CHAPTER 3

FACILITY REQUIREMENTS

Comprehensive Chapter v3.0

TABLE OF CONTENTS

LIST OF FIGURES

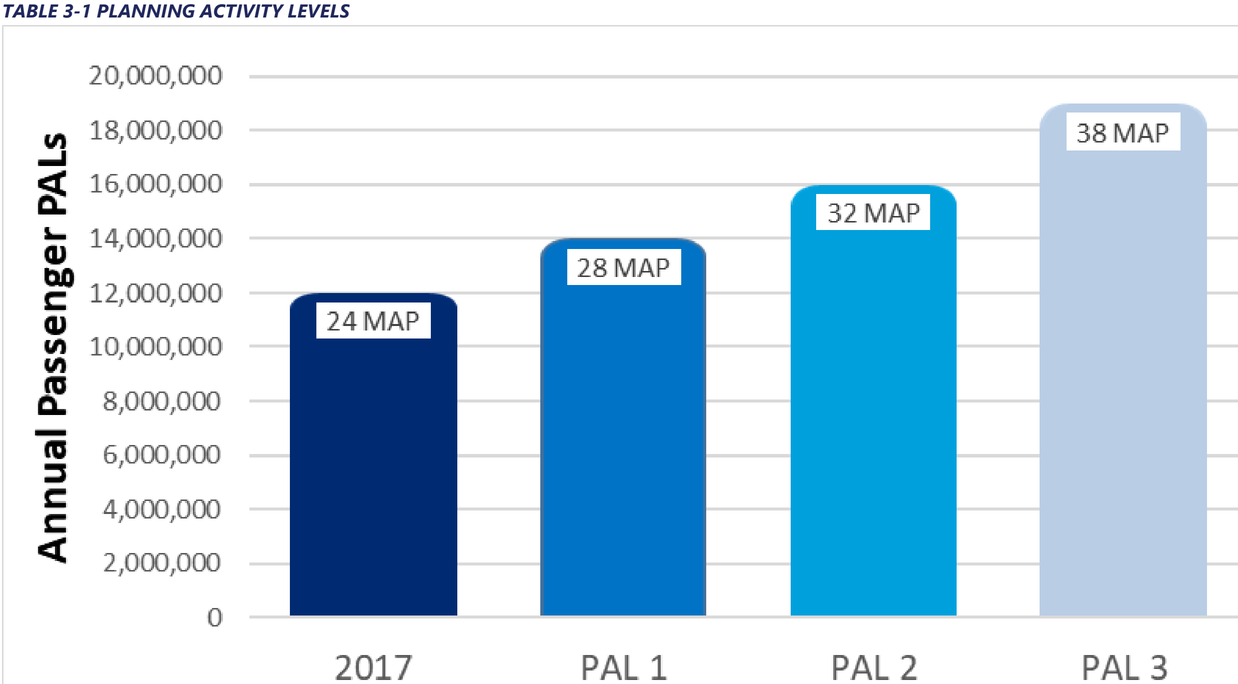
LIST OF TABLES

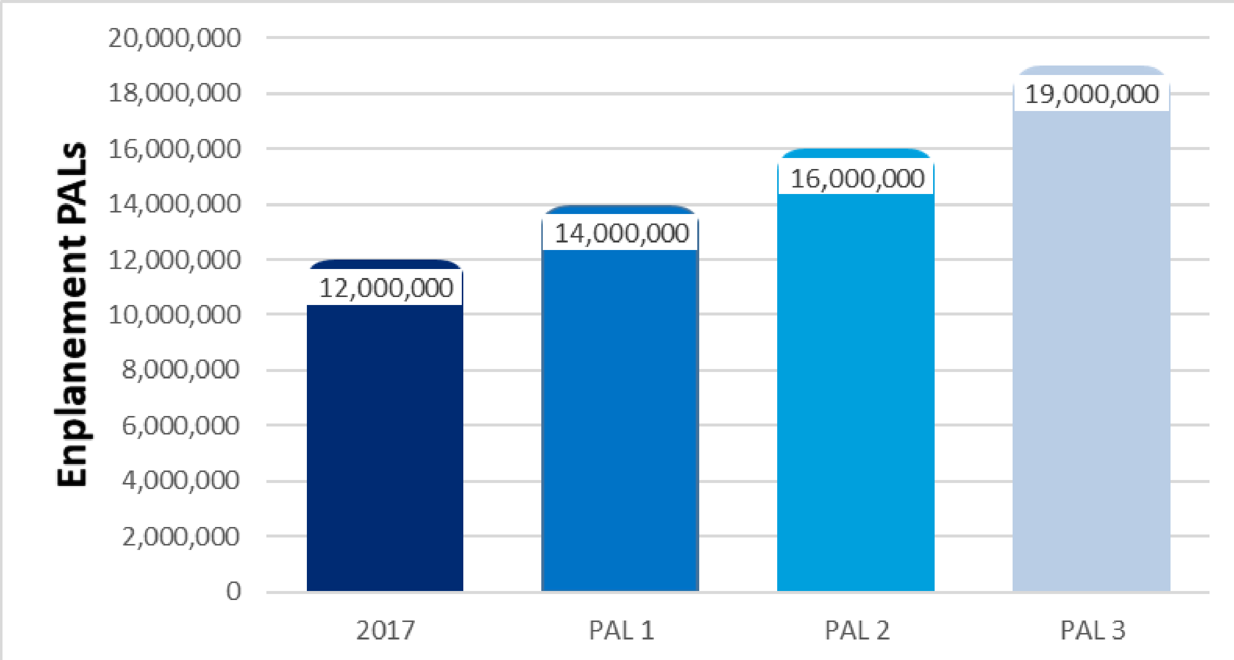
3.1 INTRODUCTION

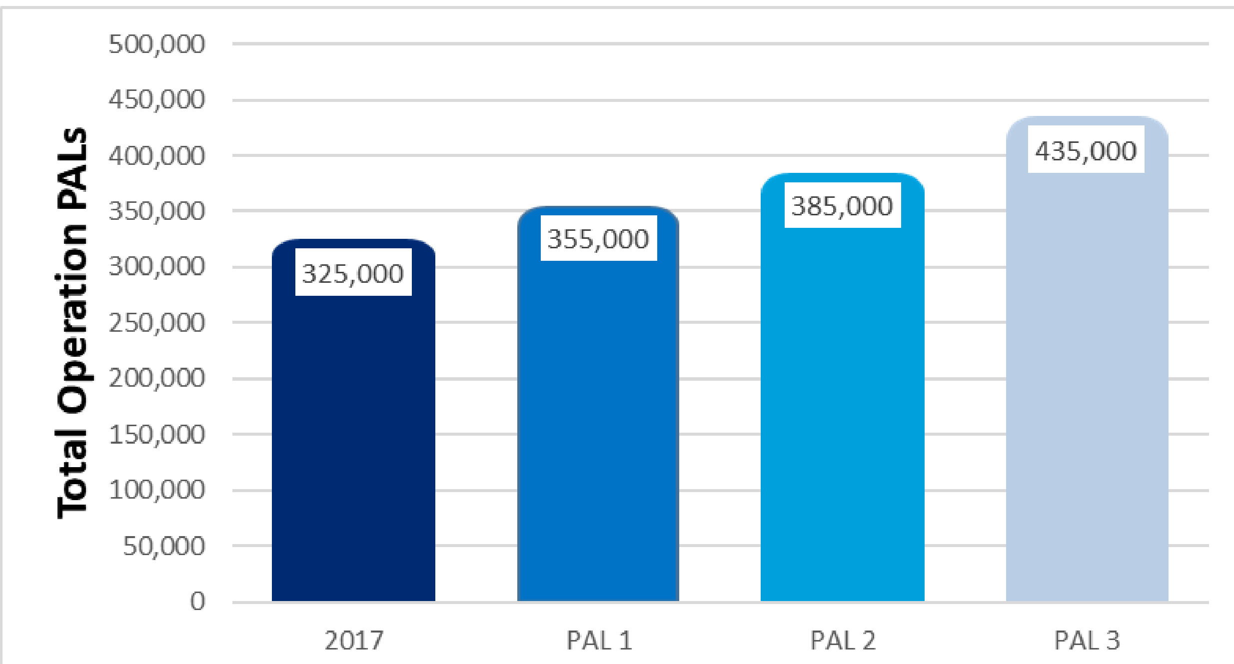
Future airport facility requirements, including the type, size, and quantity, are dependent on the future aviation activity levels projected in the aviation demand forecasts discussed in Chapter 2. The need for new or expanded facilities is often driven by capacity shortfalls that leave an airport unable to accommodate the forecasted growth using existing facilities. However, the requirements for new or improved facilities can also be driven by other circumstances, such as, updated standards which have been adopted by the FAA or another regulatory agency, an evolving strategic vision for the airport, the replacement of outdated or inefficient facilities, or the desire to introduce new services and facilities. These various circumstances can have a significant impact on future needs and have been considered in this analysis for the Airport.

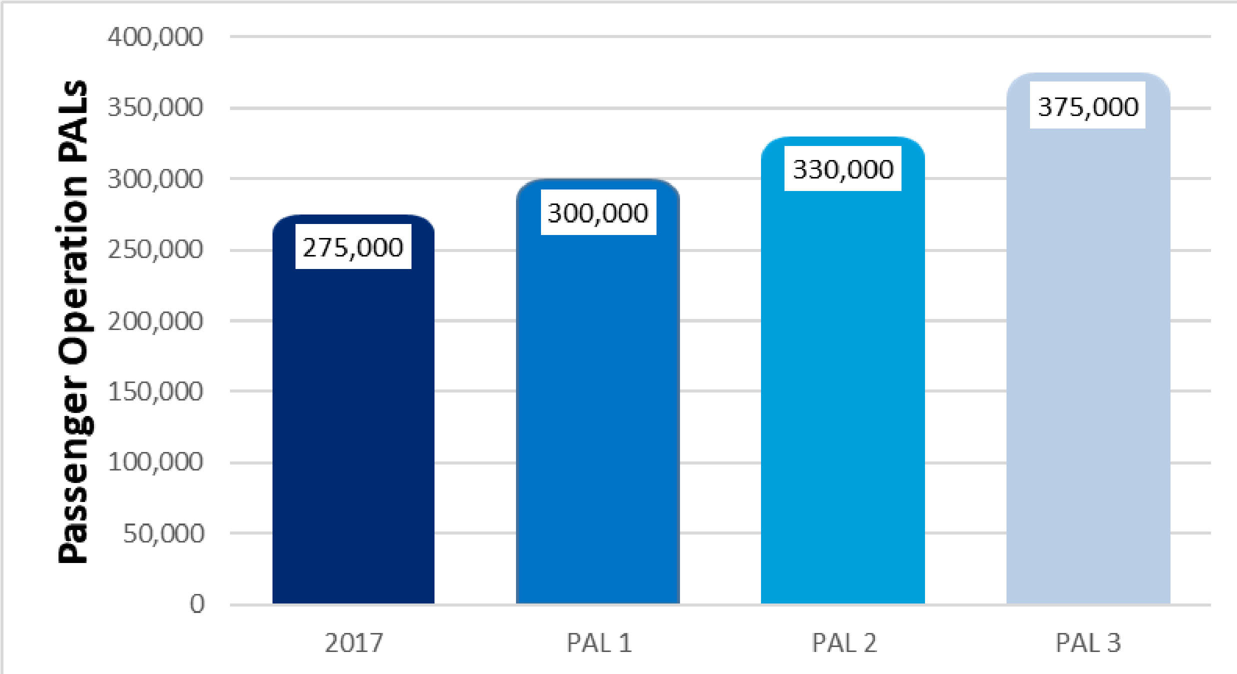
The aviation demand forecast used demographic, economic, and geographic statistical analysis to derive three forecast scenarios tied to real-world factors in the Salt Lake City metropolitan area. From this analysis, aviation activity was forecasted out for a twenty-year period (2017 – 2037). Although the forecast defines aviation activity milestones for the years 2022 (short-term), 2027 (mid-term), and 2037 (long-term), it is important to understand that facility requirements are driven by levels of aircraft operations and passenger enplanement demands, which may or may not coincide with those specific years. Therefore, to eliminate associations between demand levels and specific years, the levels of demand which trigger facility improvements, referred to as a Planning Activity Level (PAL), are broken into three activity levels: PAL 1, PAL 2, and PAL 3 respectively. The projected demand, based on the base-case forecast scenario, for the based year and each of the planning levels is shown in **Table 3-1**.

TABLE 3-1 PLANNING ACTIVITY LEVELS

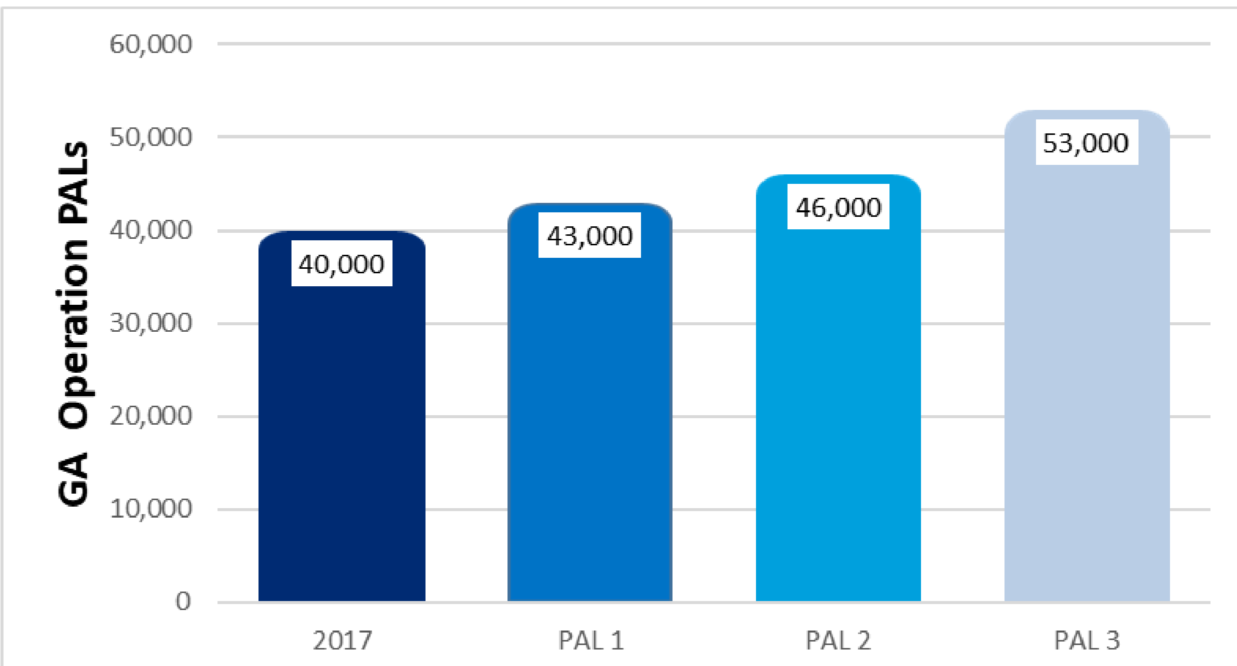



20,000,000
18,000,000
16,000,000
14,000,000
12,000,000
10,000,000
8,000,000
6,000,000
4,000,000
2,000,000
0
Enplanement PALs
12,000,000
14,000,000
16,000,000
19,000,000
2017
PAL 1
PAL 2
PAL 3

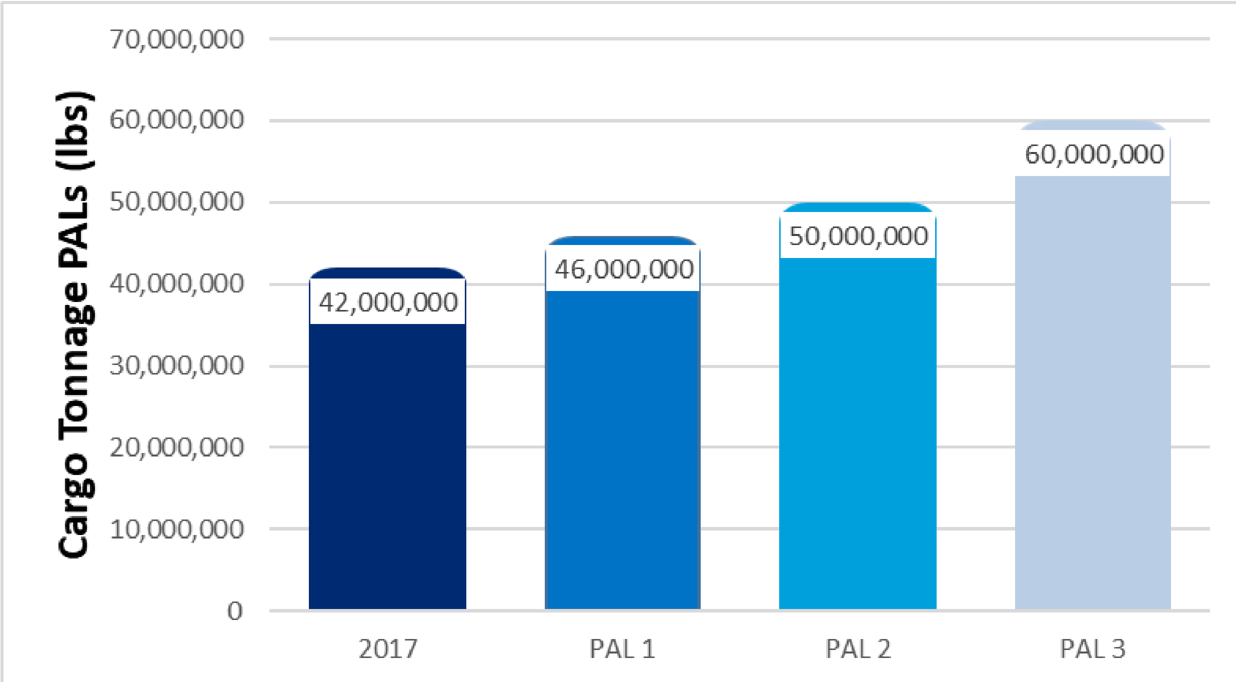

500,000
450,000
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
Total Operation PALs
325,000
355,000
385,000
435,000
2017
PAL 1
PAL 2
PAL 3



Passenger Operation PALs
400,000
350,000
300,000
250,000
200,000
150,000
100,000
50,000
0
275,000
300,000
330,000
375,000
2017
PAL 1
PAL 2
PAL 3

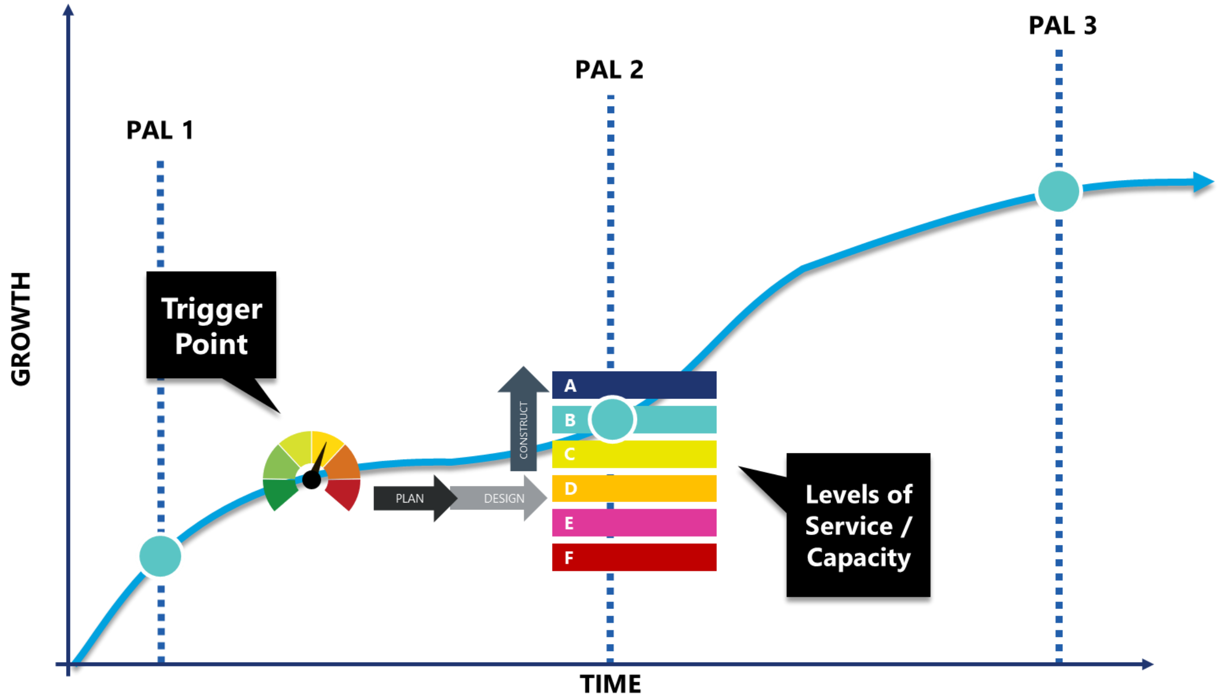


GA Operation PALs
60,000
50,000
40,000
30,000
20,000
10,000
0
40,000
43,000
46,000
53,000
2017
PAL 1
PAL 2
PAL 3



In this facility requirements chapter, some requirements are simply based on airport design standards, while others are requirements based on demand levels. Those based on demand are directly tied to a planning activity level. This approach enables Airport staff to track demand and implement development to ensure the right size facility is built to accommodate demand as it increases in the future. **Figure 3-1** illustrates this principle. As demand, represented by the blue line, increases, a facility must also increase in size and/or capacity to accommodate that demand. The premise of this approach is to plan, design, and implement facility enhancements to ensure that each PAL level is adequately accommodated.

FIGURE 3-1
PLANNING ACTIVITY LEVEL DEVELOPMENT APPROACH



Developing facility requirements is a foundational element of this and any airport master plan. The resulting facility requirements were used as the basis for planning future development at the Airport including the development of a long-term airport layout and an evaluation of alternatives.

3.2 AIRFIELD REQUIREMENTS

This section details the analysis conducted on each airfield component to determine its ability to accommodate future demand and meet current design standards. Airfield components were evaluated based on their ability to meet forecast demand and meet FAA design standards outlined in AC 150/5300-13A Change 1, *Airport Design*. Capacity. Design requirements were applied to the evaluation of SLC airfield infrastructure based on critical aircraft requirements, runway approach capabilities, and typical usage of pavement and aircraft flows.

3.2.1 Runway Requirements

Analyses of the runways addresses the ability of the existing runways to meet both current and forecast demand. The number of runways at an airport are directly correlated to capacity and wind coverage. The first parts of this section detail the capacity analysis and wind coverage analysis conducted as part of this master plan.

Specific runway related focus points in this master plan include study elements from previous reports, including the 2006 Airport Layout Plan Update and the 1996 Master Plan. These elements along with new elements of focus in this study include the following:

- **Fifth Runway** – An area for a new west parallel runway was preserved on the 2006 ALP to provide capacity relief when needed. The capacity analysis of the existing airfield, as detailed in this chapter, has determined that a fifth runway will not be needed within the planning period. However, this study will still consider a fifth runway as an ultra-long range capacity enhancement option. The alternatives analysis examines capacity relief benefits and integration of a fifth runway.

  Runway 17-35 – Runway 17-35 was studied in the 1996 Master Plan and 2006 ALP for its ability to be realigned with the other parallel runways to provide capacity benefit. During this master plan process, airport and airline stakeholders expressed that an extension of the existing runway would prevent having to limit larger narrow body aircraft from using the runway for departures in hot conditions. The operational and capacity related benefits of an extension to Runway 17-35 and a runway realignment is analyzed further within the alternatives analysis.

- **Runway 14-32** – While not a focus of previous studies, this runway was a focus element for this master plan. Two "Hot Spots" associated with this runway have been identified by the FAA, which have the potential to encourage runway incursions. In order to eliminate the potential for runway incursions, modifications to the runway were evaluated as discussed in the alternatives chapter. The master plan analyses evaluated the runway for wind coverage and capacity to determine if the runway is needed or can be taken out of the system.

This study's approach for analyzing and recommending airfield and capacity related components is tiered, with a primary objective of enhancing safety and capacity through design modifications to the existing airfield prior to any major new runway development. The following details the priority of objectives for this study. This approach is carried into the alternatives, which will focus on the development of demand-dependent, cohesive solutions.

- **Priority 1** – address all safety and design deficiencies. This includes the hot spots adjacent to Runway 14-32, as well as other taxiway configurations that do not adhere to FAA best practices. This facility requirements chapter outlines current deficiencies.
- **Priority 2** – maximize capacity and efficiency of the existing airfield. The alternatives chapter details airfield solutions that have been explored and vetted in this study.
- **Priority 3** – utilize demand reduction techniques to delay major capacity enhancements. The General Aviation Strategy Plan, included in **Appendix X**, provides recommended methods to transfer general aviation demand from SLC to the other two SLCDA general aviation airports.
- **Priority 4**- provide additional runway capacity with a realignment of Runway 17-35 and/or addition of a west parallel runway.

Beyond capacity and wind coverage, this Runway Requirements section also provides an overview of the analyses conducted to determine runway design related requirements. These include, runway designation, length, width, strength, and runway protection zones.

3.2.1.1 Airfield Capacity and Delay

Airport capacity is the number of aircraft an airport system can accommodate in a reference time period, e.g. hourly, daily, yearly. Capacity is influenced by many factors including airport layout, airspace, aircraft mix, ATC operational procedures, navigation equipment, and meteorological conditions. As an airport reaches its capacity there is an increase in the amount of delay, defined as the amount of time above the unimpeded travel time that exists when not delayed by other aircraft or airport operations. Unimpeded travel time accounts for required air traffic control flight and taxi spacing between aircraft. Delays can occur during each phase of aircraft operation, including push-back, taxi-out, departure, arrival, and taxi-in. Delay increases can have serious impacts to airline and cargo operations. By understanding the amount of delay being experienced at SLC, and during which segment of operation the delay occurs, determinations can be made if the current airfield configuration can accommodate existing and forecasted traffic levels or if, and where, improvements will be required.

4.2.1.1.1 Methodology

The capacity of the airport system was determined using SIMMOD modeling software, which considers airline flight schedules, aircraft taxi time and flight speeds, the various runway configurations used at SLC, and the required separation distances required between different sized aircraft to avoid wake turbulence generated by aircraft. For the modeling efforts, a baseline model was developed and calibrated to reflect existing conditions and operations using radar data, reported ground travel times, and field observations. The model was verified against the experienced throughput levels and taxi times for 2018 as reported by the FAA Aviation System Performance Metrics (ASPM).

Arrival operations were modeled starting from the aircraft's position entering the terminal airspace and continuing through landing, exiting the runway, and taxiing to the non-movement area and to the gate.

Departure operations were modeled starting from aircraft gate pushback and continuing through taxi, transition from the non-movement ramp area to the controlled taxiways, taxi to the departure queues, take-off, initial departure heading, and flying out of terminal airspace.

As discussed in detail in the ***Chapter 2, Aviation Activity Forecast***, a Base Case Forecast Planning Day Model was completed to forecast the operational counts and times for each of the PAL levels. The results of that forecast are overviewed below and included in **Table 3-2**. Note that the peak hour times and corresponding operations are based on a combined total of commercial passenger, cargo, and general aviation operations.

- The average day peak month (ADPM) for 2018 includes 377 arriving and 377 departing scheduled airline operations as well as 121 arriving and 115 departing unscheduled operations, consisting of general aviation, cargo, and military. The peak hour for arrivals is 7:00-7:59 p.m. with 62 operations, the peak hour for departures is 11:00-11:59 a.m. with 56 operations, and the combined peak hour is 1:00-1:59 p.m. with 71 operations.
- PAL 2 forecasts a total of 453 arriving and 453 departing scheduled airline operations per day as well as 124 arriving and 120 departing unscheduled operations, consisting of general aviation, cargo, and military. The peak hour for arrivals is 7:00-7:59 p.m. with 64 operations, the peak hour for departures is 11:00-11:59 a.m. with 65 operations, and the combined peak hour is 1:00-1:59 p.m. with 91 operations.
- PAL 3 forecasts a total of 503 arriving and 503 departing scheduled airline operations per day as well as 147 arriving and 144 departing unscheduled operations, consisting of general aviation, cargo, and military. The peak hour for arrivals is 7:00-7:59 p.m. with 68 operations, the peak hour for departures is 11:00-11:59 a.m. with 70 operations, and the combined peak hour is 1:00-1:59 p.m. with 103 operations.

TABLE 3-2 BASE CASE FORECAST PLANNING DAY MODEL

	2018		PAL 2		PAL 3	
	Arrivals	Departures	Arrivals	Departures	Arrivals	Departures
Airline	377	377	453	453	503	503
GA	75	69	74	70	86	82
Cargo	34	34	38	39	49	51
Military	12	12	12	11	12	11
Total	498	492	577	573	650	647
Peak Hour	62	56	64	65	68	70

Source: TransSolutions, RS&H; 2019

Runway use is dynamic and dependent on many factors such as weather and peak hour operations. ATC staff adjust the SLC runway use plan throughout the day to best accommodate the demand during the airline peak arrival periods and peak departure periods. Runway use for 2018 was calculated using the distribution experienced according to data obtained from the FAA National Offload Program. It should be noted that as traffic demand grows in each PAL, especially in future IMC scenarios, the existing runway use could not accommodate demand without significant delays showing up in the model. As such, the runway use was adjusted for PAL 2 and PAL 3 using detailed assumptions provided by SLC air traffic controllers. The resulting runway use for each flow, weather, and demand level is shown in **Table 3-3**.

Generally, Runway 16R-34L is the most used runway for arriving aircraft, Runway 16L-34R is the most used runway for departing aircraft, and Runway 17-35 is used for a mix between arriving and departing aircraft depending of if there are more arrivals or departures at that time. However, if few arrivals occur during a departure peak, Runway 16R-34L is used for departures rather than Runway 17-35 and if few departures occur during an arrival peak, Runway 16L-34R is used rather than Runway 17-35. Runway 14-32 was excluded from the table as all percentages would round to zero percent due to a negligible number of operations.

TABLE 3-3 RUNWAY USE

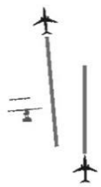
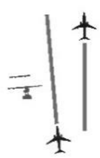
Flow	Weather	Demand	Arrival			Departure		
			16R/34L	16L/34R	17/35	16R/34L	16L/34R	17/35
North	VMC	2018	39%	40%	20%	26%	58%	16%
		PAL 2	56%	20%	24%	17%	61%	22%
		PAL 3	54%	21%	24%	16%	62%	22%
	IMC	2018	39%	40%	21%	26%	58%	16%
		PAL 2	63%	15%	22%	14%	60%	26%
		PAL 3	62%	17%	22%	13%	60%	26%
South	VMC	2018	44%	37%	19%	23%	59%	18%
		PAL 2	48%	30%	21%	23%	59%	18%
		PAL 3	48%	32%	20%	23%	58%	19%
	IMC	2018	44%	38%	18%	22%	60%	18%
		PAL 2	49%	31%	20%	24%	58%	18%
		PAL 3	46%	27%	27%	22%	56%	22%

Source: TransSolutions, 2019

An in-depth discussion of the original and revised runway use, as well as additional details of the methodology and assumptions used in SIMMOD airfield capacity and delay analysis is included in the Methods, Assumptions and Performance Specifications report provided in **Appendix D**.

While aircraft using Runway 16R-34L can operate mostly independently of all other runways and Runway 14-32 is always dependent, the interdependencies of Runway 16L-34R and Runway 17-35 differ based on runway operations and weather conditions. **Table 3-4** shows the independence or dependence of the two runways in each condition.

TABLE 3-4 RUNWAY 17-35 AND 16L-34R DEPENDENCIES

North Flow		VMC	IMC
	Arrival: RWY 35 Arrival: RWY 34L	Dependent	Dependent, staggered 3 NM
	Arrival: RWY 35 Departure: RWY 34L	Independent	Dependent, treat as single RWY. Arrival must have 2 NM from landing when straight-out departure is released. Independent if departure turning left.
	Departure: RWY 35 Arrival: RWY 34L	Independent	Dependent, treat as single RWY. Arrival must be 2 NM from landing when straight-out departure is released.
	Departure: RWY 35 Departure: RWY 34L	Dependent only when departing same heading, then used as single RWY	Dependent only when departing same heading, then used as single RWY
South Flow		**VMC**	**IMC**
	Arrival: RWY 17 Arrival: RWY 16L	Independent	Dependent, staggered 3 NM
	Arrival: RWY 17 Departure: RWY 16L	Independent	Dependent, departure on RWY 16L not allowed when arrivals on RWY 17 are within 2 NM. Independent if departure from Runway 16L turns west
	Departure: RWY 17 Arrival: RWY 16L	Independent	Dependent, departures on RWY 17 not allowed when arrivals on RWY 16L are within 2 NM
	Departure: RWY 17 Departure: RWY 16L	Dependent, considered as a single RWY with 2 NM separation	Dependent, considered as a single RWY with 3 NM separation

Source: TransSolutions, RS&H; 2019

4.2.1.1.2 Average Annualized Delay

The weighted average daily delay, or average annualized delay, is the average delay for the flight schedule across an entire 24-hour schedule. Each of the simulation exercises is run independently of one another for an entire 24-hour period, and the average delay per aircraft is calculated per simulation run. Average annualized delay is the weighted average delay per aircraft based on the annual percentage the airport is in each flow direction and weather condition. The delay is measured in air delay, arrival taxi delay, and departure delay as noted below. Additionally, taxi time is measured and can change based upon runway utilization.

- Arrival Air Delay – the amount of delay experienced in the air on approach to the Airport.
- Arrival Taxi Delay – the delay an aircraft may experience during taxi after landing, between the runway exit and the terminal.
- Departure Delay – the amount of delay associated with taxi delay and departure queue delay.
- Taxi Time – the amount of unimpeded taxi time between terminal and runway, and runway and terminal.

A table showing average daily and average annualized delay per aircraft is shown in **Table 3-5**. The aviation industry has settled on a standard metric for determining the amount of average delay that is generally acceptable before capacity enhancements are needed. At major connecting hubs with low incidence of IMC and reduced capacity in IMC, average annualized delay of five minutes is used as a general threshold of acceptable delay[1], but every additional minute has negative impacts for the airlines and traveling public.

[1] ACRP Report 104: Defining and Measuring Aircraft Delay and Airport Capacity Thresholds

TABLE 3-5 SIMMOD AVERAGE DAILY AND AVERAGE ANNUALIZED DELAY FORECAST

Demand	Weather	Flow	Average Daily Times (minutes)						
			Arrival				Departure		
			Air Delay	Taxi Time	Taxi Delay	Total	Taxi Time	Delay	Total
2018 (Existing Terminal)	VMC	North	1.4	6.5	0.5	**7.0**	12.6	4.1	**16.7**
		South	1.0	6.9	0.6	**7.5**	13.9	2.5	**16.4**
	IMC	North	1.9	6.7	0.5	**7.2**	12.7	8.6	**21.3**
		South	1.5	6.9	0.6	**7.5**	13.8	8.5	**22.3**
	Average Annualized		*1.3*	*6.7*	*0.6*		*13.3*	*3.6*	
2018 (New Terminal)	VMC	North	1.5	5.7	0.2	**5.9**	12.0	2.7	**14.7**
		South	1.0	5.4	0.2	**5.6**	13.1	2.2	**15.3**
	IMC	North	2.0	5.7	0.3	**6.0**	12.0	6.6	**18.6**
		South	1.6	5.5	0.2	**5.7**	13.2	8.3	**21.5**
	Average Annualized		*1.3*	*5.5*	*0.2*		*12.5*	*2.7*	
PAL 2	VMC	North	2.7	6.1	0.5	**6.6**	12.7	2.9	**15.6**
		South	1.5	5.9	0.4	**6.3**	13.8	2.4	**16.2**
	IMC	North	4.2	6.0	0.4	**6.4**	12.7	6.1	**18.8**
		South	2.6	5.7	0.4	**6.1**	13.5	9.4	**22.9**
	Average Annualized		*2.1*	*5.9*	*0.4*		*13*	*2.9*	
PAL 3	VMC	North	3.6	6.1	0.6	**6.7**	12.8	3.9	**16.7**
		South	1.8	5.9	0.5	**6.4**	13.7	3.5	**17.2**
	IMC	North	6.2	5.9	0.4	**6.3**	12.8	9.2	**22.0**
		South	3.4	6.1	0.6	**6.7**	13.4	17.4	**30.8**
	Average Annualized		*2.8*	*5.8*	*0.5*		*13*	*4.2*	

Source: TransSolutions, 2019

Table 3-6 details the overall annualized taxi times, total delay, and combined total. Note that taxi times change slightly between 2018 and the planning activity levels due to changes in runway utilization assumptions.

TABLE 3-6 AVERAGE ANNUALIZED TRAVEL TIME

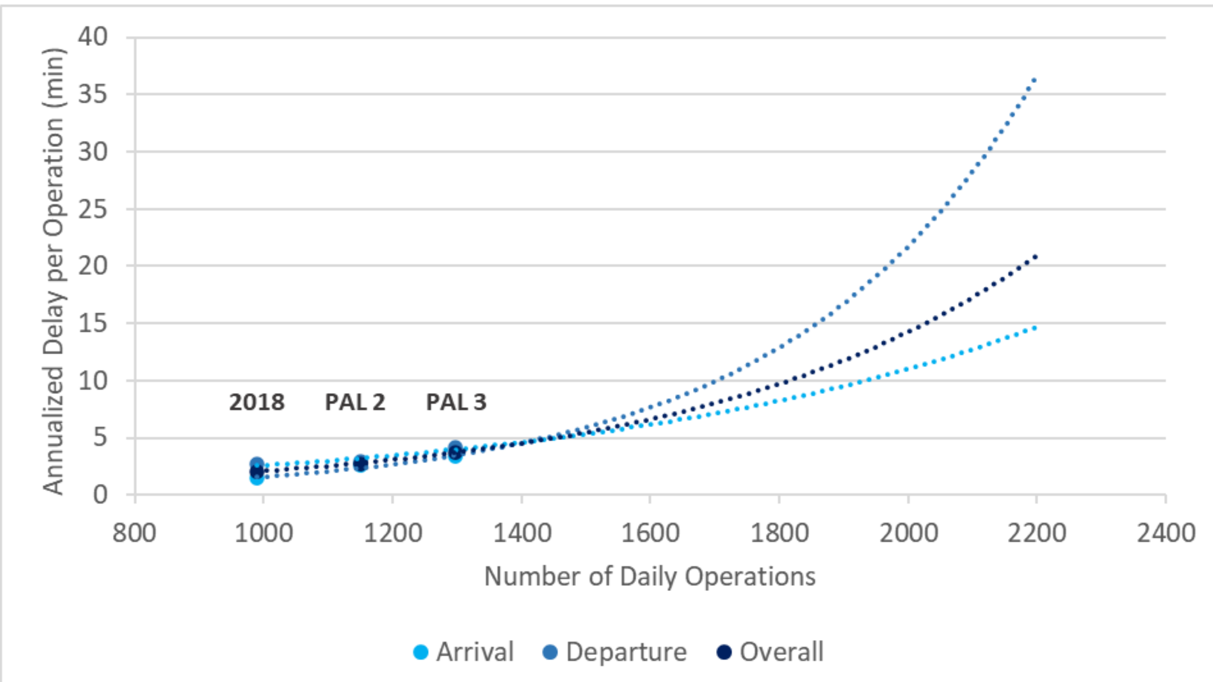
Demand	Annual Weighted Average (minutes)		
	Taxi Time	Delay	Total
2018 (Existing Terminal)	10.0	2.7	12.7
2018 (New Terminal)	9.0	2.1	11.1
PAL 2	9.4	2.7	12.1
PAL 3	9.4	3.8	13.2

Source: TransSolutions, 2019

Average annualized delay increases exponentially as operations increase towards maximum capacity. **Figure 3-2** shows the increase in delay as arrivals and departures increase. Through PAL 3 SLC is forecasted to remain below the five-minute threshold of acceptable delay. Five minutes of average annualized delay is expected to occur at around 1,500 daily operations, which is roughly an 11 percent increase beyond PAL 3. An inflection point is expected at around 1,800 to 1,900 daily operations. Within those levels, it is estimated that delay will exponentially increase.

While the results show that SLC has capacity through the planning period to keep delay below the five-minute threshold, capacity improvements must be planned for now to ensure enabling projects can be completed prior to the construction of any major improvement. This master plan alternatives section will explore alternative airfield solutions in effort to ensure a long-range plan is in place for SLC to add capacity to its system.

FIGURE 3-2 SLC AVERAGE ANNUALIZED DELAY



Source: TransSolutions, 2019

4.2.1.1.3 Peak Hour Delay

Due to the large amount of connecting flights and cargo operations at SLC, peak hour delay is an important metric. The peak hour delay metric reports the highest average hourly delay of all flights that operate during each hour over the 24-hour period. In other words, it represents the average amount of delay experienced by any given flight within the peak hour of delay. At major connecting hubs with a typical incidence of VMC and reduced capacity in IMC, peak hour delays of approximately 30 minutes in VMC or 45 minutes in IMC are considered delay thresholds not to be exceeded[2]. As shown in **Table 3-7**,

[2] ACRP Report 104: Defining and Measuring Aircraft Delay and Airport Capacity Thresholds

peak hour departure delays reach as high as 40 minutes in south flow IMC conditions in PAL 3, but none exceed industry standard delay thresholds.

TABLE 3-7 SIMMOD PEAK HOUR DELAY FORECAST

Demand	Weather	Flow	Peak Hour Daily Times (minutes)						
			Arrival				Departure		
			Air Delay	Taxi Time	Delay	Total	Taxi Time	Delay	Total
2018 (Existing Terminal)	VMC	North	4.3	6.9	0.9	**7.8**	13.2	7.5	**20.7**
		South	3.9	7.8	1.1	**8.9**	14.0	7.9	**21.9**
	IMC	North	6.8	6.2	2.3	**8.5**	13.3	17.0	**30.3**
		South	5.6	7.4	1.5	**8.9**	14.2	21.2	**35.4**
2018 (New Terminal)	VMC	North	4.6	5.6	1.0	**6.6**	12.3	5.1	**17.4**
		South	3.9	5.5	0.5	**6.0**	13.4	8.3	**21.7**
	IMC	North	6.6	5.5	1.7	**7.2**	13.0	10.0	**23.0**
		South	5.3	5.8	0.6	**6.4**	13.7	22.6	**36.3**
PAL 2	VMC	North	7.9	7.1	1.5	**8.6**	13.9	6.5	**20.4**
		South	6.8	7.4	0.8	**8.2**	14.3	5.4	**19.7**
	IMC	North	11.4	6.5	0.7	**7.2**	13.0	13.7	**26.7**
		South	11.4	7.4	0.8	**8.2**	13.5	21.7	**35.2**
PAL 3	VMC	North	10.9	6.9	2.1	**9.0**	13.7	8.3	**22.0**
		South	8.4	6.9	1.1	**8.0**	14.2	10.2	**24.4**
	IMC	North	14.1	6.4	0.6	**7.0**	13.3	19.5	**32.8**
		South	11.1	7.0	1.6	**8.6**	14.2	40.0	**54.2**

Source: TransSolutions, 2019

4.2.1.1.4 Hourly Throughput

A sensitivity analysis was performed to determine the existing airfield runway capacity. Both the north flow and south flow VMC models were utilized in this analysis. Initial findings indicated that the existing SLC airfield capacity could accommodate beyond PAL 3. In order to determine the true existing runway throughput, PAL 3 operations were increased by an additional 50 percent. **Table 3-8** summarizes the highest hourly runway throughputs averaged over 10 simulated days. This analysis assumes perfect conditions and the actual sustainable runway capacity would likely be approximately 5 percent lower.

TABLE 3-8 SIMMOD AVERAGE HOURLY RUNWAY THROUGHPUT

Flow	Arrivals	Departures	Overall
North	77	71	124
South	79	80	135

Source: TransSolutions, 2019

4.2.1.1.5 Summary

Overall, the SLC airfield has adequate capacity to accommodate demand through PAL 3. The new terminal configuration will significantly reduce aircraft taxi times and delays. The capacity of the existing airfield will be reached at around 1,500 daily operations. At that point, the five-minute industry standard average annualized delay threshold will be reached.

Simulation findings indicate that the runway capacity at SLC is very sensitive to runway use. While the runway use was developed using the principles of the SLC ATCT, adjustments to the runway use have a significant impact on delay and capacity.

While the airport system is forecasted to reach the five-minute average delay threshold around 1,500 daily operations, which is beyond PAL 3, alternatives will have to be selected to take the necessary preparatory steps to be able to have improvements complete before delay becomes a major constraint.

3.2.1.2 Wind Analysis

Runway wind coverage analysis was conducted using the FAA's Wind Analysis Airport Design Tool. To analyze the wind coverage for each of the Airport's runways, wind data from 2008-2017 was supplied by the National Climatic Data Center from the weather reporting station located at Salt Lake City International Airport[3]. Over that ten-year period, more than 125,000 wind observations were recorded, 6,756 observations of which were Instrument Flight Rules (IFR) conditions. This equates to 5 percent of the observations being IFR conditions while 95 percent were of Visual Flight Rules (VFR) conditions. FAA runway design standards recommend an airport's runway system provide a minimum of 95 percent wind coverage. The 95 percent wind coverage is computed based on the crosswind component not exceeding the set value of the Runway Design Code (RDC)[4]. If a single runway cannot provide this level of coverage, then a crosswind runway is warranted.

The RDC for Runway 16R-34L and 16L-34R is D-V and Runway 17-35 is D-IV, meaning the allowable crosswind component is 20 knots. For Runway 14-32, which has an RDC of B-II, the allowable crosswind components is 13 knots. **Table 3-9** details the crosswind analysis results for each runway. Combined, the four runways provide 99.96 percent or better wind coverage with a 20 knot crosswind component for all-weather conditions. Each runway at SLC provides sufficient wind coverage individually at all crosswind component categories. Thus, there is no need for a crosswind runway based on wind coverage as all runways today can individually meet FAA wind coverage requirements. The wind analysis concluded that Runway 14-32 is not needed as a crosswind runway to provide wind coverage at SLC.

[3] Weather observation data was collected from the SLC Automated Surface Observation System (ASOS).

[4] The RDC is a design standard specific to a single runway, and per FAA Advisory Circular AC 150/5300-13A Change 1, *Airport Design*, "runway standards are related to aircraft approach speed, aircraft wingspan, and designated or planned approach visibility minimums." Designing to the RDC ensures runways meet necessary physical and operational characteristics for the most demanding aircraft operating at the Airport.

TABLE 3-9 WIND COVERAGE ANALYSIS

ALL WEATHER WIND DATA				
RUNWAY	**10.5 KNOTS**	**13 KNOTS**	**16 KNOTS**	**20 KNOTS**
Runway 16L-34R	97.89%	98.96%	99.62%	99.88%
Runway 16R-34L	97.89%	98.96%	99.62%	99.88%
Runway 17-35	97.57%	98.75%	99.54%	99.85%
Runway 14-32	96.46%	98.47%	99.50%	99.86%
Combined	99.10%	99.60%	99.86%	99.96%

Source: NOAA National Climatic Data Center
All Weather Observations: 125,538
Station: Salt Lake City International Airport
Data Range: 2008 - 2017

IFR WIND DATA				
RUNWAY	**10.5 KNOTS**	**13 KNOTS**	**16 KNOTS**	**20 KNOTS**
Runway 16L-34R	96.01%	97.62%	98.95%	99.63%
Runway 16R-34L	96.01%	97.62%	98.95%	99.63%
Runway 17-35	95.24%	97.03%	98.54%	99.48%
Runway 14-32	96.29%	98.35%	99.35%	99.78%
Combined	98.20%	99.17%	99.68%	99.91%

Source: NOAA National Climatic Data Center
IFR Observations: 6,756
Station: Salt Lake City International Airport
Data Range: 2008 - 2017

3.2.1.1 Runway Designation

Every runway has two associated directional headings. A true heading, or the direction toward which it is physically oriented that will not change unless the runway is realigned, and a magnetic heading, which is determined by the runway's orientation along with an adjustment for magnetic declination. A runway's magnetic heading is important for pilots since they use magnetic compasses to determine their heading while in flight. Runway designations are provided on each runway to indicate the runway orientation according to the magnetic compass bearing. Due to the slow drift of the magnetic poles on the Earth's surface in relation to the location of the Airport, the magnetic bearing of a runway can change over time and runway designations must occasionally be updated. It is industry standard that a runway designation be considered when the runway magnetic heading shifts more than 5° from the runway marking designation.

As of November 27, 2015, the magnetic declination at the Airport is 11° 35' E and is changing by 0° 11' W per year. As illustrated in **Table 3-10**, Runway 16R-34L, Runway 16L-34R, and Runway 14-32 will have magnetic bearings greater than the 5° tolerance, during the planning period. At the current rate of change in magnetic declination in Salt Lake City, it is estimated that Runway 16R-34L and Runway 16L-34R will exceed a 5° tolerance in the year 2026 and Runway 14-32 will exceed the tolerance in the year 2037. Runway 17-35 is not expected to exceed the 5° tolerance in the planning period.

The expected change in magnetic bearing for Runway 16L-34R and 16R-34L would purportedly require the runways to be designated as "17-35" runways. However, because existing Runway 17-35 is not parallel to these runways, a new runway designation scheme will have to be worked out by FAA. There is no hard-set rule on runway designation, and there are multiple stakeholders within FAA that coordinate the implementation of runway re-designations. Prior to runway designation changes, coordination should commence between the FAA Airport District Office (ADO), SLC ATC, FAA Operational Support Group/Flight Procedures Team (OSG-FPT), and SLCDA staff.

Further exploration and coordination in regard to the need to re-designate the runways in the planning period will be carried forward into the alternatives analysis. If it is determined that a runway re-designation is required in the planning period, the cost of that project will be included in the implementation plan developed during the last phase of this study.

TABLE 3-10 EXISTING AND FUTURE MAGNETIC BEARING

Existing			2022		2027		2037	
Runway Designation	**True Bearing**	**Magnetic Bearing**	**Magnetic Bearing**	**Runway Designation**	**Magnetic Bearing**	**Runway Designation**	**Magnetic Bearing**	**Runway Designation**
Runway 16R	174° 56' 58"	163° 21' 58"	164° 16' 58"	Runway 16R	165° 11' 58"	Runway 17R	167° 01' 58"	Runway 17R
Runway 34L	354° 57' 07"	343° 22' 07"	344° 17' 07"	Runway 34L	345° 12' 07"	Runway 35L	347° 02' 07"	Runway 35L
Runway 16L	174° 57' 50"	163° 22' 50"	164° 17' 50"	Runway 16L	165° 12' 50"	Runway 17C	167° 02' 50"	Runway 17C
Runway 34R	354° 57' 59"	343° 22' 59"	344° 17' 59"	Runway 34R	345° 12' 59"	Runway 35C	347° 02' 59"	Runway 35C
Runway 17	179° 59' 43"	168° 24' 43"	169° 19' 43"	Runway 17	170° 14' 43"	Runway 17L	172° 04' 43"	Runway 17L
Runway 35	359° 59' 43"	348° 24' 43"	349° 19' 43"	Runway 35	350° 14' 43"	Runway 35R	352° 04' 43"	Runway 35R
Runway 14	152° 58' 32"	141° 23' 32"	142° 18' 32"	Runway 14	143° 13' 32"	Runway 14	145° 03' 32"	Runway 15
Runway 32	332° 58' 51"	321° 23' 51"	322° 18' 51"	Runway 32	323° 13' 51"	Runway 32	325° 03' 51"	Runway 33

Source: NOAA - National Centers for Environmental Information; RS&H Analysis, 2018

3.2.1.1 Critical Aircraft

The FAA requires the identification of the existing and future critical aircraft, also known as the design aircraft, for airport planning purposes. In some cases, the critical aircraft may be a collection of aircraft with similar characteristics. For airports with multiple runway and taxiway complexes, like SLC, critical aircraft are identified for each runway or taxiway complex.

The critical aircraft for SLC is the most demanding aircraft having substantial use of each runway/taxiway complex. Per FAA Advisory Circular 150/5000-17 *Critical Aircraft and Regular Use Determination*, substantial use is defined as 500 annual operations, not counting touch-and-go operations, or operations related to atypical conditions such as construction projects. However, the designated critical aircraft can be a composite of several aircraft for each of the parameters that determined the critical aircraft.

Three parameters are used to classify the critical aircraft: Aircraft Approach Category (AAC) shown in **Table 3-11**. Airplane Design Group (ADG) shown in **Table 3-12**, and Taxiway Design Group (TDG) shown in **Table 3-13**. The ACC, depicted by a letter, relates to aircraft approach speeds. The ADG, depicted by a Roman numeral, relates to airplane wingspan and height. The TDG, classified by number, relates to the outer to outer main gear width and the distance between the cockpit and main gear. These parameters serve as the basis of the design and construction of airport infrastructure.

TABLE 3-11 AIRCRAFT APPROACH CATEGORY

Aircraft Approach Category	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

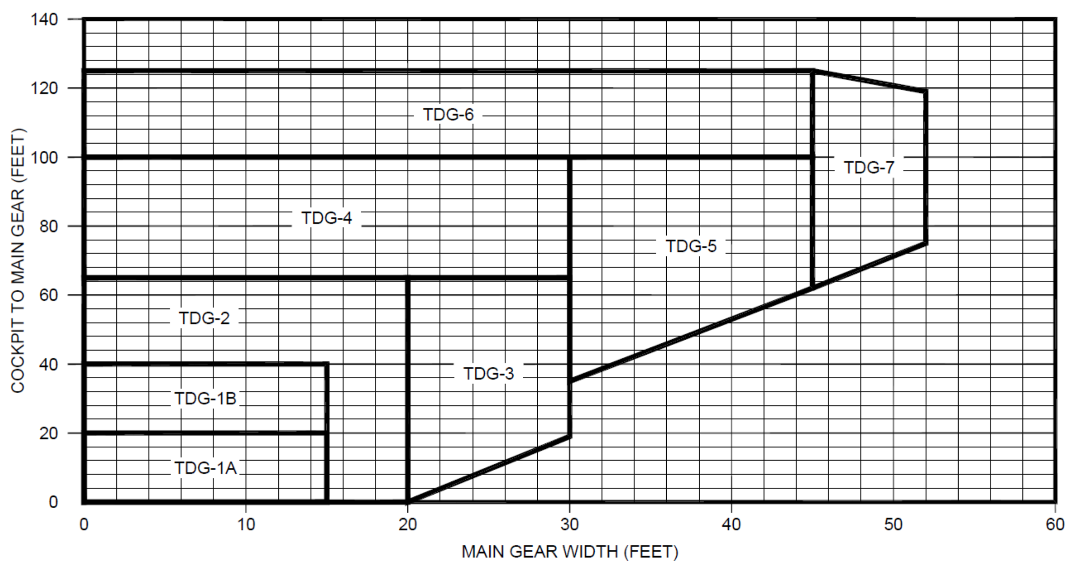
Source: FAA AC 150/5300-13A, *Airport Design*

TABLE 3-12
AIRCRAFT DESIGN GROUP

Group	Tail Height	Wingspan
I	< 20'	< 49'
II	20' ≤ 30'	49' ≤ 79'
III	30' ≤ 45'	79' ≤ 118'
IV	45' ≤ 60'	118' ≤ 171'
V	60' ≤ 66'	171' ≤ 214'
VI	66' ≤ 80'	214' ≤ 262'

Source: FAA AC 150/5300-13A, *Airport Design*

TABLE 3-13 TAXIWAY DESIGN GROUP



Source: FAA AC 150/5300-13A Change 1 *Airport Design*

The critical aircraft for each runway at SLC is detailed in **Table 3-14**. The previous Airport Layout Plan listed the Boeing 767-400 as the critical aircraft for Runway 16L-34R, 16R-34L, and 17-35. The B767 is an aircraft approach category (AAC) D and airplane design group (ADG) IV aircraft.

Since the Airport Layout Plan was updated in 2006, the critical aircraft for Runway 16L-34R and 16R-34L has increased to ADG V, as was verified in the analysis completed for the Aviation Activity Forecast. Growth in operations by aircraft such as the Airbus A330, Boeing 777, and Boeing 787 have resulted in this increase. This results in increased runway design characteristics, such as holding position distances and runway blast pad sizing, as discussed in detail in **Section 3.2.1.2**.

The critical aircraft characteristics for Runway 17-35 and Runway 14-32 remains the same today and through the planning period, despite slightly different aircraft models. However, it should be noted that if Runway 17-35 is realigned as a parallel runway, it is recommended it be designed to D-V standards as its functionality and capability would be enhanced to equal the exiting parallel runways.

TABLE 3-14 CRITICAL AIRCRAFT

		Runway 16L/34R	Runway 16R/34L	Runway 17/35	Runway 14/32
Previous Critical Aircraft		B767-400	B767-400	B767-400	EMB120
	AAC	D	D	D	B
	ADG	IV	IV	IV	II
	TDG	5	5	5	3
Existing Critical Aircraft		A330/B737-9	A330/B737-9	B757/767	B1900D
	AAC	D	D	D	B
	ADG	V	V	IV	II
	TDG	5	5	5	2
Future Critical Aircraft		A350/B777-3	A350/B777-3	B767	B1900D
	AAC	D	D	D	B
	ADG	V	V	IV	II
	TDG	6	6	5	2

Source: 2006 Airport Layout Plan, RS&H Analysis, 2019

3.2.1.2 Runway Length

The previous master plan for SLC recommends an extension of Runway 16L-34R to 15,100 feet. Since the completion of the last master plan, important industry events and trends have emerged which influence runway length requirements. New generation aircraft have generally reduced runway length requirements at airports. However, at SLC, high elevation, high maximum mean temperature, and existing obstructions such as the powerlines to the north present challenges to aircraft performance and result in limitations to the allowable take-off weight of some aircraft using the Airport.

In addition to the last master plan, several runway length analyses have been completed in support of air service development at the Airport. A validation of previously studied runway lengths of 12,002’, 13,500’, 15,100’, and 16,000’ feet was conducted based on both the existing and forecasted fleet, and updates to meteorological conditions. A temperature of 95.6° F, the 95 percentile of temperature at SLC, and dry runways were assumed. The existing and future aircraft fleet mix which would have the greatest likelihood to be benefited by a runway extension including the Airbus A330, Airbus A350, Boeing 737-900, Boeing 777-200F, and Boeing 787-900 were examined.

There are five factors that can restrict the allowable maximum take-off weight for aircraft. These include:

- Brake Energy – the aircraft brakes will be unable to absorb the amount of energy required to stop the aircraft during an aborted take-off
- Climb – the allowable weight of the aircraft to meet climb gradients for takeoff flight path segments
- Field Length – the runway length available does not allow the aircraft to meet regulations such as the accelerate stop distance, or take-off distance for weight beyond the restricted weight
- Obstacle – the aircraft will be unable to sufficiently clear the existing obstacles such as powerlines and trees to the north of the airfield beyond the allowable weight
- Tire Speed – the speed required for take-off will be greater than the maximum speed for which the aircraft tires are rated

The runway length calculations are based on departures on Runway 34R. For each of the aircraft studied, an allowable take-off weight for each runway length was determined with and without the powerlines located north of the Airport. At 95.6° F, all aircraft examined were limited from reaching the maximum take-off weight of the aircraft. However, lower temperatures would allow for an increase in allowable take-off weight. All aircraft faced a limitation other than field length at a runway length of 15,100 feet or longer. **Table 3-15** shows the results of this analysis.

TABLE 3-15 RUNWAY LENGTH ALLOWABLE TAKE-OFF WEIGHT AND LIMITATIONS

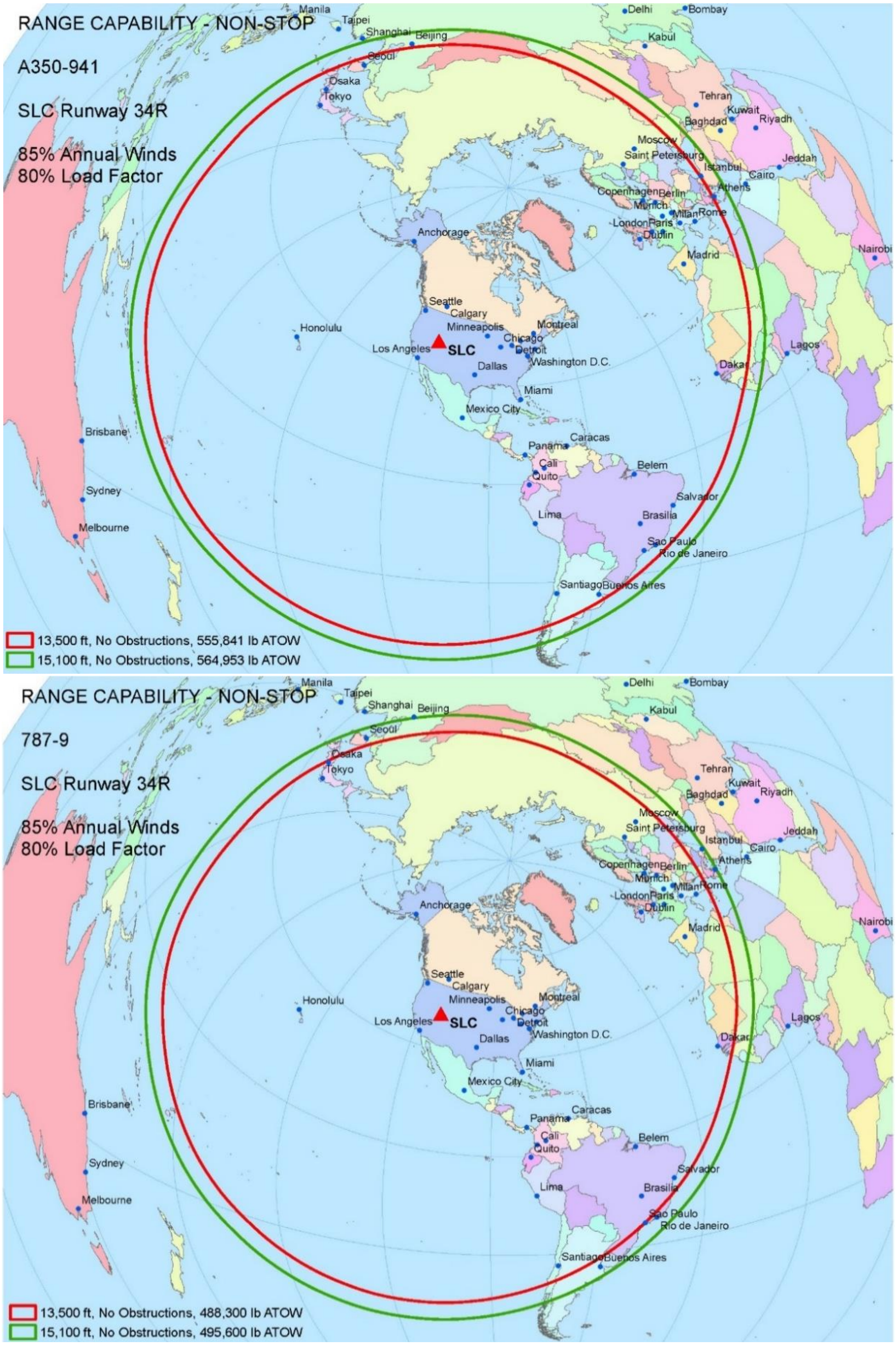
Aircraft		Airbus A330-243		Airbus A350-941		Boeing 737-900		Boeing 777-200F		Boeing 787-9	
Engine		Trent 772		Trent XWB-84		CFM56-7B26		GE90-110BL		Genx-1B74/75	
MTOW (lbs)		524,700		617,294		187,000		766,000		557,000	
Runway Length	Obstructions	Allowable Take-Off Weight (lbs)	Limitation	Allowable Take-Off Weight (lbs)	Limitation	Allowable Take-Off Weight (lbs)	Limitation	Allowable Take-Off Weight (lbs)	Limitation	Allowable Take-Off Weight (lbs)	Limitation
12,002'	Existing	482,750	Brake Energy	539,035	Obstacle	165,481	Climb	654,300	Field Length	477,500	Field Length
13,500'		483,976	Obstacle	545,999	Obstacle	166,858	Climb	668,300	Tire Speed	488,300	Field Length
15,100'		483,827	Obstacle	548,509	Obstacle	166,858	Climb	669,300	Tire Speed	495,600	Climb
16,000'		483,742	Obstacle	548,409	Obstacle	166,858	Climb	669,300	Tire Speed	495,600	Climb
12,002'	None	482,750	Brake Energy	541,366	Field Length	165,481	Climb	654,300	Field Length	477,500	Field Length
13,500'		488,304	Brake Energy	555,841	Field Length	166,858	Climb	668,300	Tire Speed	488,300	Field Length
14,500'		-	-	562,858	Brake Energy	-	-	-	-	-	-
15,100'		493,570	Brake Energy	564,953	Brake Energy	166,858	Climb	669,300	Tire Speed	495,600	Climb
16,000'		496,214	Brake Energy	567,350	Brake Energy	166,858	Climb	669,300	Tire Speed	495,600	Climb

Source: Flight Engineering, May 2019

The existing obstacles, such as the powerlines, were found to impact the allowable take-off weight of the Airbus A330 and A350 at almost all runway lengths, but have no impact on the B737-900, B777-200F, or B787-900. If these obstacles are removed, the Airbus A330 and A350 would have a greater allowable take-off weight that require up to a 16,000-foot runway. However, the increases in allowable take-off weight become less between 13,500 feet and 15,100 feet. The B777-200F receives no benefit from a runway length beyond 13,100 feet, and the B787-9 receives no benefit from a runway length beyond 15,100 feet.

Using the determined allowable take-off weights, approximate range capabilities were determined for the A350 and B787-900 as shown in **Figure 3-3**. Routes between major cities in Asia including the Delta hub at Incheon International Airport serving Seoul, South Korea, Beijing China and other cities in the region, were identified in the Aviation Activity Forecast as locations likely to see demand growth. Assumptions in this calculation include mitigation of all existing obstructions, 85 percent of the annual winds, and an 80 percent load factor. For the A350, a 13,500-foot runway allows for a range that includes Seoul, South Korea; Rio de Janeiro, Brazil; and nearly all of Europe. With a reduction in payload, the A350 could reach Beijing, China. The B787-900 can reach Tokyo, Japan; Rio de Janeiro, Brazil; and westernmost Europe on a 13,500-foot runway. As with the A350, the B787-900 can reach markets like Beijing with a reduced payload. Although limited by brake energy, the A330 could increase its take-off weight to a point it would require a 16,000-foot runway. However, this aircraft is not expected to be widely used in the Asian market from SLC.

FIGURE 3-3 RUNWAY EXTENSION RANGE CAPABILITIES



Source Flight Engineering, May 2019

The point at which the limiting take-off factor is not field length occurs between 13,500 feet and 15,100 feet (A350 and B787-900, no obstructions). Interpolating the take-off weight for those two aircraft yields a runway length requirement of 14,500 feet. The A350, the largest aircraft Delta is likely to utilize for flights to Asia, can accommodate a maximum passenger payload on both a 13,500-foot and 14,500-foot runway to Seoul, Beijing, and Tokyo. At 14,500 feet, the A350 can accommodate an additional 5,000 pounds to 6,000 pounds of cargo to these three markets.

To maximize allowable take-off weight for the future critical aircraft, it is recommended that the master plan provide for a future 14,500-foot runway.

3.2.1.3 Runway Pavement Strength

Runway pavement strength determines the aircraft weight that can land repeatedly with normal wear on a runway. If an aircraft landing regularly exceeds the pavement strength of the runway, the runway will age prematurely and can be damaged. This can compromise the integrity of the pavement, requiring reconstruction at an earlier and unscheduled time. In order to ensure that aircraft are capable of landing on a runway according to weight, aircraft are assigned their weights in conjunction to the configuration of their main gear.

Table 3-16 details the max takeoff weight (MTOW) of the existing and future critical aircraft at SLC. The heaviest of the existing critical aircraft are the Airbus A330-300 and the Boeing 767-300. In the future, it is expected that the Airbus A350-900 and Boeing 777-300 will be the heaviest aircraft using the runways at SLC with substantial use. The Boeing 777 is expected to be used by cargo operators by PAL 1, and forecast in the base case scenario to exceed the substantial use threshold of 500 annual operations by PAL 2. Use of the A350 is forecasted in the high case scenario to exceed the substantial use threshold in PAL 2.

TABLE 3-16 EXISTING AND FUTURE CRITICAL AIRCRAFT MTOW

Existing Critical Aircraft	ARC	Gear Type	Maximum Take-Off Weight
Boeing 737-900	D-III	Dual Wheel	188,000 lbs.
Airbus A330-300	C-V	Dual-Tandem Wheel	518,000 lbs.
Boeing 767-300	D-IV	Dual-Tandem Wheel	412,000 lbs.
Beech 1900	B-II	Dual-Wheel	27,000 lbs.
Future Critical Aircraft	**ARC**	**Gear Type**	**Maximum Take-Off Weight**
Boeing 777-300	D-V	Triple-Tandem Wheel	660,000 lbs.
Airbus A350-900	D-V	Dual-Tandem Wheel	591,000 lbs.
Boeing 767-300	D-IV	Dual-Tandem Wheel	412,000 lbs.
Beech 1900	B-II	Dual-Wheel	27,000 lbs.

Source: RS&H 2019, Advisory Circular 150/5300-13A Change 1, *Airport Design*

The analysis of runway pavement strength is a high-level analysis which compares published weight capacity to the MTOW of critical aircraft, and does not include examination of aircraft condition numbers (ACN), pavement condition numbers (PCN), or typical takeoff and landing weights of aircraft operating at the Airport. The analysis found a delta between the published maximum runway strength and the MTOW of dual-tandem wheel critical aircraft, both existing and future. The published strength for dual-tandem wheel aircraft for all runways at SLC is 350,000 pounds. The existing critical aircraft, the A330-300 and Boeing 767-300, both dual-tandem wheel aircraft, have MTOW that exceed the published weight capacity. The future critical aircraft, the Airbus A350-900, also exceeds the published weight capacity. The Boeing 777-300, the heaviest of all future critical aircraft, is configured with a triple-tandem gear, of which there is no published weight capacity. **Table 3-17** details the existing published runway strength and the recommended strength to accommodate the MTOW of the critical aircraft. Overall, it is recommended that Runway 16L-34R, Runway 16R-34L and Runway 17-35 be strengthened in the future.

Interesting to note, during the analysis completed for the Aviation Forecast, it was found that no aircraft with a MTOW of 20,000 pounds or greater conducted any operations on Runway 14-32 in 2017, although the pavement strength is comparable to the other three runways. Runway 14-32 is a remnant WWII era runway, assumed to have been built to accommodate very heavy aircraft. As the airport was further developed, Runway 14-32 was often used for taxiing aircraft from the terminal area to Runway 35. Today, Taxiway L allows this operation, but the previous history and use of Runway 14-32 is estimated to be related to the high weight bearing capacity of the runway. To serve existing and expected operations, Runway 14-32 need only accommodate single gear aircraft up to roughly 30,000 pounds, and dual-wheel gear up to 50,000 pounds.

TABLE 3-17 RUNWAY STRENGTH REQUIREMENTS

Gear Type	Existing Pavement Strength		Recommended Pavement Strength		Meets Requirements
Runway 16L-34R					
Single (S)	60,000	lbs	60,000	lbs	✓
Dual (D)	200,000	lbs	200,000	lbs	✓
Dual Tandem (2D)	350,000	lbs	600,000	lbs	X
Triple Tandem (3D)	Unknown		660,000	lbs	Unknown
Double-Dual Tandem (2D/2D2)	850,000	lbs	850,000	lbs	✓
Runway 16R-34L					
Single (S)	60,000	lbs	60,000	lbs	✓
Dual (D)	200,000	lbs	200,000	lbs	✓
Dual Tandem (2D)	350,000	lbs	600,000	lbs	X
Triple Tandem (3D)	Unknown		660,000	lbs	Unknown
Double-Dual Tandem (2D/2D2)	850,000	lbs	850,000	lbs	✓
Runway 17-35					
Single (S)	60,000	lbs	60,000	lbs	✓
Dual (D)	200,000	lbs	200,000	lbs	✓
Dual Tandem (2D)	350,000	lbs	600,000	lbs	X
Triple Tandem (3D)	Unknown		660,000	lbs	Unknown
Double-Dual Tandem (2D/2D2)	850,000	lbs	850,000	lbs	✓
Runway 14-32					
Single (S)	60,000	lbs	30,000	lbs	✓*
Dual (D)	200,000	lbs	50,000	lbs	✓*
Dual Tandem (2D)	350,000	lbs	NA	lbs	✓*
Double-Dual Tandem (2D/2D2)	850,000	lbs	NA	lbs	✓*

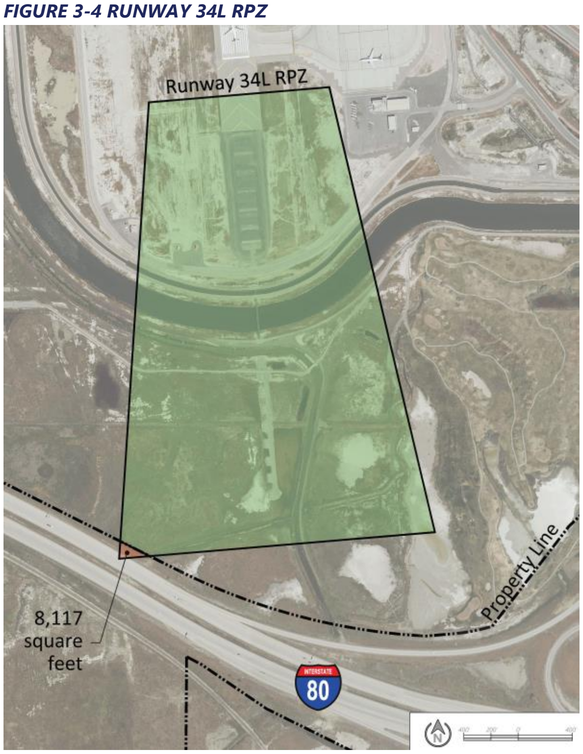
Source: Airport Facilities Directory Effective 9/13/2018 to 11/7/2018, RS&H Analysis, 2019
* Runway 14-32 is built to a strength beyond that required to support current and forecasted operations

3.2.1.1 Runway Protection Zones

For the protection of people and property on the ground, the FAA has identified an area of land located off each runway end as the Runway Protection Zone (RPZ) that should be under airport control and free of incompatible objects and activities. The size of these zones varies according to the critical aircraft characteristics and the lowest instrument approach visibility minimum defined for each runway.

FAA desires airports to own in fee all the land within RPZs. Two of the eight RPZs at SLCIA are not entirely under control and/or owned in fee by SLCDA, as denoted in **Table 3-18**. An 8,117 square foot section of the Runway 34L RPZ, or approximately 0.2% of the total RPZ, extends off airport property onto property the airport sponsor does not control, as shown in **Figure 3-4**. This section extends onto a section of property for Interstate 80. Note that there is no object or use in this area that constitutes a safety issue. Considering this is such a small area of unowned land and that the primary use of the land is a right-of-way for an interstate, no action is recommended at this time. If Interstate 80 is ever relocated, it is recommended that SLCDA purchase the land remaining in the RPZ.

FIGURE 3-4 RUNWAY 34L RPZ



Source: RS&H Analysis, 2019

According to the Salt Lake County Assessors web viewer, the Utah Transit Authority owns slivers of land within the Runway 35 RPZ where the TRAX line runs. This land is assumed to have been sold to the Utah Transit Authority with a perpetual easement, and thus was acceptable for conveyance by FAA. Coordination between the Airport and FAA is ongoing on other parcels of land used but not owned by TRAX, and no further action is recommended.

TABLE 3-18 RUNWAY PROTECTION ZONE REQUIREMENTS

	Runway							
Runway	**16R**	**34L**	**16L**	**34R**	**17**	**35**	**14**	**32**
Length	2,500'	2,500'	2,500'	2,500'	2,500'	2,500'	1,000'	1,000'
Inner Width	1,000'	1,000'	1,000'	1,000'	1,000'	1,000'	500'	500'
Outer Width	1,750'	1,750'	1,750'	1,750'	1,750'	1,750'	700'	700'
Percent SLCDA Controlled	100%	**99.08%**	100%	100%	100%	**Unknown**	100%	100%
Mets Standard	✓	✓*	✓	✓	✓	✓*	✓	✓

Source: Advisory Circular 150/5300-13A Change 1, *Airport Design,* RS&H Analysis 2019

*These instances of land not under direct control by SLCDA do not require immediate action. The land under the Runway 35 RPZ that is not owned by SLCDA is assumed to have a perpetual easement.

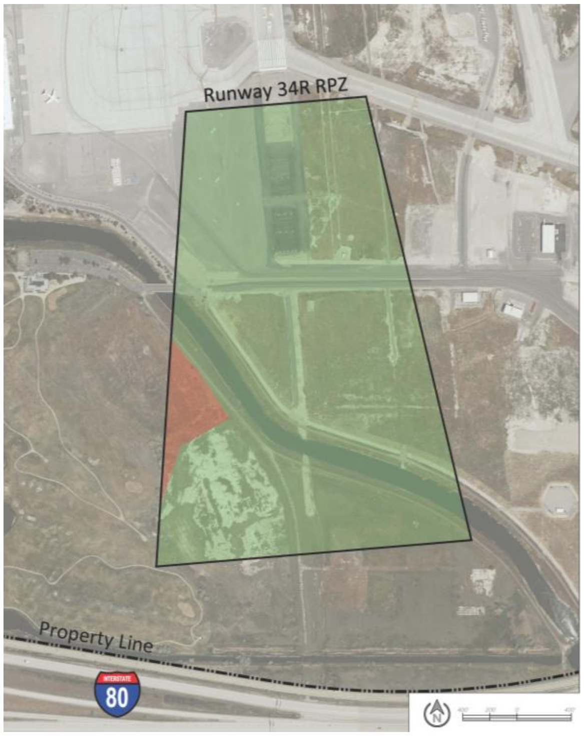
Three RPZs have existing transportation facilities, within their boundaries. These include the 2100 N roadway inside the Runway 16L RPZ, the TRAX light rail Green Line and North Temple roadway inside the Runway 35R RPZ, and I-80 inside the Runway 34L RPZ (as noted). Note that Salt Lake City owns all the land used by 2100 N and North Temple roadways. While not an incompatible land use, as each was an existing condition prior to the 2012 FAA Memorandum *Interim Guidance on Land Uses within a Runway Protection Zone*, it is recommended that if any of these facilities are rebuilt in the future, they be relocated outside of the RPZ. Furthermore, if Runway 17-35 is realigned, it should be positioned such that the RPZ is clear of roadways and the TRAX line if possible.

A portion of the now closed Wingpointe Golf Course sits under and immediately adjacent to the Runway 35R RPZ. The portion shown in red in **Figure 3-5** used to be part of the driving range. The intent of the 2012 FAA Memorandum is to reduce hazards to people and property. The document notes that new recreational land uses, including golf courses, require APP-400 approval. The reopening of the Wingpointe Golf Course would constitute a new land use compared to today's condition; thus APP-400 approval would be required.

To remain in compliance with current FAA policy, it is recommended that the former golf course remain vacant until compatible development is proposed for the site It is not recommended that any of the land within the airport property boundary be returned to use as a golf course. In addition to the issue of the golf course being under the Runway 35R RPZ, the land itself was and currently is a wildlife attractant due to the presence of open water ponds and grass expanses that can be used for feeding birds. Advisory Circular 150/5200-33B *Hazardous Wildlife Attractants On or Near Airports* notes specifically that FAA recommends against construction of new golf courses located within 5 miles of an airport operations area. Thus, reopening the Wingpointe Golf Course, which constitutes a new usage of this land compared to the exiting condition, directly conflicts with AC 150/5200-33B.

Overall, it is not recommended that the golf course be reopened, as that action goes against FAA recommendations provided within AC 150/5200-33B *Hazardous Wildlife Attractants On or Near Airports* and is not a preferred land use within an RPZ. The area formally used as a golf course and the canal system on the south and west sides of the airport are recommended to be mitigated for wildlife to the fullest extent possible. This would include the modification of the canal systems and repurposing the land in a manner that discourages use by wildlife and meets RPZ requirements.

FIGURE 3-5 RUNWAY 34R RPZ



Source: RS&H Analysis, 2019

3.2.1.2 Runway Geometric and Separation Standards

This section analyzes the existing runway geometric layouts and separation distances against the dimensional standards that correspond with the critical aircraft category designated for each runway. Compliance with FAA airport geometric layouts and separation standards, without modification to standards, is intended to meet a minimum level of airport operational safety and efficiency.

Table 3-20 compares the FAA airport design standards for the Runway 16L-34R and 16R-34L, based on existing design standards. Design standards not in compliance are denoted by a bold "X." Layouts that are not compliant include blast pads and blast pad markings. In addition, runway hold position marking separation and runway to taxiway separation at specific locations that only apply when visibility is decreased were determined to be non-compliant. The details of these instances are discussed below. Blast pads should be marked with chevrons aligned with the runway for the total width and length of the blast pad[5]. The markings on the Runway 16L blast pad are not currently full width, and the markings on the Runway 34R blast pad do not extend the full length of the paved surface. Additionally, the Runway 34R blast pad pavement is not full width. These issues do not require alternatives analysis, but the cost to fix the deficiencies will be included in the capital improvement program developed as part of this study.

[5] Advisory Circular 150/5340-1L – *Standards for Airport Markings*

As it relates to runway hold position markings and runway to taxiway separation, deficiencies were found that only apply when visibility decreases to specific levels. Runway 16L-34R and 16R-34L both meet base level ADG V standards for runway to taxiway and runway to hold position separation. Note that both runways meet all standards for ADG IV separation standards during any visibility. Thus, the deficiencies identified only apply for ADG V runway operations during specific visibility conditions, as detailed in **Table 3-19**.

TABLE 3-19 RUNWAY TO TAXIWAY AND HOLD MARKING SEPARATIONS

Aircraft Design Group / Visibility	FAA Standard	Runway 16L/34R	Runway 16R/34L
Runway to Taxiway Separation			
ADG IV -- Any Visibility	400 Feet	✓	✓
ADG V -- 1/2 SM Visibility or Above	450 Feet	✓	✓
ADG V -- Below 1/2 SM Visibility	500 Feet	X*	X*
Runway to Hold Position Separation			
ADG IV -- Any Visibility	292 Feet	✓	✓
ADG V -- 3/4 SM Visibility or Above	292 Feet	✓	✓
ADG V -- Below 3/4 SM Visibility	322 Feet	X	✓

Source: Advisory Circular 150/5300-13A Change 1, Airport Design, RS&H Analysis, 2019
Note that runway to hold position requirement accounts for SLC field elevation
* Runway 16L/34R and 16R/34L are only deficient in the areas adjacent to deice pads where taxiway to runway separation is decreased.
SM is statute mile

The hold position lines for Runway 16L-34R meet the standards for an ADG V runway at 292 feet from the runway centerline, when visibility is ¾-statute miles or greater. However, when visibility drops below ¾-statute miles, the standard requires runway hold positions to be 322 feet from the runway centerline[6]. In an analysis evaluating the runway's Inner-transitional obstacle free zone (OFZ), it was found the current hold position markings are placed in a location sufficient to keep holding aircraft clear of that surface. Thus, the current placement of these markings do not require any special operational procedures.

The current runway to parallel taxiway separation for Runway 16L-34R and Runway 16R-34L is adequate for ADG V operations, except when visibility is less than ½-statute mile. Both runways have 600 feet of separation to the taxiways, centerline to centerline, except where the taxiways run adjacent to the deice pads. At those points, separation is reduced to 460 feet between Runway 16L-34R and Taxiway H, and 450 feet between Runway 16R-34L and Taxiway A. That amount of separation is adequate for ADG V runway operations when visibility is ½-statute mile or greater. When visibility drops below ½-statute mile, 500 feet separation is required[7]. Today, SLCDA Operations restricts operations on the parallel taxiway when ADG V are landing and runway visual range (RVR) is below 1,200 feet. For ADG V aircraft to land on Runway 16L-34R or 16R-34L when RVR is less than 1,200 feet, the correlated parallel taxiway must be clear of aircraft in those areas where separation is reduced adjacent to the deice pads.

[6] For a D-V runway the required holding position separation from runway centerline when visibility is less than ¾ statute miles is 280' from the runway centerline plus 1 additional foot for each 100 feet above sea level of the airport elevation.

[7] Advisory Circular 150/5300-13A Change 1 – *Airport Design*, Footnote 5, page 94. Note applies to ADG V runways

The runway to taxiway and hold marking position separation issues described will be brought forward together into the alternatives analysis. Alternatives analysis will examine if fixing these issues is warranted based upon cost versus overall benefit to airport operations.

TABLE 3-20 RUNWAY 16L-34R AND RUNWAY 16R-34L DESIGN STANDARDS

Airfield Components	ADG D-V-2400 Requirement	Runway 16L-34R		Runway 16R-34L	
		Existing	Future Met (✓)	Existing	Future Met (✓)
Runway Design					
Runway Width	150'	150'	✓	150'	✓
Runway Shoulder Width	35'	50'	✓	35'	✓
Runway Blast Pad Width	220'	150'	X (34R)*	220'	✓*
Runway Blast Pad Length	400'	400'	✓	400'	✓
Runway Protection					
Runway Safety Area (RSA)					
Length beyond departure end	1,000'	1,000'	✓	1,000'	✓
Length prior to threshold	600'	600'	✓	600'	✓
Width	500'	500'	✓	500'	✓
Runway Object Free Area (ROFA)					
Length beyond runway end	1,000'	1,000'	✓	1,000'	✓
Length prior to threshold	600'	600'	✓	600'	✓
Width	800'	800'	✓	800'	✓
Runway Obstacle Free Zone (ROFZ)					
Length	200'	200'	✓	200'	✓
Width	400'	400'	✓	400'	✓
Precision Obstacle Free Zone (POFZ)					
Length	200'	200'	✓	200'	✓
Width	800'	800'	✓	800'	✓
Approach Runway Protection Zone (ARPZ)					
Length	2,500'	2,500'	✓	2,500'	✓
Inner Width	1,000'	1,000'	✓	1,000'	✓
Outer Width	1,750'	1,750'	✓	1,750'	✓
Acres	78.914	78.914	✓	78.914	✓
Departure Runway Protection Zone (DRPZ)					
Length	1,700'	1,700'	✓	1,700'	✓
Inner Width	500'	500'	✓	500'	✓
Outer Width	1,010'	1,010'	✓	1,010'	✓
Acres	29.465	29.465	✓	29.465	✓
Runway Separation					
Runway centerline to:					
Parallel runway centerline	4,300'	6,156'	✓	6,156'	✓
Holding position	322'	292'	X	322'	✓
Parallel Taxiway/Taxilane Centerline	500'	460'	X	450'	X
Aircraft parking area	500'	590'	✓	645'	✓

Source: Advisory Circular 150/5300-13A Change 1, *Airport Design,* RS&H Analysis, 2019

*Runway blast pad markings for Runway 16L and 34R are not to standard

Table 3-21 compares the FAA airport design standards for Runway 17-35 and Runway 14-32. The only non-compliant design standard found in analyzing these two runways is the blast pad for Runway 17. That blast pad does not meet the ADG IV runway blast pad length requirement of 200 feet.

TABLE 3-21 RUNWAY 17-35 AND RUNWAY 14-32 DESIGN STANDARDS

Airfield Components	ADG D-IV-2400 Requirement	Runway 17-35		ADG B-II-VIS Requirement	Runway 14-32	
		Existing	Future Met (✓)		Existing	Future Met (✓)
Runway Design						
Runway Width	150'	150'	✓	75'	150'	✓
Runway Shoulder Width	25'	35'	✓	10'	25'	✓
Runway Blast Pad Width	200'	200'	✓	95'	150'	✓
Runway Blast Pad Length	200'	104'	X (17)	150'	125'	✓
Runway Protection						
Runway Safety Area (RSA)						
Length beyond departure end	1,000'	1,000'	✓	300'	300'	✓
Length prior to threshold	600'	600'	✓	300'	300'	✓
Width	500'	500'	✓	150'	150'	✓
Runway Object Free Area (ROFA)						
Length beyond runway end	1,000'	1,000'	✓	300'	300'	✓
Length prior to threshold	600'	600'	✓	300'	300'	✓
Width	800'	800'	✓	500'	500'	✓
Runway Obstacle Free Zone (ROFZ)						
Length	200'	200'	✓	200'	200'	✓
Width	400'	400'	✓	400'	400'	✓
Precision Obstacle Free Zone (POFZ)						
Length	200'	200'	✓	N/A	N/A	N/A
Width	800'	800'	✓	N/A	N/A	N/A
Approach Runway Protection Zone (ARPZ)						
Length	2,500'	2,500'	✓	1,000'	1,000'	✓
Inner Width	1,000'	1,000'	✓	500'	500'	✓
Outer Width	1,750'	1,750'	✓	700'	700'	✓
Acres	78.914	78.914	✓	13.770	13.770	✓
Departure Runway Protection Zone (DRPZ)						
Length	1,700'	1,700'	✓	1,000'	1,000'	✓
Inner Width	500'	500'	✓	500'	500'	✓
Outer Width	1,010'	1,010'	✓	700'	700'	✓
Acres	29.465	29.465	✓	13.770	13.770	✓
Runway Separation						
Runway centerline to:						
Parallel runway centerline	N/A	N/A	N/A	N/A	N/A	N/A
Holding position	292'	292'	✓	200'	240'	✓
Parallel Taxiway/Taxilane Centerline	400'	400'	✓	N/A	N/A	N/A
Aircraft parking area	500'	558'	✓	250'	525'	✓

Source: Advisory Circular 150/5300-13A Change 1, *Airport Design,* RS&H Analysis, 2019

Figure 3-6 shows the locations on the airfield of each of these deficiencies. Overall, the blast pad deficiencies are minor deficiencies that require small investment to correct. The hold position markings for Runway 16L-34R are recommended to be moved during large scale taxiway projects that involve fillet design, lighting, and signage changes if it is determined by Airport staff that these changes are warranted. The runway to taxiway separation deficiencies will be brought forward into the alternatives to determine if changes to allow unrestricted ADG V operations on Runway 16L-34R or 16R-34L are justified.

As it relates to the next phase of study, **Chapter 4 – Identification and Evaluation of Alternatives**, the relocation of runways and deice pads will be evaluated to determine how best to accommodate unrestricted ADG V operations at SLC.

3.2.1.3 Hot Spots

The FAA defines a hot spot as a location on an airport movement area with a history of runway incursions or the potential risk of aircraft collisions, and where heightened attention by pilots and drivers is necessary. As previously mentioned in **Chapter 1 – Inventory of Existing Conditions**, two hot spots have been designated at SLC. Both hot spots are on the FAA Runway Incursion Mitigation list. The first hot spot is located near the threshold of Runway 32 and Runway 35, designated as "HS1". The second hot spot is located at the intersection of Taxiway Q and Taxiway L, near the approach end of Runway 14, designated as "HS2". The location of the two FAA hot spots are shown in **Figure 3-6**.

HS1 has been identified as a hot spot because of the risk of departing on the wrong runway. The v-shaped configuration for Runway 14-32 and Runway 17-35 has the potential risk for aircraft departing and landing on the wrong runway. HS2 has been identified as a hot spot because of the risk of runway incursions due to the short taxi distance on Taxiway Q between Runway 14-32 and Runway 16L-34R. SLCDA Operations staff noted that the incursions at HS2 are typically related to pilots taxiing east across Runway 16L-34R, missing the right turn on Taxiway L, and subsequently running the hold-short markings for Runway 14-32.

FIGURE 3-6
RUNWAY DEFICIENCIES AND HOT SPOT

RUNWAY DEFICIENCIES AND HOT SPOTS

Hot Spot

1. HS1 - Wrong runway departure risk. Hold lines for Runway 32 and Runway 35 are at the same location at Taxiway K1 and Taxiway M with short taxi distance to either runway.
2. HS2 - High risk of runway incursion at runway 14-32 on Taxiway Q due to short taxi distance between runways.

Blast Pad

3. Runway 34R blast pad is not full width.
4. Runway 17 blast pad is not full length.

Blast Pad Marking

5. Runway 16L blast pad markings are not full width.
6. Runway 34R blast pad markings are not full length.

Runway Hold Position

7. Runway 16L-34R hold positions at Taxiways H2-H6, H8-H12 and S less than ADG V requirement of 322'.

Runway / Taxiway Separation

8. Taxi restrictions on Taxiway H and A when RVR is below 1,200' and adjacent runway is in use by ADG V aircraft.

Deficiencies carried forward into alternatives are denoted by a red square above.

1,500' 750' 0' 1,500'
Scale 1":1,500'

3.2.2 Taxiway Requirements

The taxiway system requirements analysis addresses specific requirements relative to FAA design criteria and the ability of the existing taxiways to accommodate current and forecasted demand. At a minimum, taxiways must provide safe and efficient circulation by maintaining traffic flow using taxi routing with a minimum number of points requiring a change in the airplane's taxiing speed, provide access between runways, aircraft parking and hangar areas, and meet FAA design standards to safely accommodate the critical aircraft.

Examining taxiways requires two different types of perspectives of evaluation. The first is through a lens focused only on the design of the taxiway as it relates to pavement width and separation from other surfaces and obstacles. For this, the critical aircraft associated with each taxiway drives the design standards that are required. The second perspective of evaluation is related to how each taxiway integrates with other pavement surfaces, such as runways, aprons, and other taxiways. This section details the analysis conducted under the purview of both perspectives.

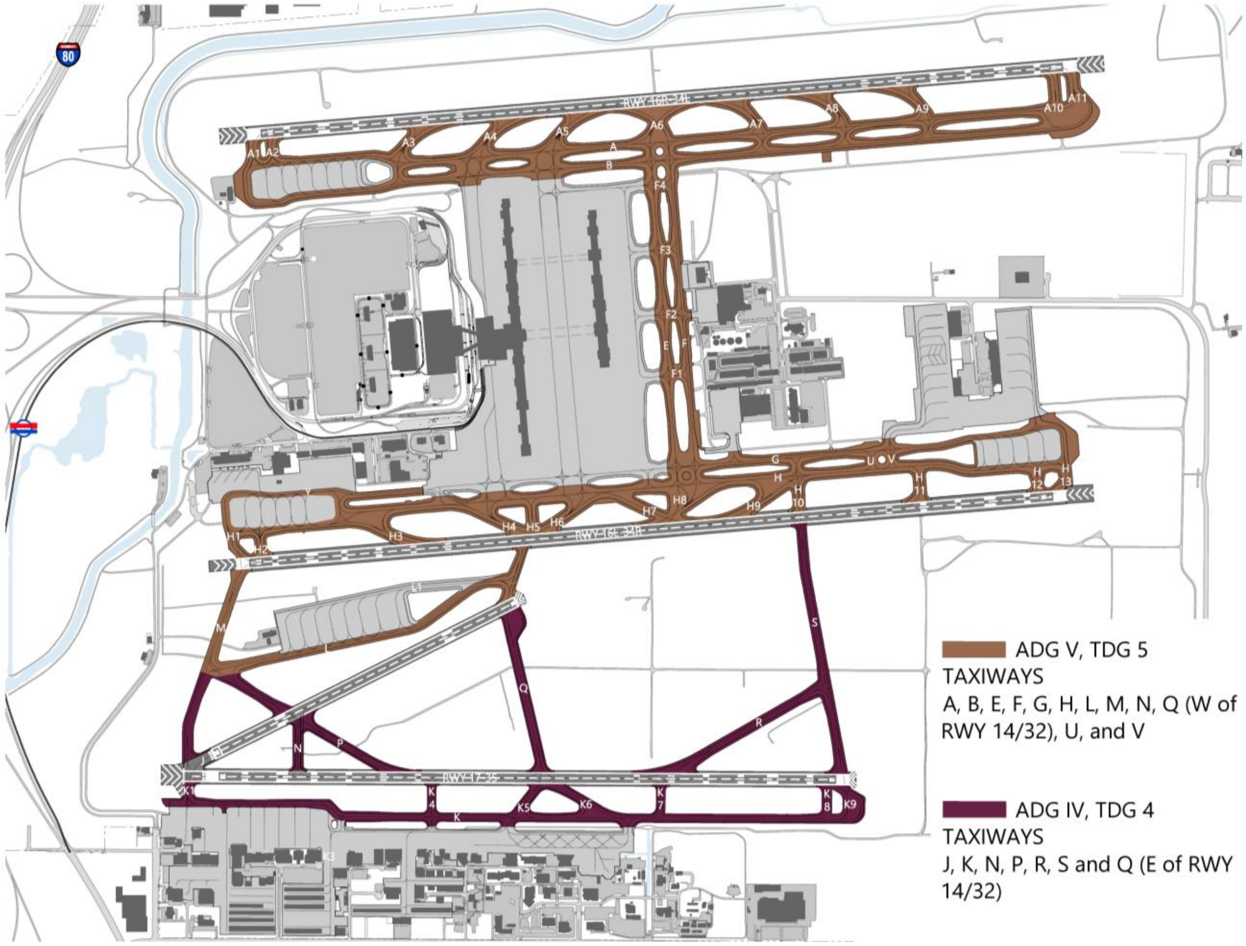
3.2.2.1 Taxiway Design Analysis

The taxiway design criteria analysis included an evaluation of each taxiway to meet the design criteria of the associated critical aircraft. Taxiway pavement width is determined by the TDG of the critical aircraft. Separation standards are determined by the ADG of the critical aircraft. Depending on use, portions of an airfield are designed for one specific aircraft type while other portions are designed for other aircraft types.

Figure 3-7 illustrates the ADG and TDG for which each taxiway at SLC was evaluated. The categorization between ADG V/TDG 5 and ADG IV/TDG 4 is correlated to the critical aircraft of the runway the taxiways serve, and typical aircraft routing patterns employed by Airport Traffic Control. The taxiways that serve the parallel runways and the terminal area were evaluated for ADG V and TDG 5 standards. The taxiways that serve Runway 17-35 and the general aviation area were evaluated for ADG IV and TDG 4 standards.

Note, new taxiway infrastructure for a future realigned Runway 17-35 is recommended to be built to ADG V and TDG 5 standards to ensure maximum airfield capability.

FIGURE 3-7 TAXIWAY DESIGN BASED ON RUNWAY CRITICAL AIRCRAFT



Prepared by: RS&H, 2018

Table 3-22 details the analysis findings of the ADG V/TDG 5 taxiway that serve the parallel runways and connect the terminal area to Runway 16R-34L and Runway 16L-34R. The design deficiencies identified includes Taxiway Q, which is primarily used to transition aircraft from the terminal area to the L Deicing Pad. That taxiway has 25-foot paved shoulder on the north side instead of a standard 30' TDG 5 shoulder. Taxiway B has a fence penetrating the TOFA in the area adjacent to the vehicle service road north of Taxiway F. Additionally, almost all taxiway fillet geometry does not meet current FAA standards. This issue is common for taxiways built prior to 2012 when AC 150/5300 Air*port Design* was updated and began using new fillet geometry standards. That AC was updated again in 2014 with additional fillet design changes. Correction to fillet geometry is recommended anytime there is need for full-depth taxiway reconstruction.

The future critical aircraft for Runway 16L-34R and 16R-34L is the A350 and B777-300, which are both ADG V/TDG 6 aircraft. All taxiways that meet TDG 5 standards today, also meet TDG 6 standards in all categories except fillet design. It is recommended that when current TDG 5 taxiways are reconstructed throughout the planning period, they be designed to meet TDG 6 fillet geometry standards.

TABLE 3-22 SLC ADG V/TDG 5 TAXIWAYS

Taxiway Components	Taxiway Width	Taxiway Shoulder Width	Taxiway Safety Area Width	Taxiway Object Free Area Width	Centerline to Parallel Taxiway	Centerline to Fixed or Movable Object	Taxiway Fillet Design	Meets TDG 6 Requirements
Requirement (ADG V, TDG 5)	**75'**	**30'(1)**	**214'**	**320'**	**267'**	**138'**	**(2)**	
A	✓	✓	✓	✓	✓	✓	X	✓*
B	✓	✓	✓	X	✓	✓	X	✓*
E	✓	✓	✓	✓	✓	✓	X	✓*
F	✓	✓	✓	✓	✓	✓	X	✓*
G	✓	✓	✓	✓	✓	✓	✓	✓*
H	✓	✓	✓	✓	✓	✓	X (3)	✓*
L	✓	✓	✓	✓	N/A	✓	X	✓*
M	✓	✓	✓	✓	N/A	✓	X	✓*
Q (W of RWY 14/32)	✓	X**	✓	✓	N/A	✓	X	X**
U	✓	✓	✓	✓	✓	✓	X	✓*
V	✓	✓	✓	✓	✓	✓	X	✓*

(1) FAA Advisory Circular 150/5300-13A, Change 1 recommends paved shoulders for ADG IV/V aircraft.

(2) See Section 406, paragraph (b) in FAA Advisory Circular 150/5300-13A, Change 1 for fillet design dimensions.

(3) Taxiway H12 and H13 meet TDG 5 Taxiway Fillet Design standards

* Taxiway fillet design does not meet TDG 6 standards

** Taxiway Q west of Runway 14/32 does not meet TDG 5 or 6 shoulder width on the north side of the taxiway.

Source: FAA Advisory Circular 150/5300-13A, Change 1

Table 3-23 details the findings of the analysis of the ADG IV/TDG 4 taxiways that serve Runway 17-35 and the general aviation areas. The only design deficiency found is related to fillet design. The fillets on these taxiways do not meet the newest design standards outlined in AC 150/5300-13A Change 1, Air*port Design*.

In addition, it was determined that all these taxiways, except Taxiway K, are designed with width and separation to support ADG V/ TDG 5/6 aircraft. Taxiway widths in many cases are greater than the ADG V/ TDG 5/6 required 75 feet, and in all instances where shoulder width is less than 30 feet, additional taxiway width makes up for the difference in overall pavement width. Taxiway K meets the ADG 5/TDG 5 standard width of 75 feet, but only has 25-foot shoulders as opposed to 30-foot which is required. Taxiway K also only meets ADG IV separation standards between taxiway centerline and all facilities, taxilanes, and apron on the east side.

TABLE 3-23 SLC ADG IV/TDG 4 TAXIWAYS

Taxiway Components	Taxiway Width	Taxiway Shoulder Width	Taxiway Safety Area Width	Taxiway Object Free Area Width	Centerline to Parallel Taxiway	Centerline to Fixed or Movable Object	Taxiway Fillet Design	ADG V / TDG 5 & 6 Capable*
Requirement (ADG IV, TDG 4)	**50'**	**20'(1)**	**171'**	**259'**	**215'**	**129.5'**	**(2)**	
J	✓	✓	✓	✓	N/A	✓	X	✓
K	✓	✓	✓	✓	N/A	✓	X	NO
N	✓	✓	✓	✓	N/A	✓	X	✓
P	✓	✓	✓	✓	N/A	✓	X	✓
Q (E of RWY 14/32)	✓	✓	✓	✓	N/A	✓	X	✓
R	✓	✓	✓	✓	N/A	✓	X	✓
S	✓	✓	✓	✓	N/A	✓	X	✓

(1) FAA Advisory Circular 150/5300-13A, Change 1 recommends paved shoulders for ADG IV/V aircraft.

(2) See Section 406, paragraph (b) in FAA Advisory Circular 150/5300-13A, Change 1 for fillet design dimensions.

* Taxiway fillet design also does not meet TDG 5 or 6 standards

Source: FAA Advisory Circular 150/5300-13A, Change 1

The Airport taxiway system is robust and overbuilt to the extent that taxiways provide a great deal of flexibility for accommodating a wide variety of aircraft types. In many cases, taxiway widths far exceed the base ADG/TDG requirements. Overall, no design deficiencies exist that require alternative analysis. However, the current design and use of taxiways will be considered in the development of alternatives.

3.2.2.2 Taxiway Layout Analysis

In addition to design standards for taxiways related to pavement width and separation, FAA provides standards for recommended taxiway layout to enhance safety and decrease risk of runway incursions. An analysis was conducted of the taxiway layout at SLC to identify those taxiways and areas where taxiway layout does not meet the recommendations in Advisory Circular 150/5300-13A, Change 1, *Airport Design*.

Figure 3-8 details the layout related deficiencies identified in the analysis. Some of the deficiencies identified are related to the airfield hot spots discussed in **Section 3.2.1.3**, while others have been in place for decades at SLC with no issue. A primary component of this study is to develop alternatives that correct those areas that are prone to issues and work to fix airfield hot spots. The following bullets detail the FAA criteria for taxiway layouts, and where each criterion is applicable for consideration at SLC.

» **Three-Node Concept**

The three-node concept means that a pilot is presented with no more than three choices at an intersection. Using the three-node concept simplifies taxiway intersections, allowing for consistent placement of airfield markings, signage and lighting, and increasing pilot situational awareness. Complex intersections increase the possibility of pilot error, and if near a runway entrance can increase chance for a runway incursion.

The following taxiways have greater than three-node intersections: Taxiways H, H9, and H10; Taxiways H8, H, F, and E; Taxiways A5, A and the parallel terminal taxilanes; and Taxiway A4 and the parallel terminal taxilanes. The latter three intersections can be considered a three-node intersection, with one node having two options that run parallel to each other. The fact that these taxiways are all runway exits removes the chances of the intersection creating confusion that could lead to a runway incursion. As such, it was not found to be an issue that requires future correction. However, the intersection of Taxiway H8, H, F, and E, in addition to a three-node layout, creates a wide expanse of pavement. Alternatives to correct this non-conforming layout will be evaluated in the next chapter.

The intersection of Taxiways H, H9 and H10 presents a "forth" node when pilots are taxiing from Taxiway G to H10 to cross Runway 16L-34R to Taxiway S. This is a common operation, as Taxiways H10 and S are used to route aircraft to Runway 17 for departure. Though the likelihood of a pilot turning from Taxiways G and/or H into the high-speed runway exit Taxiway H9 is low, this intersection is recommended to be further evaluated for alternatives to correct the deficiency.

» **High Energy Intersection**

High energy intersections are considered those in the middle third of the runway. The middle third is most often a "high-energy" zone of a runway where an aircraft, landing or taking off, is travelling at a rate at which a pilot can least maneuver to avoid a collision with another aircraft. Runway crossings should be limited to the outer third of runways. Taxiways K5, K6, and Q form an intersection within the middle third of Runway 16L-34R. If Runway 16L-34R is extended in the future, what is considered the middle third of the runway will change, and the intersection of Taxiway S and H10 may become part of the middle third of the runway depending on the ultimate runway length. Runway 17-35 has an intersection in the center of the middle third of the runway where K5, K6, and Q connect.

Alternatives to remove the above referenced taxiways from the middle third of the runway and provide efficient and safe connectivity between the terminal area and Runway 17-35 will be evaluated in the next chapter.

» **Aligned Taxiway**

An aligned taxiway is one where the centerline of a taxiway aligns directly with a runway centerline. FAA specifically prohibits these types of alignments for new airfield construction, and notes in AC 150/5330-13A that any existing configuration "should be removed as soon as practicable." An aligned taxiway layout is present at SLC where Taxiway J is aligned with Runway 14-32. Taxiway J also intersects with two runways which is not a permitted layout per current FAA standards. That layout creates a wide expanse of pavement which can lead to pilot disorientation and potentially wrong runway departures. These factors correlate to the reasoning behind the area being labeled a Hot Spot. Alternative layouts to correct these deficiencies will be evaluated in the Alternatives chapter.

» **Direct Access to Runway**

Direct access between aircraft parking aprons and a runway is not recommended, as it has proven too easy for a pilot to lose situational awareness while taxiing out, miss the turn for a taxiway and mistakenly end up on a runway. FAA requires indirect access between aircraft parking aprons and a runway. To accomplish this, the taxiway layout must require a pilot to make a series of turns while taxiing from an apron to a runway.

Instances of direct access at SLC are denoted on **Figure 3-8** and include the following: south cargo ramp to Runway 34R; south deice pad to Runway 34R; and the GA apron to Runway 17 via Taxiway K1, K4 and K5. Note that Taxiway A4 and A5 provide nearly direct access between runway and apron. However, the configuration of these taxiways was not found to create a direct access deficiency that increases risk of runway incursion. This determination is based on the fact that a turn is required to enter the runway, and that two parallel taxiways are between the runway and the apron. These factors greatly reduce the chance that a pilot would mistake the runway for Taxiway A or B.

In regard to the instances of direct access at the south cargo apron and the south deice pad, it was determined that the high degree of signage, markings, and in-pavement lighting at H2 and H1, and the fact that the apron is at the threshold of the runway lessen the chance that pilots would mistake the runway for a parallel taxiway and taxi onto it. Direct access from the south cargo ramp and the deice pad was not found to be a deficiency requiring realignment of infrastructure.

The instance of direct access involving Taxiways K1, K4, and K5, is recommended to be brought into the alternatives analysis to determine solutions to limit direct access to Runway 17-35.

» **Runway / Taxiway Right-Angle Intersections**

Right-angle intersections are FAA standard for all runway entrances and runway/taxiway intersections except for high-speed exit taxiways. A right-angle intersection provides a pilot the best possible vantage point to scan for aircraft on the runway before entering or crossing the runway. Additionally, a right-angle intersection allows the optimum orientation of signage so that it is clearly visible to pilots. Runway/taxiway intersections that are at acute angles but are not high-speed taxiways are denoted with a red dot in **Figure 3-8**.

Of these, alternatives to realign runway entrance Taxiways Q, K5, M, P, and N will be evaluated in the Alternatives chapter. Other instances of acute angle taxiway entrances are currently negated by having hold position bars at a right angle to the runway, or are configured to position aircraft at an angle to face arriving traffic. As such, these are acceptable and do not require reconfiguration.

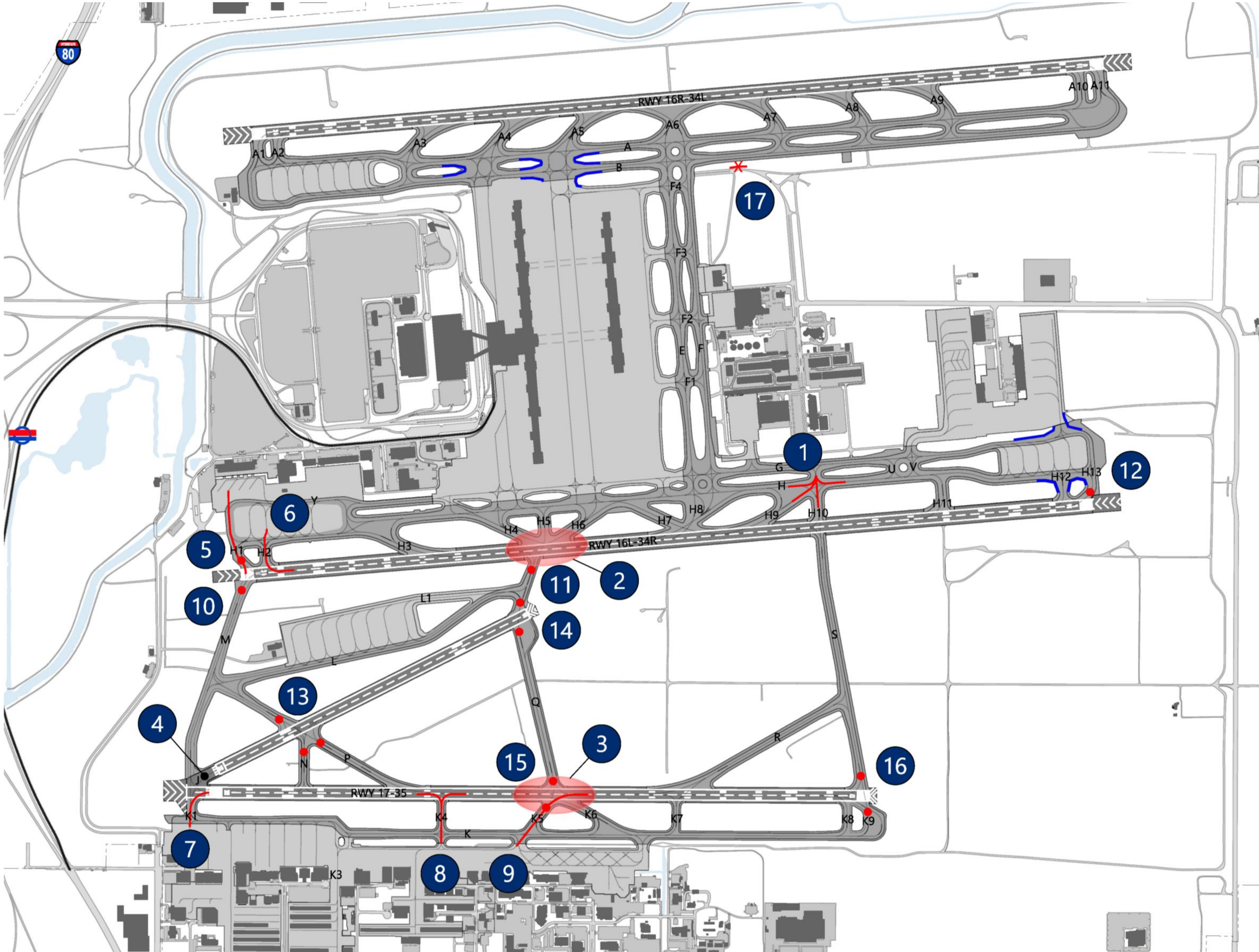
» **Wide Expanse of Pavement**

Wide expanses of pavement require placement of signs far from a pilot's eye and reduce other visual cues. Under low visibility conditions a pilot's focus is on the centerline, which may result in the pilot not seeing a sign located beyond the pavement extents. This is especially critical at runway entrance points. A list of expansive pavement deficiencies is depicted in **Figure 3-9.** Some of the wide expanses of pavement are unavoidable at SLC, such as where dual taxilanes intersect parallel taxiways. An example of this configuration is where Taxiway A5 intersects Taxiway A and B. This type of configuration was determined to be an acceptable configuration at SLC.

Taxiways that have a wide expanse of pavement adjacent to runways were found to pose potential safety issues. These include the intersection of Taxiways P, N, and Runway 14-32; the intersection of Taxiway Q, K5, K6, and Runway 17-35; the intersection of Taxiway H4, H5, H6 and Runway 17L-34R; the intersection of Taxiway H7, H8 and Runway 17L-34R; and the intersection of Taxiway J, M, Runway

32, and Runway 35 thresholds. Alternatives to correct these layouts will be evaluated in the Alternatives chapter.

FIGURE 3-8
TAXIWAY SYSTEM DEFICIENCIES



TAXIWAY SYSTEM ANALYSIS

Three Node Concept
1. Taxiways H, H9, and H10 intersection

High Energy Intersection
2. Runway 16L-34R and Taxiways H4, H5, H6, and Q
3. Runway 17-35 and Taxiways K5, K6, and Q

Aligned Taxiway
4. Taxiway J / Runway 14-32

Direct Access
5. South cargo apron to Runway 34R via Taxiway H1
6. Runway 34R de-icing pad to Runway 34R via Taxiway H2
7. Apron access to Runway 17 via Taxiway K1
8. Apron access to Runway 17-35 via Taxiway K4
9. Apron access to Runway 17-35 via Taxiway K5

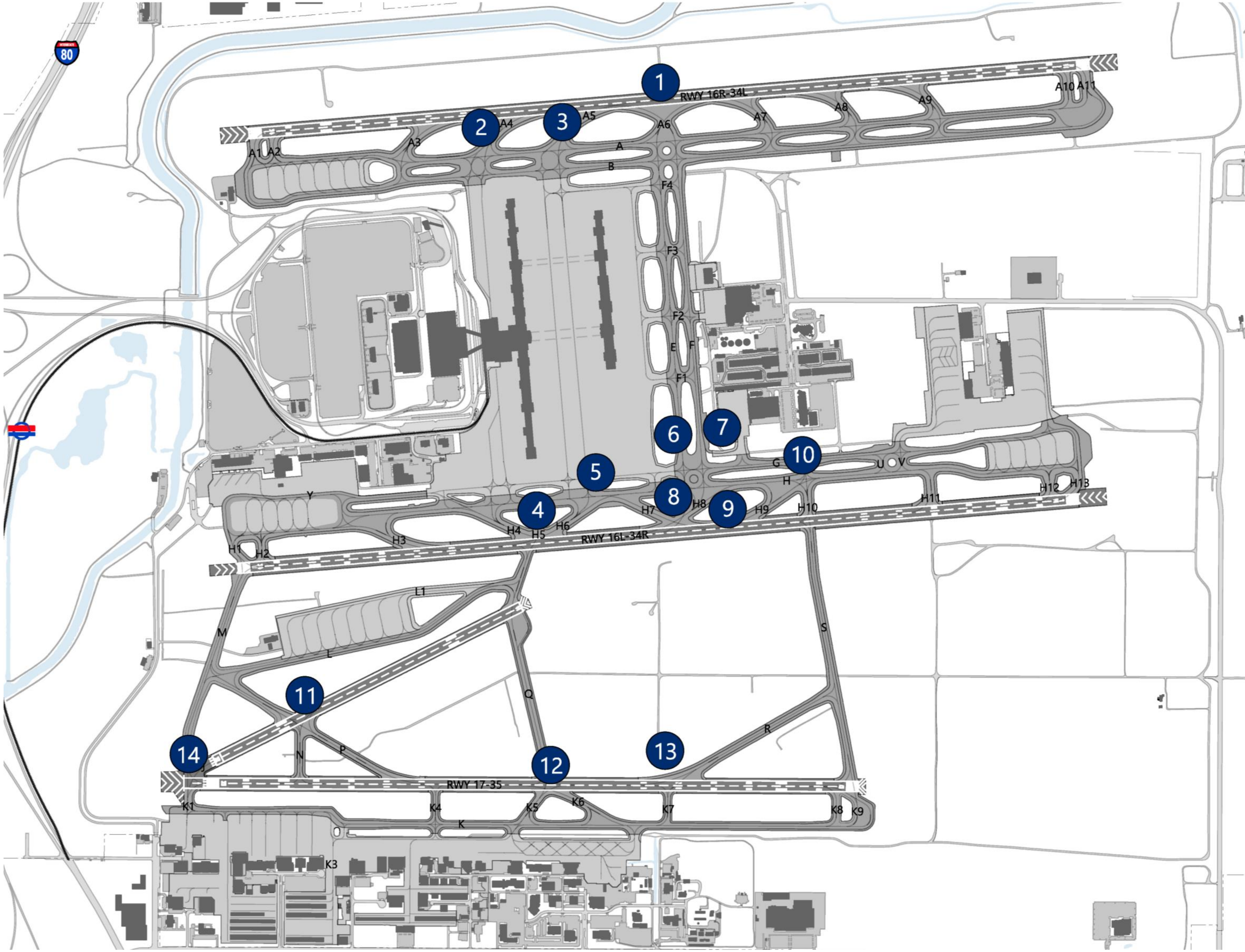
Runway / Taxiway Right-Angle Intersection
10. Runway 34R / Taxiways H1 and M
11. Runway 16L-34R / Taxiway Q
12. Runway 16L-34R / Taxiway H13
13. Runway 14-32 / Taxiways N and P
14. Runway 14-32 / Taxiway Q
15. Runway 17-35 / Taxiway Q and K5
16. Runway 17-35 / Taxiways K9 and S

TOFA
17. Fence within Taxiway B ADG V TOFA.

Taxiway Fillets
Except those shown in blue, all taxiway fillets deficient per AC 150/5300-13A, Change 1, *Airport Design* - 406.b Fillet Design.

Deficiencies carried forward into alternatives are denoted by a red square above.

FIGURE 3-9
WIDE EXPANSE OF PAVEMENT DEFICIENCIES



INSTANCES OF WIDE EXPANSE OF PAVEMENT

1. Runway 16R/34L and Taxiways A6, E, and F intersection
2. Taxiways A, A4, and B intersection
3. Taxiways A, A5, and B intersection
4. Runway 16L-34R and Taxiways H4, H5, and H6 intersection
5. Taxiways H, H6, and H7 intersection
6. Taxiways E, F, and G have double taxiway edge markings.
7. Taxiway G between Taxiway F and Taxilane Delta have double taxiway edge markings.
8. Runway 16L-34R and Taxiways H7, H8 intersection
9. Taxiways E, F, H, and H8 intersection
10. Taxiways H, H9, and H10 intersection
11. Runway 14-32 and Taxiways P and N intersection
12. Runway 17-35 and Taxiways K5, K6, and Q intersection
13. Runway 17-35 and Taxiways K7 and R intersection
14. Runway 14-32 and Taxiways J and M intersection

Deficiencies carried forward into alternatives are denoted by a red square above.

1,500' 750' 0' 1,500'
Scale 1":1,500'

3.2.3 Operationally Related Facility Requirement Considerations

In conversations with ATC and SLCDA staff, a few important factors were noted that will be considered when developing airfield alternatives. The following bullets detail those factors:

- Having a single parallel taxiway (Taxiway K) to serve Runway 17-35 presents challenges for ATC when routing aircraft to and from the GA area, especially when Runway 17 is in use. In that condition, head-to-head traffic is possible when a small aircraft lands on Runway 17, exits and taxis south on Taxiway K while other GA aircraft are taxiing north on Taxiway K to depart Runway 17. Note that in that scenario, the need for having an aircraft exit as soon as possible, instead of rolling out long and exiting at the end of the runway, is related to capacity. During peak periods, ATC must have aircraft land and exit as quickly as possible to allow the next departure and/or landing operation.

- It is recommended that the alternatives development process consider how to add another parallel taxiway to serve Runway 17-35 to provide additional circulation. This could be accommodated with a parallel taxiway to the west of the existing runway, a runway shift and realignment that allows a dual parallel taxiway system on the east, or a combination thereof.

- The Taxiway Q intersection with Runway 16L-34R is within the 34R localizer critical area. When Runway 34R is in use during deicing operations, this becomes an issue, as aircraft must cross the runway to Taxiway Q to access the Taxiway L Deice Pad. To permit this operation, arrival separation for Runway 34R must be increased, which effectively drops the runway's arrival capacity. A South End Around Taxiway is recommended to improve the circulation between the terminal area and the Taxiway L Deice Pad.

- The Runway 34R Deice Pad is preferred for use unless the Taxiway L Deice Pad is also needed. A factor in that preference includes the fact that the holding position for Runway 34R on Taxiway M is relatively far back from the runway. The holding bar is placed correctly to protect the Runway 34R ILS, but consequently adds runway occupancy time for those aircraft departing 34R from Taxiway M. This factor will be considered in the alternatives analysis to determine if a better connection to Runway 34R is viable.

- Cross-field (east/west) circulation is important, specifically with the new terminal concourse layout. The taxilanes between the new concourses are also used for aircraft push-back, which increases the need for orchestrated aircraft routing between the terminal gates and the runways. The need for cross-field routing of aircraft other than on taxilanes between the concourses is expected to increase through the planning period. During snow events, additional east/west circulation is expected to be required to prevent bottlenecks and allow uninterrupted access to all terminal gates. It is recommended that the alternatives analysis determine whether Taxiways V and U should be constructed as planned and/or if other locations for cross-field taxiways may be advantageous.

- The Runway 16L deice pad does not have restroom facilities or truck deicing refill facilities. As such, during extended deice events, deicing operations in south flow must be conducted on the south deicing pads. This is not optimal as it creates congestion and delays during busy periods of the day. It is recommended that facilities be added to the Runway 16L deice pad, and a deice pad be added adjacent the Runway 16R threshold.

3.2.4 Airfield Requirements Summary

The analysis of the airfield identified all circumstances of any geometry that differed from the most current FAA design standards and recommendations. Each circumstance was further analyzed to determine if the existing geometry requires correction to meet the intent of the current FAA design standards. Some circumstances were found acceptable and do not require changes. Those circumstances that do require changes are detailed in **Table 3-24**. Those identified with a blue box will be carried forward into the alternatives analysis so that a remedy to the issue may be developed and incorporated into the SLC development plan. Additionally, all operational facility requirement considerations described in **Section 3.2.3** will be integrated with these airfield requirements during the alternatives analysis.

The planning team in conjunction with Airport staff determined that the South End Around Taxiway is required and should be programed for near-term implementation. This airfield component will be brought into alternatives analysis to determine a preferred configuration.

TABLE 3-24
AIRFIELD REQUIREMENTS SUMMARY

Elements	Description of Need and/or Recommendation
Runway Requirements	
■ Hot Spot HS1 and HS2	Hot Spot HS1 and HS2 require alternative analysis to determine if geometric related solutions can remedy the issues at these airfield locations.
■ Runway Length	A future runway length for Runway 16L-34R of 14,500 feet will be carried forward.
■ Runway 17-35	Runway 17-35 will be brought into the alternatives to examine realignment options and other options to enchance capacity and overall system performance.
Runway Designation	Re-designation of runway headings will be vetted for inclusion in the CIP as a capital project.
Blast Pads	Runway 34R blast pad is not full width. Runway 17 blast pad is not full length. Additionally, the Runway 16L blast pad markings are not full width, and Runway 34R blast pad markings are not full length. These deficiencies are easily remedied though addition of asphalt and new paint markings as appropriate.
Runway Pavement Strength	Runway 16L-34R, 16R-34L, and Runway 17-35 are recommended to be strengthened during future rehabilitation projects to support future forecasted aircraft operations.
■ Runway to Taxiway and Hold Position Separation	Runway 16L-34R and 16R-34L have runway to taxiway centerline separation reductions adjacent to each deice pad that restricts ADG V operations during low visibility conditions. Additionally, the runway centerline to hold position separation on Runway 16L-34R does not meet ADG V standards in low visibility. These conditions will be brought forward into alternative analysis to determine if remedies to this situations are justified, and if so, what options are viable.
Taxiway Requirements	
■ Three Node Concept	The intersection of Taxiway H, H9 and H10 require a revised configuration to eliminate the current 4-node intersection
■ High Energy Intersections	The following intersections require consideration in the alternatives analysis: Runway 16L-34R and Taxiways H4, H5, H6 and Q; Runway 17-35 and Taxiways K5, K6, and Q
■ Aligned Taxiway	The configuration of Runway 32 and Taxiway J is not standard and contributes to the Hot Spot in this area.
■ Direct Access	The following taxiways have been identified as providing direct access from the apron to Runway 17-35: Taxiway K1, K4 and K5. These require alternatives analysis to remedy this condition.
■ Runway / Taxiway Right-Angle Intersection	The following intersections are identified for future correction: Runway 34R and TWY H1 and M; Runway 16L-34R and TWY Q; Runway 14-32 and TWY N and P; Runway 14 and TWY Q; Runway 17-35 and TWY Q and K5.
Wide Expanses of Pavement	
■ Runway 16L-34R	Wide expanse of pavement related to the following taxiway/runway intersections are identified for future correction: H4-H5-H6 and H7-H8.
■ Runway 14-32	Wide expanse of pavement related to the following taxiway/runway intersections are identified for future correction: P-N and J-M.
■ Runway 17-35	Wide expanse of pavement related to the following taxiway/runway intersections are identified for future correction: K5-K6-Q.

■ Elements that will be carried forward in the alternatives analysis

3.3 NAVIGATIONAL AIDS

Navigational aids, referred to as NAVAIDS, consist of equipment to help pilots locate and operate at the airport. NAVAIDS can provide information to pilots about the aircraft's horizontal alignment, height above the ground, location of airport facilities, and the aircraft's position relative to the airfield. SLCIA features all three types of navigational aids (visual, electronic, and meteorological), as detailed in **Chapter 1 Inventory of Existing Conditions**. The following narrative describes the three types of NAVAIDs as well as any deficiencies. This section also identifies new technology SLCIA could implement to provide a higher-level of service and increase efficiency for its users and tenants.

3.3.1 Visual Aids

Visual aids at SLCIA include those specific to each runway and those that serve the whole airport. **Table 3-25** lists the visual aids at SLCIA. Analysis determined the airport is equipped with all the required and recommended visual aids.

TABLE 3-25 VISUAL AIDS

Visual Aids	Runway		Runway		Runway		Runway		Adequate (✓) Deficient (X)
	16L	34R	16R	34L	17	35	14	32	
Approach Lighting	ALSF-2	ALSF-2	ALSF-2	ALSF-2	MALSR	MALSR	-	-	✓
Lighting System	HIRL	HIRL	HIRL	HIRL	HIRL	HIRL	HIRL	HIRL	✓
Runway Centerline Lights	Yes	Yes	Yes	Yes	Yes	Yes	No	No	✓
Runway Guard Lights	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	✓
Runway Markings	Precision	Precision	Precision	Precision	Precision	Precision	Visual	Visual	✓
Runway Windcone	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	✓
Stop Bar	Yes	Yes	Yes	Yes	Yes	Yes	No	No	✓
Touchdown Zone Lighting	Yes	Yes	Yes	Yes	Yes	Yes	No	No	✓
Visual Slope Indicator	PAPI (P4L)	PAPI (P4L)	PAPI (P4L)	PAPI (P4L)	PAPI (P4R)	PAPI (P4L)	PAPI (P4L)	PAPI (P4L)	✓
Rotating Beacon	-	-	-	-	-	-	-	-	✓
Segmented Circle	-	-	-	-	-	-	-	-	✓

Source: FAA Chart Supplements, FAA.gov, RS&H Analysis, 2019
Notes: ALSF-2 = High intensity approach light system with sequenced flashers, MALSR = Medium intensity approach light system with runway alignment indicator lights, ODALS = Omnidirectional approach light system, PAPI = Precision approach path indicator, VASI = Visual approach slope indicator, REIL = Runway end identifier lights, RVR = Runway visual range is used for determining airfield visibility for all precision approaches.

It was noted that some PAPI units at SLC use incandescent bulbs. As existing incandescent PAPI units begin to fail, it is recommended SLCIA coordinate the purchase and installation of LED units. The FAA has been conducting research to replace incandescent with light emitting (LED) technology in PAPI units. LED PAPI units reduce the time needed to warm up, resulting in decreased energy use. The light spectrum of LED compared to incandescent also provides an increased visual clarity for pilots as indicated from FAA field tests.

3.3.2 Electronic NAVAIDS

Electronic aids include devices and equipment used for aircraft instrument approaches. Electronic aids at SLCIA are listed in **Table 3-26**. Analysis of the existing equipment and the needs of the airport indicate that there are no deficiencies and that all electronic aids are adequate considering the current configuration and usage of the airfield.

TABLE 3-26 ELECTRONIC AIDS

Electronic Aids	Runway		Runway		Runway		Runway		Adequate (✓)
	16L	34R	16R	34L	17	35	14	32	Deficient (X)
Glideslope	Yes	Yes	Yes	Yes	Yes	Yes	No	No	✓
Localizer	Yes	Yes	Yes	Yes	Yes	Yes	No	No	✓
LDA	Yes	Yes	Yes	Yes	Yes	Yes	No	No	✓

Source: FAA Chart Supplements, FAA.gov, RS&H Analysis, 2019
Notes: LDA = localizer directional aid

SLCIA does not have an on-airport VOR; however, these navigational services are provided by the Wasatch VOR, two miles to the north of the airport. Since the Wasatch VOR is near SLCIA, an on-airport VOR is not needed. All non-directional beacon (NDB) facilities identified in the previous master plan have since been decommissioned and replaced by GPS technology.

Instrument approach procedures have been designed for SLCIA that use GPS technology. As part of NextGEN, the FAA plans to further modernize the national airspace system (NAS) by implementing new technology, with one goal being to increase capacity. One method that has been tested and approved by the FAA, is to implement performance-based navigation (PBN). PBN navigation provides additional precision compared to GPS alone. Required Navigation Performance (RNP), a form of PBN, requires additional navigational equipment for an aircraft but provides a more precise path of navigation. As the path of travel is more precise, the airspace protected around the aircraft becomes narrower. A RNAV[8] (RNP) approach compared to an RNAV (GPS) approach saves fuel and time for operators. The advantage for an airport to implement RNP based procedures is a reduction in required separation between aircraft. The protection around the aircraft in the terminal area reduces from five nautical miles to three. This allows more aircraft to operate in and out of an airport, enhancing the capacity of the airspace system. It is recommended SLCIA coordinate with the FAA to develop and implement RNAV (RNP) instrument approach procedures for each instrument runway end to enhance capacity and efficiency.

Ground-Based Augmentation System (GBAS) is another NextGEN system that provides navigation and precision approach capabilities at an airport, that could be considered for future implementation at SLCIA. The system is comprised of a ground facility and various antennas to communicate with the aircraft during takeoffs and landings. A single GBAS system can provide precision instrument approaches for multiple runway ends. This can provide a cost savings if implementing a new precision instrument approach compared to a traditional ILS system. The downside of the GBAS system is the amount of land needed to protect the antennas. Also, the antennas themselves need to have a clear line of sight of each runway end. To fly a GBAS approach also referred to as GLS, aircraft are required to be fitted with proper VHF data broadcast (VDB) equipment. At the time of this writing, the FAA has approved the use of GBAS Approach Service Type-C, which is the same as an ILS Category I approach. Testing has been completed for GBAS Approach Service Type-D, which is the same as an ILS Category III approach; however, has yet to be implemented at a non-test airport.

SLCIA has ILS Category III on both ends of the parallel runways and a Category I ILS approach on both ends of Runway 17-35. To enhance the approaches on Runway 17-35 to that of the parallel runway, a

[8] "Area navigation (RNAV) is a method of navigation the permits aircraft operation on any desired flight path within the coverage of ground- or space-based navigational aids or within the limits of the capability of self-contained aids, or a combination of these." Aeronautical Information Publication (AIP), 2012.

GBAS Approach Service Type-D system could be installed to service both runway ends. Implementing the system could potentially upgrade Runway 17-35 to support CAT II/III approaches. Though the initial cost of implementation may be greater than a single ILS system, over time operating and maintenance costs may be less than maintaining two ILS systems. Efficiencies would be even greater if a future GBAS serves all runway ends, including the parallel runways. It is recommended that SLCIA reserve a parcel of land for a GBAS Approach Service Type-D system. Opportunities to integrate a GBAS system at SLCIA will be examined in the alternatives analysis.

3.3.3 Meteorological Aids

Meteorological aids consist of equipment that reports weather conditions to users and tenants at an airport. The metrological aids at SLCIA are listed in **Table 3-27**.

TABLE 3-27 METROLOGICAL AIDS

Metrological Aids	Runway 16L	Runway 34R	Runway 16R	Runway 34L	Runway 17	Runway 35	Runway 14	Runway 32	Adequate (✓) Deficient (X)
LLWAS	No	Yes	Yes	Yes	Yes	Yes	No	Yes	✓*
RVR Equipment	Yes	Yes	Yes	Yes	Yes	Yes	No	No	✓
ASOS	-	-	-	-	-	-	-	-	✓

Source: FAA Chart Supplements, FAA.gov, RS&H Analysis, 2019

Notes: ASOS = automated surface observing system, RVR = runway visual range, LLWAS = low level wind shear alert system.

*LLWAS system type is unknown. Noted that the system is configured differently than discussed in the 1989 document "FAA Order 6560.21A, Siting Guidelines for Low Level Windshear Alert System (LLWAS)"

The LLWAS system type is unknown but was found to be configured differently than as suggested in the 1989 document FAA Order 6560.21A. It is recommended the Airport continue to ensure the LLWAS is up-to-date and working as needed to support safe operations. The runway visual range (RVR) system and existing AWOS system at SLCIA are adequate for current operations.

While not an FAA requirement, SLCIA staff may want to consider installing a runway weather information system (RWIS). An RWIS provides real time monitoring information to airport personnel. Sensors are installed underneath the runway to report surface temperature, ambient air temperature and type of contaminants. This system is ideal for airports that experience regular snow fall, like SLCIA. This system could improve snow removal operations by providing real time weather conditions and historical trends. Historical trends can be used to determine the most effective time to apply an application of runway deicing fluid, potentially resulting in cost savings and more efficient operations.

3.4 TERMINAL CAPACITY AND REQUIREMENTS

This section details passenger aircraft gate requirements for each PAL. Additionally, an analysis was conducted on primary terminal processing components to determine what, if any, deficiencies may arise as passenger traffic increases through the planning horizon.

3.4.1 Aircraft Gate Requirements

The purpose of this section is to establish the timing for terminal gate development at SLC. Gate capacity requirements are based upon an analysis of the design day flight schedule generated as part of the aviation activity forecasts, which was approved by the FAA on May 1, 2019. This task will also identify the potential needs for long-term parking apron requirements for passenger aircraft that would be at the Airport during extended over-night hours identified as Remain Over-Night (RON), or during extended daytime hours, identified as Remain All-Day (RAD).

In particular, the exercise will focus on the potential timing for necessary gate additions to Concourse B after it opens in 2020 relative to PAL 1, PAL 2, and PAL 3.

3.4.1.1 New Terminal Layout 2020

Table 3-28 shows the distribution of the gates by their ADG capacity.

TABLE 3-28 TERMINAL GATES BY ADG CAPACITY (2020)

Terminal Gates Leased and Operated by Delta Air Lines				
Concourse	**ADG-III**	**ADG-IV**	**ADG-V**	**Total**
Concourse A	31	13	3	47
Concourse B	6	2	0	8
Delta Air Lines Total	37	15	3	55
Terminal Gates Leased and Operated by Other Airlines				
Concourse	**ADG-III**	**ADG-IV**	**ADG-V**	**Total**
Concourse A	0	0	0	0
Concourse B	19	2	2	23
Other Airlines Total	19	2	2	23

Source: RS&H, 2019

The current design of Concourse A includes the international arrivals sterile corridor on the third level of the north-western portion of the concourse. As such, the Airport's international gates are integrated on the north-western portion of Concourse A. In addition to the three international ADG-III/ADG-V MARS gates, there are two international ADG-III gates and one international ADG-IV gate, making up a total of six international gates.

Table 3-29 shows the distribution of gates for international and domestic use in 2020.

TABLE 3-29 TERMINAL GATES BY DOMESTIC AND INTERNATIONAL USE (2020)

Terminal Gates Leased and Operated by Delta Air Lines			
Concourse	**Domestic**	**International [1]**	**Total**
Concourse A	41	6	47

Concourse B	8	0	8
Delta Air Lines Total	49	6	55
Terminal Gates Leased and Operated by Other Airlines			
Concourse	**Domestic**	**International**	**Total**
Concourse A	0	0	0
Concourse B	23	0	23
Other Airlines Total	23	0	23

Note: 1- Any airlines with international arrivals receive precedence at the Delta International gates over Delta Domestic flights,
Source: RS&H, 2019

3.4.1.2 Gate Chart Model Analysis

A gate chart model was completed to analyze the gate capacity and occupancy of the newly constructed terminal as well as the increasing requirements over the planning horizon. The model utilized the Master Plan Update Base Case Forecast, and the design day flight schedule, which was based upon an Average Day of the Peak Month (ADPM) of PAL 1, PAL 2, and PAL 3. To create a more detailed model of what the gate usage would look like, several assumptions were created based on airline and industry standards and meetings with Airport and airline staff. The assumptions used in this analysis include:

- All airlines will attempt to operate their own or Salt Lake City gates at maximum efficiency before moving an aircraft to the RON-RAD Apron or requiring a new gate.
- Separation time, or the minimum time allocated by an airline between consecutive arriving and departing aircraft at a gate, is 20 minutes.
- Airlines will only operate out of their leased gates. The three Salt Lake City designated gates may be used by any airline at the Airport.
- International gates are swing gates and may be as domestic gates by Delta when international arrival operations do not require them. Any airline with an international arrival will take precedence over any Delta domestic flight on these gates.
- Any aircraft may be considered RON-RAD when it is at SLCIA for more than three hours at a time. Those aircraft may be moved from the gate to a RON-RAD Apron if the gate is needed for other arrival or departure operations. If moved, it is assumed the aircraft vacate the gate no sooner than one hour after arrival and return no later than one hour prior to departure.
- Aircraft returning to a gate from the RON-RAD Apron may use a different gate other than which it used initially.

The gate chart model works by taking each arriving and/or departing flight and placing it at a gate leased by that airline, if it can accommodate that aircraft based on its ADG. The exception being the SLC gates, which may be used by any airline, or the Delta international gates which must first serve international arriving flights, before serving any Delta domestic flights. As more flights are added to the schedules of each of the forecast years consecutively, the duration that an aircraft is at any gate begins to create conflicts, especially during peak hours. When gate space becomes limited for an airline, it is assumed that the airline would tow the longest parked aircraft to the RON-RAD Apron as an initial solution. Ultimately, after the RON-RAD tows are no longer an option, any remaining aircraft that cannot be accommodated generates demand for an additional gate. The gate chart analysis for each forecast year identifies the number of new gate(s) needed, if any, to accommodate the design day flight schedule at peak hour times.

Likewise, the number of RON-RAD aircraft towed to the apron at any given time fluctuates over the course of the day causing a peak hour(s) of usage in which a maximum number of parking spaces on the RON-RAD Apron is identified.

3.4.1.3 Peak Hour Usage

The peak hour indicates the hour each day in which the greatest strain on Airport facilities will occur. The results of the gate chart analysis showed that during peak hours all of the gates may not be necessarily used, but because of separation times, ADG capacity, and the use of gates exclusively by airlines whom they are leased to, peak hours are the driving force for new gates and RON-RAD Apron aircraft parking space.

Table 3-30 shows the peak hour terminal gate requirements, including international gates needs for each of the forecast years. **Table 3-31** shows the peak hour terminal international gate requirements for the forecast years.

TABLE 3-30 PEAK HOUR TERMINAL GATE REQUIREMENTS

	PAL 1	PAL 2	PAL 3
Existing Gates[9]	78	78	78
Required Gates	82	84	87
Peak Hour(s)	2100-2159 2200-2259	1000-1059 2200-2259	1000-1059

Source: RS&H, 2019

TABLE 3-31 PEAK HOUR TERMINAL INTERNATIONAL GATE REQUIREMENTS

	PAL 1	PAL 2	PAL 3
Existing Gates	6	6	6
Required Gates	6	8	9
Peak Hour(s)	1300-1359	1600-1659	1300-1359 1400-1459 1500-1559 1600-1659

Source: RS&H, 2019

3.4.1.4 Terminal Gate Requirements

The analysis results concluded that the Airport will require nine new gates over the planning horizon in addition to what it is opening with in 2020. The following details the need for each PAL.

- **PAL 1 -** Four additional domestic ADG-III gates will be needed, totaling 82 for the Airport. Because this demand is after the opening of the new terminal in 2020, the need for up to four of

[9] At the time of this writing during the summer of 2019, a partial build-out of Concourse B with 31 gates was planned for initial opening in 2020. That level of build-out, combined with the 47 gates on Concourse A equates to a total of 78 gates. With the full build-out of Concourse B, the total number of gates will increase to 93. Thus, the planned level of full build-out is in excess of these facility requirements throughout the planning period.

these additional domestic ADG-III gates might also exist at a sooner time, and therefore should be considered. These gates would be leased by Delta Air Lines and added onto the east end of Concourse B.

- **PAL 2 -** Two new international ADG-III gates will be needed, totaling 84 for the Airport. For greater flexibility it is recommended that one of the two added gates be considered as another international MARS gate that could allow up to ADG V aircraft. The two newly added gates would be leased by Delta Air Lines, however, because they are international they must be incorporated into an FIS and sterile corridor facility. To utilize the existing international facilities, it is assumed that two of the existing domestic ADG-III gates leased by Delta Air Lines adjacent to the six international gates planned for Concourse A, would be converted. The two gates that were transformed into international, would then be relocated to the east end of Concourse B, as two new domestic ADG-III gates.

- **PAL 3 -** Three new gates will be needed, which include two domestic ADG-III gates, and one international ADG-III gate, totaling 87 for the Airport. All three gates will be leased by Delta Air Lines, and the two domestic gates would be added onto the east end of Concourse B. It is assumed that the new international gate would be added adjacent to one of the existing international gates, by transforming a domestic gate into an international one and expanding the international facilities and FIS as necessary. The transformed domestic gate would be relocated to the east end of Concourse B, like the two that were relocated in PAL 2.

In total, the analysis showed that by PAL 3 there will be a need for the three international ADG-III gates and six domestic ADG-III gates.

Table 3-32 shows the terminal gate requirements when the terminal opens in 2020 and at each planning activity level. Concourse B at full build out can accommodate 46 gates, making a total gate count at full build out of 93 gates. Thus, based on the base case forecast, the total gate demand will not exceed the combined capacity of Concourse A and Concourse B. However, concourse expansion to accommodate 9 new gates on Concourse B will be needed.

TABLE 3-32 TERMINAL GATE REQUIREMENTS

Concourse	2020	PAL 1	PAL 2	PAL 3
Concourse A	47	47	47	47
Concourse B	31	35	37	40
Total	78	82	84	87
Surplus / (Deficit) Assuming Full Build Out		11	9	6

Source: RS&H, 2019

3.4.1.5 RAD-RON Apron Parking Requirements

The analysis concluded that the RON-RAD Apron peak hour of usage is between 2400 and 0059 and 1500-1559 consistently over the planning horizon based upon this studies design day flight schedules.

While most of the aircraft that would use the RON-RAD Apron are ADG-III, there are times when ADG-V aircraft will also use it, therefore added space and concrete strength should be considered in the design.

- PAL 1 - 11 ADG-III parking spaces are required on the RON-RAD Apron during peak hours.
- PAL 2 - 12 ADG-III parking spaces are required on the RON-RAD Apron during peak hours.
- PAL 3 - 13 ADG-III parking spaces are required on the RON-RAD Apron during peak hours.

Table 3-33 shows the maximum number of RON-RAD aircraft parking spaces required during peak hours, and at which times those peak hours occur for each of the forecast years.

TABLE 3-33 MAXIMUM NUMBER OF AIRCRAFT PARKING ON RAD-RON APRON

Type	PAL 1	PAL 2	PAL 3
RON-RAD parking spaces required	11	12	13
Peak Hour(s)	2400-0059 1500-1559	2400-0059 1500-1559	2400-0059 1500-1559

Source: RS&H, 2019

3.4.1.6 Timing for Concourse C

Given the results of this analysis, it can be concluded that the timing for a future C Concourse would be beyond the 20-year Master Plan time frame based on the base case forecast. A high-level analysis was conducted to examine the gate requirements associated with the high-growth scenario forecast. That analysis also indicated that Concourse C would not yet be needed within the planning horizon. However, by around 2037-2038, it could be expected that all gates on the full build out of Concourse A and B would be 100 percent utilized if the high-growth scenario forecast materializes. If the base-case scenario forecast materializes, it is estimated Concourse A and B gates would not reach full utilization until roughly 2043-2044.[10]

Though it is estimated that Concourse C is nearly two decades from being needed, planning for it must begin now as no matter where the new concourse is sited, numerous large-scale enabling projects are required. Previous studies and the Terminal Redevelopment Program planned for Concourse C to be positioned north of Concourse A and B. The alternatives analysis of this study will examine and refine the location for the future concourse and determine the sequencing of enabling projects that may be necessary before construction can begin.

3.4.2 Terminal Space Requirements

The construction of the new terminal facilities, on-going at the time of the writing of the master plan, will provide an increase in size and efficiency of terminal elements at SLC. As the terminal is still being constructed, expansions and changes to spaces have occurred that depart from the original design. Critical to this study, the terminal building is being built with an expansion to FIS, baggage claim, and Federal Inspection Services (FIS) space. As part of this study, a high-level validation of the new terminal

[10] The analysis used the 2037 base case gate schedule and maximized the utilization of all gates (assuming the full build out of Concourse A and B) while maintaining similarities in peak times currently seen and forecast at SLC. Using the average number of enplanements per aircraft as determined in the base case forecast, a total annual enplanement level was determined that included the added flights. This totaled approximately 21.8 million enplanements. Average annual growth rates of the forecast scenarios were extrapolated beyond the planning horizon of this study to determine when 21.8 million annual enplanements would be reached.

design using the master plan forecasted traffic levels was conducted. Areas of potential future congestion during the planning period were identified. Facility requirements were determined for the primary components of the terminal building including airline ticketing and check-in, baggage claim, passenger security screening, and FIS. Some terminal elements, such as concessions, baggage handling, support, and employee screening spaces were omitted from the analysis due to the status of the terminal construction.

Passenger peak hours for each PAL were calculated from the design day flight schedule discussed in Chapter 2 of this report. Connecting domestic passengers who will depart on another flight after arriving at SLC were excluded from analysis as they will not utilize any terminal processor being analyzed. A 60-minute rolling peak hour for originating passengers, domestic terminating passengers, and international terminating passengers at each PAL was created. The 60-minute rolling peak hour considers the differing time in which passengers pass through the terminal before a departing flight and the time between when an aircraft arrives and when passengers arrive at baggage claim. The summary of the peak hour for each type of passenger is detailed in **Table 3-34**.

TABLE 3-34 TERMINAL PASSENGER PEAK HOUR

Peak Hour	Originating Passengers	Domestic Terminating Passengers	International Terminating Passengers
2018	2,670	2,500	670
PAL 1	2,360	2,710	780
PAL 2	2,710	2,980	790
PAL 3	3,210	3,650	1,040

Source: Mary Lynch, RS&H; 2019

3.4.2.1 Airline Ticketing and Check-In

Airline ticketing and check-in space includes a combination of the conventional ticketing and check-in counters as well as self-service kiosks, which are provided near the conventional check-in counters and in the Gateway Building, which is attached to the parking garage and connected to the terminal by pedestrian sky bridges. The total space includes counter or kiosk space, active area, and queueing area. The number of conventional ticketing and check-in counter spaces were carried forward from the sizing in the previous terminal. This accounted for a total of 64 positions including 32 for Delta Air Lines and 32 for all other airlines. The scope of this study's analysis did not warrant a survey at SLC to determine current usage patterns. Current industry trends point towards roughly 20 percent of passengers using the ticket counter for check-in. For this analysis a conservative approach was used, and a distribution percentage of 30/30/40 was assumed for passengers using the ticket-counters, self-serve kiosks, and mobile boarding, respectively.

Overall, a surplus of counter space is estimated through the planning period at SLC. Self-serve kiosks are also estimated to have surplus due to having two locations, the airline ticketing area and the Gateway Building, accommodating those units. An overview of facility requirements for airline ticketing and check-in is shown in **Table 3-35**.

TABLE 3-35 AIRLINE TICKETING AND CHECK-IN

Terminal Area	Existing	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Ticketing				
Square Footage	43,400	11,000	12,200	14,400
Surplus / (Deficit)		32,400	31,200	29,000
Conventional Ticketing & Check-In Counter	64	30	33	39
Surplus / (Deficit)		34	31	25
Self-Service Kiosk	48	13	15	18
Surplus / (Deficit)		35	33	30

Source: RS&H, 2019

3.4.2.2 Baggage Claim

The baggage claim will have a total of 10 traditional baggage carousels and more than 70,000 square feet of space. In order to accommodate future growth and to allow baggage carousels used by Delta Air Lines to be in one consolidated location, the baggage claim lobby was built to provide surplus capacity beyond the required demand in the planning period. **Table 3-36** shows the projected surplus, including an additional 21,700 square feet at PAL 3. The additional claim units aid in providing redundancy and flexibility for irregular operations and any future magnification of the peak hour arrivals.

TABLE 3-36 BAGGAGE CLAIM

Terminal Area	Existing	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Baggage Claim				
Square Footage	71,100	35,500	47,200	49,400
Surplus / (Deficit)		35,600	23,900	21,700

Source: RS&H, 2019

3.4.2.3 Security Screening

The security screening in the new terminal will have 14 checkpoint lanes and a total square footage of just under 40,000 square feet. The existing space is designed for an expansion to a total of 16 checkpoint lanes with no modifications to the existing layout or space envelope. The checkpoint lanes being installed at SLC are estimated to process an average of 190 passengers per hour. As passenger traffic grows, the available total space including queuing and inspection is forecasted to remain sufficient through the planning period. However, the number of built checkpoint lanes are forecasted to be insufficient as one additional lane is needed at PAL 2 and a total of 17 lanes, which is one above which the current layout was designed to accommodate, are needed at PAL 3 to meet 30-minute wait time maximums as shown in **Table 3-37**.

TABLE 3-37 SECURITY SCREENING

Terminal Area	Existing	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Security Screening				
Square Footage	39,700	22,000	25,100	29,700
Surplus / (Deficit)		17,700	14,600	10,000
Inspection Lanes	14	13	15	17
Surplus / (Deficit)		1	(1)	(3)

Source: RS&H, 2019

3.4.2.4 Federal Inspection Services (FIS)

The required sizing for the Federal Inspection Services (FIS) is determined through coordination with the United States Customs and Border Protection agency and is built to handle a passenger throughput peak hour. The required services and subsequent spacing required can vary significantly between airports depending on the customs and border protection needs of the facility. For the new terminal at SLC, a layout that can accommodate approximately 1,000 passengers per hour was constructed. With a forecasted PAL 3 international terminating peak hour of approximately 1,040 passengers, the FIS is not forecasted to require additional space or facilities.

3.5 LANDSIDE FACILITY REQUIREMENTS

Landside facility requirements include all elements that provide access and egress for the airport, circulation within the public portions of the airport, and storage of vehicles at the airport. These include the regional roadway and transit system, on-airport roadways, the terminal curb roadways, public and employee parking, rental car facilities, and commercial ground transportation facilities. Each of these is addressed in the subsequent subsections.

At the time of the analysis and writing of this chapter, the new terminal facility was scheduled to be open and in use by September 2020. This new terminal facility has a different curb and parking configuration than the existing facility. Thus, this study focused entirely on the new configuration to determine requirements for that facility through the planning period. Plans of the new terminal facility and roadway network were used in instances where new infrastructure, such as the terminal curb, was not yet constructed or in use.

The determination of the landside requirements varied slightly depending on the type of facility, but the analysis generally followed this process:

- The data gathered from the airport, its landside tenants and operators, and by the Master Plan staff in the field were used to determine the current capacity and level of service using procedures appropriate to the available data and the standards of the profession.
- Level of service standards were determined that reflect the Airport's commitment to a quality experience for its passengers.
- The base case (typically, peak hour of the average day of the peak month) O-D passenger activity levels were related to the landside activity levels assembled for the capacity and level of service analyses.
- The future O-D passenger activity levels from the aviation forecasts were then used to forecast landside activity for each planning activity level as documented in **Chapter 2, Aviation Activity Forecasts**.
- Using the same procedures that analyzed current capacity and level of service, the future capacity and level of service was estimated for each planning activity level.
- If either capacity or level of service did not meet standards, these same procedures were then run again to determine the characteristics of the future facility (size, etc.) that would be required to provide the target level of service and/or capacity.

It should be noted that for some facilities, (e.g., parking and rental car, which are spatial in nature), this process is like that used for terminal facilities and provides an independent estimate of requirements. For roadways of all types, the future requirements are not only a function of size (e.g., number of lanes, or length of curb), but also of physical arrangement, and operation. Thus, the requirements provided herein reflect the future physical arrangement of roads and curbs, and their proposed manner of operation. The next sections explain trade-offs that can be explored in the development and analysis of future improvements. These changes could include either changes to physical plant, or to roadway or curb operations, in order to achieve desired capacity and/or level of service.

The requirements presented herein assume that there will be negligible changes in mode of access and egress and other landside behaviors by the traveling public over the next 20 years. The markets for the newest mode (TNC) are assumed to have stabilized, as has the degree of competition from off-airport parking. At the end of this section, those assumptions are examined, to demonstrate the degree to which requirements may change if those assumptions do not hold true. Development and evaluation of concepts will include consideration of options that can respond flexibly to how things may change at SLCIA.

3.5.1 Access and Circulation Roadways

This section presents the requirements for several regional access systems as well as for the on-airport roadway system that serves the terminal campus.

3.5.1.1 Regional Access

SLCIA has one principal access/egress route, Terminal Drive, which is a northern extension of Bangerter Highway (Utah Route 154). Terminal Drive brings in all traffic from Bangerter Highway as well as from I-80, which generates the largest inbound volumes. The interchange at I-80 and Terminal Drive/Bangerter Highway is complex, as it also includes ramps to/from North Temple Street. Furthermore, the airport interchange lies not quite two miles west of the I-80 system interchange with I-215. To assist in handling the movements among all these highways, there are collector-distributor roads adjacent to I-80 in both directions between the adjacent interchanges.

In considering how to assess the requirements for adequate capacity and level of service for the airport's interchange, the Master Plan team first examined the combined capacity of all the inbound ramps:

- One lane serving traffic from North Temple and I-215
- One lane serving traffic from westbound I-80
- Two lanes serving traffic from eastbound I-80 and Bangerter Highway.

Collectively, these four lanes have a combined maximum service volume flow of nearly 5,600 vehicles per hour at Level of Service C, which is the desired level of service on the Airport's connections to the regional road system. Given that at PAL 3 the total inbound volume at SLCIA is forecast to be only 3,980, the interchange itself was judged to be adequate across the planning period. Conversations with UDOT traffic engineering and planning staff indicated that there were no known or anticipated issues with the interchange continuing to provide adequate access to the Airport.

Regarding egress from the Airport, the team looked at whether the three ramps out of the Airport provide adequate levels of service. The ramps include:

- One lane serving traffic to westbound I-80
- Two lane serving traffic to Bangerter Highway
- Two lanes serving traffic to eastbound I-80, North Temple, and I-215.

The combined maximum service flow volume of these five lanes is nearly 7,000 vehicles per hour at Level of Service C. As such, the ramps themselves pose no issues to adequate Airport egress over the planning period.

However, observations and discussions with UDOT staff flagged one concern which can be problematic today, and which will continue to worsen over the planning period unless addressed by UDOT. The highest volume of traffic leaving SLCIA uses the two-lane ramp which feeds traffic to North Temple[11], eastbound I-80, and north- and southbound I-215. After the diverge to North Temple, the two lanes merge into eastbound I-80, quickly dropping one of the two lanes. There is a weaving area on eastbound I-80 created by this merging ramp and the exit ramp diverging 2,800 feet downstream to serve all movement to I-215. The merging area, by observation, can operate at levels of service which create queues backing up towards southbound Terminal Drive, the exit from the Airport. UDOT knows of the issue, and while it has a long-range project to potentially widen I-80 in this area, it is not likely that a widening alone will solve this problem. More than likely, braiding of the on-ramp from the Airport and the exit ramp to I-215 would be required to eliminate the weave entirely, and resolve the issue. The Airport will need to work with UDOT to ensure that some form of solution to this significant congestion is developed in order for the Airport's egress to not be constrained.

The Airport is also served by the TRAX light rail system, by UTA bus, and by a bike trail. The TRAX station served approximately 2,500 riders (boardings and alightings) per day in the 12-month period ending April 2018. The system averaged approximately a five percent month-over-month increase between 2017 and 2018. By observation, it serves a mix of employees and passengers. The Airport is the end of line station for the Green Line, and with overall no congestion points on the line, no issues are anticipated for continued high quality light rail service throughout the planning period.

UTA bus routes 453, 454, (both inter-county routes) and 551 (limited stop service in the peak hours) serve the airport. The first two routes continue west to Tooele or Grantsville, and east to the TRAX Red Line or the Central Station with connections to the Blue Line and the FrontRunner commuter rail. Route 551 serves commutes to/from the International Center just west of the Airport, connecting to TRAX at the Airport. Across the planning period, no issues are anticipated with continuing provision of UTA bus service.

For bike connectivity, the Airport Trail follows North Temple, 3700 West, and its own trail alignment to connect the Airport with roadways and developed areas east and west of the airport, such as International Center. Bike racks are provided at the Airport Station as well as in the parking garage. By observation, cycling is a mode used far more frequently by employees than by passengers. The Airport Trail, though, where it passes south of the east side of the AOA, has gates on it, which constrain the hours of its use and requires a SLC Airport Security Badge to access. There are no capacity or level of service issues anticipated with bicycle access to the Airport through the planning period, unless the operations of these gates were to change.

[11] Traffic to North Temple, which provides access to the eastern and northern portions of the Airport (e.g., to the cargo and general aviation areas) and to the north end of the city, uses the single lane ramp which diverges right from the two-lane main ramp. This ramp and movement is not a concern.

3.5.2 Terminal Area Roadways

From the entry of the Airport to about the entry to Economy Parking, the future terminal area roadway network will be the same as it was in 2018 when the traffic data were collected. Similarly, from the parking exit plaza all the way to off the Airport, the roadway network will remain the same. What changes with the opening of the new terminal is how the inbound roadway (Terminal Drive) divides to serve the various on-airport destinations, and how, once past the new terminal curbs, garage, and rental car facilities, the several roadways merge together before the parking exit plaza's ramp merges in. The future roadway configuration is presented in **Chapter 1** - **Inventory of Existing Conditions, Figure 1-20**.

Using the forecast volumes from **Chapter 2** – **Aviation Activity Forecast**, and the roadway configuration from **Figure 1-20**, the traffic operations of the critical roadway locations were analyzed, both for the base case and for the three PALs. Techniques for assessing level of service were sourced from the *Highway Capacity Manual*[12] and *ACRP Report 40*[13], depending on the nature, with each level of service color coded (shown in **Table 3-38**):

- Levels of service A and B are green, representing high quality operation
- Level of service C is yellow, indicating it is the lowest level of tolerable operation
- Level of service D is orange, representing operations which are approaching failure
- Levels of service E and F are red, representing significant congestion and delay or failure of the system.

Most of the roadway segments will operate well throughout the planning period, providing levels of service A – C. Five locations are flagged for consideration for improvements which will help them meet those standards:

- The rental car return: This operated at LOS F in 2018, with congestion internal to the garage creating queues that blocked the left lane of the outer curb roadway. With the new facilities operational, a single-lane ramp will feed a two-lane roadway across the north side of the garage, with entrances and exits for each rental car company. The single lane ramp will degrade in operation from LOS C to LOS D across the planning period.
- The exit from the rental car ready/return at the ground level of the new garage: This is being constructed as a two-lane roadway across the north face of the garage, which narrows down to one lane prior to merging into the two lanes of much heavier traffic from the outer (POV) arrivals curb. By PAL 3, it will operate at LOS E.
- Terminal Drive on the inbound approach has three critical locations:
    - Today, and in the future, there is a significant weaving area between the return-to-terminal ramp entering on the left and the exit to 3700 West on the right. This weave degrades in LOS over the planning period to LOS D.

[12] TRB, *Highway Capacity Manual*, 2010, Washington, DC

[13] TRB, *ACRP Report 40*, Airport Curbside and Terminal Area Roadway Operations, 2010, Washington, DC

- The future Terminal Drive will have a four-lane segment downstream after the left exit to the Park'n'Wait lot. Under 2018 traffic loads, this segment would operate at LOS C, with further degradation to LOS E by PAL 3.
- The next segment downstream, on the final approach to the terminal curbs, with three lanes, includes only the traffic for the POV curbs (upper curb at Departures, and outer curb at Arrivals). With 2018 volumes, it would operate at LOS C, but by PAL 3, the level of service would decrease to D.

In the development of alternatives, in conjunction with terminal planning, these level of service issues will be addressed, and options defined and evaluated for their amelioration.

TABLE 3-38 FUTURE TERMINAL AREA ROADWAY LEVEL OF SERVICE

Location	Name	Type of Analysis	Peak Hour	Free Flow Speed (mph)	Lanes	Volumes				Level of Service				Technique
						Base Case	PAL 1	PAL 2	PAL 3	Base Case	PAL 1	PAL 2	PAL 3	
1	Inbound Terminal Dr.	uninterrupted flow	1245 - 1345	50	4	2,350	2,920	3,270	3,980	B	C	C	C	a
2	Outbound Terminal Dr.	uninterrupted flow	1315 - 1415	55	3	2,050	2,550	2,860	3,480	B	B	B	C	b
3	Exit to 3700 W	ramp	0600 - 0700	40	1	590	730	820	1,000	B	C	D	D	a
4	Entrance to Park'n'Wait Lot	ramp	1230 - 1330	25	1	260	330	370	450	B	B	B	C	a
5	Exit from Park'n'Wait Lot	ramp	1245 - 1345	25	1	310	390	430	530	B	B	C	C	a
6	Return to Terminal Ramp	uninterrupted flow	1300 - 1400	40	1	290	360	400	490	A	A	B	B	a
8	Exit from All Parking	ramp	1315 - 1415	40	1	460	570	640	780	B	B	C	C	a
10	Exit from Garage	uninterrupted flow	1300 - 1400	25	1	150	180	210	250	A	A	A	B	a
11	Rental Car Return	ramp	1415 - 1515	25	1	400	500	550	670	F	C	C	D	a
12	Rental Car Exit	uninterrupted flow	1030 - 1130	25	1	510	640	720	870	C	D	D	E	a
13	Terminal Curb Approach	uninterrupted flow	2100 - 2200	25	3	1,970	1,950	2,190	2,660	C	C	C	D	a
14	Terminal Approach	uninterrupted flow	1245 - 1345	30	4	2,230	2,770	3,100	3,770	C	C	D	E	a
NA	Inbound Weave	weave	1245 - 1345	40	5	2,720	3,390	3,780	4,610	B	C	C	D	c

Techniques: (a) *ACRP Report 40* , Table 4-1, (b) *2010 HCM* , Exh. 11-6, (c) *ACRP Report 40* , QATAR airport weave analysis.

Source: Curtis Transportation Consulting LLC; Prepared by RS&H, 2019

3.5.3 Terminal Curb Roadways

The four terminal curb roadways were analyzed for their future[14] capacity and level of service for the three PALs. The analysis utilized a spreadsheet-based model which has been previously used at SLC in the development of the initial comprehensive landside improvement plan and the initial conceptual and schematic design of the new terminal and its curbs. The model simultaneously considers the capacity of a curb roadway to service vehicles stopped to unload or load passengers (service capacity), and the capacity of the same roadway to move those vehicles to, along, and away from the curb ("thru" capacity). The actual capacity of the overall curb is the equilibrium point between service capacity and thru capacity. Level of service is a function of the ratio of the demand volume to the equilibrium capacity (V/C). The target is to achieve a PHADPM V/C < 0.70, which is the threshold of LOS C. If the curbs operate no worse than this during the PHADPM, then during the very busiest hours of the year (e.g., peak hours during Thanksgiving or Christmas holidays), the quality of service will still be acceptable and manageable.

The analysis requires the following data:

- Curb length
- Number of lanes
- Assigned classes of vehicles and their function (drop off, pick up, or both)
- Volume of stopping vehicles by vehicle class (POVs, taxis, TNCs, hotel shuttles, et al.)
- Vehicle length by vehicle class
- Average dwell time by vehicle class (duration of stopped time for unloading and loading)
- Volume of non-stopping vehicles (typically those who are recirculating on the arrivals curb looking for their party, or service vehicles).

Curb lengths and lane configurations were taken from the design plans for the ARP. Assignments were provided by SLCIA staff, based on their currently proposed operations plan. Vehicle lengths (which provide for some small maneuvering distance between vehicles) are noted from field observations. All remaining data were those collected in June 2018, as adjusted to reflect any proposed changes in operational characteristics. Notably, dwell times were adjusted for certain classes of vehicles which in 2018 made separate stops for drop off and pick up, but which in the future would dwell at a single point to drop off one passenger or group, and then wait a short time to pick up the next. The dwell time data did reflect a continuation of the grace period for a rematch for TNCs.

Table 3-39 presents the key data on peak hour demand volumes, capacity, and level of service. Through PAL 2, all curb roadways are anticipated to operate well, at LOS A or B. By PAL 3, though, the center arrivals curb, serving TNCs and off-airport parking shuttles, will degrade to a LOS C in the late evening arrivals peak, and to LOS D in the midday departures peak. With the other commercial curbs operating well during these same conditions, a simple reassignment of the various modes to better balance volumes

[14] No analyses were conducted of the current curb roadways as they will be completely replaced through ARP development.

on the curbs could potentially achieve the targeted levels of service for all. An operational change such as this, and other physical improvements, will be considered in the development and evaluation of concepts.

TABLE 3-39 FUTURE TERMINAL CURB VOLUMES, CAPACITY, AND LEVEL OF SERVICE

Year & Condition	Curb	Stopping Volume	Thru Volume	Balanced Capacity	V/C	LOS
PAL 1 Departures Peak (Midday)	Departures	774	60	1,993	0.40	A
	Inner Arrivals	137	0	724	0.19	A
	Center Arrivals	291	0	477	0.61	B
	Outer Arrivals	N/A	N/A	N/A	N/A	N/A
PAL 1 Arrivals Peak (Late Evening)	Departures	N/A	N/A	N/A	N/A	N/A
	Inner Arrivals	166	0	744	0.22	A
	Center Arrivals	254	0	477	0.53	A
	Outer Arrivals	831	120	1,775	0.49	A
Year & Condition	**Curb**	**Stopping Volume**	**Thru Volume**	**Balanced Capacity**	**V/C**	**LOS**
PAL 2 Departures Peak (Midday)	Departures	868	60	1,993	0.44	A
	Inner Arrivals	153	0	724	0.21	A
	Center Arrivals	326	0	477	0.68	B
	Outer Arrivals	N/A	N/A	N/A	N/A	N/A
PAL 2 Arrivals Peak (Late Evening)	Departures	N/A	N/A	N/A	N/A	N/A
	Inner Arrivals	186	0	744	0.25	A
	Center Arrivals	285	0	477	0.60	B
	Outer Arrivals	934	120	1,775	0.54	A
Year & Condition	**Curb**	**Stopping Volume**	**Thru Volume**	**Balanced Capacity**	**V/C**	**LOS**
PAL 3 Departures Peak (Midday)	Departures	1,055	60	1,993	0.54	A
	Inner Arrivals	186	0	724	0.26	A
	Center Arrivals	397	0	477	0.83	D
	Outer Arrivals	N/A	N/A	N/A	N/A	N/A
PAL 3 Arrivals Peak (Late Evening)	Departures	N/A	N/A	N/A	N/A	N/A
	Inner Arrivals	226	0	744	0.30	A
	Center Arrivals	346	0	477	0.73	C
	Outer Arrivals	1,134	120	1,775	0.66	B

Source: Curtis Transportation Consulting LLC; Prepared by RS&H, 2019

There is one relevant caveat to the results in **Table 3-39**. The curb lengths used in the analysis are based on the CAD drawings of the facilities which are under construction. The nominal length of all but the center arrivals curb is roughly 1,000 feet; the center arrivals curb is 760 feet long. However, the terminal itself is only about 590 feet long. At the departures level, there typically is the greatest relationship between where a driver stops to drop off a passenger and what is happening inside the terminal (where the doors, ticket counters, bag check stations, and security screening checkpoint are located). Drivers look to stop in front of where their passenger is going. On this curb, though, more than 40 percent of its length will not be adjacent to anything in the terminal, implying the need for increased walking distances, passenger/driver disorientation, and the likely chance that the driver will choose to wait in front of the terminal for a space to become available, rather than drop off from a location that is perceived as being far away. As noted, the curb length was not assumed to be reduced to reflect the idea that many will not take full advantage of its length. But clearly, there is a need to reconsider such impacts as concepts are developed and evaluated to ensure the desired level of service is provided to the users.

3.5.4 Commercial Vehicle Staging Areas

The new landside that will open with the new terminal includes commercial vehicle staging areas upstream of the two at-grade curbs to be used by the all ground transportation modes except the TNCs. These include 30 spaces for the taxi queue, and 83 other pull-through stalls for use by the various shuttles and buses.

For on-demand modes (taxi, limo, certain shuttles), staging areas need to be able to provide the necessary number of waiting vehicles such that passengers coming to the curb do not have to wait for service. For the services which run on a schedule, to encourage efficient operations, operators like to minimize lost time sitting in a staging area. Thus, such vehicles tend to wait no more than one headway if the headways are small (< 30 minutes), and if the headways are longer, they tend to wait no more than 30 minutes. The requirements were therefore calculated with an assumption that the mean wait time across all modes (except taxis) was 20 minutes. The requirements are highly sensitive to this assumption, which in turn is related to the final set of fees to be charged and other operational policies and practices which have yet to be determined.

The SLCDA intends to create a geo-fenced area that would be the only place a TNC would be able to receive and accept a call for service[15]. The location of this geo-fenced area has not yet been determined. The requirements for the geo-fenced area assume that a third of the TNCs would accept a re-check, with the balance of the vehicles to be provided from a geo-fenced staging area in which the mean wait time would be 10 minutes.

The collective requirements for commercial vehicle staging are shown in **Table 3-40**. Whether these requirements will be met within the staging areas just upstream from the terminal curb or in other locations as well (i.e., for TNCs) will be examined in the development and evaluation of concepts.

[15] TNCs would also be able to accept a call for service on the center arrivals curb with the continuation of a five-minute grace period for re-check.

TABLE 3-40 COMMERCIAL VEHICLE STAGING AREA REQUIREMENTS

	Base Year 2018	PAL 1	PAL 2	PAL 3
Mode				
Taxi	16	20	22	27
TNC	25	31	35	43
All Others	42	52	58	71
Total	**83**	**103**	**115**	**141**

Source: Curtis Transportation Consulting LLC; Prepared by RS&H, 2019

3.5.5 Parking Requirements

Parking requirements reflect an airport's goals and policies regarding how well to serve the public relative to providing readily available parking. In the U.S. there are two logical and commonly used ways to decide how much parking an airport wants to provide:

- To provide enough parking that no customer is ever turned away from the lot, even on the busiest hour of the busiest time of the year.
- To provide enough parking based on a quality-of-service standard which is defined by the difficulty of finding a space in the peak hours of parking demand. For surface lots typically used for long-term parking, the rule of thumb is that when the lot is 90 percent occupied, the difficulty of tracking down an available space suggests that the lot is "effectively full". For garage parking, where the driver seeking a space must go up or down between levels, the rule of thumb is that 80 – 85 percent occupied is "effectively full". The lower end of this range is typically applied to garage areas with hourly or short-term parking; the upper end applies more to garages which serve daily or multi-day parking.

Based on discussions with airport staff and the parking operator, the following criteria were established as setting the requirements for public parking:

- The target for both garage and economy parking is to provide enough spaces to accommodate the 99th percentile of demand at the effectively full level, meaning that enough spaces are provided to meet nearly all demand at the effectively full level.
- For the Economy lot and Employee lots, effectively full is defined as when 90 percent of available spaces are occupied.
- For the Parking garage, effectively full is defined as when 83 percent of available spaces are occupied.

The public parking requirements are shown in **Table 3-41**. To meet future needs in PAL 3, the public parking in the terminal campus needs to increase from a total of 14,063 spaces to a total of 20,815, an increase of 6,752 spaces (48 percent increase). This need assumes that there will be no required closures of the parking garage to redirect traffic to a dedicated long-term parking facility.

TABLE 3-41 ECONOMY LOT AND GARAGE PARKING FACILITY REQUIREMENTS

	Base Year 2018	PAL 1	PAL 2	PAL 3
Economy Lot				
Space Count	10,463	10,463	10,463	10,463
Effective Capacity	9,417	9,417	9,417	9,417
PHADPM Demand	9,771	11,366	12,893	15,238
Required Spaces	10,857	12,629	14,326	16,931
Surplus / (Deficit)	**(394)**	**(2,166)**	**(3,863)**	**(6,468)**
Parking Garage				
Space Count	1,770	3,600	3,600	3,600
Effective Capacity	1,469	2,988	2,988	2,988
PHADPM Unconstrained Demand	1,903	2,367	2,652	3,224
Required Spaces	2,293	2,851	3,195	3,884
Surplus / (Deficit)	**(523)**	**749**	**405**	**(284)**
Total System Required Spaces	13,149	15,480	17,521	20,815
Total System Surplus / (Deficit)	**(916)**	**(1,417)**	**(3,458)**	**(6,752)**

Source: RS&H and Curtis Transportation Consulting LLC, 2019

The economy lot and garage parking have their own specific entrances but share an exit plaza. Customer transaction times were sampled for both parking entry locations and the parking exit plaza. Entry transactions for both locations averaged 14 seconds, equivalent to 257 vehicle entries per hour. Exit plaza transaction times varied by type, with cashier lane transactions averaging 40 seconds (90 vehicles per hour) and automated lane transactions averaging 36 seconds (100 vehicles per hour), **Table 3-42** shows peak hour volumes at the economy lot and garage lot entrances, associated number of required lanes, and the expected length and time of queues. **Table 3-43** shows peak hour volumes, lane requirements, and expected queue length and times at the parking exit plaza by transaction type.

TABLE 3-42 PUBLIC PARKING ENTRY PLAZA REQUIREMENTS

	2018		PAL 1		PAL 2		PAL 3	
	PH Volume	Lanes	PH Volume	Lanes	PH Volume	Lanes	PH Volume	Lanes
Economy Entry								
Forecast Hourly Volume	560		690		780		940	
Effective Hourly Volume	659	3	812	4	918	4	1106	5
Exp Queue Length	4.3		2.2		6.5		4.2	
Time in Queue (sec)	24		10		25		14	
Garage Entry								
Forecast Hourly Volume	270		330		370		450	
Effective Hourly Volume	333	3	407	3	457	3	556	3
Exp Queue Length	0.1		0.3		0.5		1.4	
Time in Queue (sec)	1		2		4		9	

Source: RS&H and Curtis Transportation Consulting LLC, 2019

TABLE 3-43 PUBLIC PARKING EXIT PLAZA REQUIREMENTS

	2018		PAL 1		PAL 2		PAL 3	
	PH Volume	Lanes	PH Volume	Lanes	PH Volume	Lanes	PH Volume	Lanes
Cashier								
Forecast Hourly Volume	178		220		247		301	
Effective Hourly Volume	197	3	244	4	274	4	335	5
Exp Queue Length	1.4		0.8		1.7		1.3	
Time in Queue (sec)	26		12		22		14	
Automated								
Forecast Hourly Volume	282		350		393		479	
Effective Hourly Volume	314	8	389	7	437	7	532	6
Exp Queue Length	0		0.2		0.3		5.5	
Time in Queue (sec)	0		1		2		37	
Total								
Forecast Hourly Volume	460		570		640		780	
Effective Hourly Volume	511		633		711		867	
Existing Lanes		12		12		12		12
Required Lanes		11		11		11		11
Surplus / (Deficit)		**1**		**1**		**1**		**1**

Source: RS&H and Curtis Transportation Consulting LLC, 2019

Requirements for the Park'n'Wait lot are shown in **Table 3-44**. Using the combined capacity of the Park'n'Wait lot and the Service Center, no deficiencies occur over the planning period. This is because Service Center users make use of Park'n'Wait spaces during peak hour demand.

TABLE 3-44 PARK'N'WAIT LOT REQUIREMENTS

	Base Year 2018	PAL 1	PAL 2	PAL 3
Park 'n' Wait Lot Capacity	131	131	131	131
PH Park 'n' Wait Demand	56	70	78	95
PH Surplus / (Deficit)	**75**	**61**	**53**	**36**
Service Center Capacity	31	31	31	31
PH Service Center Demand	34	42	47	58
PH Surplus / (Deficit)	**(3)**	**(11)**	**(16)**	**(27)**
Total Surplus / (Deficit)	**72**	**50**	**37**	**9**

Source: RS&H and Curtis Transportation Consulting LLC, 2019

The requirements shown in **Table 3-44** assumed that the Park'n'Wait lot remains in its current location, and would continue to serve some of the customers of the convenience center. Observations and feedback from users and staff indicate that the relocation of the lot decreased its utilization. Comments from customers indicated that the lot is hard to find, not well signed, and it is hard to get from the lot to the terminal. If the lot were to be relocated, perhaps to near where it used to be (off to the right of Terminal Drive after the exit for 3700 West), demand might increase. However, since a relocated lot would not share usage with the convenience center, the requirements in **Table 3-44** stand as a reasonable estimate.

Employee parking requirements are shown in **Table 3-45**. Peak hour deficits already exist in the base year and into PAL 1. Future ARP changes in employee parking reduce overall deficiency in PAL 2. However, employee parking deficiencies increase again by PAL 3.

TABLE 3-45 EMPLOYEE PARKING LOT REQUIREMENTS

	Base Year 2018	PAL 1	PAL 2	PAL 3
Employee Lot				
Capacity	2,950	2,950	2,950	2,950
Demand	2,708	2,925	3,168	3,826
Percent Occupied	92%	99%	107%	130%
Surplus / (Deficit)	**242**	**25**	**(218)**	**(876)**
Additional Employee Lots				
Capacity[1]	250	0	780	780
Demand	215	232	252	304
Percent Occupied	86%	0%	32%	39%
Surplus / (Deficit)	**35**	**(232)**	**528**	**476**
Total Employee Demand	**2,923**	**3,157**	**3,420**	**4,130**
Demand Surplus / (Deficit)	**277**	**(207)**	**310**	**(400)**
Total Required Spaces	**3,248**	**3,508**	**3,800**	**4,589**
Required Spaces Surplus / (Deficit)	**(48)**	**(558)**	**(70)**	**(859)**

Note: (1) Lot 3 closes by PAL 1. Two lots east of garage and QTA assumed to open in PAL 2.
Source: RS&H and Curtis Transportation Consulting LLC, 2019

3.5.6 Rental Car Requirements

The sizing of rental car facilities is an exercise in balancing the cost of the physical plant with the costs of operating out of that physical plant over its lifetime. If the facilities are larger, then capital costs are higher, but fewer staff are needed to keep customers supplied with cars. The converse is also true. Under-sized facilities can significantly increase the cost of staff needed to move cars from storage to waiting customers. There are no accepted industry standards, and planners and designers of rental car facilities in the United States have used a variety of methods to estimate facility requirements.

The requirement for physical space to store cars is best viewed in the aggregate. The ready-return lot is not the only location where cars are stored, but it is the only one with direct customer access to the waiting vehicle. At SLCIA, cars are stored on-airport above the QTA, as well as in proprietary lots off-airport. In this analysis, the ready-return lot requirement was first estimated. Then the on-airport storage requirement was estimated, linking it with the scale of the required ready-return lot. Service areas were estimated independently. All requirements are for the on-airport companies in the aggregate.

A measure of the efficiency of the ready-return spaces is the number of times per day a space needs to have a car moved into it in order to meet demand. This is referred to as “turns per day.” In the current facility, the industry experiences 6.6 turns per day overall, though some companies reported turning their spaces as many as 10 times per day. This is very high, above the experience at most large U.S. airports, and well above the number of turns per day the rental car companies prefer. Companies tend to look for 3 or fewer turns per day as representing a minimization of their staffing, while more than 4 turns per day brings them into the territory of increasing costs, and thus decreasing margins. For some companies, the turns per day in SLC are the highest at any U.S. airport.

The planning of the SLCIA landside system included a program review in 2007. That effort forecasted the need for ready-return spaces which would evolve over 20 years from 2.9 turns per day to 4.8 turns per day. The planning of other large airport consolidated rental car facilities used values of 3.1 turns per day[16] to 3.8 turns per day[17] to size ready-return spaces. Feedback from current SLC rental car station managers suggested that 4.3 turns per day would greatly improve their operations. From these varying approaches, requirements for ready-return spaces were developed using 4.0 turns per day as the target that balanced customer satisfaction (with low wait times), capital cost, and rental car staffing operating costs. Those requirements are shown in **Table 3-46**.

Ideally, all rental cars would be stored on airport, near the customer, to minimize/eliminate wait times. Given the competition for land at the terminal campus, that is not feasible. Nonetheless, with approximately 900 storage spaces above the QTA, some companies deploy as many as 50 staff on the busy rental day (Monday) to shuttle cars from off-airport lots as much as 20 minutes away. Their customers can end up waiting an hour or more for a car. Clearly, more on-airport spaces are required.

Rental car storage requirements are based on providing adequate availability of cars for customers without requiring extensive waits for a vehicle. August 2018 data (factored from June 2018 vehicle counts) showed that available cars located at ready-return and the QTA storage area began to falter around 9am Monday morning as rental car companies were required to shuttle in vehicles from storage sites other than the QTA storage deck. This trend continued through Friday when more cars began to return, and vehicles began to require shuttling off-airport for weekend storage. Using weekly average rental car availability deficits derived from average daily deficits, the spaces required to meet average demand levels was determined, as shown in **Table 3-46**.

The requirements for the number of service positions in the QTA are based upon the idea that the surplus of cars returned over the weekend all need to be ready by the start of the peak Monday rental day. The analysis reflected several key assumptions:

- Each position can process five cars per hour
- Each position would be operated 12 hours per day
- The targeted utilization would be 80 percent. The estimated utilization of the current 62-position facility is 88 percent, which can lead to queuing of dirty cars and cars between fuel/vacuum and the wash racks.

[16] 3.1 turns per day rental car planning metric used at Charlotte Douglas International Airport (CLT).

[17] 3.8 turns per day rental car planning metric used at Minneapolis-St. Paul International Airport (MSP).

TABLE 3-46 RENTAL CAR FACILITY REQUIREMENTS

	August 2018	PAL 1	PAL 2	PAL 3
Ready-Return Spaces				
Rentals, Busy Day, Peak Month	4,620	5,750	6,440	7,830
Turns per Day	4	4	4	4
Ready-Return Spaces Required	1,155	1,438	1,610	1,958
Available Spaces	699	1,122	1,122	1,122
Surplus / (Deficit)	**(456)**	**(316)**	**(488)**	**(836)**
Rental Car Storage				
Total On-Airport Storage Required	2,213	2,095	2,574	3,005
Available Storage at Ready-Return	699	1,122	1,122	1,122
Available Storage Above QTA	900	900	900	900
Surplus / (Deficit)	**(614)**	**(73)**	**(552)**	**(983)**
QTA Positions				
Total Returns (Thu - Sun) to be Ready Monday AM	14,033	17,453	19,557	23,776
Required QTA Positions	68	84	94	115
Available Positions	62	62	62	62
Surplus / (Deficit)	**(6)**	**(22)**	**(32)**	**(53)**

Source: RS&H and Curtis Transportation Consulting LLC, 2019

The results of the QTA analysis are provided in **Table 3-46**. As with other landside facilities, there are trade-offs between physical plant and operating practices. In the case of the QTA, the number of service positions required would decrease to 75 percent of the value in **Table 3-46** if the QTA were operated for 16 hours per day rather than the assumed 12 hours per day.

Immediately south of the QTA building is the Remote Service Site (RSS), the rental car maintenance and repair area. The area occupies approximately 11.5 acres, of which 1.8 acres is occupied by three maintenance buildings, and the rest is paved lot for storage and maneuvering of rental cars, and/or parking of employee and visitor vehicles. In the aggregate over the industry, the area can hold an estimated 1,468 cars. The area is secure and divided into seven parcels of varying size from one to nearly two acres. The parcels are allocated similarly to how QTA and ready-return spaces are allocated.

The rental car station managers report that the RSS is very heavily used, and undersized for current (2018) operations. Their estimates of additional required spaces for car storage range from 500 to 750 spaces needed, and from four to six service bays short. With additional forecast passenger growth, the range by PAL3 for additional spaces needed range from a 100 to 140 percent increase in spaces, or an additional 1,600 – 2,000 spaces. This would be result in a Remote Service Site of from 24 – 27 acres. The high and low forecasts of requirements are shown in **Table 3-47**. Whether the high or low estimate is closer to the mark remains to be seen, but in either case, it represents a significant increase in the total area required for efficient rental car operations, all of which are desirably contiguous to one another. Thus, rental car requirements compete significantly with public parking for space within the terminal loop roadway.

TABLE 3-47 RENTAL CAR MAINTENANCE AND REPAIR AREA REQUIREMENTS

Item	Actual	Low Estimate				High Estimate			
	Aug '18	Aug '18	PAL 1	PAL 2	PAL 3	Aug '18	PAL 1	PAL 2	PAL 3
Storage									
Spaces	1,468	1,968	2,289	2,597	3,069	2,218	2,580	2,927	3,459
Square feet (sf)	366,490	492,000	572,306	649,211	767,265	554,500	645,008	731,682	864,733
Buildings/parking (sf)	78,000	91,000	105,853	120,078	141,913	97,500	113,414	128,655	152,050
Circulation/misc. (sf)	60,810	81,620	94,942	107,700	127,285	91,280	106,179	120,447	142,350
Total Square Feet	505,300	664,620	773,102	876,989	1,036,463	743,280	864,601	980,784	1,159,132
Total Acres	11.6	15.3	17.7	20.1	23.8	17.1	19.8	22.5	26.6

Source: RS&H and Curtis Transportation Consulting LLC, 2019

3.5.7 Off-Airport Parking

The first off-airport parking operation began in 1989. A second operation began in 1991, and the third started in 2018. Collectively, they offer several thousand surface spaces (some covered) within 5 to 10 minutes of the terminal curb. They offer trunk-to-door service, which some passengers find attractive, and they tend to price their product below on-airport rates. Undoubtedly, they have siphoned off demand for parking which otherwise SLCIA might serve in their own facilities. Unfortunately, data are not available to provide the scale of the impact of these operations.

The parking requirements in **Table 3-41** are all based on these operations continuing through the planning period, neither gaining nor losing market share. Stated otherwise, they assume the airport's parking products will continue to compete successfully for the passengers who prefer on-airport parking, providing those passengers with the right combination of price, location (convenience), and availability, relative to the off-airport operators.

The SLCDA may choose to challenge the off-airport providers, by increasing on-airport availability, lowering prices, and/or providing higher customer utility (closer locations, trunk-to-door service, amenities, etc.). In doing so, of course, the requirements for on-airport parking would commensurately increase.

Changes to the relative attractiveness of on-airport parking can best be considered in this Master Plan within the development and evaluation of concepts for meeting the requirements and satisfaction of Airport objectives. Any such moves could have significant financial implications, all of which will be considered in concept development and evaluation.

3.5.7.1 Potential Impacts of True Hourly Parking

With two-thirds of all garage parkers parking for less than 90 minutes, and three-quarters parking for under 3.5 hours, it is reasonable to consider whether the spaces in the garage should be developed in part to provide very convenient spaces for the exclusive use of those who are parking for only a few hours. Many airports provide their most convenient parking as Hourly Parking, with an upper limit of permitted time being typically in the 2 to 4-hour range. If a special ticket is pulled to access these spaces, then enforcement is accomplished through very aggressive prices for those who stay over the limit. Where a common ticket is pulled for all spaces in the garage, enforcement is required, with violations being issued, requiring special fines to be paid for overstaying the limit. Airports such as Dallas-Fort Worth International Airport (DFW), which has reserved the front row of all its garages for hourly parking since 1974, find that strong signing and friendly but firm enforcement lead to very little effort in the way of issuing violations.

The implications on parking requirements are somewhat less clear than the desirable impacts of making this change. Today, two issues constrain the availability of garage parking for short-term customers:

- Level 2 permits parking of any duration that does not include an overnight stay. These are the most convenient spaces, too, being at the pedestrian bridge level. Consequently, day-tripping flyers, most of them on business, can park on Level 2, catch an early flight out, a late flight back, and not park overnight. When short-term parkers come to the airport any time after 8 or 9am, they find many of the spaces on Level 2 already filled by day-tripping travelers.
- Overnight parkers are actively turned away by operations staff when the garage approaches maximum capacity. As upper garage Levels 3 and 4 fill, some longer-term parkers begin to overflow into the short-term area (Level 2) which further decreases hourly parking availability.

With true hourly parking, sized correctly, not only would the closures not happen, but the level of service provided the customers would greatly increase. This is because the air traveler who garage parks is typically 1.4 to 1.6 people per vehicle, or roughly 3 person trips between garage and terminal. When a meeter-greeter or well-wisher parks, the number of person trips between garage and terminal goes up, as the size of the air travel party (1.5 people on average) is more than doubled by the number of visitors sending them off or greeting them upon return. In addition, the visiting customer will make two trips, one for departure, one for arrival. Thus, an hourly space generates nearly five times the number of person trips between garage and terminal as a regular garage space. Providing this much higher number of people with the closest spaces greatly improves overall quality of service at the airport for the greatest number of customers.

The potential for true hourly parking spaces will be dealt with in detail in the development and evaluation of concepts. In general, since true hourly spaces turn over 5 to 10 times per day, it is not necessary to provide that many hourly spaces to meet demand. This drops the overall parking space requirement slightly from the values identified in this section. The implications of that decrease will be examined in concept development and evaluation.

3.5.7.2 Impacts of TNCs on Landside Facilities

Transportation Network Companies (e.g., Lyft, Uber) began service to SLCIA in the Fall of 2015. Their self-reported trips had grown to over 100,000 monthly by the summer of 2018. What is not known is whether the market has been saturated, and whether their growth will level off or continue to gain market share. They have chiefly taken market share from other for-hire modes, predominantly taxi and shared-ride shuttles.

The available data were analyzed to see if there have been impacts of TNCs that have affected parking at the airport, and rental cars. The data are not very clear in their message. Using the TSA counts of O-D passengers (on a monthly basis) passing through the security screening checkpoints (SSCP), the month-over-month growth rates were examined and compared with the month-over-month growth rates for three indices: parking revenues, parking transactions, and rental car revenues. The results are shown in **Table 3-48**.

TABLE 3-48 GROWTH IN O-D PASSENGERS COMPARED WITH GROWTH IN LANDSIDE INDICES

Period	O-D Passenger Volume at SSCP	Growth Ratio in a Year		
		Parking Revenue	Parking Transactions	Rental Car Revenue
Oct-15 - Oct-16	1.082	1.056	0.963	1.111
Nov -15 - Nov-16	1.095	1.000	1.157	1.131
Dec-15 - Dec-16	1.101	0.975	0.924	1.193
Jan-16 - Jan-17	1.124	1.175	0.967	1.184
Feb-16 - Feb-17	1.065	0.893	1.289	1.140
Mar-16 - Mar-17	1.132	0.980	1.082	1.229
Apr-16 - Apr-17	1.138	1.005	1.200	1.181
May-16 - May-17	1.109	1.099	1.206	1.148
Jun-16 - Jun-17	1.067	1.022	1.120	1.094
Jul-16 - Jul-17	1.110	1.178	1.153	1.164
Aug-16 - Aug-17	1.090	0.918	1.154	1.182
Sep-16 - Sep17	1.063	1.034	1.162	1.083
Oct-16 - Oct-17	1.073	1.106	1.222	1.063
Nov-16 - Nov-17	1.093	1.014	1.149	1.133
Dec-16 - Dec-17	1.043	0.977	1.192	1.042
Jan-17 - Jan-18	1.032	1.025	1.242	0.919
Feb-17 - Feb-18	1.060	1.098	1.210	0.989
Mar-17 - Mar-18	1.048	0.984	1.196	1.014
Apr-17 - Apr-18	1.084	1.128	1.184	1.063
May-17 - May-18	1.079	0.976	1.187	1.066

Note: Green cells represent growth higher than in O-D passenger volumes at the Security Screening Checkpoint (SSCP).
Source: Curtis Transportation Consulting LLC; Prepared by RS&H, 2019

The green highlighted cells are months in which the growth of a landside index was higher than the growth of the O-D passenger count. Overall, the number of parking transactions more than kept pace with O-D passenger growth for the 19 months for which data were available. Parking revenues generally did not keep pace with passenger growth. One interpretation is that the number of short-term parkers (meeter-greeters, well-wishers, and visitors) is increasing, but not parkers who stay for longer periods and drive up mean revenues per transaction. But any impact of TNCs on these data can only be speculative.

Rental car revenues, for the first 13 months of data, grew faster than O-D passengers in 12 of the 13 months. In the final six months, rental car revenues have fallen behind. During that same period, there was a 20 percent increase in TNC trips to/from the airport, but again, it is unclear whether the TNC growth came from taking market share from the rental car companies.

Absent clearer indications of impacts by the TNCs on parking and rental cars, the requirements in this section remain as provided, but open for discussion with the SLCDA in terms of how best to consider them as the Master Plan moves into alternative concept development and evaluation.

3.5.8 Landside Facility Requirement Summary

The following is a brief summary of landside facility requirement conclusions.

3.5.8.1 Roadway Facility Requirements Summary

Terminal Area Roadways – Five locations are flagged for consideration for improvements which will help SLCDA meet LOS standards (Reference **Table 3-38**):

- The future rental car return ramp.
- The future exit from the rental car ready/return at the ground level of the new garage.
- Terminal Drive on the inbound approach has three critical locations:
    - Current and future weaving area between the return-to-terminal ramp entering on the left and the exit to 3700 West on the right
    - The future four-lane segment downstream of the left exit to the Park'n'Wait lot.
    - The future final approach to the terminal curbs (three lanes) serving only the traffic for the POV curbs (upper curb at Departures, and outer curb at Arrivals).

Terminal Curb Roadways – By PAL 3 the center arrivals curb serving TNCs and off-airport parking shuttles will degrade to a LOS C during the late evening arrivals peak, and to LOS D during the midday departures peak. With other commercial curbs operating well during these same conditions, reassignment of the various modes to better balance volumes on the curbs may achieve the targeted levels of service for all. (Reference **Table 3-39**)

3.5.8.2 Parking Facility Requirement Summary

Public Parking – To meet future needs in PAL 3, public parking in the terminal campus needs to increase from a total of 14,063 spaces to a total of 20,120, an increase of 6,057 spaces. This need assumes that there will be no required closures of the parking garage to redirect traffic to a dedicated long-term parking facility. (Reference **Table 3-41**)

Employee Parking – Peak hour deficits occur in PAL 2 as the main employee lot begins to exceed capacity. (Reference **Table 3-45**)

3.5.8.3 Rental Car Facility Requirements Summary

Rental Car Ready Return – Ready-return spaces were determined using 4.0 turns per day as the target that balanced customer satisfaction (low wait times), capital cost, and rental car staffing operating costs. These spaces are currently deficient and remain so throughout the planning period under future facility conditions. (Reference **Table 3-46**)

Rental Car Storage - Rental car storage requirements are based on providing adequate availability of cars for customers without requiring extensive waits for a vehicle. Using weekly average rental car availability deficits derived from average daily deficits, the spaces required to meet average demand levels was determined to be deficient throughout the planning period. (Reference **Table 3-46**)

Rental Car QTA – The number of service positions required in the QTA are based upon the idea that the surplus of cars returned over the weekend all need to be ready by the start of the peak Monday rental day. QTA service positions are, and remain deficient, throughout the planning period. In the case of the QTA, the number of service positions required would decrease to 75 percent of the value in **Table 3-46** if the QTA were operated for 16 rather than 12 hours per day.

3.6 AIR CARGO CAPACITY AND REQUIREMENTS

This portion of the Facility Requirements chapter addresses air cargo requirements for both passenger aircraft that also carry cargo and mail or "belly cargo" and air cargo and mail carried by the dedicated air cargo airlines through the 20-year master plan time frame.

Dedicated air cargo airlines at SLC include integrated carriers, freighters, and e-commerce transportation providers. FedEx, UPS, and to some extent DHL are integrated carriers that provide the full range of logistic services, not just transportation. Freighters are airlines that are dedicated to carrying only cargo and do not operate as frequently, such as Atlas, or are other airlines operating on-demand services. E-commerce transportation are customer-focused shippers that provide transportation; these airlines are continuing to emerge and include Amazon.

E-commerce is accelerating quickly and has become an increasingly important part of global trade. Over two billion consumers will be regularly shopping online, completing approximately 13.5% of total retail consumption[18]. E-commerce is forecasted to ultimately drive a change in the air freight industry and require airlines to consider where air freight hubs can expand as "availability in existing logistics buildings at mature cargo hubs[19] are at historic lows[20]. SLC is one of twelve airports that is "well-suited to capitalize on this global cargo boom, provide authorities take proper action today to invest in required infrastructure.[21] "It is important to note that "historically e-commerce orders have overwhelmingly flowed from Asia into the US and other western nations. The boom in cross-border e-commerce is rebalancing these flows whereby more goods that originate in the West are flowing into Asia"[22].

Customer-focused shippers like Amazon are developing both sortation and fulfillment facilities on airports. This is having an impact on leasehold areas, building sizes, landside, and security[23] requirements.

---

[18] Internet: https://www.accenture.com/_acnmedia/PDF-10/Accenture-APAC-China,-d-,v10-Infographic.pdf. Accenture, *The Future of Commerce has Arrived: Understanding the New Asian Customer*.

[19] Internet: https://www.supplychaindive.com/news/air-cargo-boom-real-estate-implications/542344/. *International e-commerce is taking off and airports better get ready,* Ben Cromwell, senior managing director and e-Commerce Advisory Group practice leader at Cushman & Wakefield, November 15, 2018, p 4.

[20] John F. Kennedy International Airport (JFK); Los Angeles International Airport (LAX); Miami International Airport (MIA); San Francisco International Airport (SFO); Chicago O'Hare International Airport (ORD); New Liberty International Airport, (EWR); George Bush Intercontinental Airport (IAH); Dallas-Fort Worth International Airport (DFW); and Hartsfield-Jackson Atlanta International Airport (ATL), Internet: https://www.supplychaindive.com/news/air-cargo-boom-real-estate-implications/542344/. *International e-commerce is taking off and airports better get ready,* Ben Cromwell, November 15, 2018, pp. 1-7.

[21] Internet: https://www.supplychaindive.com/news/air-cargo-boom-real-estate-implications/542344/. *International e-commerce is taking off and airports better get ready,* Ben Cromwell, November 15, 2018, p 6.

[22] Internet: https://www.supplychaindive.com/news/air-cargo-boom-real-estate-implications/542344/. *International e-commerce is taking off and airports better get ready,* Ben Cromwell, November 15, 2018, p 2.

[23] The U.S. Transportation Security Administration (TSA) and Customs and Border Protection (CPB) are both study the issues of screening e-Commerce. Customer expectations around e-Commerce include expedited handling and tracking that drive the need to reassess and redesign some of the traditional ways airlines, forwarders, cargo ground handlers and truck companies have done business, Internet: https://www.freightwaves.com/news/aircargo/ecommerce-cns-partnership-conference/, e-Commerce is the Hot Topic for Air Cargo at the Upcoming CNS Partnership Conference, Jesse Cohen, April 21, 2019.

Recently, Amazon opened a new 855,000 square foot customer fulfillment center adjacent to SLC[24]. While there are no plans to connect the fulfillment center with the Airport, SLC should be prepared to address either through direct connections or a standalone Amazon facility. Already, Amazon Air is flying to 20 destinations across the U.S. using B-767 and B-737 aircraft and operated by ABX Air, Atlas Air, Air Transport Services Group, and Southern Air.[25]

At this time, SLC is primarily serviced by integrators but there are also occasional freighter and e-commerce operations. Facility requirements are identified for the two largest integrated carriers, FedEx and UPS. All other air cargo integrators, freighters, and e-commerce operators are combined in "dedicated air cargo carriers".

3.6.1 Background

These facility requirements address combination carriers and dedicated air cargo carriers. Different approaches are taken for each since the two function differently. Passenger airlines carry belly cargo and mail as part of their overall revenue strategy but it is not their main function whereas air cargo handling is the major function of the dedicated air cargo carriers. For dedicated air cargo airlines, the customers criteria is for delivery of parcels by a specified time with no regard for routes, type of aircraft, etc.

Mail is carried by both passenger and dedicated air cargo airlines. SLCDA tracks mail statistics separately by weight but not by airline. However, statistics by airline for cargo does include mail poundage. Therefore, air cargo tonnage forecasts do account for mail but does not separate it from cargo.

Air cargo facility requirements summarizes the estimated facilities necessary to meet forecasted demand levels through the 20-year planning period for: cargo warehousing building; aircraft parking and maneuvering areas; storage for containers and GSE equipment; truck docks and truck dock maneuvering areas; and, vehicular parking.

Maneuvering areas refer to pavement that is used for positioning aircraft on the apron or trucks at a truck dock plus the pavement associated with circulation and movement. For aircraft, this includes taxilanes and the area extending out to the Taxilane Obstacle Free Areas (TOFA). For trucks, this includes truck vehicular lanes, service roads, and maneuvering areas.

Where practices by particular airlines are unique to that carrier, modifications of general industry-wide criteria are made. The best example is UPS. From interviews with UPS, the carrier has a practice to minimize space at airports and move as much cargo from off-site warehouses as it can. UPS sorts air cargo both on the air cargo apron as well as on the pavement adjacent to the truck docks. While aviation air cargo forecasts indicate significant future growth for UPS, the carrier indicates it does not have plans

[24] Internet: https://www.sltrib.com/news/2019/04/17/amazon-opens-its-new-salt/, Amazon opens its new Salt Lake City center – ant it is loaded with Robots, *The Salt Lake City Tribune*, Tony Semerad, April 17, 2019.

[25]Internet: *"Amazon's Prime Air cargo jet fleet is bigger than ever and has a new name"*, Jim Hammerand, Houston Business Journal. Houston, Texas, December 30, 2017.

to expand the warehouse facility on-site. At the same time, UPS does plan to move containers currently stored on-site to the off-site facility, opening up additional pavement for sortation on the pavement.

Therefore, planning criteria use for air cargo are based in part on interviews with stakeholders, common industry practices, and general practices of specific airlines at SLC.

3.6.2 Planning Criteria Used for Facility Requirements

Aviation industry planning standards for air cargo facilities are adhered to wherever possible but also take into consideration interviews with tenants and presumed continuation of practices particular to an airline.

3.6.2.1 Cargo Buildings

Forecasts consider different characteristics for cargo buildings, passenger carriers and dedicated air cargo carriers since they are entirely different functions. Building needs will be addressed in terms of building square footage.

Most often air cargo facility capacity is measured through the amount of air cargo handled per square foot. Most studies indicate air cargo facilities that operate at approximately one metric ton of cargo per square foot of building are the best balanced. Major cargo airports including Los Angeles International Airport and Hong Kong International Airport can exceed this level of capacity through greater efficiency. At SLC, FedEx operates at 1.46 tons of cargo per square foot of building. Smaller airports that do not have specialized cargo equipment or have older or repurposed buildings have much lower utilization, as low as 0.4 tons per square foot. This is also true of belly cargo facilities of passenger airlines where cargo handling is an important but secondary function.

For belly cargo, Table 8-2 of the 2015 Report identified a range of 0.22-0.63 tons per square feet.[26] This may be function of the passenger airlines having cargo buildings that date from the 1970s or 1980s to match demand at that time. At SLC, this is the case regarding belly cargo facilities. Airlines have cargo space in multiple buildings. As a result, the facility requirement indicates a surplus of space but that surplus of space is not indicative of the large number of airlines, each needing separate belly cargo areas for its particular use.

However, there was a period when the average aircraft size went down and passenger airlines could not carry as much cargo. FedEx and UPS picked up the demand. Today, TSA screening requirements have suppressed demand for the combination carrier. Such low capacity ratios may be more an issue that the passenger carriers are just operating with buildings that are too large and it is not economical to alter them.

Replacement of older facilities for belly cargo at major international gateway airports like Los Angeles International or John F. Kennedy International is a consideration. As a result of the significant number of wide body passenger aircraft operations, belly cargo is a much bigger business. At this time, this is not an

[26] National Academies of Sciences, Engineering, and Medicine, 2015, *Air Cargo Facility Planning and Development Final Report, Washington, D.C.:* The National Academies Press, Chapter 8: Air Cargo Facility Requirements, Table 8-2 Air Cargo Facility Requirements Ratio Matrix, pp, 8-11.

important issue for SLCDA but could be considered an emerging issue for consideration toward the end of the 20-year master plan time frame. If Delta's announced plans to begin non-stop operations to Asia materialize and result in greater success than anticipated, there may be opportunities for substantial belly cargo growth at SLC.

At SLC, each of the facilities were evaluated in terms of how they compare to these ratios. For belly cargo, Delta operates at 0.45 tons per square foot which is within the range anticipated. The 0.45 tons per square foot factor was applied to Delta forecasts and other belly cargo facilities at SLC. Interviews with Delta indicate that they soon will be needing additional building space.

While both UPS and FedEx operate well beyond the 1.0 tons per square foot general capacity ratio, each carrier approaches their facilities differently. More recently, a higher capacity ratio of 1.25 tons per square foot has been used and better reflects the nature of today's air carrier carriers. This criteria will be used for air cargo building facility requirements.

3.6.3 Cargo Apron

Peak hour fleet forecasts for each of the integrated carriers were used for estimating apron needs. Apron requirements assume the long-term parking positions will be like what is existing today. Aircraft parking positions for mainline and feeder aircraft will each be served by a taxilane, service road, and maneuvering areas.

There is little belly cargo apron for dedicated aircraft parking; it is primarily used for storage and loading/unloading of containers.

3.6.3.1 Other Cargo Facility Requirements

Factors for facility requirements for GSE/storage areas, truck docks and maneuvering areas, and vehicular parking requirements are also discussed in the *2015 Air Cargo Facility Planning and Development Final Report*. Similarly, general ranges for facility requirements were discussed and applied to replicate existing conditions at SLC. Not unexpectedly for a major hub airport with wide-ranging sizes of airline operations by both passenger and dedicated air cargo airlines, general criteria does not apply very well and often provide conflicting results. For example, if one applies the ratio in the 2015 Report of 10 truck docks per 20,000 square feet of building space, the number of estimated truck docks needed far exceeds current levels. This may very well be because SLC is a regional hub with substantial cargo coming in on mainline carriers and distributed via feeder carriers.

Interviews with the largest airline tenants both for passenger and dedicated air cargo carriers indicated their space requirements for buildings, aprons, storage areas, and vehicular parking would need to consider expansion within the next five years. During interviews, the largest passenger carriers (Delta and Southwest) and dedicated air cargo carriers (FedEx and UPS) indicated their cargo facilities were at or nearing capacity. For FedEx and UPS, space for container storage, truck docks, and vehicular parking was at or nearing capacity as well. Because of the unique characteristics for each operation and that major operators are nearing capacity, it was assumed for these other facility requirements that needs would be determined using the percentage of growth in cargo.

3.6.3.2 Passenger and Dedicated Air Cargo Carrier Facility Requirements

The following sections provide factors for passenger airline belly cargo facility requirements in the South Cargo Area and for dedicated air cargo carriers in the North Cargo Area.

3.6.4 South Cargo Area

Specific comments for each airline not identified in **Table 3-49** are provided in bullet points below and includes information not found in the Inventory Chapter.

3.6.4.1 Delta

- Additional wide body aircraft operations in the future could increase the need for additional space dedicated to belly cargo.
- The current building will need to be relocated if/when Taxiway G is realigned.
- There is no apron parking and maneuvering/deicing at this facility.

3.6.4.2 Southwest

- Southwest leases approximately 35% of Joint Cargo Building #1 for a total of 10,500 square feet composed of three lease areas:
  - The largest lease area is on the north end of the building with 4,900 square feet of cargo area, 900 square yards of GSE/Container/Storage area between the building and the vehicle service road, and five truck docks
  - The second lease area is in the center of Cargo Building #1 comprising of 3,300 square feet of cargo area, 600 square yards of GSE/Container/Storage area between the building and the vehicle service road, and three truck docks
  - The third lease area is south of the center of Cargo Building #1 consisting of 2,300 square feet of cargo area, 600 square yards of GSE/Container/Storage area between the building and the vehicle service road, and two truck docks
- There is RON apron parking east of the building.

3.6.4.3 All Other Passenger Airline Cargo

- Three areas comprise the other passenger airline cargo area:
  - Air General handles cargo for Alaska Air, United cargo, and American cargo at the Consolidated Cargo Facility. This facility has 29,500 square feet of air cargo area, 2,600 square yards of GSE/Container/Storage area between the building and the vehicle service road, and ten truck docks
  - G-2 Secure handles cargo for American cargo, SkyWest, and Southwest in a small portion (approximately 5%) of the Joint Cargo Building #1 which consists of 1,300 square feet of cargo area, 300 square yards of GSE/Container/Storage area between the building and the vehicle service road, and one truck dock
  - SkyWest leases Joint Cargo Building #2. It has 7,000 square feet of cargo area, 1,500 square yards of GSE/Container/Storage area between the building and the vehicle service road, and three truck docks

- There is RON apron parking east of Joint Cargo Building #1 and #2 that SkyWest uses temporarily for containers.
- Other Passenger Airline Cargo operators are American, Alaska, Compass, Frontier, Horizon, SkyWest, and United.

Table 3-49 provides Facility Requirements for Passenger Airline Cargo.

TABLE 3-49 PASSENGER CARGO REQUIREMENTS

	Criteria	Requirements				
		2018 Existing	2018	PAL 1	PAL 2	PAL 3
Freight (tons)	Forecast	21,200	21,200	23,100	25,150	29,850
Cargo Building (sf) (1)	0.45 (tons/sf)	83,000	47,100	51,300	55,900	66,300
GSE/Container/Storage (sy)	Percent Increase of Cargo Forecast	17,400	17,400	18,900	20,600	24,500
Truck Docks		33	19	20	22	26
Truck Parking/Maneuvering (sy)		6,800	3,900	4,200	4,600	5,400
Vehicular Parking		128	73	79	86	102
Acreage		6	5	5	6 (2)	7 (2)

Source: RS&H Analysis, 2019

(1) This is cargo storage area only. Does not include an airline's office space or other non-airline tenant's square footages within a building.

(2) Does not include potential space for an increase of belly cargo operations due to more frequent activity by wide body aircraft.

3.6.5 North Cargo Area

Specific comments for each airline not identified in **Table 3-50** are provided in bullet points below and includes information not found in the Inventory Chapter.

3.6.5.1 FedEx

- The East apron is shared area between FedEx and UPS. For purposes of Facility Requirements, it was assumed that the east-west vehicle service road on the apron is an approximate boundary.
- The existing apron parking and maneuvering area is marked for five ADG IV wide body aircraft and 12 ≤ADG II aircraft with an existing peak demand of 5 ADG IV, 1 ADG III and 7 ADG II. **Table 3-51** provides the existing peak hour demand and future demand for air carrier and feeder operations for PAL 1, PAL 2, and PAL 3. Assumptions for apron parking requirements for various existing and future aircraft that would be parked on the FedEx apron.
- **Table 3-52** provides apron parking requirements for various existing and future aircraft that would be parked on the FedEx apron.
- Deicing takes place on the concrete collection area, 38,700 square yards, on the FedEx ramp.

3.6.5.2 UPS

- The East apron is shared area between UPS and FedEx. For purposes of Facility Requirements, it was assumed that the east-west vehicle service road on the apron is an approximate boundary.

- There is also a shared apron area between UPS and DHL on the South apron. It is assumed the north-south vehicle service road that runs between them an approximate border. During interviews, UPS indicated a need for immediate additional ramp for feeder aircraft as verified in **Table 3-50** below.
- Existing apron parking and maneuvering area is marked for four ADG IV aircraft and 9 feeder aircraft with an existing peak hour parking demand of 3 ADG IV, 5 ADG II and 6 ADG I. **Table 3-51** provides the existing peak hour and future demand for air carrier and feeder operations for PAL 1, PAL 2, and PAL 3.
- **Table 3-52** provides assumptions for apron parking requirements for various existing and future aircraft that would be parked on the UPS apron.
- Deicing takes place in the designated deice boxes marked in green on the ramp. The deicing area is currently 37,600 square yards.

3.6.5.3 Other Dedicated Air Cargo Carriers

- The greatest percentage of other dedicated air cargo carriers is carried by DHL.
- Amazon may obtain their own aircraft, including narrow body aircraft such as the B737-800 or wide-body aircraft such as the B767-300.
- DHL Building, apron parking and maneuvering, truck docks, truck parking and maneuvering and vehicular parking exceed facility requirements throughout planning period. In addition to truck and vehicular parking area, DHL has 2,345 square yards of fenced-in parking for delivery vans.
- Existing apron parking and maneuvering area is marked for 2 ADG III aircraft and the existing aircraft parking demand during peak periods is one ADG III. **Table 3-51** provides the existing peak hour demand and future demand for air carrier operations for PAL 1, PAL 2, and PAL 3; currently, there are no feeder operations during peak hour. Assumptions for apron parking requirements for various existing and future aircraft that would be parked on the apron serving other dedicated air cargo carriers.
- **Table 3-52** provides apron parking requirements for various existing and future aircraft that would be parked on the apron of dedicated air cargo carriers.
- Deicing takes place in the designated deice boxes marked in green on the ramp. The deicing area is currently 6,800 square yards.
- Any additional GSE/Container/Storage space requirements can be accommodated on the excess aircraft apron parking area.

Table 3-50 provides Facility Requirements for Dedicated Air Cargo Carriers.

TABLE 3-50 DEDICATED AIR CARGO FACILITY REQUIREMENTS

	Criteria	Requirements				
		2018 Existing	2018	PAL 1	PAL 2	PAL 3
Freight (tons)	Forecast	169,850	169,850	190,650	214,200	272,000
Cargo Building (sf) [1]	1.25 (tons/sf)	142,900	135,900	152,500	171,400	217,600
Narrow/Wide body Apron Parking and Maneuvering (sy) [2][3]	Forecast	128,000	100,600	110,300	128,000	154,300
Feeder Apron Parking and Maneuvering (sy) [2][3]	Forecast	43,200	60,000	62,700	83,000	87,600
Deicing (sy) [4]	Forecast	83,100	87,300	99,300	118,600	147,800
GSE/Container/Storage (sy)	Percent Increase of Cargo Forecast	56,300	56,300	63,200	71,000	90,200
Truck Docks		27	26	29	32	41
Truck Parking/Maneuvering (sy)		23,600	22,400	25,100	28,300	35,900
Vehicular Parking		349	332	372	418	531
Acreage		**55**	**52**	**57** [5]	**68** [5]	**81** [5]
Acreage Surplus / (Deficit)			**3**	**(2)**	**(13)**	**(26)**

Source: RS&H Analysis, 2019

(1) This is cargo storage area only. Does not include an airline's office space or other non-airline tenant's square footages within a building.

(2) Apron parking and maneuvering includes aircraft parking and taxilane.

(3) N/A - From interviews with UPS, there are no plans to increase the size of the building. In the future, all cargo will be sorted and containerized at their off-airport sort facility that is doubling in size. Additional truck maneuvering area is assumed to be accommodated by that portion of existing GSE/Container/Storage square yardage pavement which is now stored in containers that will be moved to the off-site sort facility.

(4) Deicing occurs on and is included within the facility requirement for narrow/wide body and feeder aprons. However, this category does indicate the incremental need for deicing areas as all cargo aprons expand.

(5) Does not include potential space for an increase of e-Commerce operations.

Table 3-51 provides the existing and forecast peak hour demand for apron parking positions for dedicated air cargo carriers, both for air carrier and feeder aircraft operations.

TABLE 3-51 PEAK HOUR DEMAND FOR DEDICATED AIR CARGO AIRCRAFT

	Criteria	Requirements 2018 Existing	2018	PAL 1	PAL 2	PAL 3
		FedEx				
Narrow/Wide body Aircraft	Forecast	2 A-300 2 B-757 1 MD-11	5 D-IV	6 D-IV	7 D-V	8 D-V
Feeder Aircraft	Forecast	1 AT43 5 C-208 2 E120	8 B-III	8 B-III	9 B-III	10 B-III
		UPS				
Narrow/Wide body Aircraft	Forecast	1 B-757 1 B-767 1 A-300	3 C-IV	4 C-IV	4 D-V	5 D-V
Feeder Aircraft	Forecast	5 B190 6 BE99	11 B-II	12 B-II	13 B-III	14 B-III
		All Other				
Aircraft	Forecast	1 B-737	1 ADG III	1 ADG III	1 ADG III	2 ADG III

Source: RS&H Analysis, 2019

Table 3-52 provides apron parking requirements for various existing and future aircraft that would be parked on the apron of various integrated carriers. The CRJ-200 freighter conversion is not identified by an airline for SLC, however it is representative of a larger feeder aircraft that might be anticipated to become part of the fleet in the next 20-years since many larger feeder aircraft may need to be replaced in the future due to age or need for larger capacities.

TABLE 3-52 REPRESENTATIVE AIRCRAFT IN AIRLINE FLEETS FOR DEDICATED AIR CARGO CARRIERS

Aircraft designator	Aircraft Model	ADG	Envelope (sy)
A333 (1)	Airbus A330-300	V	6,241
AT43	ATR-42-300/320	III	1,457
AT72	ATR-72	III	1,687
B190	Beechcraft 1900C	II	880
B734	Boeing 737-400	III	2,147
B763	Boeing 767-300	IV	4,464
B777 (1)	Boeing 777F	V	6,241
C208	Cessna 208	II	715
CRJ2 (1)	CRJ 200 Freighter Conversion	II	1,210
E120	Embraer 120	II	990
MD11	McDonnell Douglas MD-11	IV	5,009

Source: FAA Aircraft Characteristics Database; RS&H, 2019

(1) Projected design aircraft to use air cargo apron.

3.6.6 Air Cargo Summary

While these facility requirements identify future facilities needs for passenger cargo and dedicated air cargo carriers, there are significant potential opportunities that cannot be quantified that need to be kept in mind during alternatives analysis.

For passenger airlines, in particular Delta, any future change in route structure that introduces additional wide body aircraft on a frequent basis, particularly to Asia, may generate a need for additional areas for handling belly cargo.

E-Commerce could have a significant impact upon the land requirements for air cargo facility development in the future. As mentioned above, SLC is being considered as a potential alternative airport to accommodate e-Commerce operators as a result of the lack of space available at other cargo hubs. Further, operations like Amazon conduct business around the clock. This may have an operational impact upon airlines such as DHL, UPS, and FedEx.

While these facility requirements for passenger and dedicated air cargo airlines cannot forecast any specific size areas needed, it is prudent to give this serious consideration in the development of master plan alternatives.

3.7 UTILITY INFRASTRUCTURE REQUIREMENTS

Utilities at SLCIA include electrical power, sanitary sewer, stormwater, water, communication, aviation fuel and natural gas. The existing utility infrastructure was evaluated to determine deficiencies. Evaluation of the utility infrastructure examined major trunk lines, redundancy, materials, and ability to accommodate existing and future demand.

The following subsections describe each utility at SLCIA, deficiencies and recommendations to improve the infrastructure. Additional details on utility infrastructure at SLCIA can be found in **Appendix X.**

3.7.1 Electrical Utilities

The on-airport electrical system is adequate for today's needs. The Airport has purchased additional capacity for future demand in an underground duct bank to be used as a secondary power source. From discussions with SLCIA staff, on-airport electrical system information and survey varies in age and detail. It is recommended a study be conducted to inventory the existing system and determine future needs of the on-airport electrical system.

Electrical power service to SLCIA is supplied by Rocky Mountain Power through overhead and buried lines. As reported by Rocky Mountain Power, the existing trunk lines that feed power to the airport are adequate. It is recommended that SLCIA staff continue to coordinate with Rocky Mountain Power during the planning phase of any development that would necessitate large power requirements.

The electrical utilities adjacent to the airport also include major transmission lines serving other customers. On the north side of the airport are two high voltage overhead transmission lines that run east to west in a near perpendicular configuration to the runways. The lines extend around the north west corner of airport and connect to a substation in the development west of Runway 16R-34L, as can be seen in **Chapter 1, Figure 1-37**. Discussions with Rocky Mountain Power suggest no deficiencies with the existing lines. They have an indefinite lifecycle and as components become warn or faulty, they are replaced at the expense of the utility provider.

While not a deficiency of the lines themselves, the height and location of the lines north of the airport are an obstruction for certain aircraft departing Runway 34R and/or 34L depending on take-off weight. As described in **Section 3.2.1.2**, Runway Length Requirements, the transmission lines restrict some aircraft from operating at SLC with maximum allowable take-off weight. Additionally, the location of the transmission lines and substation to the west are within the area proposed on the current Airport Layout Plan for a possible future west runway. These factors are critical elements for consideration in the alternatives analyses, especially due to the high cost associated with relocating transmission line infrastructure.

The next chapter, **Evaluation and Identification of Alternatives**, will explore alternatives for possibly extending Runway 34R and relocating the transmission lines north of the airport based on runway length and aircraft requirements identified in this chapter. Additionally, concepts for future expansion of the airport to the west will include consideration of cost and complexity related to the existing transmission lines and substation location in that area.

3.7.2 Water

Water is supplied by the Salt Lake City Department of Public Utilities (SLCDPU). Two 12-inch water lines enter SLCIA from the southeast and a single 12-inch line enters the Airport from the north. A 12-inch loop has been constructed around the Terminal, as previously shown in **Chapter 1, Figure 1-38**. Information provided by SLCIA staff suggests most of the water lines are polyvinyl chloride (PVC); however, some of the older segments are steel, cast iron, ductile iron and asbestos cement. Generally, the water supply to SLCIA is adequate to accommodate the forecasted growth in passengers. As SLCIA implements large capital improvement projects in areas known to have asbestos cement pipes, it is recommended these pipes be removed and replaced with PVC piping.

3.7.3 Sanitary Sewer

SLCIA sanitary sewer system is largely comprised of 18-inch and 24-inch lines on the south and a 12-inch line on the north end of the Airport. The sanitary sewer system is supported by several lift stations, as previously shown in **Chapter 1, Figure 1-38**. Most of the piping for the sanitary sewer is PVC, with some reinforced concrete, vitrified clay, cast iron, asbestos cement, and HDPE pipe. Since 2010, the airport has constructed two smaller lift stations. One located west of the South Economy Parking Lot and another west of the terminal.

The existing sewer pump stations can accommodate existing demand and has enough capacity to accommodate full buildout of the two terminal concourses. If an additional concourse is needed in the future, the sewer pump station system will need to be modified and utility lines expanded to accommodate the additional demand.

A utility specific study is needed to determine how to increase capacity to serve future development, which is outside the purview of this master plan. When that study is conducted, it is recommended that the age and condition of the older infrastructure be inventoried, and a plan be created for upgrades as needed. Lastly, as SLCIA implements large capital improvement projects in areas known to have asbestos cement pipes, it is recommended these pipes be removed and replaced with PVC piping.

3.7.4 Stormwater

The stormwater infrastructure is comprised of various sized lines, 14 pump stations and five outfalls. Four of the five outfalls discharge into the Surplus Canal and the other into the City Drain. The location of the City Drain, outfalls and pump stations in relation to facilities at SLCIA is shown in **Chapter 1, Figure 1-38**. Information provided by SLCIA staff suggests stormwater pipes are made of reinforced concrete, high-density polyethylene (HDPE) and PVC. Generally, the existing stormwater infrastructure is adequate to accommodate existing conditions, but improvements are likely needed to accommodate future growth.

Discussions with SLCIA staff suggest the existing detention basins can retain all storm water if necessary and pump water into the Surplus Canal and City Drain. Currently, SLCIA discharges approximately 3-4 cubic feet per second (cfs) to the City Drain and is reaching the maximum allowable discharge rate of 90 cfs into the Surplus Canal. As SLCIA continues to grow and construct more impervious surfaces, storm water runoff will increase. With the last drainage study master plan having been conducted in 1997, there are now many elements that require new study. It is recommended a new drainage master plan be conducted to determine how to increase storm water discharge rates and on-site detention to ensure the Airport is equipped to handle future development.

The Surplus Canal located along the southern and western borders of SLCIA, collects most of the storm water runoff. The canal is owned and managed by Salt Lake County. The canal was originally constructed in the 1890s, and later enlarged with the addition of levees along the banks by the United States Army Corps of Engineers (USACE) in the 1960s. The USACE conducted a detailed inspection in 2012 that identified deficiencies with the levees and overall design of the canal. The study found the levees do not meet current USACE standards. Other deficiencies associated with the canal include vegetation growth, inadequate bank protection and slope, penetration to right-of-way, and lack of sod cover. A critical finding in the USACE study were high-risk flood hazard deficiencies. The sum of these deficiencies will need to be corrected to obtain FEMA certification.

Overall, the Surplus Canal is old and requires numerous upgrades and enhancements to ensure it functions safely and effectively in the future. Because deficiencies are located along the entire length of the Surplus Canal, there is opportunity to mitigate some deficiencies while expanding available land for aeronautical development. In the alternative's analysis, consideration will be given to modify the existing Surplus Canal to address deficiencies and increase available land for aeronautical use.

The North Point Canal is a divergence from the Surplus Canal which serves agricultural and wetland properties off airport property. The canal also feeds the ponds located on the golf course before crossing the Surplus Canal via a flume. The North Point Canal is owned and managed by the North Point Canal Company. Stormwater runoff does not flow into the North Point canal from SLCIA. The canal company has suggested they would like to see the elimination of the flume and improve how water diverts off the Surplus Canal. The ponds are currently used by the canal company for winter habitat of triploid carp. The carp are used during summer months when the canal is active to keep the canal clear of moss and algae. However, the ponds and the carp themselves are a concern for the Airport as they are an attractant for waterfowl. FAA AC 150/5300-33 Hazardous Wildlife Attracts On or Near Airports recommends a separation radius of 10,000 feet from an airport to the closest hazardous wildlife attractant. As the pond is located inside this imaginary radius, it is recommended that SLCIA staff coordinate with the appropriate agencies to remove the ponds. If the ponds cannot be removed, mitigation efforts should be undertaken to reduce the wildlife attractant elements of the ponds.

3.7.5 Other Airport Utilities

The following subsections summarize the evaluation of other utilities located at SLCIA. Location of other airport utilities is shown in **Chapter 1, Figure 1-39.**

3.7.5.1 Communication Infrastructure

Communication lines are owned and operated by either Century Link, MCI/Version and the FAA. From discussions with SLCIA staff, communication lines are adequate and meet the needs of the existing users and tenants. As SLCIA grows, additional communication lines may be needed. SLCIA should coordinate with the appropriate entity to ensure an acceptable level of service is maintained for its users and tenants.

3.7.5.2 Aviation Fuel Supply

A 6-inch steel jet fuel line supplies SLCIA from an oil refinery to the north. The line is connected from the oil refinery to the fuel tanks in the north support area. Two pump stations, one located west of the Air National Guard Based and another off 2200 West, north of the Boeing facility. The fuel line is adequate to accommodate existing and future demand. Note that currently, the oil refinery has reduced the amount of jet fuel blend produced, thus most of the fuel for the fuel farm tanks is being brought in via tanker trucks from Las Vegas and Wyoming. This is a fundamental shift in historical operational procedures and could impact fuel farm requirements in the future. As such, these factors will be considered in alternatives development regarding future fuel farm locations and connectivity to the refinery and vehicle roadways.

3.7.5.3 Natural Gas

SLCIA natural gas supply is supplied by Dominion Energy through a series of high to intermediate-high pressure lines. A 6-inch high pressure line runs east to west on the south side of SLCIA. This line provides natural gas for the Terminal and surrounding support facilities. Around the terminal are two high pressure gas loops that provide service to concessions and other terminal tenants. Another 6-inch line runs on the north side of West 2100 North and serves facilities in the north support area. Lastly, a 36-inch steel gas line, operated by Kern River, a supply company, runs along with north and west sides of SLCIA, providing service for various tenants, such as the FBOs. The natural gas infrastructure is adequate to accommodate existing and future demand.

3.7.6 Utility Infrastructure Summary

The existing utilities were determined to be a mix of new and old infrastructure. Future improvements will need to be made to the water, sewer and storm water systems to meet current design standards and support planned development. Additionally, the utility data is not comprehensive, and as such, a utility master plan is recommended to detail existing conditions and determine how best to upgrade existing infrastructure and provide future capacity. A utility master plan will identify the capacity of existing lines and determine triggering events for when systems need to be replaced and upgraded. Recommendations from the utility infrastructure master plan should be incorporated into SLCIA's CIP.

Development in both greyfield[27] and greenfield sites may require additional utility infrastructure enhancements. Additional utility considerations will be identified and determined in Chapter 4 – Identification and Evaluation of Alternatives.

[27] A greyfield site is a previously developed property that does not have known environmental containments. A greenfield site is one that has never been developed or disturbed.

3.8 GENERAL AVIATION REQUIREMENTS

This section outlines the requirements for the general aviation (GA) facilities for based and transient general aviation aircraft at SLC during the planning period based upon local, regional, and national trends. The areas evaluated in this section include general aviation aprons, aircraft hangars, and FBO facilities. The Master Plan forecast predicts a gradual and continuous change in the composition of the general aviation fleet. The number of single-engine aircraft and operations are projected to decrease throughout the planning period while multi-engine, jet engine, and helicopter based aircraft and operations are projected to increase. As a result of the change in fleet composition, the forecast predicts that at PAL 3 there will be a total of 12,331 additional aircraft operations and 13 additional based aircraft.

Separate from this Master Plan, a General Aviation Strategy Plan was completed in 2019 to recommend a SLCDA developmental action plan to accommodate GA users within the SLCDA airport system of SLC, South Valley Regional Airport (U42), and Tooele Valley Airport (TVY). Considerations from that report are included in this analysis to demonstrate that general aviation growth is expected throughout the system of airports and show those facilities that would be required if the policy decisions of the strategy plan were implemented. Implementation of the strategy plan is forecasted to result in growth of operations at U42 and TVY, resulting in a sharper decline of smaller general aviation aircraft at SLC.

3.8.1 Aircraft Storage

Understanding aircraft storage demand is an important element when considering facility requirements for general aviation based aircraft. The quantity and type of hangar space is driven by many different factors such as total number of based aircraft, fleet mix, local weather conditions, airport security, cost, and user preference. This section outlines requirements for the types of hangar storage provided at SLC including single T-hangars, twin T-hangars, shade hangars and box hangars. These hangar types are generic terms for different sized hangars. T-hangars are small hangars that are typically arranged so small aircraft are “nested” next to each other in alternating directions in individual bays within the facility. The twin T-hangars are similar, but approximately 30 percent larger than single T-hangars. Shade hangars are arranged in a similar fashion to T-hangars, but only provide a protective roof. Box hangars are standalone buildings of varied dimensions, which at SLC range from 5,000 to 46,000 square feet. The space within a box hangar may serve as shared hangar space that accommodates multiple aircraft or the hangar may only provide storage for one aircraft often with an office or lounge area built on the side of the building.

The hangar types used by based aircraft, determined by historical distributions of aircraft at SLC and industry trends, are included in **Table 3-53**. These percentages were used as planning parameters to determine future hangar requirements.

TABLE 3-53 SLC GENERAL AVIATION HANGAR PLANNING PARAMETERS

	Single T	Twin T	Shade	Box
Single-Engine	55%	5%	15%	25%
Multi-Engine		40%	5%	55%
Jet Engine				100%
Helicopter				100%

Source: RS&H Analysis, 2019

More than 75 percent of the box hangar facilities at SLC are provided by TAC Air and Atlantic Aviation, most of which are shared hangar space. Due to this prevalence of shared hangar space facilities provided by the FBOs, the existing average box hangar space per based aircraft of 6,300 square feet is used to determine appropriate space requirements for future box hangars needs.

Using the planning parameters, hangar requirements were determined based on the forecasted number of based aircraft at each PAL. The hangar requirements needed at each PAL for each hangar type is shown in **Table 3-54**.

TABLE 3-54 GENERAL AVIATION HANGAR REQUIREMENTS

Hangar Type	2017	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Single T-Hangar				
Hangar Rows	7	5	5	4
Hangar Bays	116	95	90	81
Square Footage	145,000[1]	110,000	104,000	94,000
Surplus / (Deficit)		35,000	41,000	51,000
Twin T-Hangar				
Hangar Rows	1	1	1	1
Hangar Bays	27	27	27	27
Square Footage	38,000	38,000	38,000	38,000
Surplus / (Deficit)		0	0	0
Shade Hangar				
Hangar Rows	2	1	1	1
Hangar Bays	54	28	27	25
Square Footage	54,000	28,000	27,000	25,000
Surplus / (Deficit)		26,000	27,000	29,000
Box Hangar				
Hangars	28	37	39	43
Based Aircraft	103	125	129	142
Square Footage	645,000	785,000	814,000	897,000
Surplus / (Deficit)		(140,000)	(169,000)	(252,000)
Total				
Square Footage Required	834,000	889,000	907,000	969,000
Surplus / (Deficit)		(55,000)	(73,000)	(135,000)

[1] Existing single T-hangars include 19 hangar bays that are unrentable due to structural deficiencies

Source: SLCDA; RS&H Analysis, 2019

The most recent of the existing row of shade or T-hangars was constructed in 1984, and in many cases the condition of the hangars reflects this age. Of the 126 total single T-hangar bays at the Airport, 19 are deemed un-rentable due to structural deficiencies. The forecasted 51,000 square feet surplus of T-hangars will allow for the removal of unusable or difficult to maintain hangar facilities as well as areas for potential redevelopment.

The General Aviation Strategic Plan recommended the forecasted need through the planning period for more than 250,000 additional square feet of box hangars be developed by the FBOs at the Airport. As discussed in **Section 1.9, General Aviation Facilities**, zones of control for future development have been determined for each FBO to accommodate demand, removing the need of the SLCDA to construct additional hangar facilities. The alternatives analysis will determine if these zones will be able to accommodate the demand forecasted.

Though this analysis identified specific requirements based on hangar type, the real use of this analysis is to determine the total amount of land that will be required in order to meet future demand. This is because actual hangar development is based primarily on financial economics and business decisions of the developer. For these reasons, land reservations must be created to ensure space is available for future hangars. For example, either FBO may find greater economy in building one large hangar and housing multiple aircraft instead of building multiple smaller hangars. Future land reservations must be flexible, and conceptual layouts must be organized to provide a functional spatial layout.

3.8.2 General Aviation Apron Requirements

General aviation apron areas provide parking and circulation for transient aircraft, those aircraft that are not based at the airport, and local aircraft, those based at the airport. For convenience and ease of movements, the parking apron area is typically located in close proximity to general aviation terminal buildings, fuel delivery systems, and ground transportation. For this analysis, the general aviation apron was divided into three areas to determine the appropriate future requirements including aircraft parking apron, box hangar apron, and circulation apron. Aircraft parking apron is pavement that is used to temporarily park transient aircraft. Box hangar apron is space leased to a based aircraft tenant of a box hangar, located between the box hangar and the circulation apron. Box hangar apron allows an aircraft owner to park his or her aircraft in front of their hangar without impacting adjacent taxilane movement areas. The circulation apron is pavement that allows for the movement and taxiing of aircraft to parking areas, hangars, and services provided at the Airport.

The demand for apron space was determined using the existing and forecasted peak day operations and fleet mix for each aircraft type. Using the fleet mix allows for consideration of appropriate apron space needed as larger aircraft, such as business jets, take up more space on the apron than smaller single engine aircraft. The facility requirements for the general aviation apron area are shown in **Table 3-55**.

TABLE 3-55 GENERAL AVIATION APRON REQUIREMENTS

General Aviation Apron Area (SqFt)	2017	Planning Activity Level Requirements		
		PAL 1	PAL 2	PAL 3
Aircraft Parking Apron				
Peak Day Square Footage	635,000	675,000	772,000	996,000
Surplus / (Deficit)		(40,000)	(137,000)	(361,000)
Box Hangar Apron				
Square Footage Required	174,000	201,000	208,000	225,000
Surplus / (Deficit)		(27,000)	(34,000)	(51,000)
Circulation Apron				
Square Footage Required	1,706,000	1,647,000	1,731,000	1,785,000
Surplus / (Deficit)		59,000	(25,000)	(79,000)
Total				
Square Footage Required	2,515,000	2,523,000	2,711,000	3,006,000
Surplus / (Deficit)		(8,000)	(196,000)	(491,000)

Source: SLCDA, FAA OPSNET, RS&H Analysis, 2019

At forecasted growth levels, SLC experiences a deficiency in apron space in every category at almost every PAL level examined. As T-hangar demand decreases in PAL 1, the existing total apron square footage is nearly sufficient. However, an additional 491,000 square feet of apron space is forecasted to be required by PAL 3.

3.8.3 General Aviation FBO Requirements

TAC Air and Atlantic Aviation provide FBO terminal facilities for daily aircraft operations of tenants, pilots, and passengers. Like apron requirements, FBO terminal facilities were determined using the number of peak month/average day operations and the projected fleet mix. The projected number of individuals flying on each aircraft type within the fleet mix was used to determine the amount of space that would be required. As shown in **Table 3-56**, FBO terminal facilities are expected to be enough throughout the planning period.

TABLE 3-56 GENERAL AVIATION FBO TERMINAL REQUIREMENTS

	2017	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
FBO Terminal Facilities				
Square Footage	22,000	18,000	19,000	22,000
Surplus / (Deficit)		4,000	3,000	0

Source: RS&H Analysis, 2019

3.8.4 General Aviation Strategy Plan Considerations

The SLC Master Plan identifies facilities required to accommodate long-term general aviation requirements based upon aviation activity forecasts, as described above. Those forecasts are unconstrained and result in a slight reduction in the number of based aircraft over the 20-year time frame but a major change in the size of the fleet mix to larger aircraft.

In addition to the SLC Master Plan, the SLCDA has developed a separate General Aviation Strategy Plan. Its purpose is to maximize efficiency within the SLCDA system to the extent reasonable by providing enhanced facilities at SLCDA reliever airports. In part, the strategy plan assumes the smaller general aviation aircraft, essentially those in shade hangars and many of those in T-hangars will be attracted to SLCDA relievers as a result of enhanced facilities and services at those airports. According to industry trends and airport development in the region, in the near-term, the General Aviation Strategy Plan forecasts single-engine aircraft based at SLC to decline by half, and multi-engine aircraft to decline by 25 percent. This sharp decline will directly affect T-hangar requirements throughout the planning period, resulting in a surplus of space for that which had been used for combined single T-hangar, twin T-hangar, and shade hangars by 2037. At the same time, the number of based jet aircraft are expected to significantly increase. Along with anticipated growth by helicopters, the General Aviation Strategy Plan forecasts an additional need to accommodate box hangars throughout the planning period.

In effect, the General Aviation Strategy Plan provides alternative scenarios that will be used in the Alternatives Evaluation process of the SLC Master Plan along with alternatives developed for accommodating general aviation requirements described in **SECTION 3.1, General Aviation Requirements**.

3.8.5 Summary of General Aviation Facility Requirements

Over the next 20 years at SLC, significant jet-oriented growth is anticipated to continue, requiring additional hangars and apron for larger aircraft. In total 3,997,000 square feet of space is forecasted to be needed at PAL 3. As shown in **Table 3-57**, this is a deficit of 626,000 square feet including 135,000 square feet of hangar space and 491,000 square feet of apron. The alternatives will examine ways to address this demand.

TABLE 3-57 SUMMARY OF GENERAL AVIATION REQUIREMENTS

	2017	PAL 1	PAL 2	PAL 3
Hangars				
Square Footage	834,000	889,000	907,000	969,000
Surplus / (Deficit)		(55,000)	(73,000)	(135,000)
Apron				
Square Footage	2,515,000	2,523,000	2,711,000	3,006,000
Surplus / (Deficit)		(8,000)	(196,000)	(491,000)
FBO				
Square Footage	22,000	16,000	18,000	22,000
Surplus / (Deficit)		6,000	4,000	0
Total				
Square Footage	3,371,000	3,428,000	3,636,000	3,997,000
Surplus / (Deficit)		(57,000)	(265,000)	(626,000)

Source: SLCDA; RS&H Analysis, 2019

During alternatives analysis, it will also be necessary to consider the potential impacts to SLC that may occur as a result of implementing the General Aviation Strategy Plan. That plan considers actions at U42 and TVY that could result in attraction of aircraft from SLC. Implementation of that plan would result in a different configuration of GA facilities at SLC. Additionally, the impact of potential changes to airfield configuration, such as the realignment of Runway 17-35, may result in additional alternative for the GA area.

3.9 SUPPORT FACILITY REQUIREMENTS

Aviation support facilities at an airport encompass a broad set of functions that exist to ensure the airport can fill its primary role and mission in a smooth, safe and efficient manner. The following sections outline the requirements for different supporting facilities at Salt Lake City International Airport.

It should be noted that the overriding issue facing all support facilities is that long range development of Concourse C will require displacement of many existing support facilities. Therefore, the future facility requirements must consider not only what is needed to meet current deficits in capacity, but also to replace what exists today in a location that will work long term.

3.9.1 Aircraft Rescue and Fire Fighting

The required Aircraft Rescue and Fire Fighting (ARFF) facilities are determined based on Code of Federal Regulations Title 14 Part 139. This section evaluates the ARFF index, equipment, and station requirements.

3.9.1.1 Airport Index

Airports serving scheduled air carrier flights are required to provide facilities and equipment for ARFF. ARFF equipment requirements for FAR Part 139 airports are determined by an index ranking based on aircraft size, number and type of emergency vehicles, as well as number of scheduled daily aircraft departures.

SLC is classified as Index E based on the aircraft operations experienced at the airport. Except as provided in Part 139.319(c), the air carrier aircraft with the largest length and an average of five or more daily departures determines the ARFF Index required for an airport. The ARFF Index then determines the specific ARFF standards and equipment requirements for that airport. ARFF Index requirements for SLC are shown in **Table 3-58**. Based on the future fleet mix in the aviation activity forecast, it is expected that SLC will remain classified as an Index E facility throughout the forecast period.

TABLE 3-58 ARFF CLASSIFICATIONS AND REQUIREMENTS

ARFF Index	Aircraft Length in Feet	Example Aircraft	Required ARFF Vehicles
A	<90	Canadair Regional Jet 200 (CRJ-200)	1
B	90 - <126	McDonnel Douglas DC-9 (DC-9)	1 - 2
C	126 - <159	Boeing 757-200 (B-757-200)	2 - 3
D	159 - <200	Airbus A-300 (A-300)	3
E	>200	Boeing 777 (B-777)	3

Source: 14 CFR Part 139.315, 2018

3.9.1.2 Vehicle Requirements

Under Part 139.317, Index E requires the airport operator to have response equipment ready that hold specified amounts of dry chemical and water. Three vehicles are required for ARFF under Index E including;

- One vehicle carrying 500 pounds of sodium-based dry chemical, halon 1211, or clean agent; or

- 450 pounds of potassium-based dry chemical and water with a commensurate quantity of aqueous film forming foam (AFFF) to total 100 gallons for simultaneous dry chemical and AFFF application.
- Two vehicles carrying an amount of water and the commensurate quantity of AFFF so the total quantity of water for foam production carried by all three vehicles is at least 6,000 gallons.

The Airport currently has eight ARFF equipment vehicles, including four Oshkosh Striker 3000. In total, the ARFF vehicles at SLC provide 18,600 gallons of water capacity, 2,600 gallons of foam capacity, 3,620 gallons of sodium-based dry chemical capacity, 2,880 gallons of halotron, and 200 gallons of halon 1211. These amounts are greater than the requirements of Part 139.317 but allow for an increased ARFF response. Most of the ARFF equipment on the Airport is based at Fire Station #12, located in the North Support area. Based equipment at Fire Station #11, located in the General Aviation area, include a GMC 1-Ton 4x4 and an Oshkosh Striker 3000. **Table 3-59** shows an overview of the SLC ARFF vehicles.

TABLE 3-59 ARFF VEHICLE STORAGE CAPACITY

Vehicle	Capacity (gallons)				
	Water	Foam	Dry Chemical	Halotron	Halon 1211
Fire Station #11					
GMC 1-Ton 4x4	300 g	40 g	450 g	-	-
Oshkosh Striker 3000	3000 g	420 g	450 g	500 g	-
Fire Station #12					
GMC 1-Ton 4x4	300 g	40 g	450 g	-	-
Rosenbauer Panther 300	3000 g	400 g	500 g	460 g	-
Oshkosh Striker 3000	3000 g	420 g	450 g	500 g	-
Oshkosh TB3000	3000 g	420 g	420 g	420 g	200 g
Oshkosh Striker 3000	3000 g	420 g	450 g	500 g	-
Oshkosh Striker 3000	3000 g	420 g	450 g	500 g	-

Source: SLC Airport Certification Manual, 2018

3.9.1.3 Station Response Time Requirements

The Index E response time requirements are described in Part 139.319. Within three minutes, at least one ARFF truck must reach the midpoint of the farthest runway serving air carrier aircraft from its assigned post or reach any other specified point of comparable distance on the movement area that is available to air carriers and begin application of an extinguishing agent. Within four minutes from the time of alarm, all other required vehicles must reach the point specified above from their assigned posts and begin application of an extinguishing agent.

The two ARFF stations at SLC are optimally located to provide quick response to any point on the airfield and meet the response time requirements. Given the location of the ARFF stations, it is likely that these locations would be able to meet the response time requirements for potential future runway and taxiway expansions during the planning period. Beyond the planning period, as terminal expansion requires relocation of ARFF facilities, an alternative location that meets the response time requirements will need to be identified.

3.9.2 Fuel Storage

Fuel storage requirements at the Airport depend on the level of aircraft traffic, fleet mix, and fuel delivery schedules. Growth in commercial aviation operations and changes in general aviation aircraft fleet mix will both likely increase demand for Jet A fuel. Fuel storage requirements were determined for both commercial and general aviation. Fuel to support commercial aviation is stored in large storage tanks located in the North Support Area. Fuel for general aviation is managed by Atlantic Aviation and TAC Air and located in the General Aviation area.

3.9.2.1 Commercial Aviation Fuel Storage

The North Support Area includes a total storage capacity of 6.45 million gallons of Jet A fuel provided by six fuel tanks managed by Menzies Aviation. Fuel pipelines connect to the fuel farm and refill tanks directly from the Andeavor Logistics Salt Lake City Refinery. This allows for quick resupply of fuel into the tanks, but during times of lower production of aviation fuel due to profitability or other factors, tanker trucks are used to refill the fuel farm tanks. An underground pipe network extends from the fuel farm to the terminal area to provide hydrant fueling for aircraft gates at the passenger terminal.

An analysis was conducted to determine the necessary storage facilities for commercial fuel storage. The connectivity to the refinery typically allows for quick refueling of the fuel farm, but for times of low aviation fuel production a five-day storage demand was assumed for fuel to be available if there is a disruption in the supply chain caused by some unusual circumstance, such as a major weather event. Approximately 3.0 million gallons in 2017 would be needed for a five-day storage based on per departure fuel flowage for the average day for July, the busiest month. As shown in **Table 3-60**, the existing storage levels are enough for the planning period. At PAL 3 activity levels, the existing available storage levels can accommodate approximately eight days of fuel storage. Beyond the planning period, as terminal expansion requires relocation of fuel storage facilities, an alternative location that meets requirements will need to be identified.

TABLE 3-60 COMMERCIAL FUEL STORAGE CAPACITY

	2017	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Peak Month Average Day (PMAD) Fuel Flowage	605,000	663,000	728,000	809,000
(PMAD) Commercial Departures	377	413	453	503
5 - Day Fuel Need (Gallons)	3,025,000	3,315,000	3,640,000	4,045,000
Available Storage (Gallons)	6,450,000	6,450,000	6,450,000	6,450,000
Total Storage for 4 Day Need: Surplus / (Deficit)	3,425,000	3,135,000	2,810,000	2,405,000

Source: SLCDA, RS&H Analysis, 2019

3.9.2.2 General Aviation

In the general aviation area, both TAC Air and Atlantic Aviation manage a fuel farm. Combined, a total of 14 fuel tanks provide 307,600 gallons of aviation storage, including 43,600 gallons of 100LL and 264,000 gallons of Jet A. As a result of changes in the fleet mix of aircraft that use the airport, SLC is experiencing an increase in the usage of Jet A fuel by general aviation, while operations by aircraft that use 100LL fuel are steadily decreasing. The percentage of general aviation operations by aircraft that use 100LL fuel are expected to decrease by 11 percent from 2017 amounts by PAL 3.

Like commercial fuel storage, a five-day surplus supply of fuel was used for the analysis of fuel storage. The analysis to determine the five-day fuel demand was based on the peak month of fuel flowage, which was determined by examining historical fuel sales. The average day of the peak month was then used to determine the required gallons to satisfy a five-day demand based on the number of operations forecasted for each type of fuel.

As shown in **Table 3-61**, the existing available storage provides enough supply for five days using the planning factors applied. Based on the analysis, the 43,600 gallon storage capacity of 100LL fuel provides a surplus of approximately 39,800 gallons throughout the forecast period. In practice, the FBOs only have the 100LL fuel tanks partially refueled approximately every two to three weeks as that is all that is needed to meet demand given existing tank capacity. At existing levels the amount of 100LL fuel capacity would sufficiently meet demand for more than eight weeks. Each FBO manages at least one 100LL fuel tank, providing additional fuel storage than the minimum that would be necessary.

While the amount of Jet A fuel needed to meet the five-day demand rises sharply by PAL 3, the available storage is estimated to remain enough through the planning period. Again, as each FBO manages a separate fuel farm there is redundancy in tank storage when compared to requirements.

TABLE 3-61 GENERAL AVIATION FUEL STORAGE CAPACITY

	2017	Planning Activity Level		
		PAL 1	PAL 2	PAL 3
Peak Month Average Day (PMAD) Operations	136	143	153	175
100LL				
PMAD Operations	40	38	37	33
PMAD Fuel Flowage	758	720	690	630
5 - Day Fuel Need (Gallons)	3,800	3,700	3,500	3,200
Available Storage (Gallons)	43,600	43,600	43,600	43,600
Total Storage for 5 Day Need: Surplus / (Deficit)	39,800	39,900	40,100	40,400
Jet A				
PMAD Operations	96	105	116	142
PMAD Fuel Flowage	25,146	27,550	30,330	37,200
5 - Day Fuel Need (Gallons)	126,000	138,000	152,000	186,000
Available Storage (Gallons)	264,000	264,000	264,000	264,000
Total Storage for 5 Day Need: Surplus / (Deficit)	138,000	126,000	112,000	78,000

Source: RS&H Analysis, 2018

3.9.2.3 Sustainable Aviation Fuel

As part of sustainability initiatives, an increasing number of airlines are using sustainable aviation fuel (SAF), or biofuel, blended with Jet A fuel to reduce aircraft emissions. Certain certified sustainable aviation fuels, derived from a variety of feedstocks such as crops, are chemically indistinguishable from existing jet fuel and are used in some aircraft flying today without any loss of performance.

The largest issue for SAF remains in economies of scale occurring to increase fuel available for airlines while reducing cost of SAF to similar pricing of existing Jet A fuel. There exists the potential for this to occur, but the fuel must develop further before it will become widely available. Fuel farm alternatives in this master plan study will preserve a location that can accommodate the storage, hydrant system, and blending facility necessary for the use of sustainable aviation fuel on the Airport.

3.9.3 Airline Maintenance

Facility requirements for airline maintenance facilities are determined by the business decisions of each individual airline and are difficult to project long-term. However, to plan for the future of the Delta and SkyWest maintenance facilities at SLC, conservative overviews and assumptions of required space were developed based on inputs from these companies.

The Delta lease area in the North Support area includes an aircraft maintenance hangar, work areas, and office space, totaling approximately 120,000 square feet as well as a Delta reservation center consisting of more than 60,000 square feet. The total footprint of the leased area including the Delta aircraft maintenance hangar, aircraft apron parking, reservation center, and vehicle parking is approximately 1.1 million square feet. In discussions with Delta airline representatives, it was identified that Delta is experiencing a growing demand for aircraft maintenance at SLC. The existing Delta aircraft maintenance hangar can accommodate two or three aircraft, but this space is insufficient to meet the nightly demand for the facility. Additional space is needed in both the short-term and over the long-term. In total, at least a doubling in overall size must be planned for within the planning period.

Delta performs ground support equipment (GSE) maintenance in the South Cargo area located in a section of the Delta Cargo building. In discussion with Delta representatives, it was found that the existing maintenance facility space is enough to service the roughly 1,400 pieces of equipment that are operated today by Delta. While Delta flight operations are expected to increase, only a small number of additional equipment are expected to be added, which will not impact the capacity of the facility. Currently, the GSE fleet is gas powered, but Delta is transitioning to electric GSE with the opening of the new terminal. The transition from gas to electric GSE equipment does not impact the space requirements of the facility. If future site alternatives for this facility are evaluated in this study, location near the terminal envelope and a unified location must be considered.

SkyWest performs airline maintenance in the North Support area as well, leasing approximately 600,000 square feet of space. On their leased area they have an approximately 175,000 square feet hangar which is used for aircraft maintenance, GSE maintenance, and training facilities. SkyWest also uses an additional five aircraft parking spaces in the South Cargo area due to space constraints of their hangar apron. This South Cargo location creates challenges as the aircraft must travel a long distance between the maintenance hangar and overnight parking location. The GSE maintenance area in the hangar is used to maintain equipment for not only SLC, but other smaller airports in the region as well. The limited size of the existing building requires that some equipment must be located outside. The existing and forecasted demand SkyWest experiences necessities expansion of all maintenance facilities. In discussions with SkyWest, it was approximated that facilities could be expanded by 50 percent in size.

For a conservative estimate, space for future facilities for Delta and SkyWest of double their existing footprint will be reserved in the alternatives analysis.

3.9.4 Airport Maintenance

Airport maintenance facilities encompass approximately 1.0 million square feet located in the North Support area of the Airport, including approximately 320,000 square feet of buildings. Through discussions with SLCDA maintenance staff, each building was examined to determine a rough level of additional space needs, useful life remaining, and location requirements. **Table 3-62** shows the result of this analysis. Snow Removal Equipment (SRE) Storage, Airfield Maintenance, and Sand, Salt, & Urea Storage are among the buildings which will necessitate the largest growth to accommodate demand.

TABLE 3-62 AIRPORT MAINTENANCE BUILDINGS

Building Number	Square Footage	Additional Square Footage Needed at PAL 3	Space Needed Type	Useful Life Remaining (Years)
1. Airfield Maintenance	39,000	20,000	Work	5 to 8
2. Sand, Salt, & Urea	35,000	17,500	Storage	5
3. Vehicle Storage East	37,000	10,000	Storage	5 to 8
4. Vehicle Maintenance	70,000	15,000	Work	10
5. Maintenance Cold Storage	15,000	3,750	Storage	5 to 8
7. Airfield Paint Storage	6,400	2,000	Storage	20
13. Airfield Electrical Vault	8,800	0	N/A	30
14. Airport Greenhouse	4,600	0	N/A	3 to 5
15. Facility Maintenance #2	30,000	7,500	Work	18 to 20
16. Cold Storage #2	12,000	0	N/A	18 to 20
21. SRE Storage	46,000	23,000	Storage	40 to 45
26. Snow Chemical Storage	16,000	4,000	Storage	15 to 20
Total	319,800	102,750		

Source: SLCDA, 2019

The existing airport maintenance space does not meet the storage and workspace needs at the Airport. With the increasing size of the new terminal, and likely increase in pavement areas to maintain as aprons, runways and taxiways are expanded necessitating additional staffing, equipment, and materials, increases in the sizing of space and facilities will be needed. To handle the current shortage and expected growth, the maintenance campus is estimated to require an increase of the total campus envelope by 30 percent, which equates to roughly 300,000 square feet.

Many of the existing maintenance facilities were built 30 to 40 years prior and are nearing the end of their useful life. This is exasperated by industry changes, such as environmental changes and the use of SRE equipment that is larger than the equipment for which the building was designed. Additionally, several of the material storage buildings are dealing with the corrosion effects caused by the stored materials. In addition to the building expansions that are required for various maintenance needs, the life expectancy of many of the existing facilities is less than eight years, Alternatives will need to be identified to replace existing facilities before they are no longer useable.

Current space is divided by the 1200 S roadway and separated between several buildings. Consolidation of the maintenance facilities would allow for an increased ease of use as employees often travel between multiple buildings during all weather conditions. Additionally, in consideration of the potential to provide 100% employee screening, the alternatives analysis will examine locations to provide this capability. Of the facilities included in **Table 3-62**, at least elements of all buildings except #13 – Airfield Electrical Vault, #16 Cold Storage #2, #21 SRE Storage, and #26 Snow Chemical Storage can be moved to a landside facility. In total, at PAL 3, future facilities should provide 298,900 square feet of buildings for the airside functions and 123,650 square feet of buildings for landside functions with associated apron and parking as well as the ability for expandability.

3.9.5 Airline Glycol Storage and Recovery

During aircraft de-icing operations, SLCDA collects de-icing fluid in order to remove used propylene glycol from runoff and resell the reclaimed fluid. From the four commercial service runway end de-icing pads at SLC, discussed in **SECTION 1.11.3, Aircraft Deicing Facilities**, deicing fluid is collected and pumped to the Glycol Reclamation Plant for recovery. At this facility, the propylene glycol is separated from the water used as part of the deicing fluid as well as any stormwater that was also collected. Available deicing fluid and glycol storage at the Glycol Reclamation Plant includes three lagoons totaling 10.2 million gallons of storage capacity, a tank farm with a storage capacity of 478,000 gallons, and modular tanks that can store an additional 740,000 gallons. In 2017 SLC recovered and sold a total of 119,227 gallons of glycol, or 21.3 percent of the 559,471 gallons of total glycol used. For the planning period, it is assumed that 20 to 25 percent of glycol used at the Airport will be recovered.

The existing storage capacity at the Airport is expected to remain enough through the planning period despite projected increases in the number of flight operations and associated deicing required to service larger aircraft as a result of fleet mix changes. The maximum storage capacity of the existing lagoons is in excess of 12 million gallons. Processed fluid is removed from the lagoon during the season after completion of the reclamation process. With 3 million gallons of fluid processed in 2017, the lagoons can accommodate approximately four times the existing level with no changes to plant operations. Similarly, the tanks used to store processed glycol are not forecasted to approach capacity levels during the planning period.

Through the installation of diversion valves at the four runway-end de-icing pads, the amount of stormwater processed has sharply declined as rainwater and other ground moisture has not been pumped to the reclamation plant. The installation of similar valve and pump system in the cargo de-icing location can further remove additional stormwater that would otherwise be processed, which would subsequently add capacity for the plant. As cargo ramp facilities are expanded to meet the demand referenced in **SECTION 3.8, Air Cargo Capacity and Requirements,** considerations should be made to incorporate diversion valves on the cargo de-icing collection system.

3.10 AIRPORT FACILITY REQUIREMENTS SUMMARY

The facility requirements for SLC were prepared based on the projected future aviation activity levels to determine future needs. This chapter identified areas of capacity shortfalls caused by increasing activity levels. A summary of the facility requirements, including the forecasted deficits or surpluses for each major functional component is shown in **Table 3-63** at each PAL. Additionally, **Figure 3-10** is a graphical representation of the findings expressed in the table. The bars shown for each major component indicate the general level of service experienced by tenants and users throughout the planning horizon. They also give an indication of when capacity-enhancing efforts should be initiated to accommodate demand. Three main colors are shown in the figure. The green-shaded areas indicate that facility space and/or configuration are adequate to meet demand and desired service expectations. Yellow-shaded areas indicate where demand is nearing capacity. Red-shaded areas indicate when a deficit occurs for the respective facility. Note that each facility deficiency is not dependent on the others, and some metrics may be reached sooner than others. For example, if cargo operations grow faster than passenger enplanements, then cargo parking positions may need attention before the capacity deficit in the passenger terminal needs to be addressed.

As noted previously, besides the capacity deficits that each facility might exhibit in each PAL, additional considerations such as the life expectancy of the facilities and the long-range development of Concourse C will require displacement of the existing support facilities. Therefore, alternatives for future facilities must consider not only what is needed to meet current deficits in capacity, but also what is needed to replace what exists today in locations that will work long-term.

The following bullets outline the generalized conclusions of the facility requirements analysis based on demand levels at each specified planning activity level.

PAL 1 - 355,000 Annual Operations | 28 Million Annual Passengers

- Mitigate Hot Spot 1 and 2 to increase safety of the Airport by reconfiguring the associated runways and taxiways. Implement the alternatives analysis preferred solution.
- Begin advanced planning of long-haul runway extension to 14,500 feet to provide additional allowable take-off weight for aircraft and increase reachability of Asian markets such as Seoul, South Korea.
- Begin advanced planning efforts for future airfield configuration enhancements such as Taxiway U and V crossfield taxiways, future parallel taxiways, rapid exit taxiways, and deicing facility upgrades.
- Construct the South End Around Taxiway (SEAT) on Runway 34R in order to reduce runway crossings, potential incursions, and aircraft fuel consumption. In addition, the SEAT will improve airfield efficiency, improve airline gate arrival times, and increase the airfields overall capacity and hourly throughput.
- Begin initial optimization of the airfield configuration to provide enhanced operational efficiencies, increase safety, and eliminate deficiencies with FAA standards.

- Expand dedicated air cargo facilities and apron area to serve immediate growth requirements. Begin enabling projects required for long-term expansion of existing facilities, and for potential future airline entrants.
- Begin to reconfigure the east side general aviation area to provide space to meet the changing demand for general aviation hangars and apron.
- Accommodate need for additional airline maintenance and support space while preparing for long-term development and expansion in a new site outside of the future terminal envelope.
- Accommodate need for additional airport maintenance space while preparing for long-term development and expansion in a new site outside of the future terminal envelope.
- Complete a utility master plan to prepare for growth related to future airfield and landside facilities.
- Begin the advanced planning for public parking and rental car parking expansion to satisfy long-term needs should begin to be programed and implemented.
- Expand employee lot.

PAL 2 - 385,000 Annual Operations | 32 Million Annual Passengers

- Implement long-haul runway extension to 14,500 feet.
- Continue advanced planning efforts and begin to implement airfield configuration enhancements as needed. Decrease airfield deficiencies during pavement rehabilitation and reconfiguration projects.
- Convert two ADG III capable gates on Concourse A to international gates. This will require two additional gates on Concourse B to supplement the total gate count.
- Further expand dedicated cargo facilities and apron area or expect that dedicated cargo operators are now growing into any surplus space built in PAL 1.
- Potentially expand passenger cargo area to accommodate any increased belly cargo tonnage generated from new international markets.
- If no expansion of public parking and rental car parking has materialized, parking expansion will be required in PAL 3.
- Consider long-term needs and advanced planning efforts for the terminal area roadway configuration.
- Begin to implement enabling projects for Concourse C. This includes clearing the terminal envelope of existing facilities such as airline support, airport maintenance, and the fuel farm facility.
- Examine functionality of terminal processors to determine future expansion needs as demand levels near PAL 3.

PAL 3 - 435,000 Annual Operations | 38 Million Annual Passengers

- Implement airfield configuration enhancements that have been vetted through advanced planning efforts as needed. Continue to decrease airfield deficiencies during pavement rehabilitation and reconfiguration projects.
- Convert one ADG III capable gate on Concourse A to an international gate. This will require an additional gate on Concourse B to supplement the total gate count. Additionally, it is expected that another two domestic gates will be needed on Concourse B. Concourse B may be fully built-out by PAL 3.
- Implement enhancements to terminal area roadways that have deteriorated in level of service.
- Increase passenger cargo area to accommodate increased belly cargo tonnage.
- Further expand dedicated cargo facilities and apron area or expect that dedicated cargo operators are now growing into any extra space built in PAL 2.
- Begin advanced planning efforts for Concourse C and/or begin initial design. Complete final enabling projects for Concourse C development.
- Examine functionality of terminal processors to determine future expansion needs.

TABLE 3-63 FACILITY REQUIREMENTS SUMMARY

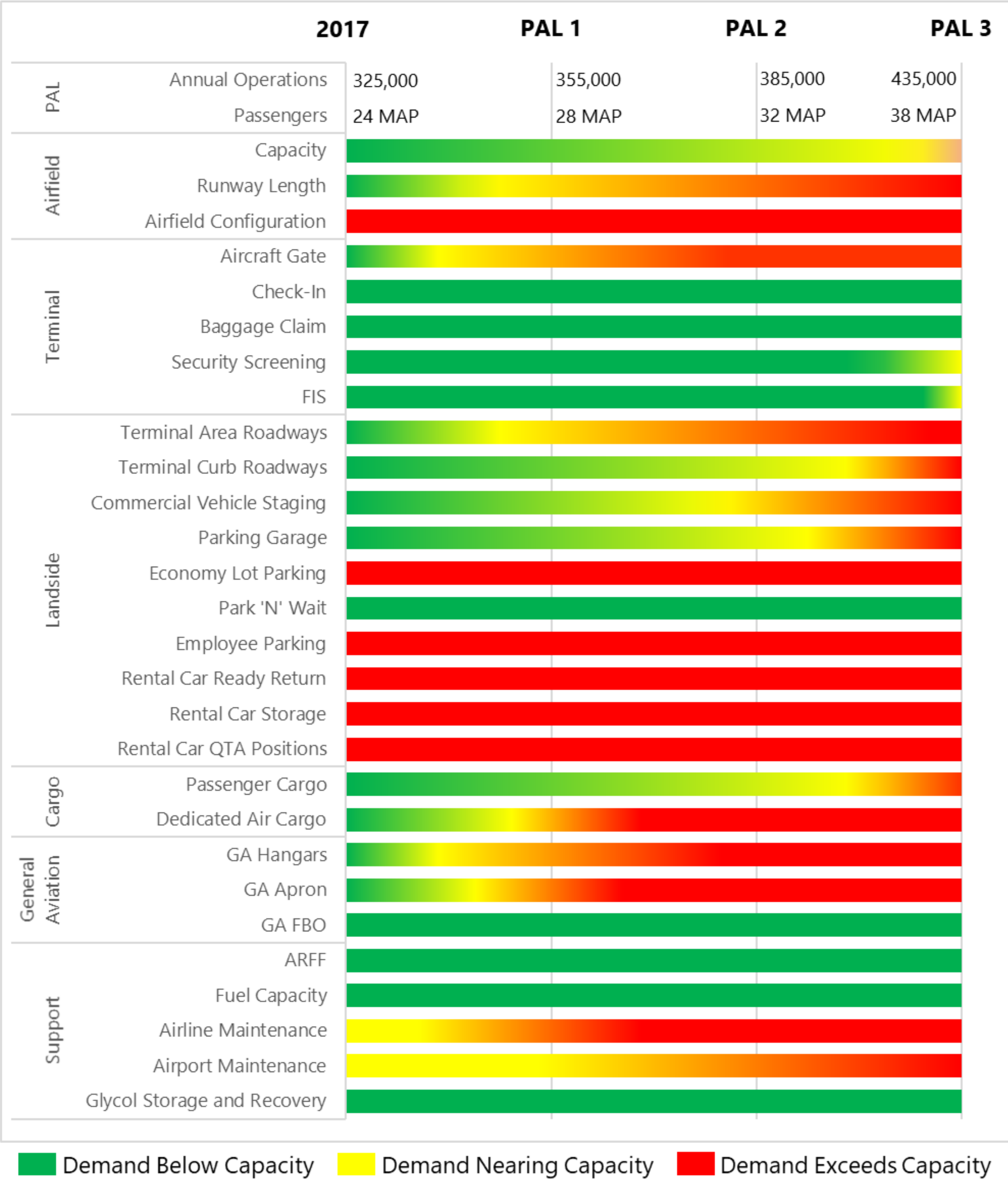
Area						Surplus / Deficiency		
		PAL 1	PAL 2	PAL 3	Existing	PAL 1	PAL 2	PAL 3
Airfield	Longest Runway Length (feet)	14,500	14,500	14,500	12,002	(2,498)	(2,498)	(2,498)
Terminal	Aircraft Gates	82	84	87	78 / 93	(4) / 11	(6) / 9	(9) / 6
	Check-In (sq ft)	11,000	12,200	14,400	43,400	32,400	31,200	29,000
	Baggage Claim (sq ft)	35,500	47,200	49,400	71,100	35,600	23,900	21,700
	Security Screening (sq ft)	22,000	25,100	29,700	39,700	17,700	14,600	10,000
	FIS (passengers per hour)	780	790	1,040	1,000	220	210	(40)
Landside	Terminal Area Roadways (LOS)	D	D	E	C	-	-	-
	Terminal Curb Roadways (LOS)	B	B	D	C	+	+	-
	Commercial Vehicle Staging Areas	103	115	141	113	10	(2)	(28)
	Economy Lot	12,629	14,326	16,931	10,463	(2,166)	(3,863)	(6,468)
	Parking Garage	2,851	3,195	3,884	3600	749	405	(284)
	Park 'n' Wait	112	125	153	162	50	37	9
	Employee Lot	3,508	3,800	4,589	3,200	(558)	(70)	(859)
	Rental Car Ready-Return Spaces	1,438	1,610	1,958	1,122	(316)	(488)	(836)
	Rental Car Storage	2,348	2,828	3,381	2,022	(326)	(806)	(1,359)
	Rental Car QTA Positions	84	94	115	62	(22)	(32)	(53)
Air Cargo	Passenger Cargo (acres)	5	6	7	6	1	0	(1)
	Dedicated Air Cargo (acres)	57	68	81	55	(2)	(13)	(26)
General Aviation	GA Hangars (sq ft)	889,000	907,000	969,000	834,000	(55,000)	(73,000)	(135,000)
	GA Apron (sq ft)	2,523,000	2,711,000	3,006,000	2,515,000	(8,000)	(196,000)	(491,000)
	GA FBO Buildings (sq ft)	18,000	19,000	22,000	22,000	4,000	3,000	0
Support	5-Day Commercial Fuel Storage (gallons)	3,310,000	3,630,000	4,030,000	6,450,000	3,140,000	2,820,000	2,420,000
	5-Day GA Fuel Storage - 100LL (gallons)	3,700	3,500	3,200	43,600	39,900	40,100	40,400
	5-Day GA Fuel Storage - Jet A (gallons)	138,000	152,000	186,000	264,000	126,000	112,000	78,000
	Airline Maintenance (acres)			78	39	-	-	(39)
	Airport Maintenance (acres)			30	23	-	-	(7)
	Glycol Storage and Recovery (gallons)				11,420,000	+	+	+

Source: RS&H Analysis, 2019

Notes: '+' indicates surplus. '-' indicates deficiency

Aircraft gates requirements are segmented with two numbers. The first number accounts for the initial planned build out of Concourse B. The second number accounts for the full build out of Concourse B.

FIGURE 3-10 FACILITY REQUIREMENTS SUMMARY CHART



Source: RS&H Analysis, 2019