane when another aircraft is being pushed back from a gate. However, based on peak activity figures, the terminal gates are not expected to be occupied at 100 percent during the planning period making this scenario unlikely.

Figure 3-16
Terminal Apron

Terminal Apron Pavement Strength

A Pavement Management Program was produced in 2015 that evaluated pavement condition on the aprons at RNO. The pavement within the Terminal and Cargo Apron is currently in good to fair condition. The Pavement Condition Index (PCI) for each section is presented in **Table 3-20**.

Table 3-20: Terminal and Cargo Apron PCI Ratings

Terminal Apron	PCI
Central Cargo Apron	60
West Cargo Apron	80
Southwest corner of Cargo Apron	68
North C-Gate Parking	74
South C-Gate Parking	62
East B-Gate Parking	76
South Terminal Apron	66
All other areas	86-98
Source: Stantec Pavement Management Program 2015	

PCI is a numerical index between 0 and 100 used to indicate the general condition of a pavement and detailed in **Table 3-21**. PCI surveying processes and calculation methods have been standardized by ASTM D5340-11 for airport pavements. The following table illustrates how pavements are rated based on the corresponding PCI value. The table also shows maintenance recommendations for Portland cement concrete (PCC) pavement based on the PCI value.

Table 3-21: PCI Rating System

PCI	Pavement Condition Rating	Recommendation
100-86	Good	Crack seal every 8 years Seal joints every 8 years
85-71	Satisfactory	
70-56	Fair	
55-41	Poor	
40-26	Very Poor	Reconstruct
25-11	Serious	
10-0	Failed	
Source: Stantec Pavement Management Program 2015		

Maintenance recommendations from the 2015 report included performing a crack and joint seal every eight years. Following this recommendation is advised as is conducting regular inspections.

Based on the selected Master Plan forecast, the terminal aircraft apron is adequate in size for the planning period. This is based on the projected commercial fleet mix expected to be using gates at the commercial terminal. The existing gate sizes accommodate ADG-III and ADG-IV aircraft. The projected design aircraft for the terminal area is the Boeing 737-800 which is ADG-III. Any potential commercial passenger operations by ADG-IV aircraft can also be accommodated by existing gates, up to 145-foot wingspan.

Landside Facility Requirements

Except for the passenger terminal building, the landside facility requirements section includes facilities having direct landside access at RNO. Landside requirements are those necessary to support airport, aircraft, and passenger operations. A review of existing conditions, capacity levels, activity demand forecasts, and airport design standards using FAA guidance and industry standards is the basis for proposed requirements. This analysis identifies landside facility requirements needed to meet future demand for the 5-, 10-, and 20-year period. The terminal facility requirements section of this chapter specifically addresses the terminal facility requirements.

Federal Inspection Services (FIS) and U.S. Customs and Border Protection (CBP)

All airports with international flights require FIS facilities. On March 1, 2003, the Immigration and Naturalization Service, the U.S. Customs Service, and the Agricultural and Plant Health Inspection Service were consolidated to establish the CBP. CBP is responsible for inspecting all international passengers, international baggage, and international air cargo.

Although the inspection process has varied over time, CBP procedures now call for all passengers to be processed through the primary inspection counters. Secondary baggage inspection is based on more selective procedures. These inspection procedures use computer-based lists of passengers, roving agents, designations of “high-risk” and “low-risk” flights, and other selection techniques.

A terminal for international arrivals has the actual CBP processing area, plus these major elements: a sterile corridor system, CBP primary inspection, baggage claim, CBP secondary inspection, and processing and transfer passenger recheck.

International passengers arriving at RNO currently deplane directly onto the apron and are guided towards the CBP facility. Upon entering the CBP Facility, the passengers proceed to the appropriate primary processing booth for document review, fingerprinting, photographing, and declarations, if warranted by the CBP officer. The CBP officer may direct the passenger to secondary screening due to any concerns or random selection for further interviews. Secondary screening may include the passenger’s baggage. If secondary screening is not required, the passenger proceeds to baggage claim to retrieve their luggage and deliver their declaration form to the CBP exit checkpoint.

The required facility calculations shown in **Table 3-22** are based on the need to process a single Volaris A320 with 179 seats at peak hour. The forecast does not project an increase in peak international service demand during the planning period. However, the consultant evaluated the CBP facility requirements against a potential increase in aircraft size, or another similar sized aircraft using the facility at the same time. Calculations used the following assumptions for planning:

- Primary processing rate: 100 passengers per double booth per hour
- Primary processing by percent of the total CBP facility: 45 percent
- Secondary processing by percent of the total CBP facility: 25 percent
- Offices by percent of the total CBP facility: 30 percent
- Minimum passenger queue depth: 75-foot minimum

Table 3-22: CBP Facility Requirements

	178 seats	200 seats	400 seats
Load Factor	80%	80%	80%
Arriving Passengers	143	160	320
Number of double booths required	2	2	4
Max number of passengers in queue	110	127	200
Average wait time in queue (minutes)	17.5	19.7	15.9
Maximum wait time in queue (minutes)	33.0	38.0	30.0
Minimum passenger queue area (SF)	1,190	1,380	2,160
Minimum queue depth required (ft)	52	60	47
Total primary processing area (SF)	2,760	2,760	5,520
Secondary processing area (SF)	**1,533**	**1,533**	**3,067**
Primary and secondary offices (SF)	**1,840**	**1,840**	**3,680**
Circulation (25% of total CBP area, SF)	**1,831**	**1,878**	**3,642**
Total Required (SF)	**7,667**	**7,667**	**15,333**

Source: ACRP Spreadsheet Model
SF = Square feet

CBP approved the current facility for secure operations in 2013. With a current footprint of 13,850 square feet, not including the international baggage claim area, the CBP facility is of a physical size to accommodate both current and forecasted international arrivals. However, the individual components located within the facility are either undersized or organized in a manner leading to operational shortcomings.

- The primary process queue depth is currently only 40 feet. A minimum of 52 feet is required, while 75 feet is recommended.
- Baggage claim operations currently interfere with passenger flow and require additional staffing.
- There is not currently a dedicated sterile corridor connecting the terminal proper to the CBP facility. The inclusion of a sterile corridor would allow deplaning to take place by way of jet bridge either at a dedicated international or multi-purpose gate.

While it is also of a size to accommodate a 200-seat aircraft, it physically cannot handle a 400-seat aircraft. In addition to the spatial and organizational deficiencies noted, a lack of CBP agents currently leads to excessive processing times that often exceed 90 minutes or more. As a result, **Chapter 4** will evaluate options to address international passenger facility deficiencies.

CBP Condition Assessment

As with other RTAA owned facilities at RNO, a Facility Condition Assessment (**Appendix A**) was completed to provide a light assessment of the CBP. Overall, the CBP was found to be in fair to good condition. Metal siding, stucco exterior, and calking were in fair condition. The expansion joints, stone, and mortar joints are in good condition. A crack was found in concrete at the Northwest column corner which shows signs of possible column footing movement. This requires further investigation. Metal soffit siding is in fair condition; with some vehicle damage evident.

Passenger Terminal Roadway Demand and Capacity Analysis

This section records the analysis of the demand and capacity for the passenger terminal roadway in terms of the number of lanes available and the length of curb available for passenger pick-up and drop-off. This section assumes that all existing connections to the off-airport vehicular infrastructure, roads and freeways, remain in place. Changes to off-airport ground transportation infrastructure would also impact the demands on the terminal roadway system.

Airport Access

Average peak hour passengers are expected to increase from 829 to 1,291 by 2036 and from 14 passengers per minute to 22, a 64-percent increase. This equates to a significant increase in the number of vehicles, primarily personal automobiles, accessing RNO. Any decrease to number of vehicle access points will introduce congestion at the remaining access points. In 2017, the Nevada Department of Transportation (NDOT) initiated environmental efforts for the Spaghetti Bowl project, which will reconstruct the Interstate 80 / Interstate 580 system-to-system interchange. Some of NDOT’s alternatives remove the airport direct connect ramps. Impacts will be discussed further in the **Chapter 4**.

Terminal Curbside

One curbside area adjacent to the arrival and departure areas serves RNO's terminal building. The area comprises a total of eight lanes, providing access to the terminal area to pick up and drop off passengers:

- **Lane 1:** This lane has direct inner curbside access next to the terminal building. Its 800 linear feet of capacity allows passenger drop-off with personal occupancy vehicles (POV), transportation network companies (TNC), taxis, hotel shuttles, buses and airport authority vehicles.
- **Lane 2:** This lane is used for vehicle circulation. During peak hours, lane 2 can be used as a secondary curbside area for dropping off passengers.
- **Lane 3:** This lane is a vehicle through lane for those entering and exiting the inner curbside area.
- **Lane 4:** This lane is a vehicle through lane for those driving past the curb.
- **Lane 5**: This lane is adjacent to the 18-foot wide pedestrian median. Its outer curbside provides approximately 800 linear feet of capacity that allows passenger pick-up with POVs but is currently not used for other forms of transportation. TNC, taxi, and hotel shuttle pick-up operate out of the ground transportation lot, north of the baggage claim.
- **Lane 6**: This lane is a vehicle through lane for those entering and exiting the outer curbside area. During peak hours, lane 6 can be used as a secondary curbside area for picking up passengers.
- **Lane 7:** This lane is a vehicle through lane for those entering and exiting the outer curbside area.
- **Lane 8:** This lane is a vehicle through lane for those driving past the curb. Prior to arriving at the terminal, this lane gives access to the long-term parking surface lot, and the parking garage for short-term and long-term parking. Rental car return parking is also accessed from this lane at a point near the middle of the parking garage.

Both lane 1 and lane 5 have 800 linear feet of available terminal vehicular curbside length, for a total of 1,600 linear feet. Terminal curbside needs are evaluated using industry planning criteria to determine linear frontage for the curb to meet Level of Service (LOS) standards.

Typically, this evaluation includes historical traffic data as well as the physical characteristics already described. As historical traffic data was not available beyond the one-week traffic volume report prepared by Traffic Works in April 2017, the analysis used these assumptions to reach the curbside projections shown in **Table 3-23** below:

- Peak hour traffic growth will follow design hour passenger growth.
- 30 percent of peak hour demand occurs during a 15-minute peak period.
- Percent of Vehicle Type and vehicle length
  - 85 percent – Private auto, 22 feet
  - 8 percent – Hotel shuttles, 50 feet
  - 5 percent – Taxis and TNC, 22 feet
  - 1 percent – Airport Authority Vehicles, 22 feet
  - 0.5 percent – Buses (charter and public), 50 feet
  - 0.5 percent – Other, 30 feet
- Multiple Stop Factor of 1.0 (for all vehicle types)
- Vehicle Dwell Time
  - Private auto, 3.0 minutes
  - Hotel shuttles, 3.0 minutes
  - Taxis and TNC, 1.5 minutes
  - Airport Authority Vehicles, 2.0 minutes
  - Buses (charter and public), 5.0 minutes
  - Other, 1.5 minutes

Table 3-23: Curbside Requirements

	2016	2021	2026	2036
Total Design Hour Demand (Vehicles)	592	708	785	922
Peak 15-minute Demand (total linear feet)	849	1,015	1,125	1,322
Required LOS C Curbside Range (linear feet)	**653**	**781**	**865**	**1,017**
	771	**923**	**1,023**	**1,201**

Source: Traffic Works Traffic Volume Report dated April 24, 2017; ACRP Spreadsheet Model

Based on the existing 1,600 linear feet of available curbside, RNO maintains an excellent LOS throughout the entire planning period. If activity is properly distributed, lanes 2 and 6 should rarely be used as secondary curbside frontage. A LOS C can be maintained with the existing 1,600 linear feet of available curbside even if the total design hour demand reaches 1,250 vehicles, or approximately 7,700,000 annual passengers.

Vehicular Parking and Rental Car Demand and Capacity Analysis

The automobile parking needs at a commercial service airport directly relate to the number of annual enplaned passengers. Automobile parking types include public, employee, and rental car parking (including storage). **Table 3-24** below summarizes existing automobile parking supply. For planning purposes, the number of effective parking spaces assumes only 95 percent of the actual supply of spaces is available at any given time due to maintenance, snow removal or circulating parkers. The effective space count will be used for planning. Currently, there are approximately 280 short-term and 3,088 long-term public parking spaces.

Public Parking

Public parking includes short- and long-term parking inside the three-story parking structure and long-term parking in a surface lot, south of the parking structure. ACRP Report No. 25: *Airport Passenger Terminal and Design*, recommends that public parking supply should range from 900 to 1,400 spaces per million enplaned passengers, and 25 to 30 percent should be designated for short-term parking.

Table 3-24: Public Parking Requirements

	2016	2021	2026	2036
Enplanements	1,823,580	2,178,486	2,416,753	2,839,346
Required Parking Range	1,641	1,960	2,174	2,555
	2,520	3,049	3,382	3,975
Required Parking Range – Short Term (30%)	492	588	652	767
	756	915	1,015	1,193
Effective Supply – Short Term (Existing)	**280**	**280**	**280**	**280**
Short-Term Capacity (Deficiency)	**(476)**	**(635)**	**(735)**	**(913)**
Required Parking Range – Long Term (70%)	1,149	1,372	1,522	1,789
	1,764	2,134	2,367	2,783
Effective Supply – Long Term (Existing)	3,088	3,088	3,088	3,088
Long-Term Capacity (Deficiency)	**1,324**	**954**	**721**	**305**
Total Capacity (Deficiency)	**848**	**319**	**(14)**	**(608)**
Source: 2016 Inventory of Existing Conditions, Unison forecast analysis				

Based on this guidance, total RNO public parking (short- and long-term) exceeds the recommended range through 2021 and falls within the recommended range through 2036. However, the existing allocation between short- and long-term parking is not in line with industry recommendations.

The maximum recommended walking distance from parking space to terminal building is 1,000 feet unless a shuttle service is provided. While the parking structure is near the terminal building and never further than 435 feet away, only 86 percent of the long-term parking surface lot is within the 1,000-foot-radius of the south entry doors. The furthest distance from a parking space in the surface lot to the terminal entry is 1,175 feet.

Employee Parking

Employee parking is available in three parking lots south of the passenger terminal and illustrated on **Figure 1-25** in the **Chapter 1**. Color labels designate who uses the lots. The Green Lot has 131 spaces for staff, the Yellow Lot offers 152 spaces for supervisors of RNO staff and tenants, and the Blue Lot provides 252 spaces for tenant line employees. This is a total of 535 employee parking spots, allowing 508 effective spaces. ACRP Report 25 suggests 1 space for a range of 2.4 to 3 employees. As employment projections were not available, parking eligible employee growth is assumed to follow enplanement growth. Employee parking requirements are presented in **Table 3-25.**

Table 3-25: Employee Parking Requirements

	2016	2021	2026	2036
Enplanements	1,823,580	2,178,486	2,416,753	2,839,346
Parking Eligible Employees	1,120	1,338	1,484	1,744
Required Employee Parking (1 per 3 employees)	373	446	495	581
Effective Supply	**508**	**508**	**508**	**508**
Capacity (Deficiency)	**135**	**62**	**13**	**(73)**
Source: Gensler				

RNO currently employs 1,120 people eligible for employee parking, requiring a range of 373 to 467 parking spaces. Based on information provided by the Airport, the employee lots are currently used at less than 50 percent capacity due to either costs or convenience. Because of this, employee parking has been evaluated based on the assumption of 1 parking space for every 3 eligible employees. Unless there are changes in how employee parking is currently managed, there is physical capacity to support employee parking through the 2026 planning period.

Rental Car Parking and Facilities

Rental car parking needs include ready/return lots for customers, and long-term lots where the rental car fleet can be serviced and stored. Existing facilities within the parking areas include a quick turn-around (QTA) facility for rental car companies to fuel, perform cleaning and light maintenance of vehicles. Because each of the car rental concessionaires at RNO will have different facility needs, car rental facility requirements are evaluated cumulatively.

Ready/Return Parking

Ready/return parking needs correlate with the peak number of customer transactions rather than the total number of customers. Increased demand requires rental car staff to transport cars to and from the service/storage lot more frequently, adding costs of the operation. Currently 402 ready/return parking spaces are on the ground level of the parking structure.

As peak transaction information was unavailable, ready/return parking has been evaluated based on the following assumptions:

- There are currently 402 ready/return parking spaces.
- The existing ready/return parking spaces operate at 80 percent capacity, meaning additional demand can currently be handled by way of increased staffing and alternate operations.
- Peak customer transaction growth will follow enplanement growth.

Table 3-26 below summarizes the enplanements, ready/return demand and the effective ready/return supply.

Table 3-26: Rental Car Ready/Return Parking Requirements

	2016	2021	2026	2036
Deplanements	1,823,580	2,178,486	2,416,753	2,839,346
Ready / Return Spaces Required	322	384	426	501
Ready / Return Supply	402	402	402	402
Capacity (Deficiency)	**80**	**18**	**(24)**	**(99)**
Source: Gensler				

The rental/ready parking supply, currently located in the ground level of the parking structure, adequately serves demand through the 2021 planning period. However, the 402 spaces allocated to ready/return and the potential need to grow this number are in direct conflict with the short-term parking requirement as both are ideally located in the same general area. As a result, **Chapter 4** will identify potential options for relocating rental ready/return parking to accommodate future growth in short-term parking.

Rental Car Service/Storage

The size of the rental car service/storage lot ties directly to the total rental car fleet. Total fleet is directly attributed to the total number of arriving passengers requiring rental cars. Information regarding the peak storage demand and projections was not available. The rental car storage evaluation is therefore based on the following assumptions and requirements are detailed in **Table 3-27**:

- There is currently space for approximately 4,350 rental car storage spaces allocated across five individual lots, plus an overflow lot controlled exclusively by Enterprise.
- The existing rental car storage spaces operate at 60 percent capacity/efficiency, in aggregate.
- Peak customer transaction growth will follow deplanement growth.

Table 3-27: Rental Car Storage Parking Requirements

	2016	2021	2026	2036
Deplanements	1,823,580	2,178,486	2,416,753	2,839,346
Storage Spaces Required	3,045	3,638	4,035	4,741
Storage Supply	4,350	4,350	4,350	4,350
Capacity (Deficiency)	**1,305**	**712**	**315**	**(391)**
Source: Gensler				

In aggregate, rental car storage adequately serves the demand through 2026. The existing rental car storage lots are organized and leased around individual rental car companies. These storage lots include structures and unique layouts leading to unnecessary parking inefficiencies. If appropriately organized, the area currently dedicated to rental car storage is sufficient to serve the demand through the entire planning period.

Quick Turn Around (QTA)

QTA facilities are located within the vicinity of rental car operations and the ready/return parking area. A typical rental car QTA consists of a car wash, maintenance bays, storage, and fueling area. The existing consolidated rental car QTA is located north of the parking structure.

QTA facilities are typically evaluated based on total rental car revenue. As this information was not available, the QTA facility evaluation is based on the following assumptions and QTA facility requirements are shown in **Table 3-28**:

- The existing consolidated QTA facility is 11,400 square feet.
- The operations that may take place within the individual rental car company facilities are not considered by this evaluation.
- The existing consolidated QTA facility is assumed to operate at 80 percent capacity.
- Total rental car revenue growth, and the associated QTA demand, will follow deplanement growth.

Table 3-28: Rental Car QTA Requirements

	2016	2021	2026	2036
Enplanements	1,823,580	2,178,486	2,416,753	2,839,346
QTA Demand (SF)	9,120	10,895	12,087	14,200
Existing QTF Building	11,400	11,400	11,400	11,400
Capacity (Deficiency)	**2,280**	**505**	**(687)**	**(2,800)**
Source: Gensler SF = Square feet				

Assuming much of the cleaning, fueling, and minor maintenance demand is placed on the consolidated QTA facility, there is a deficiency in its capacity arising between the 2026 and 2036 planning periods. Excess capacity to overcome these deficiencies may be available in the individual rental car company facilities located within their individual storage lots.

Parking Facilities Condition Assessment

The Facility Condition Assessment (**Appendix A**) was completed to provide a light assessment of the parking garage and facilities near the terminal. A summary of the findings on the parking facilities follows.

The parking garage was found to be in good condition. On the level 1, minor cracking in the concrete floor was found and some cracks in some drive surfaces are showing reinforcement rebar and should be replaced. Some concrete walls have major cracks and should be addressed soon. level 2 and 3 were found to be in fair to good condition. There were signs of minor cracking in concrete walls and signs of water pooling on concrete floors.

The QTA structure was found to be in fair condition. There are seal wall and ceiling penetrations, and the calking, metal flashing, and site work in fair condition. The parking office building was found to be in fair condition as well.

Parking Facilities Analysis and Recommendations

When evaluated in aggregate, parking is sufficient to support the forecasted demand levels through the 2026 planning period. However, even currently, the allocation between short-term and long-term parking leaves a short-term deficiency. This deficiency is only compounded by additional demand being placed on the structured parking by the rental ready/return spaces. Alternatives addressed in the next chapter need to be evaluated before recommendations can be made. These alternatives will evaluate an increase in efficiency before additional structured parking is recommended.

Terminal Facility Requirements

The terminal area demand capacity analysis establishes metrics that indicate demand levels below capacity, approaching capacity, and exceeding existing capacity. These metrics identify the projected level of demand for the 5-, 10-, and 20-year planning periods.

Currently, the passenger terminal building consists of two levels and has approximately 448,650 square feet of terminal and concourse space with 23 gates. The terminal building houses airline offices and ticket counters; rental car counters and back offices; ground transportation counters; restaurants and retail concessions and storage; food and beverage offices and storage; gaming concessions office and storage; baggage claim, handling and makeup, and baggage service offices; Transportation Security Administration (TSA) offices, TSA Pre-Check and wheelchair service offices and RTAA administrative offices.

This section identifies key issues with the existing passenger terminal building and provides planning-level conceptual space requirements. The following references to FAA, TSA, ACRP, International Air Transport Association (IATA) and industry standards are the basis for the identified space requirements:

- FAA Advisory Circular AC 150/5360-13A, *Planning and Design Guidelines for Airport Terminal Facilities* (2012)
- Airports Cooperative Research Program (ACRP), Report 25: *Airport Passenger Terminal Planning and Design Guidebook* (2010)
- Airports International Air Transport Association (IATA), *Airport Development Reference Manual*, 10th Edition (2016)

Fundamentals of Terminal Design

Terminals provide passenger facilities and facilitate the flow of passengers between aircraft and ground transportation. Terminals must accommodate changes in the airline industry and passenger preferences. Factors that influence terminal design include:

- Total Passenger Volume
- Passenger Peaking Characteristics
- Passenger Preferences
- Airline Station Characteristics
- Aircraft Mix
- International Service
- Industry Trends

Level of Service (LOS)

Terminal improvements are evaluated by their ability to serve passengers and provide a comfortable experience through the airport. A LOS concept uses a set of standards to measure the quality of the passenger experience in terms of the efficiency of passenger flow, space requirements, and wait time. Each LOS has a defined space planning standard to determine facility requirements. **Table 3-29** shows the rating system and service levels.

Table 3-29: LOS Standards

LOS		Service Level
A	Excellent	Conditions of free flow; no delays; direct routes; excellent level of comfort
B	High	Condition of stable flow; high level of comfort
C	Good	Condition of stable flow; provides acceptable throughput; related systems in balance
D	Adequate	Condition of unstable flow; delays for passengers; condition acceptable for short periods of time
E	Unacceptable	Condition of unstable flow; subsystems not in balance; represents limiting capacity of the system
F	System Breakdown	Unacceptable congestion and delays
Source: ACRP Guidebook Volume 1, 147		

The assumption for this master plan is to obtain LOS C with peak wait times that are 10 minutes or below. Delays and space requirements for LOS C are typically considered acceptable by passengers. LOS C is also considered a reasonable balance between ideal size and economic considerations.

Demand Factors

The primary function of a terminal is to provide adequate space to serve passengers, so passenger and gate demand is analyzed first. The completed analysis provides overall terminal space planning metrics.

Passenger Activity Levels

Table 3-30 summarizes the planning activity levels to be used for terminal building planning. These figures estimate the number of passengers to arrive, depart, and generally flow through the terminal building.

Table 3-30: Terminal Passenger Activity Levels

	2016	2021	2026	2036
Annual Enplanements	1,823,600	2,178,500	2,416,750	2,839,350
Design Hour Departing	426	508	564	662
Design Hour Arriving	403	482	535	629
Design Hour Total	830	990	1,099	1,291
Source: Unison forecast analysis. Values rounded				

Gate Demand

The minimum number of gates needed for the peak hour activity and additional contingency metrics together determine the required number of gates. One contingency gate, as shown in **Table 3-31**, has been added to accommodate unscheduled charter flights or long-term delayed flights.

Table 3-31: Gate Demand

	Airplane Design Group	2016	2021	2026	2036
Airlines with Preferential-use Gate					
Alaska/Horizon	III	2	3	3	3
American/Compass	III	3	3	3	4
Delta/SkyWest	III	1	1	2	2
Delta/SkyWest	II	1	2	1	1
United/Mesa	III	1	1	1	1
Southwest	III	4	5	5	5
United	III	2	1	1	1
Airlines using gates on per-turn basis					
Allegiant	III	1	1	1	2
JetBlue	III				
Volaris	III				
Contingency	III	1	1	1	1
Total		**16**	**18**	**18**	**20**
Source: Unison forecast analysis.					

Effective space planning requires a consistent definition of "gate." By using the forecasted fleet mix and the Equivalent Aircraft (EQA) Index, a technique which estimates the number of gates needed based on aircraft seating capacity, the equivalent number of gates are calculated based on the ADG served. **Table 3-32** lists the recommended EQA by ADG for the 5-, 10-, and 20-year planning periods.

Table 3-32: Equivalent Aircraft (EQA) Index

	2016	2021	2026	2036
ADG II EQA	0.4	0.8	0.4	0.4
ADG III EQA	15.0	16.0	17.0	19.0
Total EQA	**15.4**	**16.8**	**17.4**	**19.4**
Source: EQA Index values based on Transportation Research Board, *ACRP Report 25 – Airport Passenger Terminal Planning and Design,* 2010				

RNO currently has 23 gates allocated across two concourses in a double-loaded pier configuration, which is when concessions and holdrooms are on both sides of the concourse circulation. Aircraft park on both sides of each concourse. The 23 gates currently meet the forecasted requirements through the entire planning period. However, the size, condition, and remaining lifespan of the concourses serving these gates are also to be considered when evaluating the gate capacity. Options for modernizing the concourses will be evaluated during the airport alternatives process.

Terminal Building Capacity Analysis

The way individual areas of the terminal building function determines the planning-level space needs to accommodate current and future demand. Space requirements will be a major consideration when evaluating terminal building alternatives.

Check-in and Ticketing

The check-in lobby is historically where departing passengers check-in for a flight, drop off checked baggage, and obtain boarding passes and other information for the flight. Traditionally, check-in lobbies were designed to be grand public spaces, or the "front door" of an important public facility. Most check-in lobbies were long, linear spaces with large areas reserved for airline ticket counters, passenger queuing and waiting, airline ticket office space, and supporting areas such as restrooms and concessions.

The way passengers use the check-in lobby today is quite different due to advances in technology and evolved security requirements. Now that self-service check-in and baggage tag kiosks are available, passengers can bypass the traditional check-in counter. These changes also allow check-in to take place anywhere inside or outside the terminal building. In addition, electronic devices allow passengers to check-in off-airport. Interactions with airline personnel are now largely reserved to drop off bags or to resolve problems. The result is a significant change in passenger and airline approaches to the check-in process and the potential for reduced space requirements in the lobby. The use of self-service equipment continues to grow, and potential future trends include self-tagging stations and remote off-airport bag-drop facilities that would reduce the need to have staffed positions at the airport.

The passenger check-in assumptions are important to evaluate space and facility needs, and the assumptions evolve over time as new technologies and trends emerge. These assumptions and the modes of check-in are shown in **Table 3-33** below:

- Passengers checking bags: 80 percent
- Average checked bags/passenger: 1.2
- Full-service processing time/passenger: 3 minutes
- Self-service kiosk processing time/passenger: 2 minutes
- Curbside processing time/passenger: 3 minutes
- Full-service maximum wait time: 10 minutes
- Self-service kiosk maximum wait time: 2 minutes
- Curbside maximum wait time: 4 minutes

Table 3-33: Check-in Mode Split

	2016	2021	2026	2036
Full-Service	50%	50%	45%	45%
Self-Service Kiosk	34%	34%	39%	39%
Offsite (online/remote location)	11%	11%	11%	11%
Curbside	5%	5%	5%	5%
Source: InfoSearch International RTIAA Customer Survey, 2017				

A total of eight airlines currently provide service at RNO. This level of service is projected to remain consistent through the entire planning period. Based on historical data, current activity, and projected gate demand, the check-in/ticketing requirements have been evaluated based on the assumption that five (United, American, Alaska, Southwest and Delta) of these eight airlines may be required to handle the peak 30-minute enplaned passenger load in its entirety. These are identified as Tier 1 airlines in **Table 3-34**. The remaining three airlines (Volaris, Allegiant and JetBlue) are assumed to only be required to service a single flight within the design hour. These are identified as Tier 2 airlines in **Table 3-34**.

Table 3-34: Check-in/Ticketing Requirements

	2016		2021		2026		2036	
	TIER 1	TIER 2	TIER 1	TIER 2	TIER 1	TIER 2	TIER 1	TIER 2
Total Peak 30-min Enplaned Passengers	205	79	245	79	272	79	319	79
Full-Service Positions	9	4	10	4	9	4	12	4
Check-in counter area (SF)	495	220	550	220	495	220	660	220
Active check-in area (SF)	450	200	500	200	450	200	600	200
Check-in queue area (SF)	336	98	462	98	546	98	518	98
Total Full-Service Area (SF)	**1281**	**518**	**1512**	**518**	**1491**	**518**	**1778**	**518**
Self-Service Kiosks	8	3	9	3	12	3	14	3
Bag drop positions	4	2	5	2	6	2	7	2
Kiosk footprint (SF)	48	18	54	18	72	18	84	18
Kiosk queue area (SF)	56	28	84	28	84	28	112	28
Bag drop area (SF)	20	10	25	10	30	10	35	10
Total Kiosk Area (SF)	**124**	**56**	**163**	**56**	**186**	**56**	**231**	**56**
Interior Space Subtotal	1,405	574	1,675	574	1,677	574	2,009	574
Circulation (25%, SF)	351	144	419	144	419	144	502	144
Total Interior Space Required (SF)	**1,756**	**718**	**2,094**	**718**	**2,096**	**718**	**2,511**	**718**
Tier 1 Airlines (x5) / Tier 2 Airlines (x3)	8,781	2,153	10,469	2,153	10,481	2,153	12,556	2,153
Total Ticketing Area Requirements (SF)	**10,934**		**12,621**		**12,634**		**14,709**	
Source: Gensler SF = Square feet								

The ticketing lobby at RNO currently consists of 20,500 square feet for ticket counters, active check-in, queuing, and circulation. This space is linear with 35 feet of depth available from the wall to the front of the counter, for circulation, queuing, and active check-in. At the time of this report, RNO provides a total of 50 check-in positions across 460 linear feet of counter space. The staff occupies a width of 11 feet from the back wall to the front of the counter, with ticket counters about 3.5 feet deep. Southwest operates a single curbside check-in facility.

The overall ticketing lobby is sufficiently sized to handle the forecasted demand through the entire planning period while still providing airline specific full-service and self-check positions; however, the depth from the wall to the front of the counter limits the ideal layout for queuing and circulation. This causes inefficiencies and congestion during periods of high demand. During periods of low demand, the ticketing lobby will give the perception that it is oversized. It is recommended that RTAA consider migrating towards common-use facilities to help balance demand loads between the airlines and achieve a higher level of efficiency in the ticketing lobby. Partial or full common-use facilities would allow for the ticketing lobby to adequately serve a demand beyond the planning period or at levels higher than those forecasted, including the addition of new carriers.

Airline Space

Currently about 11,000 square feet are dedicated for Airline Ticket Offices (ATO) behind the ticketing counters and house a total of 12 office suites. These suites range from 805 to 2,260 square feet. A common industry planning factor is 900 square feet per office. Calculations for space required are based on the total number of airlines serving the airport rather than the total volume of passengers. Eight airlines serve RNO at the time of this report. Based on this industry planning factor, RNO can adequately support up to 12 individual airlines through proper planning and reorganization of their existing space.

Outbound Baggage Screening and Make-up

Outbound baggage processing includes the area and equipment required to accommodate, sort, security screen, and process checked baggage from the check-in lobby to the aircraft. At RNO, the baggage screening facilities are directly behind the ticketing counters and airline offices.

For planning, these are the baggage screening assumptions, which are shown in **Table 3-35** below:

- Percent connecting traffic: 2 percent
- Percent of passengers checking bags: 80 percent
- Average bags/passenger: 1.2
- TSA surge factor applied: yes, on a 10-minute baggage flow rate
- Percent of over-sized bags too large for Explosive Detection System (EDS): 8 percent
- Level 1 EDS screening process rate: 150 bags/hour
- Level 1 EDS screening unit area: 800 square feet
- Level 2 On-Screen Resolution Rate (OSR) rate: 120 bags/operator
- Level 2 OSR station area: 40 square feet
- Level 3 ETD screening process rate: 24 bags/hour/screener
- Level 3 ETD screening unit area: 100 square feet

Table 3-35: **Outbound Bag Screening**

	2016	2021	2026	2036
Design Hour Passengers Departing	410	490	544	639
PMAD passengers checking in	402	480	533	626
Total bags to process in peak hour	386	461	512	601
Total bags through Level 1 EDS screening	444	521	573	663
Number of Level 1 EDS units	3	4	4	5
Level 1 EDS area (SF)	2,400	3,200	3,200	4,000
Total bags through Level 2 EDS screening	111	130	143	166
Number of Level 2 OSR stations	1	2	2	2
Level 2 OSR area (SF)	40	80	80	80
Number of bags through Level 3 ETD screening	61	72	79	91
Number of Level 3 ETD units	2	2	2	2
Level 3 ETD area (SF)	200	200	200	200
Conveyors and sorting matrices (SF)	2,640	3,380	3,380	4,280
Baggage screening circulation (SF)	660	845	845	1,070
Total (SF)	**3,300**	**4,225**	**4,225**	**5,350**

Source: Gensler
SF = Square feet

Baggage make-up includes manual or automated make-up units, the cart/container staging areas, and baggage tug/cart, or baggage train, maneuvering lanes. The type of system selected for a terminal depends on several factors including the number of airlines, the terminal configuration, operating policies (common use, exclusive use), and size of the terminal complex. At RNO, the baggage make-up facilities are behind the airline offices. After the security screening, bags are transported to one of three matrixes where bags are sorted and placed on baggage carts to deliver to the aircraft. Larger bags are delivered through one of three central collection areas. **Table 3-36** shows the space requirements projected for the baggage make-up area.

Table 3-36: Baggage Makeup

	2016	2021	2026	2036
Gate Equivalencies (EQA)	15.4	16.8	17.4	19.4
PMAD Peak Hour scheduled aircraft departures	5	5	5	6
Expected number of departures per gate	0.3	0.3	0.3	0.3
Baggage make-up area (SF)	8,316	9,072	9,393	10,476
Baggage train circulation allowance (SF)	832	907	940	1,048
Total (SF)	**9,148**	**9,979**	**10,336**	**11,524**
Source: Gensler SF = Square feet				

The baggage handling area at RNO currently consists of 49,917 square feet for both baggage screening and baggage makeup area. With proper equipment layout, the existing space is adequate throughout the planning period to allow for screening and up to three individual make-up matrixes, each capable of handling the full demand load. The three individual matrixes allow for redundancy in a critical system.

Security Screening Checkpoint (SSCP)

SSCPs are where commercial airline passengers and carry-on baggage are examined to ensure that illegal or harmful items are not carried onto aircraft. Security screening procedures are complex and constantly evolving to address new threats and requirements. The SSCP area at RNO is located directly east of the main entrance to the terminal building. Currently seven x-ray machines conduct property searches, with four walk-through metal detectors and three Advanced Image Technology scanners for seven total lanes. According to metrics from ACRP's terminal planning guidebook, the calculated maximum current wait time in queue is 10 minutes for standard check-in, and five minutes for pre-check. The SSCP is currently located on level 1 with vertical circulation to the level 2 concourses and gates located directly after security.

The current layout for the TSA Queue includes two entrances, one for known crew members and a second for passenger and employee screening. The passenger and employee entrances serve three individual queues. Each is color-coded and designated for general boarding/all passengers (green); airline priority (yellow); and TSA pre-check (blue).

The TSA pre-check line is routed to a single TSA identification (ID) checker who directs them to a dedicated screening area. The general boarding and airline priority lines are kept separate until they reach a different TSA ID checker than the TSA line. At the ID checker, the security agent calls individuals forward, their ID is checked, and then they are directed into a screening area separate from the TSA pre-check screening area.

Queuing space from the number of passengers and estimated equipment throughput rate drives SSCP space requirements.

These are the assumptions for SSCP requirements, with projections shown in **Table 3-37** below:

- Percent of additional traffic through SSCP: 15 percent, including non-passenger, employees, and crew
- Regular throughput: 135 passengers/lane/hour
- Pre-check throughput: 250 passengers/lane/hour
- Regular maximum time in queue allowed: 10 minutes
- Pre-check maximum time in queue allowed: 5 minutes
- Percent of pre-check passengers for all planning periods: 50 percent
- Allowance for future equipment changes and development: 20 percent

Table 3-37: Security Screening Checkpoint

	2016	2021	2026	2036
Total Peak 30-min enplaned passengers (less connecting pax)	185	221	245	287
Regular checkpoint lanes required	3	3	3	4
PreCheck lanes required	1	1	2	2
Total checkpoint lanes required	**4**	**4**	**5**	**6**
Checkpoint screening area, 14 feet x 80 feet (SF)	1,120	1,120	1,120	1,120
Total Checkpoint Required Area (SF)	4,480	4,480	5,600	6,720
Checkpoint queue area (SF)	1,600	1,600	2,000	2,400
Allowance for future equipment changes and development (SF)	896	896	1,120	1,344
Total Required SSCP Area (SF)	**6,976**	**6,976**	**8,720**	**10,464**
Existing SSCP Area (SF)	15,350	15,350	15,350	15,350
Total Capacity (SF) (Deficiency)	**8,374**	**8,374**	**6,630**	**4,886**

Source: Gensler
SF = Square feet

The security checkpoint at RNO currently consists of 15,350 square feet for both checkpoint screening area and passenger queuing. While this meets the physical space requirements through the planning period, its current organization has limitations. Based on current technology, the number of checkpoint lanes is adequate through the 2021 planning period. However, the length in the checkpoint screening area is not adequate to introduce innovative lanes that allow for more efficient passenger preparation for screening. These lanes require 80 feet while only 60 feet is available. Additionally, the reconciliation area directly past the screening checkpoint is inadequate, which leads to congestion and challenges in navigating the vertical circulation to level 2.

The security checkpoint area is currently configured with eight lanes and enough queue area to adequately support these lanes. This configuration has the capacity to handle a total peak 30-minute emplaned passenger demand of 450 passengers.

Passenger Holdrooms

Passenger holdrooms are designated areas in the secure concourse where passengers wait to board the aircraft at the gate. The size of the holdroom relates directly to the aircraft size at each gate. The estimated fleet mix determines holdroom sizing for each gate. The sizing of each holdroom assumes 70 percent of the total number of passengers are seated and the remaining 30 percent are standing. The required additional space for the gate podium and podium queue are also considered.

For planning, these are the assumptions (shown in **Table 3-38**):

- Design aircraft: Boeing 737-800, winglets, with 175 seats
- Seated/standing passenger mix: 70/30 (LOS C)
- Seated passenger space requirement: 15 square feet/passenger
- Standing passenger space requirement: 10 square feet/passenger
- Podiums per gate: 1, with 200 square feet of podium and queueing area
- Boarding/egress corridor area: 150 square feet of area/gate
- Holdroom circulation: 25 percent

Table 3-38: Passenger Holdrooms

Holdroom area for design aircraft	2016	2021	2026	2036
Number of seats on design aircraft	175	175	175	175
Load factor	90%	90%	90%	90%
Number of design passengers	158	158	158	158
Number of seats to be provided	126	126	126	126
Seated and standing area (SF)	2,210	2,210	2,210	2,210
Allowance for amenities (increase)	10%	10%	10%	10%
High utilization factor (increase)	0%	0%	0%	0%
Holdroom sharing factor (decrease)	10%	10%	10%	10%
Adjusted seated and standing area (SF)	2,190	2,180	2,180	2,180
Podium and queue area (SF)	200	200	200	200
Boarding area corridor (SF)	150	150	150	150
Total holdroom area for one gate(SF)	2,500	2,500	2,500	2,500
Equivalent gate	15.4	16.8	17.4	19.4
Total holdroom area (SF)	38,500	42,000	43,500	48,500
Holdroom circulation (SF)	9,625	10,500	10,875	12,125
Total Required Holdroom (SF)	**48,125**	**52,500**	**54,375**	**60,625**
Existing Holdroom Area (SF)	**33,260**	**33,260**	**33,260**	**33,260**
Total Capacity (SF) (Deficiency)	**(14,865)**	**(19,240)**	**(21,115)**	**(27,365)**

Source: Gensler
SF = Square feet

RNO has 12 leased gates and 11 non-leased gates that total 33,260 square feet in passenger holdroom space. The current concourse layout allows for 25-foot-wide gates on either side of a 22.5-foot-wide corridor. Considering a double-loaded corridor without moving walkways, a high level of service would recommend a minimum 30-foot-wide gate and 30-foot-wide concourse circulation.

Although RNO has 23 gates and an equivalent aircraft need of 15.4 for 2016, when it comes to the size of the related passenger holdrooms and associated circulation, RNO is currently deficient. Passenger holdrooms at RNO are a wide range of sizes, allowing some gates to meet current sizing needs, but others to be significantly undersized based on design aircraft and industry standards. The amount of vacant/un-leased holdroom space currently mitigates the individual holdroom size issue due to holdroom sharing. This deficiency is expected to grow more severe throughout the planning period. The primary issue is with the overall concourse width. Maximizing the aircraft parking efficiency dictates the available passenger holdroom length. Therefore, the available space depends on the concourse width. In addition, the efficient aircraft parking and compromised width limits opportunities for adequate services such as restrooms and concessions.

Due to both the lack of appropriately allocated space and the age/condition of the existing concourse, alternatives should focus on new, appropriately proportioned concourses. Once the appropriate proportions are established, gate count will dictate the airport's ability to adequately serve future demand. Therefore, the development of the alternatives and their subsequent evaluation will consider future expandability.

Domestic Baggage Claim and Inbound Baggage Handling

Baggage claim, or inbound baggage processing, includes the facilities and area required for arriving passengers to reclaim checked baggage. Baggage claim is also typically the area reserved for people meeting and greeting passengers arriving at their destination. Therefore, in addition to baggage claim devices and airline and baggage service offices, baggage claim areas traditionally include city and transportation information, rental car counters, concessions space, and support areas such as restrooms and mechanical spaces.

Baggage claim devices are provided for arriving passengers to retrieve their checked bags from the aircraft. Bags are offloaded from the aircraft, placed on baggage carts, and transported to a baggage handling area located within a secure area. From there, bags are then offloaded onto the baggage belts that carry baggage from the secure area into in the non-secure baggage claim retrieval area.

The baggage claim area at RNO has five flat-plate baggage claim devices providing approximately 835 linear feet of presentation frontage and four pass-through slides for oversized baggage. Baggage claim devices are assigned for specific airline use with each claim shared between two or three airlines. As such, the baggage claim area has been evaluated assuming that a combination of any three claim devices will be needed to meet the full demand at peak demand.

For planning, these are the assumptions (shown in **Table 3-39**):

- Percent of passengers checking bags: 80 percent
- Average traveling party size: 1.75
- Percent additional passengers at claim: 30 percent
- Claim frontage per person: 1.5 linear feet
- Flat plate claim device + circulation area: 20.4 square feet/linear foot of required frontage
- Baggage Service Offices (BSO): 20 percent of baggage claim area required
- Meeting and greeter lobby: 15 percent of baggage claim area required
- Circulation: 25 percent of baggage claim area required

Table 3-39: **Baggage Claim Demand Requirements**

	2016	2021	2026	2036
Peak Hour Deplaning Passengers	410	490	544	639
Percent Deplaning in Peak 20 Min	50%	50%	50%	50%
Percent Terminating Passengers	98%	98%	98%	98%
Percent Passengers Checking Bags	80%	80%	80%	80%
Average Traveling Party Size	1.8	1.8	1.8	1.8
Total Claim Frontage Required (LF) Per Claim Combination	169	202	224	263
Total Baggage Claim Area Required (SF) Per Claim Combination	3,448	4,121	4,570	5,365
Baggage Service Offices (SF) (25%)	862	1,030	1,142	1,341
Meeter/Greeter Lobby (SF) (15%)	517	618	685	805
Circulation (SF) (25%)	862	1,030	1,142	1,341
Total Baggage Claim Area Required (SF) Per Claim Combination	**5,689**	**6,799**	**7,540**	**8,853**
Total Baggage Claim Area Required (SF) (3 Claim Combinations)	**17,066**	**20,398**	**22,620**	**26,558**
Existing Baggage Claim Area (SF)	**32,670**	**32,670**	**32,670**	**32,670**
Total Capacity (Deficiency)	**15,604**	**12,272**	**10,050**	**6,112**

Source: Gensler
LF = Linear feet
SF = Square feet

The airport's current baggage claim area consists of 32,670 square feet. This includes the area used for the three combined baggage claim devices, BSO, the meeter/greeter lobby, and passenger circulation areas. As shown in **Table 3-39**, a total of 26,558 (8,853 x 3) square feet is recommended by 2036 to meet demand and continue assigned claim device service to the airlines. Capacity can be further expanded by migrating towards a common-use system. Assuming common-use, the existing 835 LF of presentation length has the capacity to handle 2,000 peak hour deplaning passengers.

Passenger service counters and waiting areas are part of the BSO, as is storage for late or unclaimed bags. Full baggage offices are typically required only by airlines with sufficient activity to warrant staffing. Other airlines often will request baggage lock-up areas to store late or unclaimed baggage and will handle passenger claims at their ATO counters. The seven BSO that RNO currently provides have storage behind each one, for a total of about 2,960 square feet. In December of 2016, eight commercial service airlines served RNO, and only Volaris and Allegiant did not occupy their own BSO in the baggage claim area. The current square footage of BSO provided will allow a high LOS through 2036.

Concessions

One of the most important revenue-generating components in any terminal plan today is the concessions area, and thus, this program should be carefully evaluated regarding location, massing, exposure, storage, and access. Airport industry trends demand more concessions in the secure portion of the terminal as passengers spend more time on the airside after the security checkpoint. **Table 3-40** details requirements for concession space at RNO based on the selected forecasts for enplaned passengers.

Table 3-40: Concessions Space (Square Feet)

	2016	2021	2026	2036
Annual Enplaned Passengers	1,823,620	2,178,514	2,416,747	2,839,354
Total Square Feet of Concession Space (per 1,000 enplaned passengers)	12.4	12.0	12.0	12.0
Recommended Concessions (SF)	**22,613**	**26,142**	**29,000**	**34,072**
Food & Beverage (SF)	**14,407**	**17,210**	**19,092**	**22,430**
Convenience Retail (SF)	**2,006**	**4,575**	**5,075**	**5,963**
Specialty Retail (SF)	**6,200**	**4,357**	**4,833**	**5,679**

Source: Gensler
SF = Square feet

RNO currently has 26,860 square feet of concessions space, exclusive of the storage and access areas. According to **Table 3-40**, RNO should have sufficient total square footage of concessions through 2021. Between 2021 and 2036, the concessions area should be increased by at least 7,200 square feet to meet industry standards. Presently, the concessions at RNO are split 27 percent landside and 73 percent airside, after passing through the SSCP.

Just past the main entry to the terminal building, the public concessions include a retail store, a news and gift shop, a diner, and café. The concessions within the secure area include specialty retail, news and gifts, bar and grill, pub, café, and bakery. The Gateway Project, completed in 2013, consolidated the TSA check points and provided significant upgrades to the concessions. Now a centralized hub of concessions is located between concourse B and C, with a few concessions distributed down each concourse. Recommendations for the size and location of terminal concessions will be identified during the development of terminal alternatives.

Rental Car

On the west side of baggage claim in the public area, rental car counters total 140 linear feet with offices behind. The size of the offices is sufficient for existing and future operations. The active queue area for each counter is part of a 45-foot-wide circulation corridor leading to the north building exit.

Airport Administration

In addition to offices for airport staff, many airports have a communication/incident control center that can often double as a meeting room or for other functions required on a more day-to-day basis. The 2006 Terminal Facilities Requirements report prepared by PB Aviation included a recommendation for approximately 90,000 square feet of airport administration space based on an estimate of nine million total passengers. Given the 2036 passenger enplanement forecast of 2.8 million, the same methodology may be used to determine the total square footage using the following formula FA = BYA + (1.275 x .5FE) / 1.8, where:

- FA is the future program requirement to be calculated, in square feet
- BYA is the Base Year 2016 area, in square feet
- FE is the future enplanement level in Million Annual Enplanements

Using this formula, RTAA administrative office space can be derived as: FA = 45,603 x (1.275 + (.5 x 2.8)) / 1.8 = 67,771 square feet. As a result, approximately 68,000 square feet of administration space is recommended by 2036. It should also be noted that the exact sizing of administrative space differs from one airport to another as each airport has different staffing requirements and management structures. Planning for these facilities should be considered early in the programming process with input from the airport operator.

Some airports prefer to locate management offices within the terminal while others prefer a location in a separate building. Such location decisions depend on the size of the airport staff, availability of space in the terminal, and the cost/benefit of in-terminal vs. remote locations for a given airport management's operating philosophy.

The RNO administrative offices are currently located on the second level along with critical building services. Recently required administrative offices have already been displaced to remote locations. The need for additional administrative space will be evaluated during the development of terminal alternatives. The alternatives will consider the need to expand and/or relocate the administrative offices to meet future demand. If relocated, alternative uses for the existing administrative space will need to be identified.

Public Spaces

Public spaces include non-revenue generating areas of the terminal building used for restrooms, circulation, seating, and waiting areas. Currently, a large module of restrooms is located just north of the main terminal entrance, serving both departing and arriving passengers and their guests. The concourses each have two modules of restrooms, with another module located at the High Mountain Marketplace. A summary of existing bathrooms is shown in **Table 3-41**.

Table 3-41: Terminal and Concourse Fixtures

Terminal Restrooms	Male	Female	Family	Total
Main Terminal Restrooms	16	14	1	31
North Baggage Claim	6	6	0	12
Terminal Total				**43**
Concourse Restrooms				
High Mountain Marketplace	5	5	0	10
Concourse B (2 Modules)	12	17	1	30
Concourse C (2 Modules)	12	17	1	30
Concourse Total				**70**
Total Restroom Fixtures	**51**	**59**	**4**	**113**
Source: ACAD line work provided by RNO				

The number of suggested restrooms is based on the peak hour passengers in the public area, and on the number of EQA within the secure area, as shown in **Table 3-42**. The existing restrooms are evenly distributed and provide RNO with a high LOS throughout the entire planning period of 2036.

Table 3-42: Restroom Requirements

Terminal Restrooms	2016	2021	2026	2036
Peak Hour Enplaning & Deplaning Passengers	820	980	1088	1278
Percent Additional Passengers	30%	30%	30%	30%
Total Passengers (Millions)	1,066	1,274	1,415	1,662
Total Fixtures Required (1 per 100 persons x 2)	**22**	**26**	**28**	**34**
Concourse Restrooms				
EQA	15.4	16.8	17.4	19.4
Total Restroom Modules (1 per 8 EQA)	2	3	3	3
Total Fixtures Required (10-12 fixtures per module)	**24**	**36**	**36**	**36**
Source: Gensler, 2017				

Terminal Condition Assessment

The Facility Condition Assessment (**Appendix A**) was completed to provide a light assessment of the terminal facilities. A summary of the findings on the terminal follows.

The exterior stucco of the building is in good shape and clean. There are small signs of wear and small water leaks at various exterior areas.

The ticketing hall was found to be in good shape with metal flashing, stone and mortar joints, metal siding and expansion joints in good condition.

The baggage makeup area was also found to be in average to good condition. There is an apparent leak in drywall ceiling below stairs that requires immediate attention. Some minor cracking is visible in the concrete stem wall and paint is flaking in some areas.

For the terminal connector, the suspended grid and tile ceiling is deteriorating and should be replaced soon. Monitor wall corners that have been damaged by vehicle traffic for possible future deterioration of surface material and sealants there.

Concourses B and C were found to be in fair condition. The suspended grid and tile ceiling is deteriorating and should be replaced soon. Metal flashings, siding, expansion joints were found to be fair. The concrete masonry unit (CMU) walls were found to be in good condition with paint flaking in various locations, some in need of immediate attention.

For the curbside pickup areas, concrete is beginning to spall and should be replaced soon. There is evidence of prior concrete curling in the sidewalk. It appears this was previously ground down to eliminate a tripping hazard. The current condition is average at best. There are also cracks in the drive surface; most are acceptable; however, a few are showing reinforcement rebar and should be replaced.

Terminal Facility Conclusions and Recommendations

The evaluation of the terminal facility areas identified spatial, organizational, and operational deficiencies included below. Each of the deficiencies will be addressed during the development of terminal alternatives:

- The size of the check-in/ticketing hall is adequate to handle the forecasted growth. Its location and critical dimensions are both appropriate. However, it is currently organized with a focus on a manual check-in process and should be evaluated with respect to current trends and technology.
- The size of the security checkpoint is adequate to handle the forecasted growth. While it is currently organized to efficiently accommodate current technology, the dimensions of the space limit how easily new technologies can be adopted in the future. In addition, the re-composure area and transition from security to the vertical circulation creates a less than desirable passenger experience.

- While gate demand is met with the existing gate count, both currently and through the planning period, the associated holdrooms are currently undersized. This discrepancy grows throughout the planning period. The fixed width of the two concourses directly conflicts with the efficiency of the aircraft parking layout.
- The current concessions and public spaces are appropriately sized, located, and distributed for the current layout. However, these areas should be evaluated for compatibility with future modifications.
- Administrative office space has already proved to be deficient with the potential for adjacent growth constrained by critical building services.

Support Facility Requirements

Observations noted in the inventory of existing conditions and aviation forecast chapters will be used to identify future demand for aviation support facilities over the 5-, 10-, and 20-year planning period. To help determine support facility needs, the consultant completed a Facility Condition Assessment (**Appendix A**) that provides a light assessment of RTAA owned structures. During the assessment, the buildings' structure, civil work, mechanical, electrical and plumbing (MEP) systems received a general rating (ranging from 1 for poor to 5 for like new) and a general list of improvements was provided. **Appendix A** provides full detail for each RTAA-owned structure.

Fixed Base Operator (FBO) and Corporate Facilities

Atlantic Aviation, RNO's only full-service FBO, built a new state-of-the art hangar and office/terminal facility in 2013 and a new fuel storage facility and reconstructed apron that opened in 2016. The facility provides fuel, and aircraft apron parking and storage. Atlantic is well positioned on the Airport, with a central location that provides good access to Runway 16L/34R and Runway 7/25.

The transient Atlantic Aviation apron will likely need to be expanded to accommodate the projected increase in transient aircraft. When large corporate jets (Gulfstream and Global Express) use Atlantic, these aircraft require wing-walkers when maneuvering on the Atlantic apron and Taxiway C near the apron.

Atlantic is easily accessed from South Rock Boulevard and vehicular parking is ample according to staff. Atlantic staff expressed two concerns: during peak times, the rental car agencies are not able to relocate cars from the rental car pick up area in the parking garage to Atlantic. This results in an inconvenience for corporate travelers and impacts Atlantic's ability to provide a high level of customer service. The Atlantic facility services international charters, especially during Burning Man, and having CBP staff present is required. It was noted that this is nearly impossible on days Volaris arrives, since CBP staffs the CBP Facility on those days. Atlantic coordinates with the charter to arrive on days CBP is available.

As a private business, any updates to the facility are completed and paid for by Atlantic. RTAA should support Atlantic expansion as operations increase. However, as a private business, Atlantic's business model will dictate when expansion takes place. Atlantic Aviation's facilities were not included in the Facility Condition Assessment.

The current FBO can meet the current and projected level of demand of noncommercial aircraft activity thru 2036. While the need for an additional FBO is not required to meet future demand, other local market factors must be considered. These include the Airport's interest in expanding local competition without negatively impacting existing services, establishing niche services that specialize in corporate or recreational aircraft services, and the presence of available land that is compatible with the existing land use on the airfield. The decision to support an additional FBO should consider potential impacts to customer service, long-term financial solvency, and community support. It is recommended that the RTAA review their current policy on the future GA activity at RNO to determine opportunities for new entrants at RNO. Options for additional FBO services will be included in the alternatives analysis.

GA Facilities

GA facilities at RNO are divided into two areas: GA East, which includes the facilities in the northeast quadrant, and GA West, located in the southwest quadrant. Current RTAA policy is to relocate GA facilities to the northeast quadrant. The selected Master Plan forecast shows modest growth in operations by local and itinerant aircraft. This section evaluates hangar and apron requirements associated with GA aircraft and future operations.

GA Activity and Critical Aircraft

A full list of operations by GA aircraft is presented in the GA operations section above in **Table 3-6**. Different aircraft types use different GA areas. For instance, the largest corporate jets will typically use and park on the Atlantic Aviation apron and use GA East. Smaller piston aircraft will typically use the hangar area in GA West.

These are the design aircraft and ADG for GA areas:

- GA East: Atlantic Aviation apron: ADG III, typical aircraft include Gulfstream and Global Express.
- GA East: Reno Flying Service apron: ADG II. Typical aircraft include Super King Air turboprops and lighter business jets, such as Cessna and LearJet.
- GA East: T-Hangars: ADG II, aircraft with wingspans less than 49 feet.
- GA West: T-hangars and apron: ADG II, aircraft with wingspans less than 49 feet.

Table 3-43 shows future based aircraft separated by type for the planning period.

Table 3-43: Future Based Aircraft

	2016	2021	2026	2036
Single Engine	74	74	77	75
Multi-Engine	18	20	21	21
Jet	17	19	23	31
Helicopter	5	5	6	7
Military	8	8	8	8
Total	**122**	**126**	**135**	**142**
Source: Preferred Master Plan Forecasts for based aircraft				

GA East and West

Aircraft storage, apron space and tie-down requirements are analyzed on a total airport need basis and RTAA policy is to direct future GA development to the east side of the airfield. Pavement strength analysis is separated by GA East and GA West sections.

Hangars and Storage

As of late 2016, GA hangars occupancy was 90 percent. Over the course of the planning period, the number of aircraft based at the Airport is forecasted to increase moderately as shown above. The trend of increasing GA aircraft size also plays a role in defining future development needs, with multi-engine and jet aircraft increasing share in the fleet.

There are 99 total hangars at RNO: 89 are T-hangars and 10 are small box hangars. Of the 89 T-hangars, nine on GA West are not leasable. GA West T-hangars range from 945 to 2,042 square feet and predominantly house single-engine aircraft. Hangars on GA East range from 1,050 to 2,700 square feet and store single-engine aircraft, multi-engine aircraft and some lighter jets.

- East Row 1: 18 T-hangars
- East Row 2: 18 T-hangars
- East Row 3: 21 T-hangars
- West Row 1: 16 T-hangars (8 not leasable)
- West Row 2: 8 T-hangars (1 not leasable)
- West Row 3: 8 T-hangars

The Facility Condition Assessment found the GA West hangars (RNO building numbers 2030, 2034 and 2036) to be in below average condition and the site work to be poor. For the GA East T-Hangars (4650, 4665 and 4680), the Facility Condition Assessment rated these hangars and sitework as average to below average.

The model that projects future hangar needs used the preferred forecast for based aircraft. This model assumes T-hangar/small box hangar and large box hangar occupancy depend on aircraft type. The model also assumes the size needed for T-hangars or small box hangars and large box hangars, based on an average size for the GA fleet. **Table 3-44** below shows future hangar needs at RNO, separated by T-hangars / small box hangars and large box hangars. T-hangars and small box hangars are calculated together because these store similar sized aircraft. An example of each hangar type with an example aircraft in plan view is provided in **Figure 3-17**.

Table 3-44: Hangar Requirements

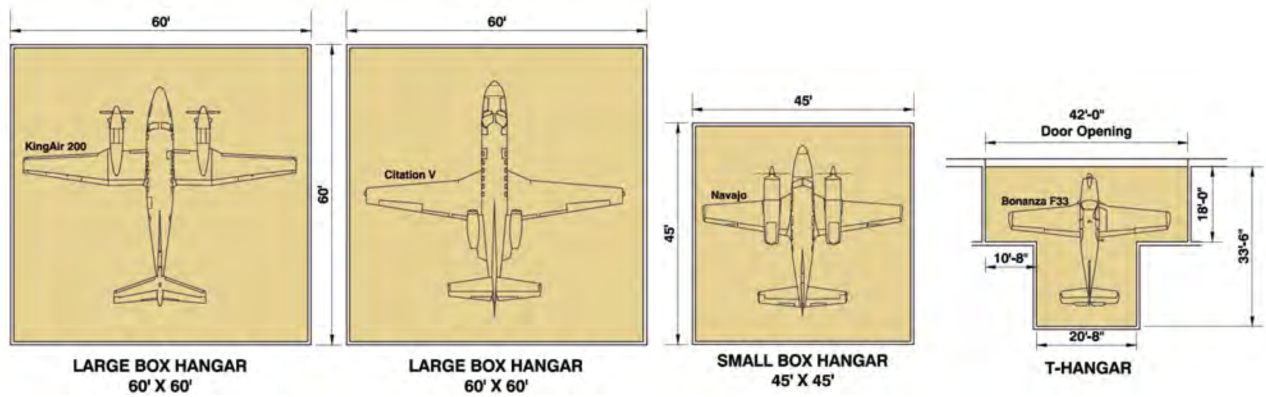
	Existing Hangars		2016	2021	2026	2036
T-Hangars or Small Box Hangars	**80 (T-hangars)**	Based Single Engine	60	60	62	61
		Based Multi Engine	10	11	12	12
		Based Jet	0	0	0	0
		Total T-Hangars / Small Box	**72**	**73**	**76**	**76**
		Increase by Phase		1	3	-
		Required Square Footage	**338,400**	**343,100**	**357,200**	**357,200**
		Increase by Phase		4,700	14,100	-
Large Hangars	**None (55 to 65-foot doors)**	Based Single Engine	7	7	7	7
		Based Multi Engine	7	8	8	8
		Based Jet	17	19	23	31
		Based Helicopter	5	5	6	7
		Total Large Hangars	**34**	**37**	**42**	**50**
		Increase by Phase	-	3	5	8
		Required Square Footage	**297,500**	**323,750**	**367,500**	**437,500**
		Increase by Phase	-	26,250	43,750	70,000

Source: Preferred Master Plan Forecasts for future based aircraft.
Formula notes and assumptions:
90 percent of SE base in T-hangars, 10 percent in large hangars
60 percent of ME base in T-hangars, 40 percent in large hangars
100 percent of jets base in large hangars
100 percent of helicopters base in large hangars
Square feet per T-hangar (includes ancillary area and pavement) = 4,700 square feet per hangar
Square feet per large hangar (includes ancillary area and pavement) = 8,750 square feet per hangar

Many of the hangars at RNO are T-hangars and small box hangars, with a few large corporate hangars that base multiple aircraft. These corporate hangars admittedly flaw the model above, since one aircraft may not equal one hangar in that situation. Future projections assume that all aircraft will base separately in individual hangars, so that one aircraft equals one hangar. Consideration should be given to this scenario, however, corporate hangars serving multiple aircraft will likely continue to exist.

The 88 hangars on GA West and East are classified as T-hangar or small box hangars based on dimensions and the aircraft type each hangar can store. Projections in **Table 3-44** are based on the preferred forecasts and show demand for 76 T-hangar or small box hangars in the planning period. **Table 3-44** also shows executive hangars that average 60 feet by 60 feet. A few corporate box hangars with doors over 60 feet exist at RNO today: Deeside Hangar G (4515), Reno Flying Service Hangar B (4605), Box Hangar F (4590), Executive Hangar 9 (2524) and a 17,000 square foot hangar (2528). These hangars have the potential to store large corporate jets or multiple aircraft. Demand based on the preferred forecasts shows a need for box hangars with 60- or 65-foot doors, for individual aircraft storage.

Figure 3-17: Hangar Examples



The recommendation is that RNO consolidate hangar expansion on the east side of the airfield, as previous RTAA guidance suggests. This will help separate uses on the airfield, so GA is located on the east and commercial and cargo on the west side. This includes replacement of GA West hangars, and potentially the existing hangars on GA East.

Transient Apron Requirements

The Atlantic Aviation facility is the terminal for transient aircraft using RNO. The Atlantic Aviation apron is 705,800 square feet, which includes taxilanes and a fuel farm. Of this, 117,000 square feet is designated for aircraft parking, split into two sections that measure 78,500 square feet and 38,500 square feet. This is the primary area for transient aircraft parking at RNO.

September is the busiest month for transient operations with air taxi flights to the Burning Man festival in late August and early September. The apron also experiences a surge in itinerant traffic during other special events such as the Reno Air Races in September. When the Atlantic Aviation apron reaches capacity, aircraft will park on Taxiway L near the approach end of Runway 7, or if needed, on Runway 7/25. Cable tiedowns for overflow transient aircraft are also located east of the Runway 25 approach end. These areas are not included in calculations for existing transient aprons.

ACRP Report 96: *Apron Planning and Design Guidebook* provides recommendations for GA apron size requirements based on the number and size of aircraft anticipated to use the apron during peak periods. The report also recommends incorporating as much flexibility in apron size and configuration as possible for the diverse fleet within GA activity. **Table 3-45** shows transient apron requirements into the future, based on the preferred forecasts for PMAD activity.

Table 3-45: Transient Apron Requirements

	2016	2021	2026	2036
Number of Tie Downs	35	36	39	43
Required Apron Square Footage	113,000	117,800	128,400	141,600
Increase by Phase	**-**	**4,800**	**10,600**	**13,200**
Existing Apron[1]	117,000	117,000	117,000	117,000
Difference from Existing (Deficiency)	**4,000**	**(800)**	**(11,400)**	**(24,600)**

Source: Preferred Master Plan Forecasts for future transient operations.
Formula notes and assumptions:
Average day of peak month (September) for itinerant ops used for operations, with a 10 percent increase for busy day.
Assumes 50 percent of itinerant operations will require apron storage. Others will hangar or take off after unloading passengers/cargo.
Assumes 60-foot-by-60-foot space for parking area, which averages multi engine piston, turboprops and business jets. Area does not include area for circulation (taxilanes), which will be added during alternative layouts.
1. Existing transient apron calculated from designated parking area on Atlantic Aviation apron.

Based on the formula, the existing transient apron is adequate for operations at the time of this report. As mentioned, the transient apron does exceed capacity for Burning Man in September. This is because more transient aircraft base at RNO for the week, and larger aircraft are using the apron than the model assumes. Regardless, the model shows that modest growth in the preferred forecasts will require expansion of apron space to accommodate transient operations.

Tiedown Apron Requirements

According to RNO records, only eight aircraft based at RNO are stored on an apron rather than a hangar. These aircraft are located east of the GA East hangar rows. There are 14 additional tie-downs along the west edge of the GA East ramp area. Formulas indicate that the percentage of aircraft using tie downs to base is approximately 10 percent of single-engine aircraft. Single-engine aircraft are only projected to increase by one aircraft over the planning period, so no additional tie downs are required, based on this model. Any consolidation of hangars and aprons on the east side of the airfield should include a designated area for based aircraft tiedowns.

GA East Apron Pavement

RTAA worked with a consultant to develop a Pavement Management Program in 2015, which included an inspection of the airfield pavement and aprons, assessment of the pavement condition, and recommendations for a pavement maintenance plan maintained by RTAA. The PMP did not evaluate the Atlantic Aviation apron since this is a tenant-maintained facility. A summary of the conditions for East GA Aprons is below.

The pavement within the GA East Apron is currently in poor to serious condition. The PCI for each section is as follows:

- Main Section, south of the T-Hangars, PCI is 22;
- West T-Hangar Taxilane, PCI is 17;
- West Central T-Hangar Taxilane, PCI is 24;
- East Central T-Hangar Taxilane, PCI is 34; and
- East T-Hangar Taxilane, PCI is 45.

The consultant's maintenance recommendations at the time of the report include a rehabilitation of the two east T-hangar taxilanes in 2017, and reconstruction of the remaining apron in 2017. If the pavement is not maintained, PCI values are anticipated to drop at the rate of about 3 per year.

GA West Apron Pavement

Below is a summary of the conditions for GA East and West Aprons, and the Aircraft Rescue and Firefighting (ARFF) facility from the 2015 PMP.

The pavement within the GA West Apron is currently in fair to serious condition. The PCI for each section is as follows:

- Main Section, northeast corner, PCI is 68;
- Southeast Section, near the ARFF, PCI is 67;
- North T-Hangar Taxilane, PCI is 14;
- Central T-Hangar Taxilane, PCI is 21; and
- South T-Hangar Taxilane, PCI is 32.

The consultant's maintenance recommendations at the time of the report include a reconstruction of the two north-most T-hangar taxilanes in 2019, and rehabilitation of the remaining apron in 2019. If the pavement is not maintained, PCI values are anticipated to drop at the rate of about 3 per year.

The pavement surrounding the ARFF facility comprises PCC pavement, and includes an asphalt pavement access road and parking. The PCC pavement is currently in very poor condition, with a PCI of 40, and the access road is in good condition with a PCI of 88. Maintenance recommendations at the time of the report included reconstruction of the PCC in 2016, and rehabilitation of the access road in 2024. If the pavement is not maintained, PCI values are anticipated to drop at the rate of about 3 per year.

GA West Recommendation

RTAA policy is to transition all GA facilities to the east side of the airfield. This will consolidate facilities and separate uses from cargo, commercial, and military on the west side of the airfield. The apron and hangars are in generally fair to poor condition. The hangars are over 40 years old. Rehabilitating these is not recommended, while allowing for the building of new apron and hangars and consolidating facilities on the east side of the airfield is preferred.

GA Conclusions and Recommendations

Modest growth is projected in GA operations and based aircraft. The projection of a shift away from piston aircraft to turboprops and jets for private aircraft means existing T-hangars may not be adequate for future based storage needs. Projected needs for the transient apron and hangars show expansion of these facilities, especially larger box hangars, is likely needed.

The recommendation is that analysis of the alternatives consider the expansion of GA facilities on the east side of the airfield, as stipulated by RTAA guidance, separating light and heavy aircraft uses on the airfield. Land is available east of the ATCT for GA expansion. Consideration should be given to consolidate hangars and potentially replace hangars that are at or beyond life cycle. Alternatives should also consider relocating GA West facilities to the east side. At an airport like RNO with diverse operations and aircraft types, the separation of uses can be beneficial for functional operations and safety.

Military

The Nevada Air National Guard (NVANG) maintains its 61-acre base located south of the terminal. Military facilities are not evaluated as part of this Master Plan. Eight C-130s are stationed at the base throughout the year; however, these aircraft may be deployed at any time. Discussion with NVANG staff indicates the U.S. Department of Defense determines the future of the base. The life and mission of the base is dependent on world events, congressional funding, and federal policies.

Discussion with ATCT staff indicated that, at times, military charters will use RNO to transfer troops to and from RNO for training at the NVANG. During these times, military aircraft may use Atlantic Aviation's apron, or if needed, be parked on Taxiway L.

The recommendation is that RNO continue to support NVANG operations at RNO. RNO should maintain the parallel taxiways and connector Taxiway K for use by C-130 aircraft. Any improvements to landside access from Terminal Way or Interstate 580 would need to be vetted with NVANG base planners.

Air Cargo Facilities

This section documents analysis of the existing and future air cargo fleet mix, and the critical aircraft selection for the cargo area design standards. This section then records the analysis of future dedicated air cargo facilities based on the following characteristics:

- Number, type, size, and location of future dedicated air cargo buildings
- Future air cargo apron size, location and orientation requirements
- Future air cargo storage and support facilities
- Air cargo vehicular access and circulation

Cargo Area Design Standards

Like the commercial terminal and GA facilities, the design and size of the airside cargo facilities is dependent on the aircraft models regularly using this area.

Air Cargo Fleet Mix

The section on **Critical Aircraft** and ARC earlier in this chapter analyzed air cargo aircraft operations for 2016 and the future. **Table 3-3** in that section summarized these operations by aircraft model. That table is repeated here as **Table 3-46** for the reader's convenience.

Table 3-46: Cargo Operations

Carrier	Aircraft Model	AAC	ADG	TDG	Operations			
					2016	2021	2026	2036
FedEx	Airbus 300-600	C	IV	5	28	29	30	32
	Boeing 757/200	C	IV	4	1,168	1,208	1,251	1,342
	Boeing 767/300ER (NEW)	D	IV	5	0	539	1,116	1,197
	MD-10/11/ER (phased out)	D	IV	6	1,042	539	0	0
UPS	Airbus 300-600	C	IV	5	788	815	844	905
	Boeing 757/200	C	IV	4	948	981	1,016	1,089
	Boeing 767/300ER	D	IV	5	68	70	73	78
DHL	Boeing 737-400F	C	III	3	526	544	564	604
	Cessna 208/B + Caravans	A	III	1	472	494	512	549
Total Operations – Cargo Operators (MP Forecast)					**5,040**	**5,220**	**5,406**	**5,798**

1. Indicates share of cargo operations only, not landed weights or market share. Operations share based on 2016 landings. Share 2016 Source: RTAA Includes RTAA Detail Landing Report, 2016. Future operations based on preferred Master Plan forecast.

For cargo operators, market share is expected to remain about the same over the forecast period. The share of operations for carrier and aircraft are assumed to also remain the same. Cargo operators typically use aircraft over a longer lifespan than passenger air carrier airlines, occasionally operating more than 30 years after delivery. However, FedEx has recently indicated that, based on Fourth Quarter Fiscal 2015 Statistics, operations by the MD 10 and 11 series will be phased out of service by 2021. FedEx is expecting delivery of 62 Boeing 767 from 2014 to 2019 to replace operations by the MD series aircraft at RNO.

UPS is expected to maintain the current fleet, but also to add 14 747-8 cargo carriers in the short-term, primarily for trunk routes connecting Europe to Asia, and Asia to the U.S. Based on projections in **Chapter 2**, these aircraft are not expected to use RNO regularly. **Table 3-46** shows future cargo operations by aircraft model.

Selection of Critical Aircraft for Air Cargo Facilities

As identified in the Critical Aircraft and ARC section earlier in this chapter, the design criteria for the cargo area are listed here:

- The existing/future design aircraft for the cargo area is the Boeing 767/300ER.
- The existing/future design code for the terminal area is D-IV.

Air Cargo Facilities Planning

Even when using industry-accepted standards, planning for air cargo facilities is an inexact science. For each type of operator, throughput capacity ratios are given a range, rather than a specific multiplier. Moreover, inferences must be made about how much cargo operators will process off-airport, rather than on-airport. At RNO, both FedEx and UPS move much of the building and breaking down of air cargo containers off-airport. One result of intensive off-airport processing can be unrealistically high ratios for the processing of shipping on-airport. For example, RNO's largest air cargo market share leader FedEx, roughly 60 percent, reported moving more than 40,000 tons through its 12,000-square-foot, on-airport warehouse in 2016. The remainder, roughly 40 percent, of RNO's cargo was processed through the considerably larger ProLogis multi-tenant, 56,562-square-foot warehouse.

While cargo carriers are not able to move their aircraft loading/unloading off-airport, they still have some flexibility in how they address variable demand. International carriers routinely truck air cargo shipments 500 miles or more to international gateways. In contrast, domestic carriers may address demand fluctuations by changes in aircraft gauge and frequencies that are determined daily with far more flexibility than passenger operations could afford. The tradeoff between additional frequencies and larger gauge aircraft may also entail the use of additional stops on cargo routes between spoke markets and hubs.

This flexibility creates uncertainty when identifying the need for future air cargo facilities; therefore, it is critical to clearly document in sufficient detail the assumptions used to determine future capacity. The following sections provide a description of the recommended air cargo facilities at RNO.

Future Dedicated Air Cargo Buildings

As detailed in the **Chapter 1**, RNO currently has three buildings designated for commercial air cargo operations. FedEx's principal operation is in a 12,000-square-foot-building leased from Properties West Welby Development, LLC and located at 1350 Air Cargo Way. FedEx also leases additional space from ProLogis for Ground Service Equipment (GSE) maintenance. ProLogis has a combined 79,849 square feet of warehouse space in two buildings; however, all its commercial cargo tenants are presently housed in a multi-tenant, 56,562-square-foot facility at 1395 Air Cargo Way. Tenants in this building include UPS, Southwest Airlines, DHL, and cargo handler Worldwide Flight Services, which acquired former RNO tenant handler Consolidated Aviation Services. This building currently has two vacancies that account for 10,427 square feet of available warehouse. A third designated cargo building located at 1500 Terminal Way accounts for another 22,922 square feet of warehouse but is used primarily for GSE storage rather than commercial cargo. As a result, the third cargo building is excluded from the cargo capacity inventory for the remainder of this analysis.

For decades, airport planners casually used a metric of one ton of cargo for each square foot of air cargo warehouse. This approach made no distinction between the disparate efficiencies and functions experienced by different types of operators. Integrated carriers like FedEx and UPS derived greater automation and efficiencies from the use of shipping containers achievable on freighters. As a result, these integrated carriers often achieved much higher rates for processing cargo than domestic passenger carriers. Domestic passenger carriers had narrow-body aircraft with insufficient belly capacity for containers, and usually even for pallets. However, third-party handlers soon assumed the cargo functions for multiple air carriers. Third-party handlers had the means to achieve greater efficiencies with equipment, manpower, and space than the individual passenger carriers could when they handled their own cargo operations.

The Transportation Research Board (TRB) of the National Academy of Sciences wanted to research the rates of use in more contemporary operating environments. The TRB also wanted to provide direction more suitable for the diversity of cargo operators. As a result, the TRB sponsored completion of Airport Cooperative Research Program (ACRP) Report 143*: Guidebook for Air Cargo Facility Planning & Development*, last modified in October 2016. The planning metrics used in the RNO cargo facilities analysis are based on this guidebook.

Although DHL has withdrawn from the domestic U.S. retail, or consumer, market, its operations are still more like integrated carriers FedEx and UPS than the other types of cargo operators. A warehouse use ratio of 1.6 U.S. tons of cargo per square foot, which accounts for 97 percent of RNO's 2016 air cargo tonnage, is applied to the all-cargo operators DHL, FedEx, and UPS. The lower efficiency of belly carriers results in 0.64 U.S. tons of cargo per square foot, which accounts for the remaining 3 percent market share.

The two principal cargo facilities in use at RNO provide 68,562 square feet of warehouse capacity. As **Table 3-47** shows, this capacity should theoretically be adequate to serve RNO's air cargo growth through at least the 2026 forecast period in the Master Plan Forecast, and reasonably close to the High Case, as well. The FedEx facility at RNO supplements with off-airport capacity and is already achieving a much higher use ratio than the TRB guidelines suggest. Doing so relieves pressure on the multi-tenant building that, at the time of this report, has more than 10,000 square feet of vacancy.

Table 3-47: Air Cargo Tons (Actual & Forecast) and Resultant Warehouse Demand

	U.S. Tons of Total Cargo					SF of Cargo Warehouse Demand			
	2016	2021	2026	2036		2016	2021	2026	2036
MP Forecast	78,200	89,450	100,250	121,150	**MP Forecast**	51,031	58,344	65,453	79,047
All-Cargo	75,900	86,850	97,350	117,600	All-Cargo	47,438	54,281	60,844	73,500
Belly	2,300	2,600	2,950	3,550	Belly	3,594	4,063	4,609	5,547
LOW	78,200	85,750	92,700	105,500	**LOW**	51,031	55,938	60,469	68,875
All-Cargo	75,900	83,250	90,000	102,450	All-Cargo	47,438	52,031	56,250	64,031
Belly	2,300	2,500	2,700	3,100	Belly	3,594	3,906	4,219	4,844
HIGH	78,200	93,550	109,000	140,500	**HIGH**	51,031	61,078	71,156	91,656
All-Cargo	75,900	90,850	105,850	136,400	All-Cargo	47,438	56,781	66,156	85,250
Belly	2,300	2,750	3,200	4,100	Belly	3,594	4,297	5,000	6,406
Source: Webber Air Cargo, Inc.SF = Square feet									

Air Cargo Vehicular Capacity, Access and Circulation

Table 3-48 shows it is possible to use the forecasted demand for warehouse square footage to derive the demand for landside truck marshaling and automobile parking. For air cargo facilities up to 50,000 square feet, the TRB guidelines recommend 1.8 square feet of landside space for each 1.0 square feet of warehouse. For facilities between 50,001 and 99,999 square feet, TRB suggests the ratio could dip slightly to 1.7 square feet. RNO's larger multi-tenant facility is slightly larger than 50,000 square feet. Landside facilities appear smaller than the recommended ratio, and yet, RNO's cargo tenants did not cite truck congestion in their concerns. Options for increased air cargo vehicular capacity, access and circulation will be included in the development of support facility alternatives.

Table 3-48: Air Cargo Facilities Demand (Square Feet) For Warehouse and Landside

	Existing	2016	2021	2026	2036
MP Forecast (Total SF)	232,562	142,888	163,363	183,269	221,331
Warehouse (SF)	68,562	51,031	58,344	65,453	79,047
Landside (SF)[1]	164,000	91,856	105,019	117,816	142,284
LOW (Total SF)	232,562	142,888	156,625	169,313	192,850
Warehouse (SF)	68,562	51,031	55,938	60,469	68,875
Landside (SF)[1]	164,000	91,856	100,688	108,844	123,975
HIGH (Total SF)	232,562	142,888	171,019	199,238	256,638
Warehouse (SF)	68,562	51,031	61,078	71,156	91,656
Landside (SF)[1]	164,000	91,856	109,941	128,081	164,981
Source: Webber Air Cargo, Inc. 1. Landside area totals from RNO GIS line work. SF = Square feet					

Air Cargo Apron Requirements

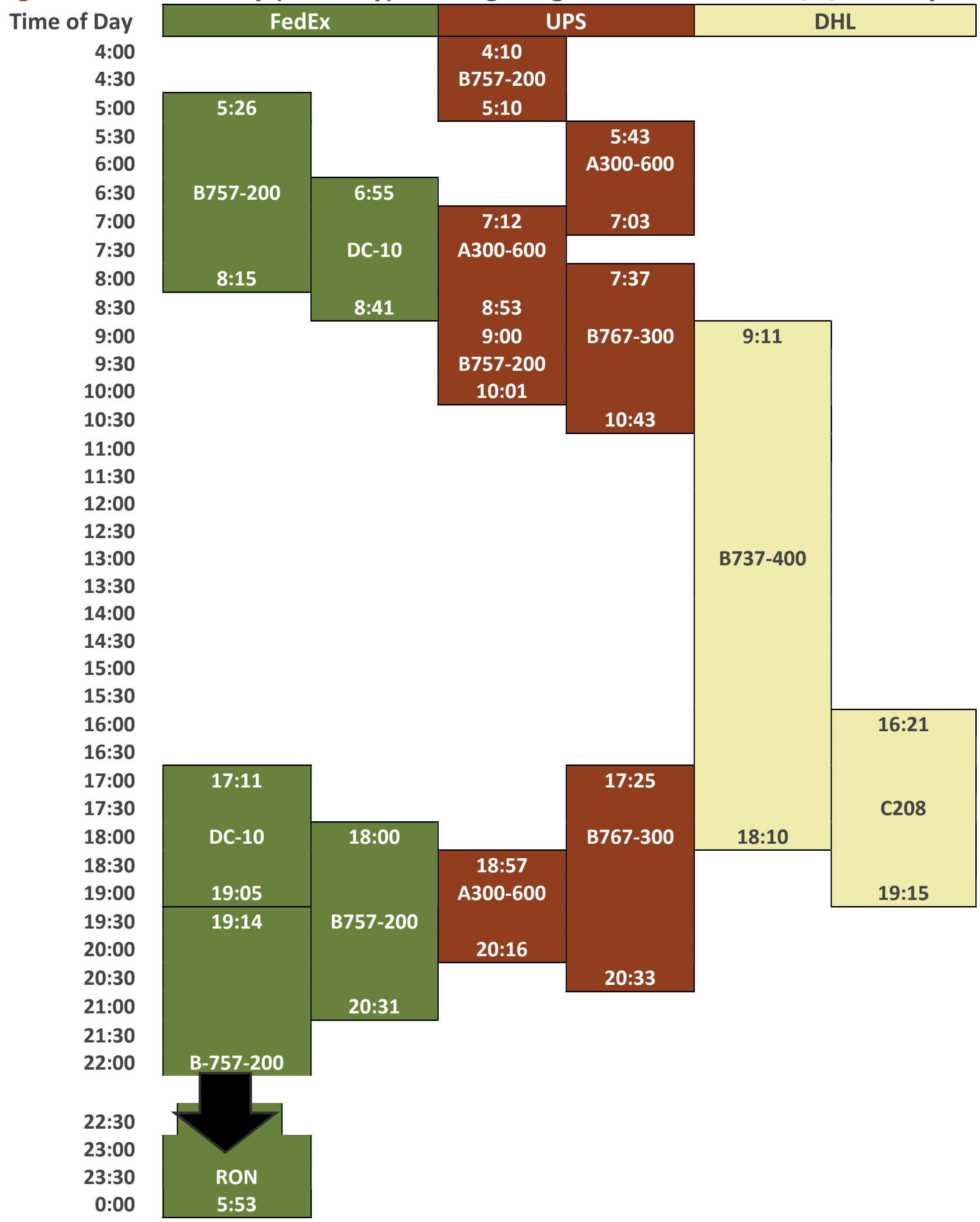
The more algorithmic emphasis on aircraft types is not the only requirement to project air cargo apron demand. Assumptions about the sequencing of freighter flight schedules are equally important but less certain than the algorithms. FedEx and UPS rarely park their aircraft at RNO for more than three hours at a time. This allows both carriers to add frequencies without necessarily imposing the need for new ramp construction. Both have morning flight operation windows: FedEx's ends by 9:00 a.m., and UPS's ends at 11:00 a.m. Both also have evening windows that begin with arrivals after 5:00 p.m., and most departures conclude by around 10:30 p.m.[1], although FedEx did have one remain overnight aircraft at RNO. DHL operates a much more modest schedule, both in terms of frequency and aircraft gauge, but leaves its main aircraft, a B737-400, parked at RNO from about 9:00 a.m. to 6:00 p.m., as well as a second regional feeder, C208, for three hours in the evening. **Figure 3-18** illustrates 2016 peak-day schedules for the three major carriers by aircraft type, and the time of day each aircraft is parked on the cargo apron.

In addition to the ability to add frequencies using existing ramp, integrated carriers may also accommodate increased tonnage by using larger aircraft. Integrated carriers can also dedicate more payload on existing flights to the RNO market, rather than to intermittent stops the carrier may have on existing routings between spoke airports and hubs. All three integrated carriers use such routings to serve RNO.

The TRB planning model for aircraft apron provides options of using cargo tonnage to project the required square footage of ramp or using freighter aircraft types. This report uses aircraft types during peak hours to project square footage of actual aircraft parking positions because tonnage data ignores the role of flight schedules in apron availability. In the model, the tonnage data is still used to project capacity required for GSE, which is calculated per TRB guidelines as 0.5637 tons per square foot.

[1]Based on schedules for the week of 12/6/2016.

Figure 3-18: Peak-Day (Tuesday) All-Cargo Flight Schedules for 12/6/2016 by Carrier and Aircraft



Source: Flight Aware with Compilation by Webber Air Cargo, Inc.

Table 3-49 presents the square footage required by the existing peak hour aircraft used by RNO's incumbent carriers. The table also presents a projected additional aircraft at peak hour, which could result from another air cargo provider expanding its network, or from organic growth within RNO's current tenant base. The impact on aircraft parking ramp is introduced within the first five years of the forecast period, while the capacity consumed by the demand for GSE grows throughout the period, according to projected tonnage.

Table 3-49: Freighter Aircraft Used at Peak Hour by Carrier and Apron Required (Square Feet)

	AAC	ADG	Ramp/Aircraft (SF)	2016	2021	2026	2036
FedEx	C	IV	51,700	51,700	51,700	51,700	51,700
	D	IV	58,700	58,700	58,700	58,700	58,700
UPS	C	IV	51,700	51,700	51,700	51,700	51,700
	D	IV	58,700	58,700	58,700	58,700	58,700
DHL	C	III	36,100	36,100	36,100	36,100	36,100
	A	III	14,000	14,000	14,000	14,000	14,000
Future Growth (New Entrant)	D	IV	58,700	--	58,700	58,700	58,700
Required Ramp Parking (SF)				270,900	329,600	329,600	329,600
Existing Ramp Parking (SF)[1]				483,100			
Difference (SF)				**212,200**	**153,500**	**153,500**	**153,500**
Required GSE Storage Area (SF)				138,726	158,684	177,843	214,919
Existing GSE Storage (SF)[1]				151,000			
Difference (SF)				**12,274**	**(7,684)**	**(26,843)**	**(63,919)**
Total Required Ramp (Apron + GSE Storage) (SF)				409,626	488,284	507,443	544,519
Existing Ramp (Apron + GSE Storage) (SF)				634,100			
Difference (SF)				**224,474**	**145,816**	**126,657**	**89,581**

Source: Webber Air Cargo, Inc.
1. Apron and GSE area totals from RNO GIS line work. SF = Square feet

Theoretically, RNO's current inventory of ten freighter parking positions, which total 483,100 square feet, should be adequate for the demand projected for the forecast period. Interviews with RNO's cargo tenants substantiate that, if schedules operate unimpaired, RNO has adequate ramp. The tenants noted that ramp positions have been lost to GSE storage. The tenants also noted their ability to operate larger aircraft to handle unexpected daily fluctuations is limited by which aircraft can be accommodated simultaneously.

GSE storage noted in **Table 3-49** is based on dedicated storage areas and does not include ramp areas that have been overtaken by GSE. Projected forecasts show more GSE area will be needed in five years, without counting ramp overflow. It is recommended that additional GSE area be analyzed for short-term expansion.

Cargo Facility Conclusions and Recommendations

The TRB released the air cargo facilities planning metrics in 2016. Applying these metrics, RNO should have sufficient warehouse and landside capacity through at least 2026 and adequate ramp capacity for the full 20-year planning horizon. Dedicated GSE storage will reach capacity in less than five years and may already be at capacity with tenants indicating GSE is currently stored on apron ramps. **Table 3-50** summarizes these elements.

Table 3-50: Summary Cargo Facilities Capacity Demand (Square Feet) For Forecast Period

	Existing	Required			
		2016	2021	2026	2036
Warehouse	68,562	51,031	58,344	65,453	79,047
Landside Parking[1]	164,000	91,856	105,019	117,816	142,284
Airside Ramp Parking[1]	483,100	270,900	329,600	329,600	329,600
GSE[1]	151,000	138,726	158,684	177,843	214,919
TOTAL (SF)	**866,662**	**552,513**	**651,647**	**690,712**	**765,850**
TOTAL (Acres)	**19.90**	**12.68**	**14.96**	**15.86**	**17.58**

Source: Webber Air Cargo, Inc.
1. Apron, landside, and GSE area totals from RNO GIS line work.
SF = Square feet

However, potential anomalies exist that can be identified, and yet, cannot necessarily be calculated. RNO's market share leader, FedEx, is already achieving an unusually high facility throughput based on an off-airport sortation that presumably is not ideal but at least acceptable. Both FedEx and UPS cited existing operating challenges at RNO, particularly regarding GSE storage and aircraft parking. Interviews for the 2015 Air Cargo Market Study completed by Campbell-Hill identified these same concerns and recommended RTAA invest in facilities improvements to address these challenges.

RTAA is already considering moving air cargo operations to the RNO's Southwest Quadrant to accommodate passenger terminal expansion toward the north. According to the Campbell-Hill Study, this 98-acre future site could accommodate 700,000 square feet of warehouse and landside operating space. The move would provide growth potential that exceeds requirements exponentially within the 20-year planning horizon. RNO's cargo capacity and forecasted demand indicate the move is as likely to be brought about by passenger-related priorities as by pressing capacity demand by RNO's cargo operators, or the introduction of a new cargo provider.

RNO's cargo tenants at the time of this report tolerate recognized challenges in existing cargo facilities rather than invest in new facilities. However, if passenger terminal expansion requires a move, the value proposition for cargo tenants changes almost entirely. Forced to invest in new facilities, FedEx may choose to move some of its off-airport operations on airport. It is doubtful that RNO's market share leader would choose to continue in similarly cramped facilities, especially after another decade of growth.

Should FedEx continue in a dedicated facility at the new location, RTAA may need to retain the rest of its cargo tenants in a multi-tenant facility. If both FedEx and UPS moved into dedicated facilities, the balance of 8,480 U.S. tons projected for 2036, net of FedEx and UPS, may be less than what is needed to anchor a new multi-purpose building's debt service.

Support and Maintenance Facility Requirements

Support facilities assist in day-to-day operations at an airport, such as the ATCT, emergency support services, operations, vehicle maintenance, snow removal, vegetation control and fuel farms. These facilities are evaluated below and if needed, improvements are recommended based on the Facility Condition Assessment. **Appendix A** provides full detail for each RTAA-owned structure.

ATCT and Line of Sight

The ATCT is in the northeast quadrant, east of Atlantic Aviation facilities. Constructed in 2008, the ATCT meets required security directives, and is considered a state-of-the-art facility. The cab floor elevation is 195 feet above ground level.

According to ATCT staff, and verified on **Figure 3-19**, the line of sight is clear of any obstructions from the tower to the movement area. The movement area is defined as taxiways and runways under the jurisdiction of the ATCT, and clearance is required prior to entering the movement area. Aircraft, vehicles, and pedestrians operating in the aircraft movement area must be in communication with the ATCT at all times. The movement area is shaded light blue on **Figure 3-19**.

The non-movement area is the area on ramps and aprons outside of the movement area. The ATCT does not control the non-movement area. Aircraft taxi in these areas without clearance or communications with the control tower. There are interruptions of controller tower line of sight to various non-movement areas on the airfield. **Figure 3-19** illustrates the interruptions, which include:

- Passenger terminal apron, north of each concourse.
- Atlantic Aviation apron directly west of the ATCT.
- Reno Flying Service apron.
- Taxilanes between T-Hangars, or Rows C, D1, and D2.

These areas obstructed from ATCT controller line of sight are in the non-movement area where clearance is not required. However, it is an advantage for the ATCT to have visual contact with aircraft in non-movement areas, particularly near the passenger terminal gates and cargo areas. Even though there is a line of sight coverage shadow north of both passenger terminal concourses, ATCT indicated they can track most aircraft movement by aircraft tails.

The ATCT was not included in the Facility Condition Assessment as it is not owned by RTAA. Relocating or replacing the ATCT within the 20-year planning period is not recommended. ATCT staff indicated that any future development on or near the airport should have clear of line of sight to movement areas.

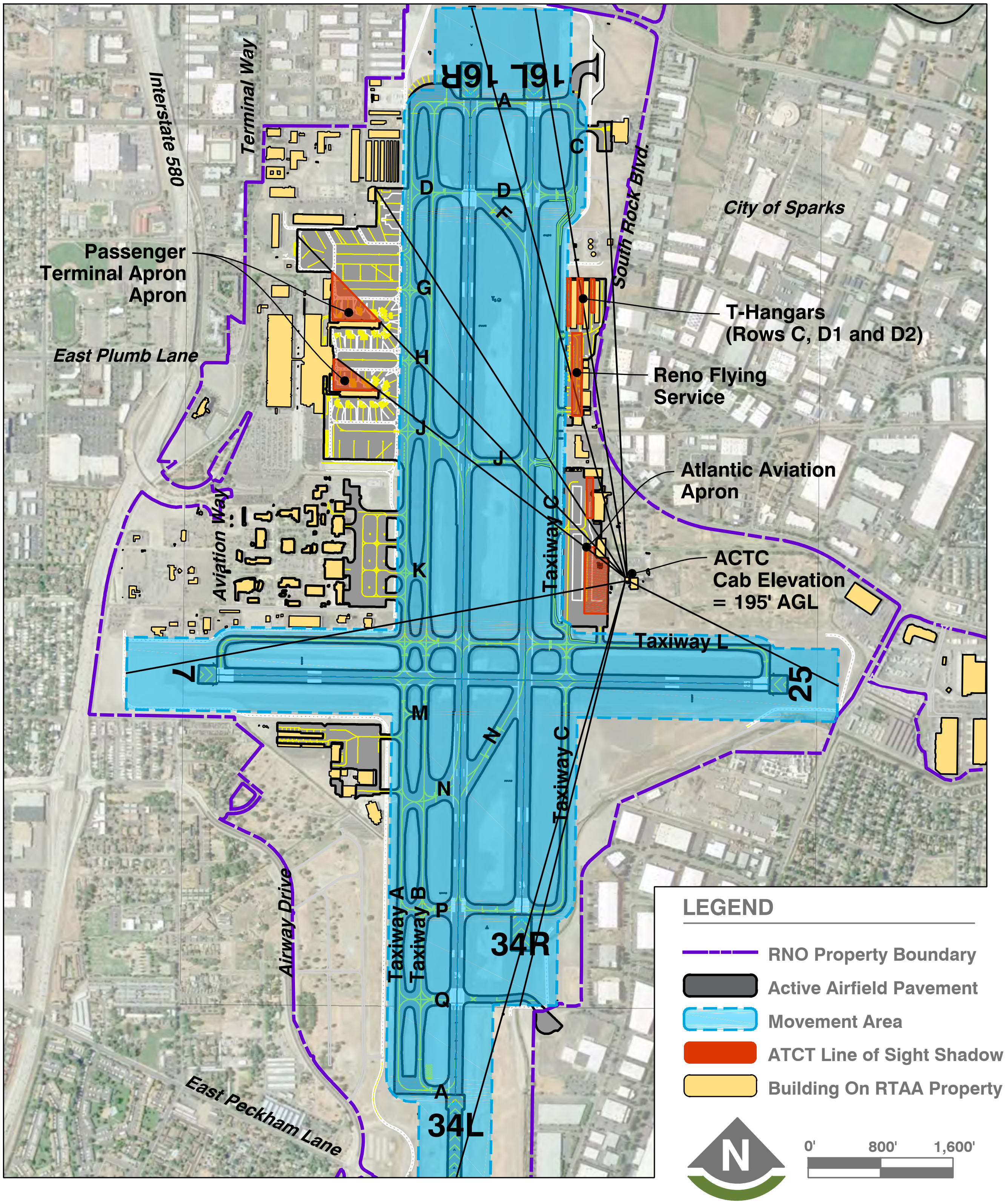


Figure 3-19
ATCT Line of Sight

Airport Rescue and Fire Fighting (ARFF)

The ARFF facility (2522), constructed in 2008, is in the southwest quadrant. RNO is certified under 14 CFR Part 139; therefore, it must comply with ARFF equipment, staff, and operational requirements developed by the FAA and the International Civil Aviation Organization Rescue and Fire Fighting Panel. According to Part 139, ARFF equipment and staff requirements are based upon the length of the largest air carrier aircraft that serves an airport with an average of five or more daily departures. **Table 3-51** presents the ARFF Index, aircraft length criteria, and representative air carrier aircraft.

Table 3-51: ARFF Index Requirements

ARFF Index	Aircraft Length Criteria	Representative Aircraft
A	Less than 90 feet	CRJ-200
B	90 feet but less than 126 feet	B-737, A-320, ERJ-145
C	**126 feet but less than 159 feet**	**B-757, MD-80, A-310**
D	159 feet but less than 200 feet	B-767, DC-10
E	More than 200 feet	B-747, A-380
Source: Code of Federal Regulations, Part 139.315		

Looking at 2016 aircraft operations in **Table 3-4** above, RNO would need to meet ARFF Index C based on the longest aircraft operating at RNO with an average of five or more daily departures. Currently, RNO is certified for ARFF Index C classification. Among the requirements for Index C:

- ARFF operational requirements specify at least one ARFF vehicle at its assigned post must be able to reach the midpoint of the farthest runway serving air carrier aircraft within three minutes. The timing begins from the time of alarm to the time of initial fire extinguishing agent application. All other required vehicles must reach this same point within four minutes of the time of alarm.

These are the calculations of distances to the ARFF Index C requirement, and the furthest point on the active airfield:

- Midpoint of Runway 16L/34R: The ARFF facility is 0.9 miles from the midpoint of Runway 16L/34R. The first ARFF vehicle would need to average 18.0 miles per hour to reach this point in 3 minutes.
- Runway 16L approach end of RSA (farthest point on active airfield from ARFF): To reach this point 1.7 miles from the ARFF, the first vehicle would need to average 34.1 miles per hour to reach this point in 3 minutes.

ARFF vehicles are capable of reaching speeds to access the Index C requirement in adequate time. No change in the ARFF facility is recommended. The location is adequate for response times to each runway and meets operational requirements. Equipment meets Index C standards, and the projected requirements to ARFF Index D because of the projected increase in operations by the Boeing 767/300.

The Facility Condition Assessment rated the ARFF building in excellent condition. The pavement surrounding the ARFF facility is PCC pavement, and includes a paved access road and vehicular parking. The PCC pavement is currently in very poor condition, with a PCI of 40, and the access road is in good condition with a PCI of 88. The PMP recommended reconstruction of the PCC in 2016, and rehabilitation of the access road in 2024. The condition assessment also rated the concrete as below average.

Additional pavement inspections are performed on a recurring basis to monitor the pavement conditions and re-evaluate the maintenance recommendations. If the pavement is not maintained, PCI values are anticipated to drop at the rate of about 3 per year.

Airport Operations and Maintenance

The majority of airfield maintenance facilities are located north of the approach end of Runway 7 and south of rental car facilities and the NVANG. There are over 10 buildings that serve maintenance operations in this area and house equipment, vehicle maintenance and utilities. Other maintenance and operations buildings are located north of the cargo area and include airport operations and shipping/receiving, an equipment building and the central disposal facility.

The condition assessment rated the following facilities as below average to poor:

- Airfield maintenance and storage (RNO building number 1087)
- Brush storage (1096)

The following buildings were rated below average to poor for structure and MEP systems:

- Airport equipment storage (1483)
- Decommissioned ATCT (1015 and 1021)
- Airfield maintenance storage (1075)
- Landscaping (1102) were low rated structures plus MEP systems.
- Airport equipment building (1483) north of the cargo area.

The site work at these maintenance facilities was also found to be in below average condition.

Airfield Maintenance (1012) MEP systems were rated poor. Building 1012 was not designed to be a maintenance facility especially for the current fleet. Internal facilities, such as restrooms and lockers, are at capacity, as is employee parking. The asphalt is breaking down to gravel, and office and meeting space is generally lacking. Discussion in the **Runway System Section** above identifies the airfield maintenance facility, building 1012, as an obstruction to the RVZ critical area between intersecting runways. This is a non-standard condition for runway protection surfaces. The recommendation is that alternative locations be considered for the airfield maintenance facility. Consolidation with other maintenance facilities may be ideal. Locating the facility near the central airfield may be ideal, but difficult, since central airfield property is at a premium.

Snow Removal Equipment (SRE) Vehicle and Material Storage

The SRE building, constructed in 2012, is in the northwest quadrant, south of the NVANG. The facility serves as the base of operations for maintenance and storage of SRE. The SRE is centrally located on the airfield, which is beneficial for access to the taxiways and runways. The Facility Condition Assessment (**Appendix A**) lists the SRE in excellent condition and rates the MEP systems as having a life span exceeding 30 years. No change is proposed to the SRE facility.

It is recommended that alternatives consider a consolidation of maintenance facilities into a common area campus. The age and condition of most maintenance structures, site work and MEP systems are below average. Refurbishing existing facilities may not be economically feasible. For full the full Facility Condition Assessment with observation notes and useful life remaining, see **Appendix A**.

Fuel Farm Facilities

Third party operators conduct fuel storage and distribution at RNO. Four fuel farms are located on the airport and tank capacities are detailed in **Chapter 1**, **Table 1-15**. Combined, these facilities offer the Airport the capability to store 1,370,000 gallons of Jet-A fuel, 24,000 gallons of 100LL aviation fuel, 1,000 gallons of Mogas, and 16,000 gallons of diesel.

To evaluate RNO's aircraft fuel storage requirements throughout the planning period, a review of the historical fuel sales is required to establish a baseline of demand. **Table 3-52** illustrates the annual fuel sales at the Airport from 2012 to 2016. As illustrated in the table, an average of approximately 25,455,592 gallons of Jet-A fuel and 118,447 gallons of 100LL fuel have be sold annually between 2012 and 2016.

Table 3-52: Fuel Sales by Year (2012-2016)

Year	Airline Jet-A Sales (gallons)	General Aviation Jet-A Sales (gallons)	100LL Sales (gallons)	Total Sales (gallons)
FY 2011-2012	27,142,031	2,318,066	107,435	29,567,532
FY 2012-2013	25,839,398	2,451,184	111,122	28,401,704
FY 2013-2014	24,205,912	2,038,087	111,984	26,355,893
FY 2014-2015	23,552,693	2,113,005	121,199	25,786,897
FY 2015-2016	26,537,928	2,557,808	140,587	29,236,323
'12-'16 Average	**25,455,592**	**2,295,630**	**118,447**	**27,869,670**

Source: RTAA Fuel Sales, 2017
FY: Fiscal Year July-June

Next, the fuel storage turnover rate, or the rate at which the fuel tanks at RNO need to be refilled to meet demand, must be calculated. This rate can be calculated by dividing the annual sale of fuel by the number of days in a year to find the average daily fuel sales. The total fuel storage capacity at the Airport is then divided by the average daily fuel sales to determine the average fuel storage turnover rate. **Table 3-53** presents the findings of the historical fuel storage turnover rate for Jet-A fuel while **Table 3-54** presents the historical fuel storage turnover rate for 100LL fuel.

Table 3-53: Historical Jet-A Fuel Storage Turnover Rate

Year	Total Jet-A Sales (gallons)	Average Daily Fuel Sales (gallons)	Total Jet-A Fuel Storage Capacity (gallons)	Average Fuel Storage Turnover Rate
FY 2011-2012	29,460,097	80,713	1,370,000	17 days
FY 2012-2013	28,290,582	77,508	1,370,000	18 days
FY 2013-2014	26,243,999	71,901	1,370,000	19 days
FY 2014-2015	25,665,698	70,317	1,370,000	19 days
FY 2015-2016	29,095,736	79,714	1,370,000	17 days
'12-'16 Average	**27,751,222**	**76,031**	**1,370,000**	**18 days**

Source: RTAA Fuel Sales, 2017
FY: Fiscal Year July-June

Table 3-54: Historical 100LL Fuel Storage Turnover Rate

Year	Total 100LL Sales (gallons)	Average Daily Fuel Sales (gallons)	Total 100LL Fuel Storage Capacity (gallons)	Average Fuel Storage Turnover Rate
FY 2011-2012	107,435	294	24,000	82 days
FY 2012-2013	111,122	304	24,000	79 days
FY 2013-2014	111,894	307	24,000	78 days
FY 2014-2015	121,199	332	24,000	72 days
FY 2015-2016	140,587	385	24,000	62 days
'12-'16 Average	**118,447**	**325**	**24,000**	**75 days**

Source: RTAA Fuel Sales, 2017
FY: Fiscal Year July-June

As shown in **Tables 3-53 and 3-54**, the storage capacity of existing fuel tanks at RNO can store, on average, an 18-day supply of Jet-A fuel and a 75-day supply of 100LL fuel. Airport fuel sales could increase if more long-range, non-stop routes, such as those to destinations in the Southeast and Northeast, are implemented from the Airport. The Airport can still make concessions for fuel facility requirements. Space should be reserved for the expansion of existing fuel storage facilities as required.

Storm Water Utilities and Deicing Collection Facilities

Drainage Infrastructure

The existing drainage infrastructure on RNO property is adequate to support the level of current development. The airport's drainage infrastructure, designed for a 10-year return storm, has not been known to flood following 10-year magnitude storms. Flooding does occur on RNO following larger storms because off-site conditions cause hydraulic impacts. For example, high water elevations in the Truckee River or Steamboat Creek have caused flooding on the airport in the presence of high backwater. Such off-site causes cannot be addressed by airport infrastructure. The Truckee River Flood Management Authority is considering these flooding concerns on a long-term basis through the construction of off-site infrastructure, such as levee construction and other measures.

The development of future airside facilities must comply with Section 18.12.605 of the City of Reno Land Development Code, which places the following limitations on any new developments:

- Peak drainage flows from the project must be limited to pre-development conditions; and
- Any loss in flood storage must be mitigated by retention basins at a ratio of 1:1.

These limitations must be addressed during facility design by sizing conveyance and storage facilities to meet the City's requirements. Further, new buildings must meet requirements for anchoring, construction materials and methods, flood proofing, and lowest flood elevation as required by Section 18.12.1703 of the City of Reno Land Development Code. The requirements vary depending on the type of floodplain in which the proposed project is located, for example, Zone AE, Zone X, etc. Floodplain restrictions have the potential to impact the location, size and finished floor elevations, and will be evaluated with any future development in alternatives analysis.

Deicing Collection Facilities

Winter operation's residual deicing and anti-icing fluids are collected at RNO using Glycol Recovery Vehicles (GRV). The GRV-collected effluent is discharged through on-site sanitary sewer disposal facilities to the local wastewater treatment plants for disposal. Because GRV recovery procedures are unlikely to capture all effluent, some residual effluent is assumed to discharge to the storm water system. Because no off-site water quality issues have been recorded, it is likely that residual discharge to the drainage system is insignificant.

GRV collection efficiencies have been documented to achieve collection efficiencies ranging from 23 to 53 percent. While these general values are not necessarily specific to RNO, these values do demonstrate the ability to improve glycol recovery without large capital investment. Other glycol collection measures are known to have greater collection efficiencies, such as centralized deicing facilities. Thus, a transition to centralized deicing facilities or another deicing collection system may be considered in the future. The recommendation from staff is to construct a dedicated deicing area at the Runways 16R/L and 34L/R ends to help facilitate operations during snow events.

Ancillary Support Facilities

Perimeter Fencing and Security Gates

Perimeter fencing is installed to limit the entry of people and animals onto the airport. A full perimeter fence exists at RNO and includes gates at various access points for authorized vehicles to access the airfield. The recommendation is that the fence and gates be maintained and upgraded when needed. When analyzing alternative layouts for buildings and aircraft storage, new fence and gates should be coordinated with new access points. Fences at runway ends should also remain clear of critical approach and departure surfaces.

Service Roads

FAA design standards specify that airport service roads be clear of ROFAs and TOFAs. As mentioned in the **Runway System Section** above, service roads breach the ROFAs at the approach ends of Runway 7, 25, and 34R, plus the GA East apron. The service road north of the cargo facilities also penetrates the TOFA.

Facilities should be designed to avoid service roads crossing runways and taxiways to the extent possible. However, when a crossing is necessary, proper marking must be in place to ensure vehicles stop or yield to aircraft. The service road should be defined with centerline and edge striping.

The service roads at RNO are in good condition and properly marked. A section of service road south of Runway 7/25 in the southeast quadrant is not paved. The recommendation is that this section be paved and marked as a service road. For service roads within the OFAs as described in the **Runway and Taxiway Sections** above, it is not recommended these be relocated. The existing condition is not an operational issue with a 24-hour ATCT. Coordination with ATCT plus additional signage to alert service vehicle operators they are entering the OFAs is recommended.

Central Disposal Facility

The centralized deicing facilities provides a disposal location for airlines and ground service operators to dump “blue water” from the airplane restrooms as well as glycol collected after aircraft deicing/anti-icing activities. Upgrades to the centralized deicing facilities in 2015 replaced all equipment, added an additional disposal bay, relocated the wash pad and glycol dump pad to the exterior, and installed a large sand/oil interceptor.

The Facility Condition Assessment rates the centralized deicing facilities as in good condition with average to above average MEP systems. The centralized deicing facilities location is ideal for access by trucks to move blue water and glycol from the adjacent cargo and passenger aprons. The recommendation is that the centralized deicing facilities be maintained. However, any alternative analysis on cargo, terminal, or CBP facility expansion may require the centralized deicing facilities to be relocated.

Executive and Tenant Workshops

Throughout its development, the Master Plan team sought the input from other RTAA staff members and tenants who were not involved in the development of this Master Plan on a regular basis. Two workshops were held on May 24, 2017: an executive workshop for RTAA staff and a tenant workshop for airport users and occupants. The purpose of the workshops was to provide an update on the Master Plan and present initial findings from this chapter to obtain feedback before launching into alternatives.

Airside Facilities

RTAA staff and tenants generally agreed with the airside areas recommended for improvement in this chapter. ATCT and operations staff concurred with the taxiway intersection issues that were presented (hot spots, five-way intersections, direct apron to runway access and squared taxiway ends) and encouraged analyzing alternative layouts. Other areas airside facility topics from staff and tenants:

- Run-up aprons are needed for GA aircraft operations at Runways 16L, 34R, 7 and 25 ends.
- A suggestion was made to look at an additional ILS to Runway 16L in alternatives to provide a backup to the ILS on Runway 16R should that be inoperable due to maintenance or shut down.
- Operations staff mentioned a need to pave the service road where possible.
- Add more RVR sensors on Runway 16R/34L to help obtain CAT-II approach.
- Staff also asked if realigning the north section of Taxiway C to line up with section south of Runway 7/25 is possible. This led to a discussion of the impact on existing facilities (GA East hangars, Atlantic Aviation, Dassault). The conclusion was that realignment was not realistic or practical.

Landside Facilities

A program is underway to study the rental car drop-off and pick-up facilities and their effectiveness in the parking garage. This recommendation from this study should be included in this Master Plan.

- The short-term parking lot is nearing capacity.
- Is a new garage needed for the long-term? The parking garage was designed for a fourth level addition.
- A suggestion was provided to maintain passenger and rental cars (pick up and drop off) in current locations and displace employee parking, if possible to remain in walking distance to terminal.
- Security bollards are needed on the drop-off curb.
- Employee lots are at capacity during shift change.

Terminal Facilities

- More concessions are needed closer to gates.
- CBP – 400-person facility
- More hold room space is needed.
- Gaming (slots) block view between seating areas, concourse and gate information boards.
- Slots are considered a visual nuisance by locals but loved by tourists.
- One-third of gaming revenue is from the lobby pre-security.
- Slots seem to hinder wayfinding to TSA.
- The utility structure is aging.
- A delivery dock and freight elevator are needed.
- The TSA re-composure area lacks space.
- There is an unsecured garbage dumpster – a secure location is needed with no impact on operations.
- The ticketing hall needs restrooms.
- The walk from TSA through concourse to gates is long with no concessions.

Support Facilities

General Aviation

- T-hangars on GA West are old, and the pavement is substandard.
- There is a lack of automobile parking for GA East.
- There is a business case for constructing new hangars for individual aircraft storage (current demand).
- There is more demand for technology upgrades in hangars (internet access).

Cargo

Consensus among RTAA staff is to continue promoting the concept that future cargo development should take place on the southwest quadrant. If an operator wishes to expand or a new operator enters the market, these cargo facilities should not replace existing facilities in the northwest quadrant. Other issues that were raised by RTAA staff and tenants:

- Access for cargo trucks between the cargo facilities and major roads is an issue. Road congestion is a problem, and this requires more time for cargo operators to move vehicles from the cargo facilities to the Interstate.
- GSE occupies significant areas designated as aircraft apron. As much as a full aircraft parking envelope is occupied by GSE.
- RTAA staff recognized that a third-party leasing an area is effectively able to do as they please with the leased land for storage and equipment. Efficiency of space is determined by the user.
- Operations response time is low during heavy cargo activity.

Support and Maintenance

The exiting location for airfield maintenance is considered a good location. However, it is recognized these buildings are old and spread out. The location of the operations and shipping building (1552) north of the cargo facilities makes this disconnected from the other facilities. It was suggested a maintenance campus be considered that centralizes facilities. Other comments on support facilities:

- The airport equipment building (1438) is nearing the end of useful life.
- A training facility for ARFF personnel and equipment was proposed.
- There is concern that fuel delivery times are slow during peak activity for GA operators.

Conclusions and Recommendations

This chapter identifies facilities in need of expansion and upgrade at RNO based on the preferred Master Plan aviation activity forecasts and FAA airport design standards. Expected facility needs created by future activities are presented to quantify future demand for airside facilities, passenger traffic, cargo facilities, and other support facilities. Some facilities have defined trigger points for implementation, whereas others will only be needed as demand presents itself.

Facility requirements will be carried forward for use in developing improvement alternatives. Vetting of improvement alternatives will consider the following priorities for airside, landside, terminal, and support facilities.

Airside Priorities

Overall, the runway and taxiway systems are in good condition and meet FAA standards in most instances. The RSAs are graded and meet obstruction clearance standards. The following airside facility improvements are recommended, listed in order of priority.

- **Approach surface clearance:** Identify and mitigate penetrations to the Runway 7 approach surfaces.
- **Non-standard taxiway geometry:** Develop plans to address taxiway hot spots and intersections that do not comply with FAA taxiway design guidance.
- **Hold lines:** Consider moving to 294 feet from runway centerlines. Coordination with ADO may be necessary to clarify new standards.

Landside Priorities

Rental car and CBP facilities should be priorities for upgrades or relocation at RNO. Public parking (long- and short-term) will likely require additional space based on projected passenger demand. Analysis of the following landside facilities for expansion or relocation should be a part of alternative analysis.

- **CBP Facility:** Investigate building improvements that address passenger processing flow and times, queueing areas, and the baggage claim. This may include analyzing other locations for a CBP facility, since the existing location may accommodate cargo or terminal expansion, if needed.
- **Rental car facilities and storage:** Analyze additional area for rental cars as existing space allocation is too small for existing demand.
- **Public parking demand:** Develop improvement alternatives for public parking. Metrics indicate additional parking will be needed by 2026, based on passenger demand forecasts.

Terminal Priorities

The existing passenger terminal facilities are generally adequate for existing and future passenger enplanements and commercial operations. As passenger use grows, demand will exceed capacity in certain areas. The Terminal Section describes the trigger points for improvements. Passenger terminal priorities include:

- **Check-in / ticketing hall:** The size of the hall is adequate to handle the forecasted growth. Its location and critical dimensions are both appropriate. However, it is currently organized with a focus on a manual check-in process and should be evaluated with respect to current trends and technology.
- **Security checkpoint:** The size is adequate to handle the forecasted growth. While it is currently organized to efficiently accommodate current technology, the dimensions of the space limit how easily new technologies can be adopted in the future. In addition, the re-composure area and transition from security to the vertical circulation creates a less than desirable passenger experience.
- **Gate demand:** While demand is met with the existing gate count, both currently and through the planning period, the associated holdrooms are currently undersized. This discrepancy grows throughout the planning period. The fixed width of the two concourses directly conflicts with the efficiency of the aircraft parking layout.
- **Concessions:** Public spaces are appropriately sized, located, and distributed for the current layout. However, these areas should be evaluated for compatibility with future modifications.
- **Administrative office space**: This has already proved to be deficient with the potential for adjacent growth constrained by critical building services.

Support Facility Priorities

Support facilities that require upgrades based on existing and future demand include transient aprons, aircraft storage hangars, service roads, deicing, and maintenance buildings. The analysis found the cargo facilities to be adequate for existing and future cargo operations; however, market demands and operator preferences may call for facility expansion or relocation. The recommendation is to consider alternatives for these support facilities:

- **Cargo facilities:** Evaluate the need to expand and relocate cargo facilities to address challenges that operations encounter related to GSE storage, aircraft parking, and off-airport sortation.
- **Airfield maintenance facility (Building 1012):** Consider relocating building 1012 outside of the RVZ. The recommendation is that the analysis considers combining this with other existing maintenance facilities, or at a new maintenance facility campus.
- **GA hangars:** Study alternative locations to expand the transient apron and build additional hangars to store turboprop and jet aircraft when the trigger points are reached. The identified trigger points are based on transient activity and future based aircraft. Alternative locations should focus on the east side of the airfield.
- **Deicing Areas:** Examine dedicated deicing or anti-icing areas at ends of Runways 16R/L and 34L/R to help facilitate operations in winter during snow events.