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FACILITY REQUIREMENTS SUMMARY

SACRAMENTO COUNTY

MASTER PLAN

July, 2020

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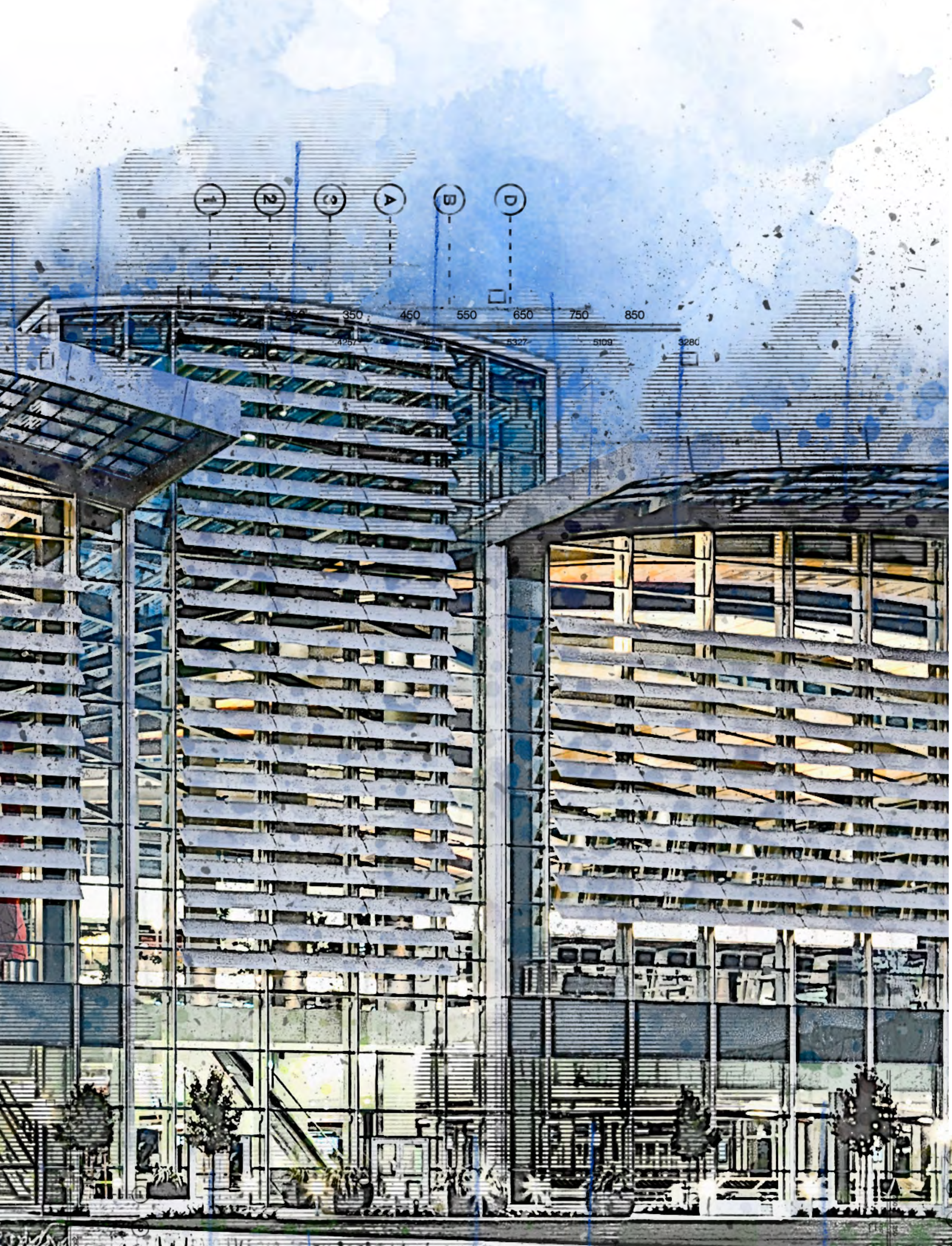

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INTRODUCTION

Facility requirements for Sacramento International Airport (SMF or the Airport) were analyzed for the following airport elements: airfield, passenger terminal, ground transportation and parking, air cargo, general aviation, airline support, airport support, and utilities. Facility requirements took into consideration forecast demand, discussions with tenants, and the age of facilities.

MASTER PLAN COMPONENTS

Airfield Requirements

Airfield facility requirements are based on the critical (design) aircraft. This analysis evaluated the airfield recommendations from the 2004 Master Plan, the need for new or modified airfield facilities to meet airport design standards, airfield/airspace demand-capacity for existing conditions versus the forecasts of future aircraft operations, and the required runway length for the existing and future fleet mix.

Passenger Terminal Complex Requirements

The requirements for various functional elements of the passenger terminal complex are based on projected passenger demand for 1) Terminal Landside: functional areas of the terminal that are non-secure and accessible to the public, such as ticketing and baggage claim lobbies, and 2) Terminal Airside: functional areas of the terminal that are secure and accessible to passengers who have been screened at a Security Screening Checkpoint (SSCP) or authorized personnel carrying the appropriate credentials.

Ground Transportation and Parking Requirements

This section summarizes requirements for key on-airport ground access and parking facilities, and describes the assumptions and methodology used to determine these requirements. Facility requirements for public and employee parking, rental car facilities, roadways, and curbsides were developed.

Air Cargo Requirements

This analysis presents the requirements that will be necessary to accommodate the cargo volumes that are forecast for SMF. For the foreseeable future, design of air cargo facilities should provide a large degree of flexibility, recognizing that the industry is subject to large changes in both traffic and technology.

General Aviation Requirements

General Aviation (GA) activity includes all flight operations by aircraft other than scheduled or charter passenger aircraft and military aircraft. GA facility requirements, expressed in terms of total land area, were developed considering activity forecasts, current leases, discussions with the fixed base operator (FBO) and other GA operators, and Sacramento County Department of Airports (SCDA) policies.

Airline Support Requirements

The requirements for each support facility area were based on discussions with SCDA staff, discussions with support facility operators, and examining forecast activity at the Airport. Fueling is a key element of airline support. The Airport's fuel farm is northeast of the aircraft rescue and fire fighting (ARFF) station, on the east side of Earhart Drive. The fuel farm is owned by an airline consortium led by Southwest Airlines and is operated by Allied Aviation under contract with Southwest.

Airport Support Requirements

Airport support requirements were assessed for airport administration, maintenance, and aircraft rescue and firefighting facilities.

This analysis identifies additional airport support facilities space (this includes concourse space) and the replacement of some support facilities within the planning period. The facilities requiring replacement are near the end of their useful life for their originally intended purposes.

Utilities Requirements

Utility service requirements were assessed for water, sanitary sewer, storm sewer, electrical, communications (telephone, internet, and cable), natural gas, and jet fuel through PAL 4. Existing demand was estimated based on a review of historical records of utilities provided by SCDA. Future demands were then estimated by scaling existing demands based on projected passenger demand.

3-1 AIRFIELD REQUIREMENTS

Airfield facility requirements are based on the critical (design) aircraft. According to FAA AC 150/5700-17, Critical Aircraft and Regular Use Determination, the critical (design) aircraft is defined as the most demanding aircraft type that uses the airport on a regular basis (defined as 500 annual operations or more). Based on the Traffic Flow Management System Count (TFMSC) data, the McDonnell Douglas MD-11F, operated by FedEx, conducted 745 operations in 2018. These FedEx operations include some operations by DC-10 aircraft (both aircraft are airplane design group IV).

The MD-11F represents the aircraft with the most demanding characteristics expected to be accommodated at the Airport. Its design characteristics are depicted in **Figure 3-1**. Based on recent discussions with FedEx, the company does not plan to retire this aircraft anytime soon and is expected to continue serving the Airport using the MD-11F through the 20-year planning period. Based on recent discussions with the passenger air carriers serving SMF, there are no anticipated short-term (5-year) changes to the fleet mix that would result in a change to the critical aircraft.

Demand-Capacity Analysis

Airfield capacity is typically defined as the maximum number of annual or peak-period aircraft operations that an airfield can accommodate. The FAA refers to this metric as the annual service volume (ASV). If demand approaches capacity, even for periods within the peak hour (busiest operational period on a given day), then costly delays may result. Conversely, for airfield facilities that have excess capacity, airports can realize cost savings by right-sizing those facilities. To evaluate the SMF system's capacity against forecast demand, airfield capacity was estimated using FAA AC 150/5060-5, Airfield Capacity and Delay, and the FAA's hourly capacity estimates for SMF that were prepared by MITRE using a capacity model called runwaySimulator.

The assumptions and inputs used to calculate the airfield capacity, include fleet mix, weather conditions, and runway use. Additionally, the model takes into account arrival and departure procedures, aircraft performance, and air traffic separation requirements.

Hourly Capacity Estimates

Hourly runway capacities were taken directly from MITRE's runwaySimulator estimates that were prepared for the FAA.

The resulting estimates of the hourly runway capacities for the various runway uses and weather conditions at the Airport for baseline and PAL 4 are summarized in **Table 3-1**. Capacity was calculated assuming 50% arrivals, meaning that the number of arrivals equals the number of departures, representing a daily average for the Airport. Hourly capacities for a given airfield, flow direction, and weather condition may differ if there are proportionally more arrivals or departures. For example, the hourly capacity may vary if the demand in that hour represents an arrival peak (for example, 70% arrivals) or a departure peak (for example, 70% departures). Weighted hourly capacity was calculated following the methodology outlined in FAA Advisory Circular 150/5060-5, Airport Capacity and Delay.

The resulting hourly runway capacities and weighted hourly capacity for the baseline and PAL 4 fleet mixes are displayed on **Figure 3-2**, and compared against peak hour demand in 2018 (34 hourly operations) and 2038 (54 hourly operations).

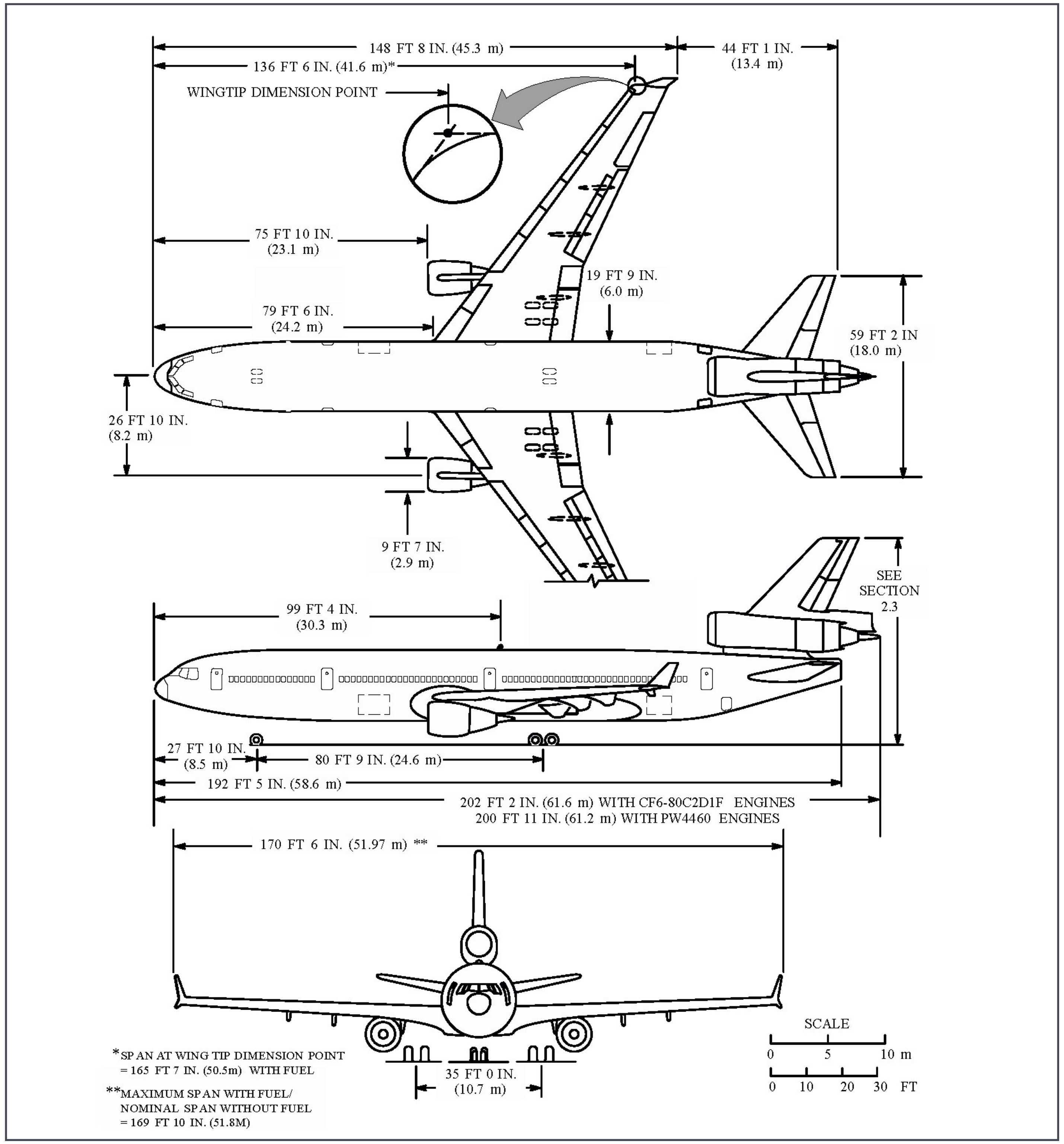
Estimated hourly runway capacity for all combinations of weather condition and runway use is above the peak hour demand for baseline and PAL 4, suggesting that delays will be minimal, and additional runway capacity will not be needed during peak hours through the forecast period.

Table 3-1 Hourly Runway Capacity

Runway use/ weather condition	Hourly Capacity (C) (a)	Runway use/ weather condition occurrence (P) (b)	Weighting factor (W) (c)	PxCxW	PxW
Baseline (2018)					
VMC South	135	62.9%	1	84.9	53.4
VMC North	135	26.3%	1	35.5	9.3
IMC South	94.3	9.2%	15	130.1	11.9
IMC North	68	1.6%	20	21.8	0.34
Baseline (2018) Weighted hourly capacity (Cw) = 104.9					
PAL 4 (2038)					
VMC South	135	62.9%	1	84.95	53.4
VMC North	135	26.3%	1	35.55	9.3
IMC South	94.3	9.2%	15	130.1	11.9
IMC North	68	1.6%	20	21.8	0.34
PAL 4 (2038) Weighted hourly capacity (Cw) = 104.9					

Sources: (a)Total hourly capacity at 50 percent arrivals calculated using Mitre's runwaySimulator analysis. (b) Analysis of runway use data from the FAA ASPM database for 2013-2018, and hourly weather observations from the National Oceanic and Atmospheric Administration (NOAA) for 2013-2018. (c) Table 3-1, AC 150/5060-5.

Figure 3-1 MD-11F AC Characteristics



Source: MD-11F Airplane Characteristics for Airport Planning, Revision "F", Issued May 2011.

Annual Service Volume

ASV is a reasonable estimate of the annual capacity of an airfield configuration. ASV is not a "hard ceiling;" rather, it has been established in practice that as the level of actual annual aircraft operations approaches ASV, there is a disproportionate increase in aircraft delays. ASV takes into account differences in runway utilization, weather conditions, and aircraft fleet mix over a one-year period.

The estimated ASV in comparison to the annual operations for Baseline (2018) and PAL 4 (2038) is shown on **Figure 3-3**. Generally, planning for airfield capacity improvements should begin when aviation activity is approaching 60% of the ASV and actual development should begin when 80% of the airfield's capacity is reached. As illustrated, ASV can accommodate the forecast demand (53% of forecast demand by PAL 4), suggesting that additional runway capacity and airfield improvements are not needed within the planning period.

Runway Length Requirements

The takeoff length requirements associated with aircraft types based on the existing and future fleet mix were evaluated using the process outlined in FAA AC 150/55325-4B; specifically, determining runway length requirements for long-haul routes at maximum takeoff weight (MTOW). **Table 3-2** summarizes runway length requirements at MTOW.

Based on a fleet mix analysis conducted in 2016, the Boeing 737-700 has the most operations at SMF, while the B767-200F, MD-11F, and DC-10 are the largest aircraft using the Airport on a regular basis.

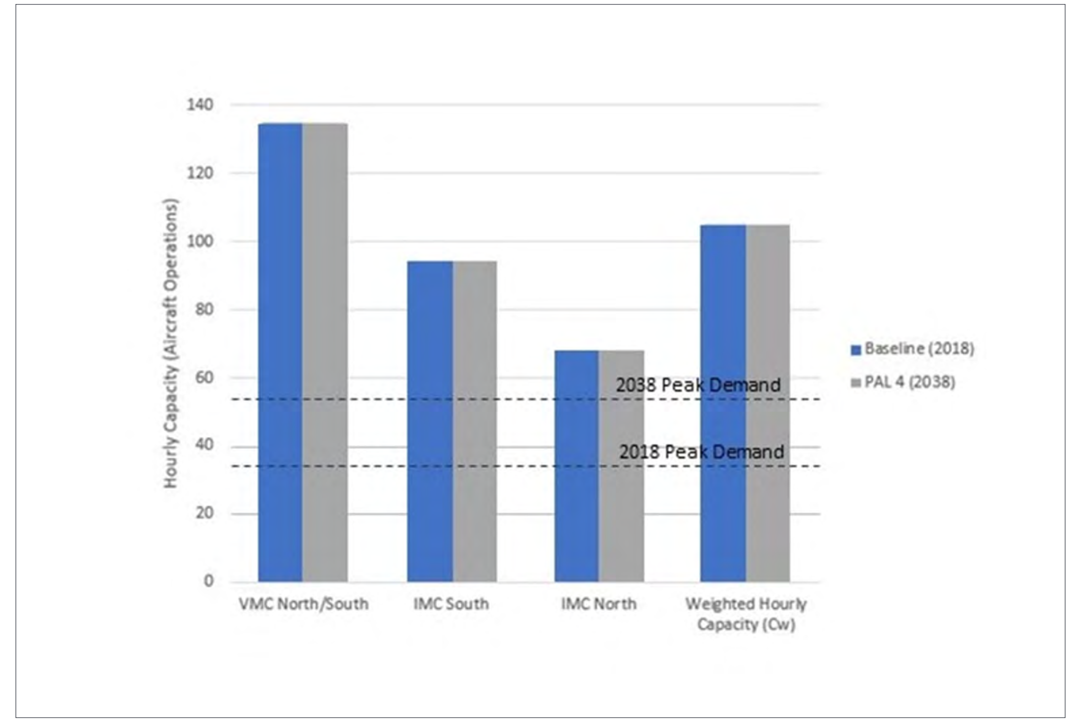
On occasion large aircraft will stop for fuel at SMF while awaiting clearance into airports in the San Francisco Bay Area during inclement weather. While some of these aircraft at MTOW may require a runway longer than that existing at SMF, these aircraft are mostly empty of fuel when they land at SMF and plan re-fueling to become airborne with less than the existing 8,605 feet of runway length.

Table 3-2 Runway Length Requirements at MTOW

Aircraft type	Engine type	MTOW (lbs.)	Required runway length (ft.)
B737-700	CFM56-7B-24	154,500	10,000
A319	IAE V2522-A5	167,300	8,400
A320	IAE V2527-A5	170,600	7,700
B737-800	CFM56-7B-26	174,200	9,100
A321	IAE V2533-A5	205,900	12,000
B767-200F	PW 4060	412,000	11,250
MD-11F	CF6-80C2D1F	610,000	11,200

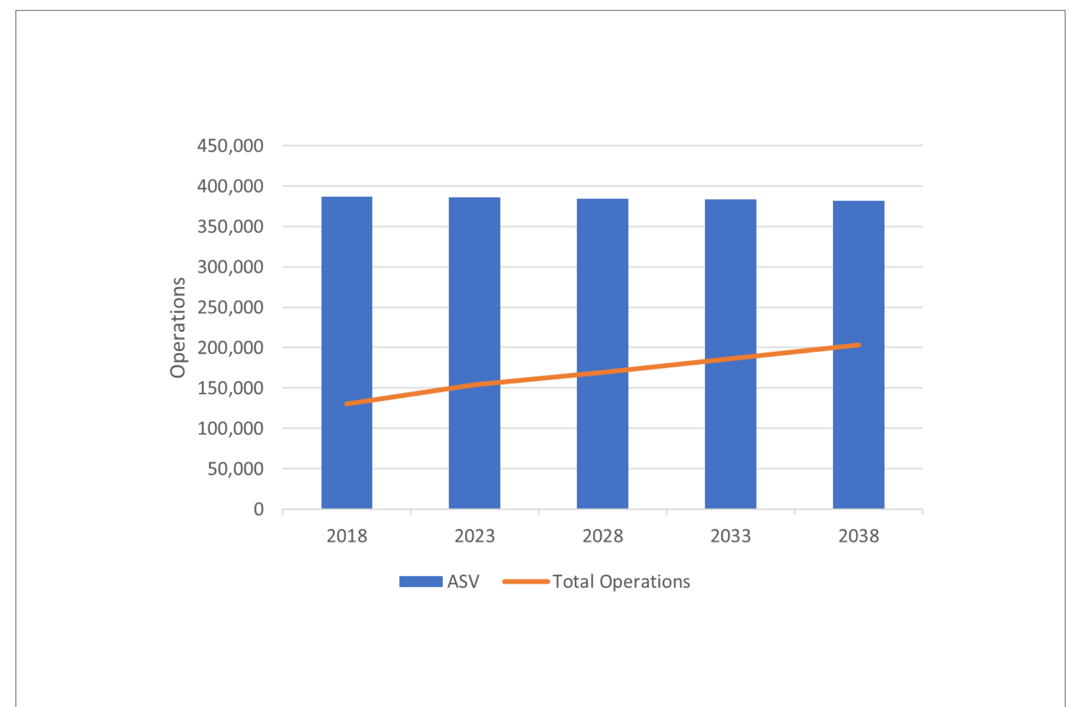
Notes: Takeoff length requirements are shown for a temperature of 94°F (mean-maximum temperature of the hottest month in Sacramento) and Airport elevation at sea level (adjusted to reflect temperature). Assumes calm wind, dry runway, and zero runway gradient. Obstacles which may limit payload are not considered within these results. Source: Analysis of Aircraft Characteristics for Airport Planning, published by the Boeing Company and Airbus SE, JP Airline-Fleets International, 2011, and FAA AC 150/5325-4B, Runway Length Requirements for Airport Design.

Figure 3-2 Hourly Runway Capacity Vs. Peak Hour Demand



Source: MITRE's runwaySimulator estimates prepared for the FAA.

Figure 3-3 Annual Service Volume Vs. Demand



Source: Sacramento County Department of Airports, 2019.

Detailed Airline-Specific Takeoff Performance

A detailed analysis of the takeoff performance of select aircraft in the fleet mix was completed to refine the runway length requirements. For this more detailed analysis, the existing route network from the Airport was examined, and combinations of aircraft types and destinations were selected. Although heavy widebody aircraft typically require the most takeoff runway length, these aircraft types do not operate to destinations that would be considered long-haul from the Airport. Instead, runway length requirements at SMF are driven by narrow-body aircraft operating to long-haul destinations such as the East Coast and Hawaii. Long-haul service to these destinations accounted for 17.5% of passenger airline departures in 2018, with 14.5% to East Coast destinations and 3% to Hawaii.

Table 3-3 presents the results of the airline-specific analysis.

Table 3-3 Runway Length Requirements to Select Destinations

Aircraft type	Airline	Destination	Required runway length (ft.)
B737-800	United	IAD	7,100
B767-300ER	Hawaiian	HNL	6,720

Notes: Runway length requirements assume 100% passenger load factor and no belly cargo.
Source: Flight Engineering analysis, July 2018.

Changing climatic conditions will be an additional driver for longer runway lengths at SMF as ambient temperatures increase and impact aircraft performance. Hotter temperatures mean larger, heavier aircraft, traveling further, will need more runway length for takeoff. It is expected that the trend of warming temperatures will continue.

Taxiway and Operational Requirements

Discussions with SCDA operations staff and FAA SMF ATCT staff revealed areas on the airfield that contribute to airfield congestion or are operationally deficient. Although existing taxiway capacity is adequate to meet forecast demand, the following taxiway improvements would enhance the operational efficiency of the airfield system and are recommended:

- The runway exits on Runway 16R-34L are not optimally located, increasing arrival runway occupancy times. For Runway 16R arrivals, Taxiway A10 is located approximately 4,000 feet from the runway threshold, too close for most aircraft types to slow down and exit the runway. For Runway 34L arrivals, there are no high-speed runway exits and aircraft must slow before making a 90-degree turn to exit the runway. Additional high-speed runway exits for Runway 16R-34L would reduce arrival runway occupancy time.
- Improvements to taxiway fillets to accommodate the MD-11F under design requirements recommended in the recently revised FAA AC 150/5300-13A, Airport Design, are recommended and will be constructed as part of the Taxiway A reconstruction.
- Hold pads are used to sequence the departure queue or to allow aircraft not ready for departure, because of mechanical problems, weather, or other reasons, to stay clear of the departure queue without taxiing on the runway. Providing bypass capability on the ends of Runways 16L, 34L, and 34R would improve operational flexibility.
- Currently, Taxiways G1 and G2 are limited in the gross aircraft load the pavement can accommodate, however they frequently accommodate aircraft up to the size of private charters using the Boeing 757. Taxiways G1 and G2 are planned to be consolidated into one taxiway that has the pavement strength and design criteria to accommodate TDG 5 aircraft.
- Taxiway P is planned to be relocated and will continue to serve TDG 3 aircraft to the GA and FAA facilities.
- Taxiway Y4 is limited to aircraft with a wingspan less than 118 feet (ADG III) because of its proximity to Concourse B. Larger aircraft are not anticipated to use this taxiway due to its location.
- The shoulder widths of Taxiways D and Y east of Taxiway Y2 lack the 30 feet required for TDG 5 aircraft and the 30 feet required for TDG 6 aircraft.

Summary of Airfield Requirements

The results of the airfield requirements analysis indicate that there will be sufficient runway capacity to accommodate forecast demand through PAL 4. Runway capacity will exceed forecast demand through the planning period, even under poor weather conditions, suggesting that no additional runways are needed. The demand and phasing for the runway extension, currently shown on the ALP, will be analyzed in greater detail when the A321 (or similar aircraft) becomes the critical aircraft, when more long-haul routes are introduced at SMF, or when climatic conditions create enough of an impediment to aircraft performance.

3-2 PASSENGER TERMINAL COMPLEX REQUIREMENTS

The requirements for various functional elements of the passenger terminal complex are based on projected passenger demand for the following areas of the terminal complex:

- Terminal Landside: functional areas of the terminal that are non-secure and accessible to the public, such as ticketing and baggage claim lobbies
- Terminal Airside: functional areas of the terminal that are secure and accessible to passengers who have been screened at a Security Screening Checkpoint (SSCP) or authorized personnel carrying the appropriate credentials

Level of Service (LOS) "C" is used for this analysis. In the context of airport terminal planning, a LOS "C" standard means "good"; a condition of stable flow that provides acceptable throughput, and where the related systems are in balance.

Background

The passenger terminal complex at the Airport consists of two terminals and associated concourses: Terminal A and Concourse A, and Terminal B and Concourse B.

Facility requirements have been identified for the following key functional elements:

- Aircraft gates and parking
- Airline check-in
- Passenger security screening
- Holdrooms
- Checked Baggage Inspection System (CBIS)
- Automated People Mover (APM)
- Domestic baggage claim
- Outbound/inbound baggage systems
- U.S. Customs and Border Protection (CBP) facilities

Facility requirements for each of the functional elements in the passenger terminal were derived using the passenger forecast demand, and specifically the peak hour passenger forecast for PAL 1, PAL 2 , PAL 3, and PAL 4.

For Terminal A, the design hour of the Average Day Peak Month (ADPM) is between 6:00 AM and 7:00 AM when the number of departing passengers is approximately 5% of the daily departures (14,800 total departing passengers) in the base year.

- 707 passengers depart Terminal A in the peak hour (base year).

For Terminal B, the design hour of the Average Day Peak Month is between 8:00 PM and 9:00 PM when the number of departing passengers is approximately 8% of the daily departures (14,800 total departing passengers) in the base year.

- 1,185 passengers depart Terminal B in the peak hour (base year).

Table 3-4 provides a summary of peak hour passenger demand by terminal.

Aircraft Gates and Parking

The requirements analysis for aircraft gates and parking was derived from two analyses: 1) a ratio method analysis that considers turns per gate (**Table 3-5**), and 2) a design day flight schedule (DDFS) gate method analysis (**Table 3-6**).

Ratio Method Analysis

The first calculation, "no new gates, calculate turns", in **Table 3-5**, shows how much aircraft turns would grow if the future DDFS were applied to the existing gate inventory. However, it may not be reasonable to expect Terminal A to operate with 7.42 turns per gate or for Terminal B to operate with 8.47 turns per gate, without significant changes to existing airline operations. This implies a need for at least some new gates.

The second calculation, "hold turns, calculate new gates", shown in **Table 3-5**, calculates the number of new gates needed to accommodate the future DDFS while holding the existing turns per gate ratio constant. This implies that each terminal would need three or four new gates by PAL 2 and three additional gates by PAL 4 for a total increase of 13 gates at the Airport.

DDFS Gate Method Analysis

The gating analysis considers the existing aircraft gate inventory, aircraft compatibility (the number of flights in the baseline and future DDFS that can only be accommodated at one or two gates), and existing airline gate allocation. There are a few common use gates at SMF, but most are preferential use (gates are used by a specific airline), and no aircraft were gated on another airline's preferential use gate for this analysis. For purpose of this terminal analysis, gate requirements from the "Ratio Method" are used, while RON position guidance is provided by the DDFS method.

Ground Service Equipment

Ground service equipment (GSE) is stored on-airport by each airline. Furthering sustainability efforts at SMF, all contact gates at both Terminal A and Terminal B have charging capabilities for a fleet of electric GSE, including baggage tugs. However, there remains a portion of baggage tugs employed at SMF that are propane-powered, mostly servicing Terminal B.

Any terminal development, especially aircraft parking modifications, will accommodate GSE and ensure continued access capabilities. Existing Storage capacity for GSE is adequate and no airlines have expressed a need for additional space.

Holdrooms

Holdrooms are areas adjacent to the gates inside both terminals where passengers wait and queue before boarding flights.

Holdroom areas required by aircraft type, are summarized in **Table 3-7**. Common use counters, backscreens, and boarding pass scanners are provided so that any airline can use the equipment when boarding aircraft, although airline proprietary boarding equipment and procedures may limit the efficiency of operations at unassigned gates.

Table 3-7 Holdroom Areas Required by Aircraft Type

Aircraft	Typical seats (a)	Holdroom area (b) (sq. ft.)
B737-900	179	1,732
B757-200	185	1,791
A321neo	196	1,897
B757-300	234	2,265
B767-300	264	2,556
B777-200	277	2,681
A330-200	278	2,691

(a) Typical seats took the average seating arrangement of the airlines using that particular aircraft.
(b) Holdroom area required was estimated based on the methodology described in this section.
Source: Alaska Airlines, American Airlines, Delta Airlines, United Airlines.

Table 3-4 Peak Hour Passenger Demand by Terminal

Aircraft type	Base (2018)	PAL1	PAL2	PAL3	PAL4
Total Annual Passengers (Millions)	6.03	7.36	8.20	9.15	10.17
Peak Hourly Departing Passengers (Terminal A)	707	1,309	1,465	1,604	1,723
Peak Hourly Arriving Passengers (Terminal A)	892	1,220	1,286	1,448	1,454
Peak Hourly Departing Passengers (Terminal B)	1,185	1,470	1,668	1,953	2,417
Peak Hourly Arriving Passengers (Terminal B)	1,463	1,728	1,851	1,971	2,119
TOTAL PEAK HOUR DEPARTING PAX	1,590	2,667	2,945	3,233	3,502
TOTAL PEAK HOUR ARRIVING PAX	1,967	2,192	2,620	2,777	2,940

Note 1: Peak hourly departing and arriving passengers in each terminal as per DDFS.
Note 2: Total Peak hour passengers as per forecast.
Source: J|D calculations based on DDFS, March 2020.

Table 3-5 Ratio Method Gate Requirements

		No new gates - Calculate turns		Hold turns - Calculate new gates	
	Baseline DDFS Existing Gates	PAL 2	PAL 4	PAL 2	PAL 4
Terminal A	60 flights 12 gates 5.00 turns	76 flights 12 gates 6.33 turns	89 flights 12 gates 7.42 turns	76 flights 15.2 -> 15 gates +3 gates 5.00 turns	89 flights 17.8 -> 18 gates +6 gates 5.00 turns
Terminal B	118 flights 19 gates 6.21 turns	142 flights 19 gates 7.47 turns	161 flights 19 gates 8.47 turns	142 flights 22.9 -> 23 gates +4 gates 6.21 turns	161 flights 25.9 -> 26 gates +7 gates 6.21 turns
Total	178 flights 31 gates 5.74 turns	218 flights 31 gates 7.03 turns	250 flights 31 gates 8.06 turns	218 flights 38.0 -> 38 gates +7 gates 5.74 turns	250 flights 43.6 -> 44 gates +13 gates 5.74 turns

Source: J|D calculations based on DDFS, March 2020.

Table 3-6 DDFS Method Gate Requirements

Aircraft Gates and Parking – Terminal A	Existing	Baseline (2018)	PAL 1	PAL2	PAL3	PAL4
Domestic Gates	12	12	15	18	19	20
International Gates	0	0	0	0	0	0
Total	12	12	15	18	19	20
Terminal A Remote/RON Parking	7	7	12	9	13	12
Aircraft Gates and Parking – Terminal B	**Existing**	**Baseline (2018)**	**PAL 1**	**PAL2**	**PAL3**	**PAL4**
Domestic Gates	17	17	19	23	26	26
International Gates	2	2	3	4	6	6
Total	19	19	22	27	32	32
Terminal B Remote/RON Parking	13	13	16	14	13	14

NOTES:
1) This table shows aircraft parking requirements using the DDFS gating analysis method.
2) International flights are through Terminal B; however, Air Canada flights are pre-clear and use domestic gates out of Terminal A.
3) The up/down trend in remote RON positions is linked to the addition of gates, which free up remote RON positions as aircraft can remain overnight at the new gates.
Source: J|D calculations based on DDFS, March 2020.

The requirements analysis for the holdrooms focused on the median holdroom area required in each concourse for an approximate future holdroom calculation in each concourse, and the gate requirements from the "Ratio Method" analysis. For Concourse A, 1,897 square feet was used for each holdroom, and for Concourse B, 1,732 square feet was used for each holdroom. Using this median calculation, Concourse A already requires additional holdroom space, while Concourse B won't require additional holdroom space until PAL 4 (**Table 3-8**).

Airline Check-in

Airline check-in facilities provide for the processing of passengers and baggage via curbside check-in, lobby check-in, and self-service check-in.

Currently, Terminal A is arranged with a traditional linear ticket counter, with each airline staffing their own counters. Some self-service kiosks support common use operations (can be used by a passenger on any airline), while other kiosks are airline specific. All baggage collected at the counters are processed in a centralized baggage collection system.

- Capacity for Terminal A is constrained due to the original facility design, which compartmentalizes the ticketing and baggage check-in functions.
- There are four vacant agent positions in Terminal A, and three vacant skycap (curbside) positions in Terminal A.

Currently, Terminal B is arranged with island-style ticket counters distributed across the ticket hall facility. Each "island" feeds into a common Checked Baggage Inspection System (CBIS) and makeup area, allowing for a true common use operation. The use of overhead dynamic signage allows for the re-assigning of ticket counters as needed. With an appropriate setup time and because of the centralized CBIS, any airline can use any counter or kiosk for check-in of passengers and baggage, which increases capacity.

- The total number of check-in processors includes 27 unused agent counter locations in the south lobby of Terminal B, and four vacant skycap (curbside) positions.

Terminal A Check-In Requirements

There is a need for nine staffed counter spaces in the baseline. By PAL 4 there will be a need for 21 staffed counters. The existing 22 bag drop counters will be sufficient through PAL 4. **Table 3-9** summarizes the Terminal A check-in requirements.

- There is a need for five additional check-in counters by PAL 4.
- There is a need for five additional kiosks by PAL 4.
- There is sufficient check-in lobby queue space at Terminal A through PAL 4 (**Table 3-10**).

Terminal B Check-In Requirements

The number of passengers requiring staffed counter space in Terminal B for the baseline is 14, with 14 bag drop counters also required in the baseline. By PAL 4, there will be a need for 29 total staffed positions and 28 total bag drop locations. **Table 3-9** summarizes the Terminal B check-in requirements.

- No additional staffed counter space or bag drop locations are required through PAL 4.
- By PAL 4, 56 kiosks will be required to meet demand.
- There is sufficient check-in lobby queue space at Terminal B through PAL 4 (**Table 3-9**).

Passenger Security Screening

Each of the existing terminals has a single Security Screening Checkpoint (SSCP) that provides equipment and facilities where passengers transitioning from the landside to the airside, including employees, and contractors, are screened as required by the Transportation Security Administration (TSA). According to the local TSA director, the number of passengers than can be processed by a single standard lane per hour is 150, and for a single expedited (PreCheck) lane, throughput per hour is 220 passengers. The SSCP requirements are summarized in **Table 3-10**.

- Both terminals will need additional SSCP by PAL 2. Terminal B will also need additional queuing area by PAL 3.

Table 3-8 Holdroom Requirements

Holdrooms (Area in Square Feet)	Existing	Base (2018	PAL1	PAL2	PAL3	PAL4
Concourse A (based on 1,897 sq.ft./ea)	22,615	22,764	26,558	28,455	32,249	34,146
Concourse B (based on 1,732 sq.ft./ea)	43,089	32,908	36,372	39,836	41,568	45,032
Total Holdroom Area	65,704	57,569	66,559	80,910	91,467	93,364

Source: Sacramento County Department of Airports, 2019.

Table 3-9 Airline Check-In Requirements

Terminal A Number of Processors	Existing	Baseline (2018)	PAL1	PAL2	PAL3	PAL4
Agent Counters	16	9	16	17	19	21
Bag Drop Counters	22	10	16	17	19	21
Kiosks	36	19	31	34	38	41
Curbside (with Bag Check)	7	1	2	2	3	3
Lobby Queuing Space	3,715	884	1,962	2,320	2,447	2,572
Terminal B Number of Processors	**Existing**	**Baseline (2018)**	**PAL1**	**PAL2**	**PAL3**	**PAL4**
Agent Counters	48	14	18	20	23	29
Bag Drop Counters	48	14	17	20	23	28
Kiosks	44	28	34	39	46	56
Curbside (with Bag Check)	10	2	2	3	3	4
Lobby Queuing Space	12,032	1,818	2,266	2,567	3,012	3,760

Source: Sacramento County Department of Airports, 2019.

Table 3-10 SSCP Requirements

Passenger Security Screening	Existing	2018 (Base)	PAL 1	PAL 2	PAL 3	PAL 4
Terminal A: Total Number of Screening Lanes	5	3	6	7	8	8
Number of PreCheck Lanes	2	2	3	3	3	3
Total Lanes	**7**	**5**	**9**	**10**	**11**	**11**
Queuing Area (sq.ft.)	7,400	1,129	2,248	2,560	2,772	2,865
Terminal B: Total Number of Screening Lanes	6	8	7	8	9	11
Number of PreCheck Lanes	4	2	3	3	4	5
Total Lanes	**10**	**10**	**10**	**11**	**13**	**16**
Queuing Area (sq.ft.)	4,870	2,988	3,911	4,688	4,975	5,382

Source: Sacramento County Department of Airports, 2019.

Automated People Mover

Terminal B uses an APM system to shuttle passengers between the landside building and the airside concourse. The APM is a train system automatically controlled by computers and tied into the building systems.

The present configuration of the APM system is two single-car trains, each car with a design holding capacity of 65 passengers. It should be noted that the normal holding capacity is 50 passengers. The system has a 91-second cycle time, which includes headway, dwell, and door cycles. This normal cycle time can be affected by people holding the door open or otherwise delaying the trains.

The design capacity of the two-car system is 2,570 passengers per hour in each direction. The "normal" capacity of the two-car system is 1,980 passengers per hour in each direction.

- Additional cars should be added by PAL 4, which forecasts 2,417 departing passengers (**Table 3-11**).

The existing queueing space for passengers waiting for the APM is 2,457 square feet in Terminal B for departing passengers, and 3,830 square feet in Concourse B for arriving passengers (**Table 3-11**).

- The queueing area for both departing and arriving passengers is adequate through PAL 4, assuming 14 square feet per passenger (**Table 3-11**).

Checked Baggage Inspection System

Both terminals provide a CBIS consisting of conveyor equipment, controls, Explosives Detection Systems (EDS), and resolution systems for the screening of checked baggage by the TSA.

The Terminal B CBIS cannot be physically expanded, but anticipated advances in EDS screening technology will allow for additional throughput for the existing CBIS equipment in both terminals.

Design capacity of the Terminal A CBIS is 1,760 bags per hour, using 550 bags per hour for inline systems and 330 bags per hour for standalone systems. This also assumes a N+1 function of EDS machines in the CBIS. Using a factor of 0.8 checked bags per passenger, this is equivalent to 2,200 bags per hour.

- One additional EDS machine will be required in Terminal A by PAL 3 (**Table 3-12**).

Design capacity of the Terminal B CBIS is 2,750 bags per hour, assuming a N+1 function of EDS machines in the CBIS. Using a factor of 0.8 checked bags per passenger, this is equivalent to 3,438 bags per hour.

- The baggage system for Terminal B is adequate through PAL 4 (**Table 3-12**).

Passenger Baggage Claim

Passenger baggage claim lobbies are provided in both terminals for claiming of checked baggage. Passengers can check Baggage Information Display System (BIDS) monitors to see where their bags will be arriving, as well as signage to direct them to the appropriate device.

At Terminal A, passengers were assumed to gather within 10 feet of the carousels. Each carousel occupies a total area of approximately 4,336 square feet (based on actual measurement). The base requirement for space then is three carousels at 13,008 sq.ft.

- By PAL 2, the Airport will need to install one new baggage carousel at Terminal A and will need more area for claiming baggage (**Table 3-13**).

In Terminal B, the base year peak will have 441 people at baggage claim. At 1.5 feet per passenger, this equates to 585 feet of claim frontage required in the base year. Each carousel, offset 10 feet, occupies an area of 5,833 square feet (based on actual measurement). The base requirement for space then is four carousels at 23,333 square feet.

- By PAL 2, the Airport will need to install one new baggage carousel at Terminal B (**Table 3-13**).

Table 3-11 APM Requirements

Automated People Mover - Terminal B Only	Existing (2019)	Base (2018)	PAL1	PAL2	PAL3	PAL4
Cars per Train/2 Trains (1,980 Passengers/Hour/Car) - Departures	1,980	1,185	1,470	1,668	1,953	2,417
Queuing Space – Departures (sq.ft.)	2,457	912	1,132	1,284	1,504	1,861
Cars per Train/2 Trains (1,980 Passengers/Hour/Car) - Arrivals	1,980	1,463	1,728	1,851	1,971	2,119
Queuing Space – Arrivals (sq.ft.)	3,830	1,127	1,331	1,425	1,518	1,632

Source: Sacramento County Department of Airports, 2019.

Table 3-12 CBIS Requirements

Baggage Security Screening - Number of Primary EDS Machines	Existing	Base (2018)	PAL1	PAL2	PAL3	PAL4
Terminal A	3	2	3	3	3	4
Terminal B	6	3	3	3	4	5
Total	9	5	6	6	7	9

Source: Sacramento County Department of Airports, 2019.

Table 3-13 Baggage Claim Requirements

Terminal A Baggage Claim	Existing	Base (2018)	PAL1	PAL2	PAL3	PAL4
Total Presentation Frontage (LF)	495	357	488	514	579	582
Number of Carousels/Devices (165 feet/device)	3	3	3	4	4	4
Total Area for Claiming Baggage (sq.ft.)	13,008	13,008	13,008	17,344	17,344	17,344
Terminal B Baggage Claim						
Total Presentation Frontage (LF)	720	585	691	740	788	848
Number of Carousels/Devices (180 feet/carousel)	4	4	4	5	5	5
Total Area for Claiming Baggage (sq.ft.)	35,000	23,333	23,200	29,000	29,000	29,000

Source: Sacramento County Department of Airports, 2019.

Outbound/Inbound Baggage Systems

The outbound/inbound baggage systems are the portions of the conveyor belt used to provide an area for the loading and unloading of baggage carts to and from aircraft. Generally, these areas are secured and not seen by the general public, but are an important element in the operation of the facility.

Outbound Baggage Makeup

There are currently 30 cart staging positions in Terminal A, which means that baggage for 1,250 passengers can be staged simultaneously. The existing outbound baggage system will require additional cart staging positions by PAL 3, as shown in **Table 3-14**.

There are currently 89 cart staging positions in Terminal B, which means that baggage for 4,450 passengers can be staged simultaneously. The existing outbound baggage system meets demand through PAL 4, as shown in **Table 3-14**.

Inbound Baggage Handling

The total offload frontage available in Terminal A is 96 linear feet. By PAL 4, 175 linear feet will be required (**Table 3-14**).

The total offload frontage available in Terminal B is 211 linear feet. By PAL 4, 255 linear feet will be required (**Table 3-14**).

U.S. Customs and Border Protection Screening

A U.S. CBP screening facility provides for the screening of arriving international passengers for immigration status, claim of international baggage, and the processing of passengers and baggage through customs. At SMF, the facility is located in Terminal B and consists of all the offices, sterile corridors, and auxiliary facilities required to provide these functions to accommodate up to 400 passengers per hour. With minor modifications and installation of a second baggage claim device, the existing facility could accommodate almost 800 passengers per hour.

International passenger enplanements are expected to grow from 132,946 in the baseline to 318,200 by PAL 4; a growth of approximately 2.4 times baseline. The load factor is expected to stay consistent at 84%.

This high-level analysis presumed two international peak arrivals growing by a factor of 2.4 in PAL 4, which means a peak of five international arrivals can be expected by PAL 4. This high-level analysis also presumed 175 passengers per arriving flight (100% load factor), which means approximately 875 passengers can be expected to arrive in the peak hour by PAL 4.

- CBP will require expanded facilities by PAL 4.

Terminal Requirements Summary

The terminal requirements analysis revealed that the following elements will require some expansion in the future years: aircraft gates, aircraft remain overnight positions, holdroom space, check-in facilities, security screening checkpoints, baggage handling systems, and CBP facilities.

To effectively meet demand and thoughtfully expand terminal facilities, further discussions are required with airlines, TSA, and other stakeholders, to understand priorities and coordinate with their individual planning efforts. Each tenant and agency are constantly evaluating their needs, level of service, and level of investment to meet passenger demand within the confines of existing terminal space. Technology and equipment trends over the years (such as common use terminal equipment and sloped plate baggage conveyors) have focused on fewer staffed ticket counters, more self-service kiosks, and less check-in baggage. Fluidity and flexibility within the terminal environment is essential to incorporating the changes in technology, methodology, and customer trends to deliver the most efficient terminal operation possible. Additional consideration must also be given to events like the 9/11 attacks and the current coronavirus pandemic, which impact space requirements. The coronavirus pandemic is causing not only airports to rethink their operations, but also airport tenants to consider new social distancing measures.

Table 3-14 Outbound/Inbound Baggage System Requirements

Outbound Baggage Makeup						
Number of Cart Staging Positions	**Existing (2019)**	**Baseline (2018)**	**PAL1**	**PAL2**	**PAL3**	**PAL4**
Terminal A	30	15	27	30	33	35
Terminal B	89	24	30	34	40	49
Total	119	39	57	64	73	84
Inbound Baggage Handling						
Offload Frontage (LF)	**Existing (2019)**	**Baseline (2018)**	**PAL1**	**PAL2**	**PAL3**	**PAL4**
Terminal A	96	108	147	155	174	175
Terminal B	211	176	208	223	237	255
Total	307	284	355	378	411	430

Source: Sacramento County Department of Airports, 2019.

3-3 GROUND TRANSPORTATION AND PARKING REQUIREMENTS

Key on-airport ground access and parking facilities include public and employee parking, rental car facilities, roadways, and curbsides. Requirements are primarily based on data and observations collected in 2017 and 2018.

Three ground transportation growth scenarios (GT1, GT2, and GT3) were prepared for this landside analysis, were considered to develop requirements for each ground access and parking component.

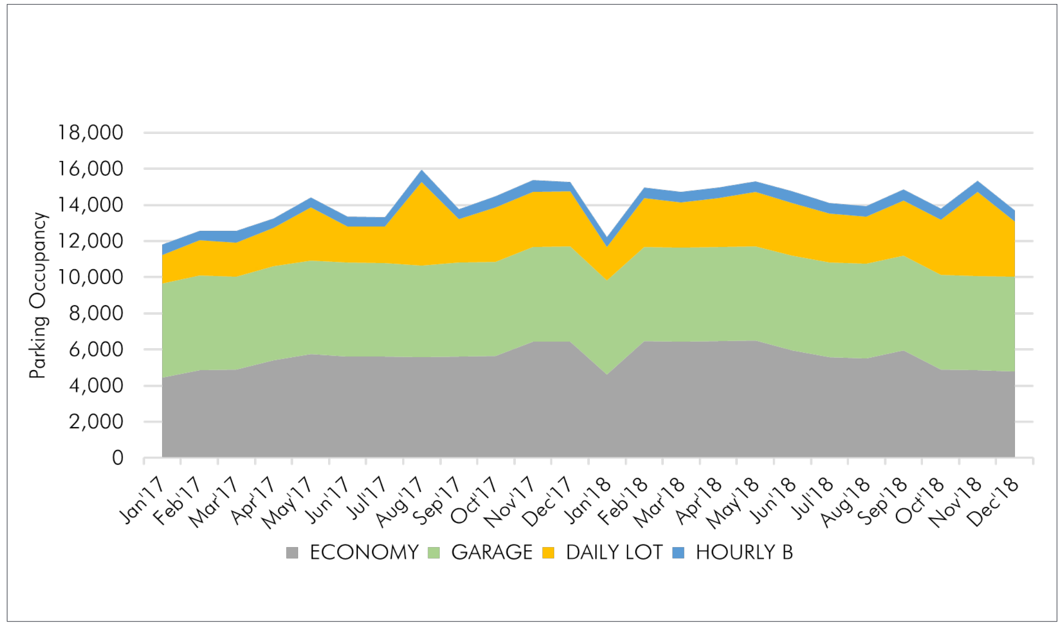
Demand for PAL 2 through PAL 4 were increased in proportion to the passenger growth forecast. The influence of transportation network companies (TNCs) on the overall mode shares also guided the three growth scenarios. **Table 3-15** summarizes the forecast for the five major ground transportation modes under three different scenarios.

Table 3-15 Ground Transportation Mode Share under three Different Growth Scenarios

Modes	2016	2017	GT 1	GT2	GT3
Parking	43.4%	39.2%	35.5%	31.8%	27.6%
RACs	19.0%	17.2%	16.1%	15.0%	13.2%
CVs except TNCs	9.6%	8.2%	6.4%	4.6%	3.1%
TNCs	5.1%	8.7%	10.5%	12.4%	16.0%
Private Vehicles	22.9%	26.7%	31.5%	36.2%	40.1%

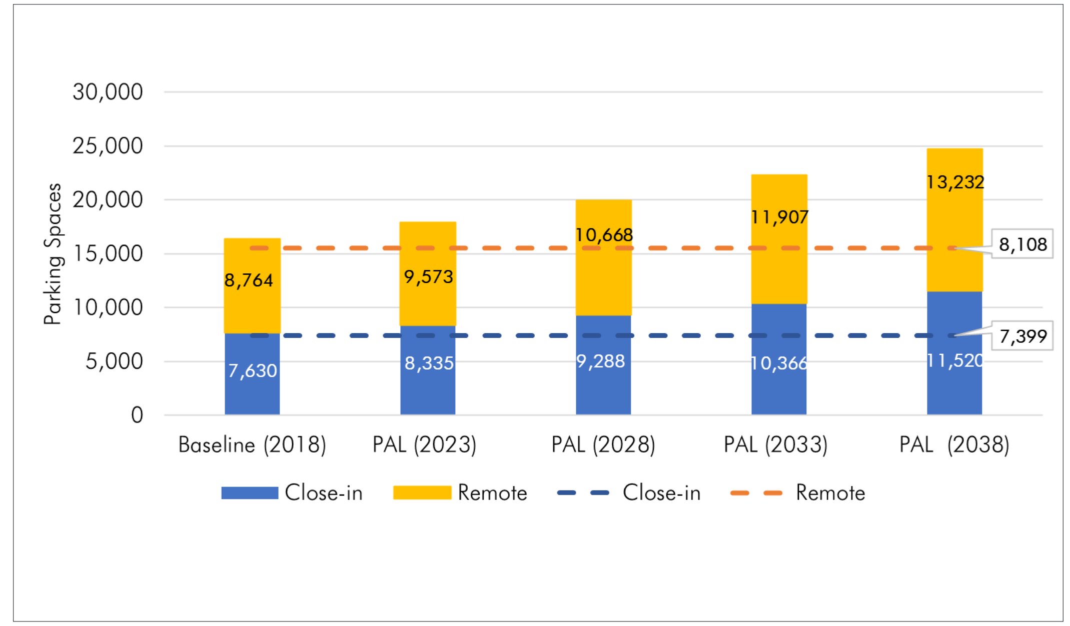
Source: Sacramento County Department of Airports, 2019.

Figure 3-4 Observed Peak Occupancies at Individual Parking Facilities (2017-2018)



Source: Sacramento County Department of Airports, 2019.

Figure 3-5 Estimated Public Parking Needs in Different PALs



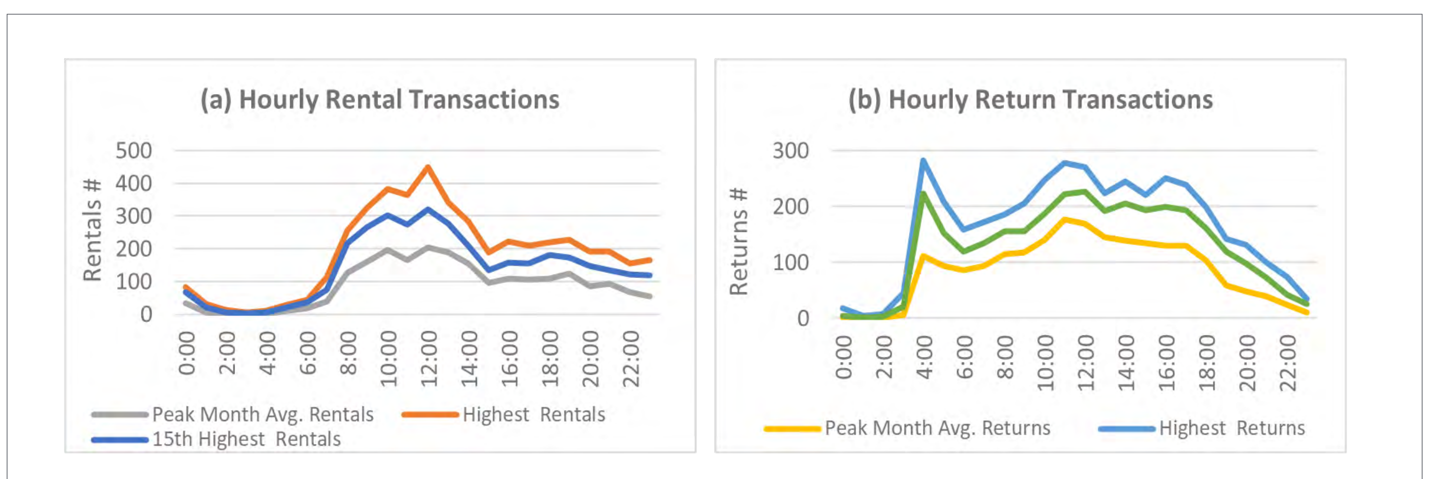
Source: Jacobsen|Daniels, 2020.

Table 3-16 Projected Total Public Parking Demand

	Baseline (2018)	PAL 1 (2023)	PAL 2 (2028)	PAL 3 (2033)	PAL 4 (2038)
Annual Transactions	1,899,773	2,075,154	2,312,510	2,581,070	2,868,251

Source: Jacobsen|Daniels, 2020.

Figure 3-6 Hourly Rental and Return Transactions at SMF



Source: Sacramento County Department of Airports (SCDA), 2019.

Public Parking Facilities

Future parking requirements are calculated to accommodate the design day parking demand. Typically, a design day is selected that represents approximately 95% of demand on the peak parking days throughout the year. At SMF however, peak demand does not occur on the same day across different parking products.

Consequently, this analysis does not attempt to define one single day as the design day. Instead, it considers the sum of peak demand observed at different facilities (i.e. the 5th busiest day of the year in 2018) to define ultimate parking demand **Figure 3-4** illustrates historical peak occupancies at SMF by different parking products.

Parking Demand and Parking Requirements

Future parking demand, presented in **Table 3-16**, is projected based on Growth Scenario 2, assuming moderate TNC growth cutting into the parking mode share, reducing it from 35.5 percent to 31.8 percent. The total parking demand is assumed to increase in proportion to the growth of originating passengers following the baseline aviation forecast. **Table 3-16** presents the total public parking demands i.e. estimated annual transactions at SMF for different PALs.

Figure 3-5 summarizes total public parking demand at SMF showing the current capacity (dashed lines) as well as future needs for close-in and remote parking facilities.

Figure 3-5 also depicts a growing parking demand at SMF. Estimated demand was projected to increase by approximately 10%, 25%, and 41% in PAL 1, PAL 2 and PAL 3 respectively, compared against 16,394 total parking spaces during the peak period in baseline (2018). Total public parking demand was projected to grow as high as 24,572 total parking spaces by PAL 4. Public parking demand is assumed to grow in proportion to passenger growth under the baseline forecast, considering a mode share cut due to moderate TNC growth.

Rental Car Facilities Requirements

Requirements for a Consolidated Rental Car facility (ConRAC) were developed using facility utilization rates based on the 15th highest hourly transactions of rental and return. The baseline needs were then projected for PAL 1 using GT Growth Scenario 2 (presented in Table 3-16) and increased in proportion to the passenger enplanement forecast to estimate the facility requirements for different PALs. **Figure 3-6** depicts an hourly rentals and returns comparison between the average transactions during the peak month (September) and the highest rental and return transactions.

Customer Service Building (CSB)

The customer service building/area is used to process rental transactions of arriving customers. **Table 3-17** presents the customer service counter facility requirements for baseline (2018) through PAL 4. The CSB is estimated to require 22,500 sq.ft. by PAL 4, which includes CSB counters, RAC administration space, lobby space, and circulation space.

ConRAC Garage

The Garage is the primary facility of a ConRAC, and is comprised of five elements:

- Ready spaces: Spaces where vehicles are parked prior to being rented by customers in a parking bay configuration.
- Return spaces: Spaces where vehicles are returned by customers in a nose-to-tail parking configuration.
- Flex spaces: Spaces that can be used for either ready or return operations and include pavement striping for both.
- Customer service booths: Transaction booths in the ConRAC Garage for premium customers who bypass CSB counters.
- Exit plaza: Security booth where all customers with rented vehicles leave the garage.

Table 3-18 summarizes the facility requirements for baseline (2018) through PAL 4 demand.

Quick Turnaround Area

The Quick Turnaround Area (QTA) is a separate facility that supports fueling, vacuuming, washing, and light maintenance of rental cars. **Table 3-19** summarizes the QTA facility requirements for baseline (2018) through PAL 4. The QTA is comprised of four parts:

- Wash bays: Drive through car wash facilities used by RAC employees to wash returned vehicles.
- Fuel/vacuum stations: Dedicated fuel pumps and vacuums used by RAC employees to refuel and clean vehicles.
- Maintenance bays: vehicle servicing sites for mechanics to perform light maintenance (oil changes and tire rotation).
- Staging spaces: Used to park returned vehicles waiting for a car wash/vacuum. Ready vehicles can also be parked in staging spaces after being processed through the QTA and before being returned to the ready area.

Table 3-17 Customer Service Area Requirements

Customer Service Area Components	Baseline		PAL 1		PAL 2		PAL 3		PAL 4	
	qty	sq ft	qty	sq ft	qty	sq ft	qty	sq ft	qty	sq ft
CSB Queue/ Counter (120 sq ft per counter)	34	4,080	37	4,440	42	5,040	45	5,400	50	6,000
RAC Admin Space (150 sq ft per counter)		5,100		5,550		6,300		6,750		7,500
CSB Lobby Space (90 sq ft per counter)		3,060		3,330		3,780		4,050		4,500
Subtotal sq. ft.		**12,240**		**13,320**		**15,120**		**16,200**		**18,000**
Circulation (25% of subtotal sq ft)		**3,060**		**3,330**		**3,780**		**4,050**		**4,500**
Total sq. ft.		**15,300**		**16,650**		**18,900**		**20,250**		**22,500**

Source: Jacobsen|Daniels, 2020.

Table 3-18 ConRAC Garage Requirements

ConRAC Garage Components	Baseline (2018)		PAL 1 (2023)		PAL 2 (2028)		PAL 3 (2033)		PAL 4 (2038)	
	qty	sq ft	qty	sq ft	qty	sq ft	qty	sq ft	qty	sq ft
Ready Spaces (345 sq ft per space)	894	308,430	1,022	352,590	1,139	392,955	1,270	438,150	1,410	486,450
Return Spaces (270 sq ft per space)	576	155,520	656	177,120	732	197,640	815	220,050	905	244,350
Customer Service Booths (600 sq ft per booth)	10	6,000	10	6,000	10	6,000	10	6,000	10	6,000
Exit Booths (1,000 sq ft per booth)	18	18,000	19	19,000	20	20,000	21	21,000	24	24,000
Exit Booth Queue Area (2,750 sq ft per booth)	49,500		52,250		55,000		57,750		66,000	
Subtotal sq. ft.	**537,450**		**606,960**		**671,595**		**742,950**		**826,800**	
Circulation (20% of subtotal sq ft)	**97,590**		**110,942**		**123,319**		**137,040**		**152,160**	
Total sq. ft.	**635,040**		**717,902**		**794,914**		**879,990**		**978,960**	

Source: Jacobsen|Daniels, 2020.

Table 3-19 Facility Requirements of the Quick Turnaround Area

Customer Service Area Components	Baseline (2018)		PAL 1 (2023)		PAL 2 (2028)		PAL 3 (2033)		PAL 4 (2038)	
	qty	sq ft	qty	sq ft	qty	sq ft	qty	sq ft	qty	sq ft
Fueling/Vac Positions (500 sq ft per position)	57	28,500	65	32,500	72	36,000	80	40,000	89	44,500
Wash Bays (2,000 sq ft per bay)	12	24,000	12	24,000	14	28,000	15	30,000	17	34,000
Maintenance Bays (1,000 sq ft per bay)	20	20,000	21	21,000	24	24,000	26	26,000	30	30,000
QTA Spaces (200 sq ft per space)	256	51,200	292	58,400	322	64,400	358	71,600	398	79,600
QTA Admin Support (175 sq ft per fuel/vac position)	9,975		11,375		12,600		14,000		15,575	
QTA Storage (75 sq ft per position)	4,275		4,875		5,400		6,000		6,675	
QTA Circulation around Fuel/ CW/Admin	65,681		71,531		80,650		88,500		99,081	
QTA Perimeter Circulation	101,816		111,841		125,525		138,050		154,716	
Total sq. ft.	305,447		335,522		376,575		414,150		464,147	

Source: Jacobsen|Daniels, 2020.

Additional Storage/ConRAC Employee Parking

Rental car companies use the vehicle storage area (overflow parking) to store vehicles away from the ConRAC Garage and QTA. Dedicated parking for rental car employees is ideally provided adjacent to QTA and requires access controls.

Table 3-20 summarizes the additional storage and rental car facility employee parking requirements for the baseline (2018) year through PAL 4.

Employee Parking

The SCDA provides parking for Airport and tenant employees in eight parking facilities throughout the terminal area with a total capacity of 1,784 spaces.

Typically, airport employment grows at a lower rate than enplaned passenger forecasts. If employee parking demand grows at half of the rate of forecast aircraft operations growth, or 1.0% over 20 years, and it is assumed that facilities are relatively full in the baseline, then employee parking need grow by approximately 400 spaces to a total requirement of approximately 2,175 (**Table 3-21**).

Roadways

On-Airport

Roadway requirements are determined using observed or estimated peak hour traffic volumes to and from key traffic generators in the terminal core. Future volumes are estimated using anticipated growth in enplanements.

The peak-hour volumes are compared to roadway capacity, calculated using roadway speeds and number of lanes, assuming a desired LOS "C", and applying the highway capacity manual methods shown in **Figure 3-7**. For example, many of the airport roadways analyzed feature two lanes and speed limits of 35 mph. According to **Figure 3-7**, a 35-mph roadway performing at LOS "C" has a capacity of approximately 900 vehicles per hour, per lane, or 1,800 vehicles per hour on the roadway.

A comparison of existing and future roadway volumes to calculated roadway capacity is achieved through a volume to capacity ratio (V/C). Traffic engineering principles generally dictate that when a roadway V/C ratio reaches 0.7, the roadway should be considered for additional lanes, and when V/C reaches 0.9, the roadway fails to perform its function.

Figure 3-8 shows the on-airport traffic generators considered in the roadway capacity analysis, along with the numbered highlighted roadway links that were evaluated.

The primary airport entry and exit roadways generally do not have sufficient capacity to accommodate future demand, and will likely need to be expanded.

There may be other minor generators of traffic such as personnel working in the public safety building, fixed based operator, ATCT, shuttle bus maintenance facility, and other facilities that are not considered in this analysis. However, the conclusions from this analysis are directionally useful.

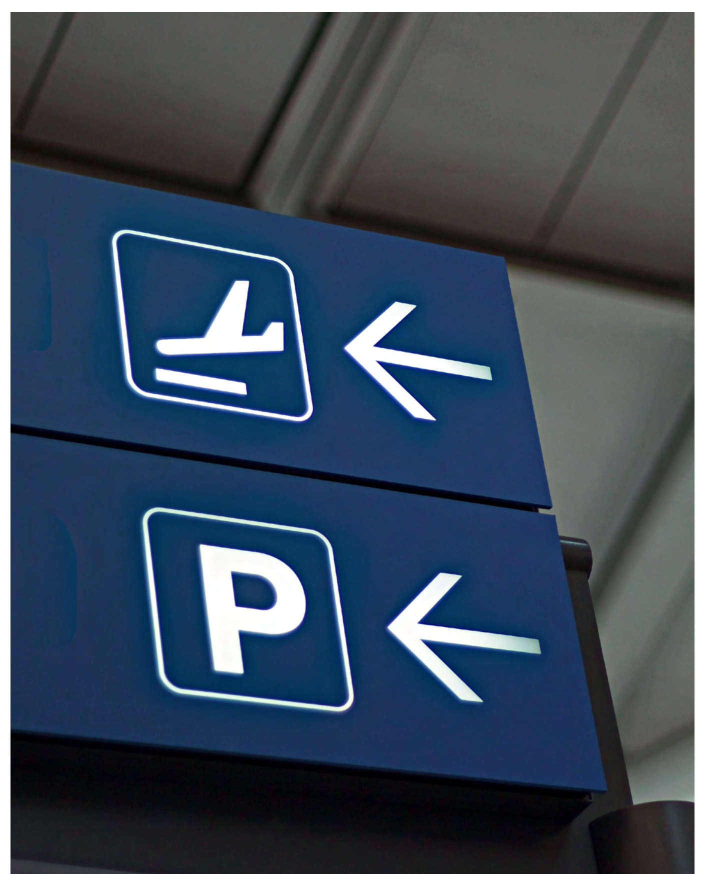


Table 3-20 Additional Storage and ConRAC Employee Parking Requirements

Additional Storage and Employee Parking	Baseline (2018)		PAL 1 (2023)		PAL 2 (2028)		PAL 3 (2033)		PAL 4 (2038)	
	qty	sq ft	qty	sq ft	qty	sq ft	qty	sq ft	qty	sq ft
Overflow Storage (200 sq ft per storage)	3,956	791,177	4,491	898,143	5,011	1,002,172	5,595	1,119,077	6,217	1,243,485
Employee Parking (345 sq ft per space)	395	136,275	415	143,089	435	149,903	454	156,716	474	163,530
Total sq. ft.	927,452		1,041,232		1,152,074		1,275,793		1,407,015	

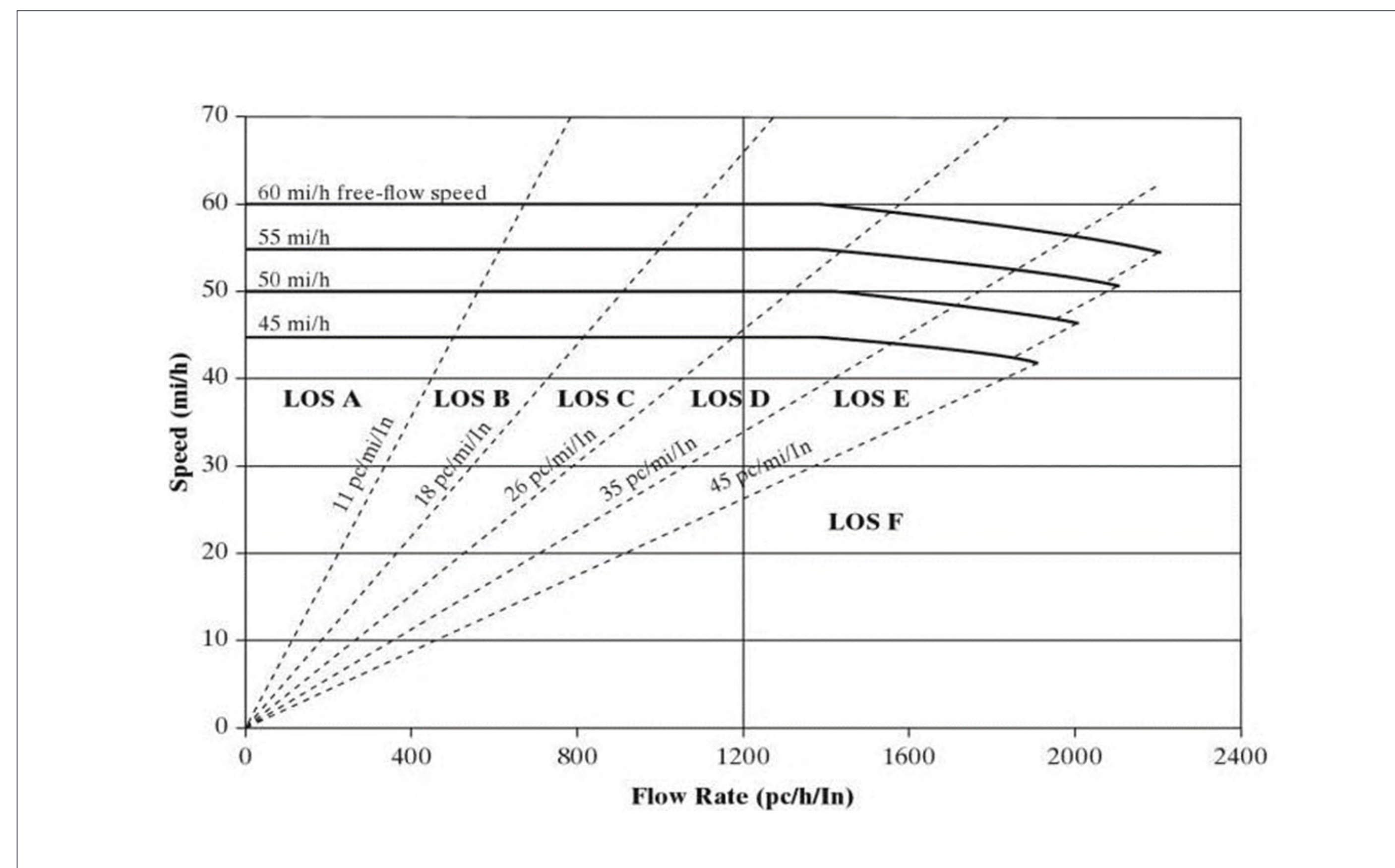
Source: Jacobsen|Daniels, 2020.

Table 3-21 Employee Parking Requirements

	Base (2018)	PAL1	PAL2	PAL3	PAL4	AAGR 2018-2038
Air Carrier Operations	118,863	129,333	142,002	156,190	171,087	2%
Employee Parking Demand	1,784	1,875	1,971	2,071	2,175	1%

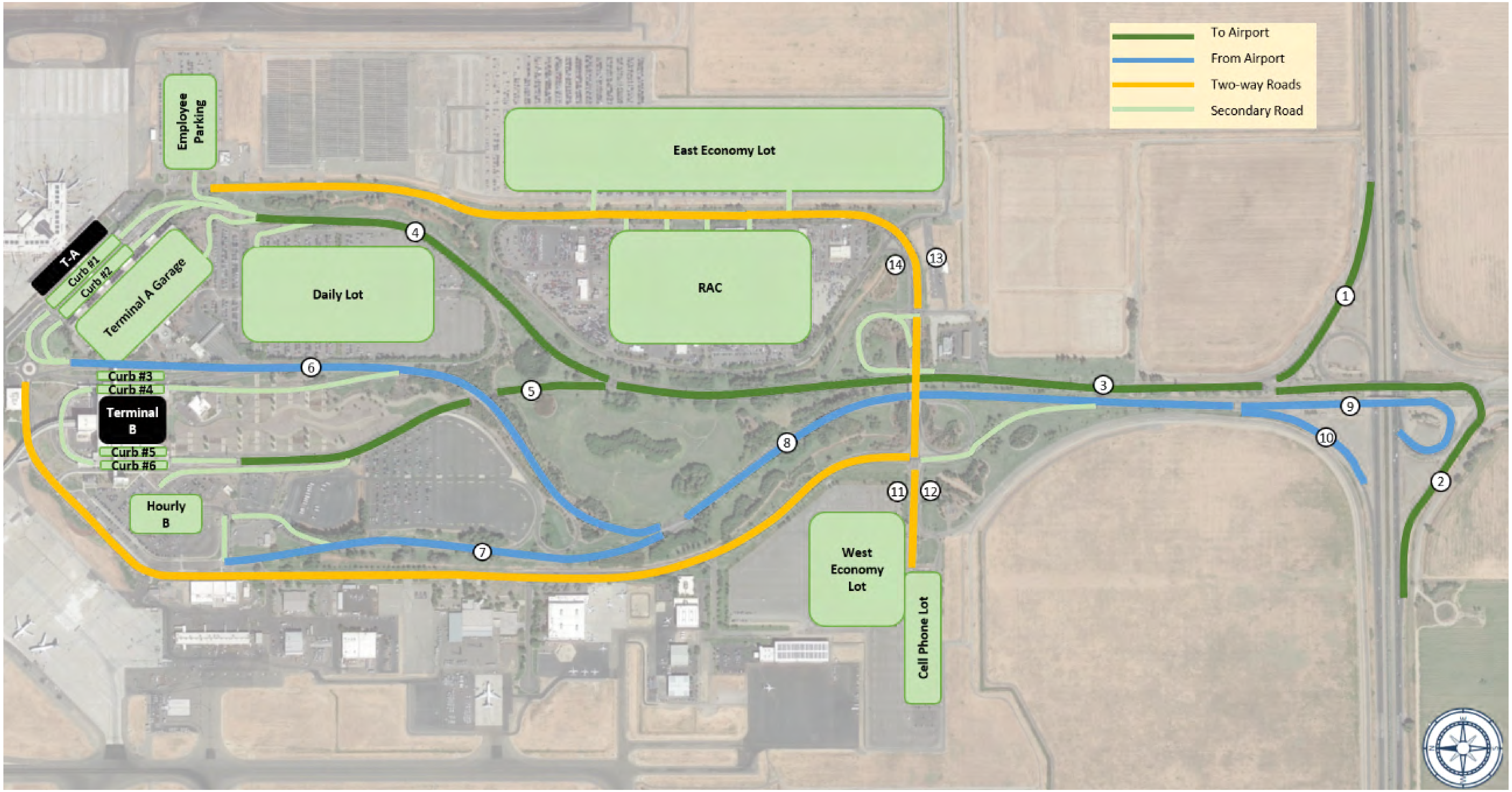
Source: Jacobsen|Daniels, 2020.

Figure 3-7 Highway Capacity Manual Roadway Capacity



Source: Highway Capacity Manual.

Figure 3-8 Traffic Generators and Roadway Links



Source: Highway Capacity Manual.

Curbsides

The curbside portion of the terminal roadways, where the primary pickup and drop-off functions are accommodated, is often the most constrained element of Airport roadway operations. For this analysis, the curbside roadways are divided into separate facilities according to:

- Passenger Terminal (A or B)
- Whether users are predominantly dropping off, picking up, or a mix of both operations
- Whether users are private vehicles, commercial vehicles, airport shuttles, or a mix of multiple user types

Curbside length requirements are determined based on the peak-hour or design hour volumes of vehicles observed on the curbside and then compared to existing facility size to determine future need.

Curbsides Requirements

Table 3-22 shows the required curbside length in the baseline and future planning activity levels. The existing total airport curbside roadway capacity is adequate through PAL 3, but capacity at each terminal or at specific curbsides may not be sufficient.

The upper level curbside at Terminal B appears to be capacity constrained on the west side in the baseline and on both east and west sides by PAL 1. However, various operational measures could be employed to increase throughput capacity, reducing the need for new curbside facilities including:

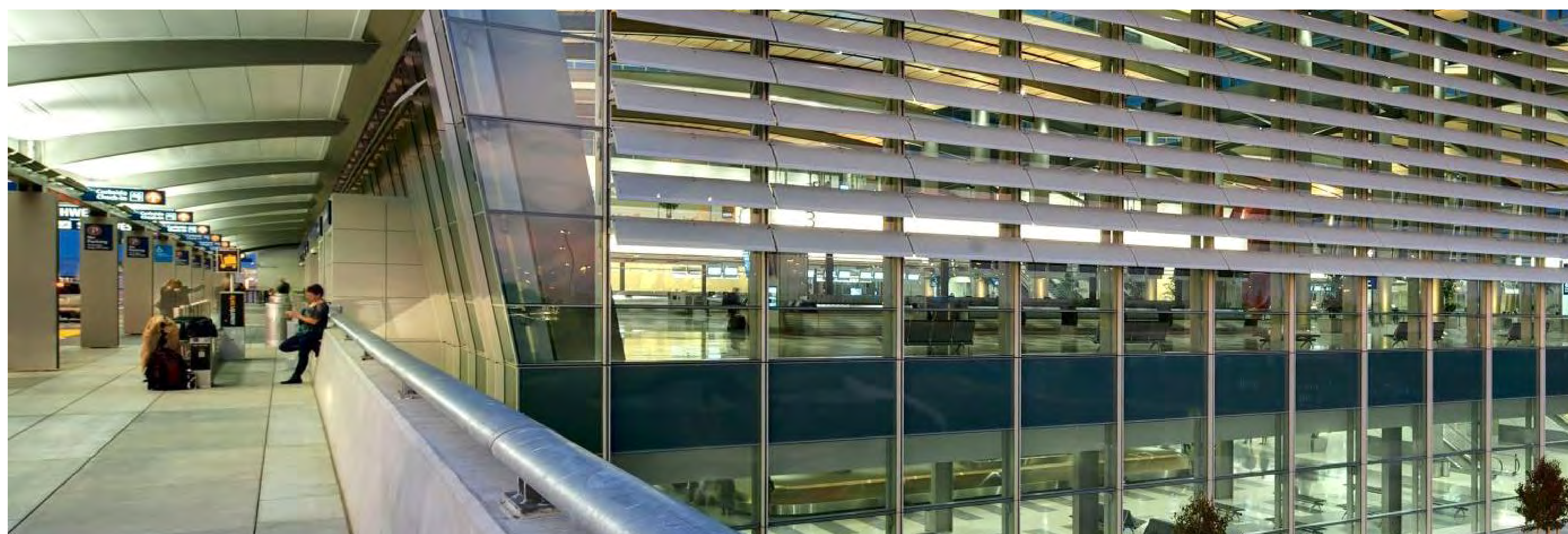
- Providing alternate drop-off locations for TNCs
- Enforcing shorter drop-off times and reducing average dwell times
- Balancing airline check-in operations between Terminal B east and west

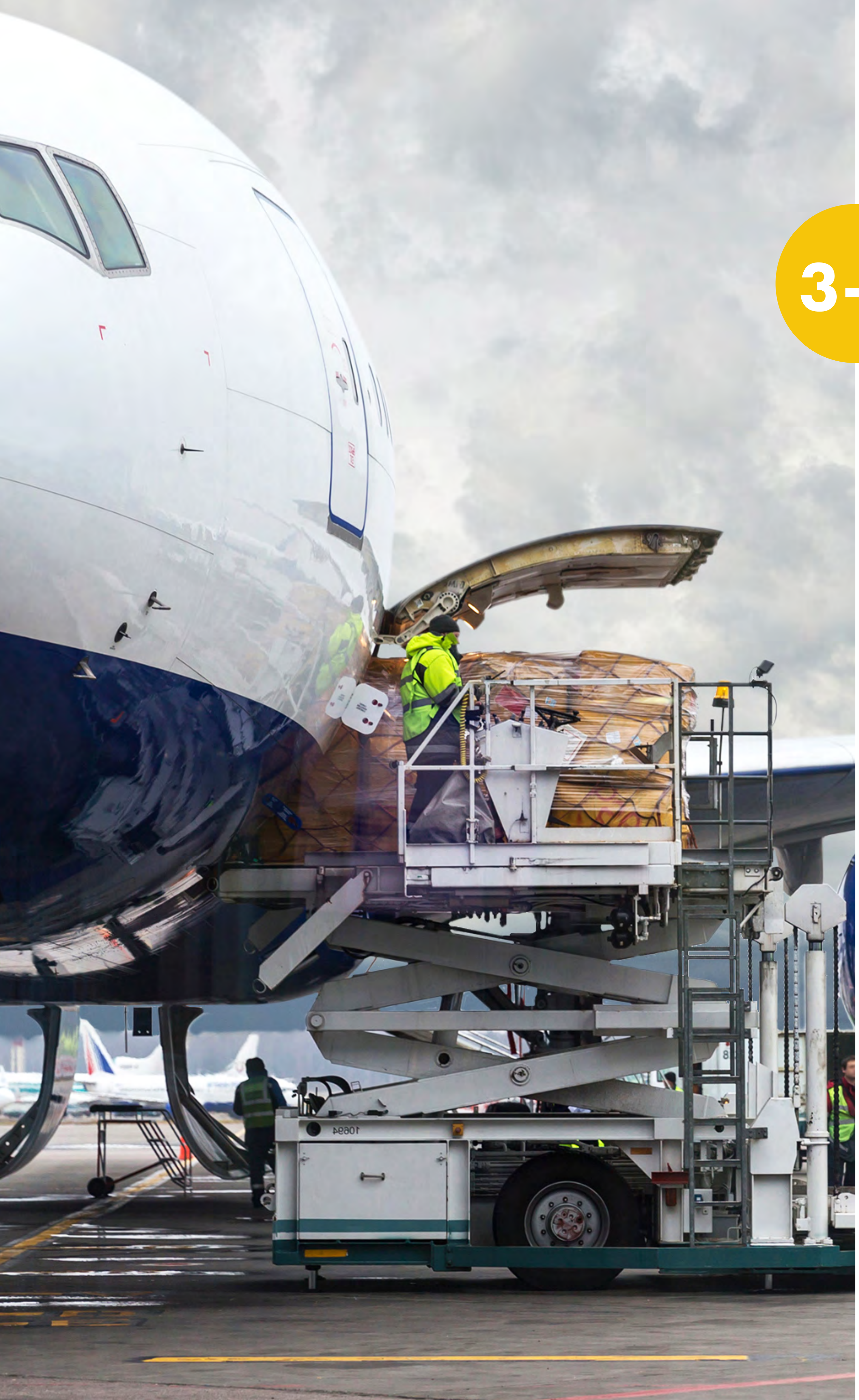
One facility-based solution to providing alternate drop-off and pickup locations is constructing a new consolidated ground transportation center (GTC), which would offer customer service benefits and efficiencies for ground transportation operations.

Table 3-22 Curbside Capacity Summary

		Baseline		PAL 1		PAL 2		PAL 3		PAL 4	
Curbside	Existing Curb length	Hourly Volume	Curbside Required (ft)	Hourly Volume	Curbside Required (ft)	Hourly Volume	Curbside Required (ft)	Hourly Volume	Curbside Required (ft)	Hourly Volume	Curbside Required (ft)
TA Inner	825	425	725	524	875	583	950	651	1,075	724	1,150
TA Outer	825	50	240	62	240	69	240	77	320	85	320
TA GTC	1,000	106	360	131	420	146	450	162	510	180	540
Terminal A Subtotal	2,650	581	1,325	716	1,535	798	1,640	890	1,905	989	2,010
TB Upper West	425	278	500	342	600	382	650	426	725	473	800
TB Upper East	425	228	425	281	500	313	575	349	600	388	650
TB Lower West	425	196	475	241	575	269	625	300	700	334	750
TB Lower West CVs	500	51	200	63	225	70	250	78	300	87	300
TB Lower East	425	157	375	193	475	216	500	241	575	267	625
TB Lower East (Shuttles)	425	36	200	44	240	49	240	55	320	61	320
TB GTC (TNC Only)	600	159	325	196	375	218	425	244	450	271	500
Terminal B Subtotal	3,225	1,105	2,500	1,361	2,990	1,517	3,265	1,693	3,670	1,882	3,945
Airport Total	**5,875**	**1,686**	**3,825**	**2,077**	**4,525**	**2,315**	**4,905**	**2,583**	**5,575**	**2,871**	**5,955**

Source: Jacobsen|Daniels, 2020.





3-4 AIR CARGO REQUIREMENTS

For the foreseeable future, design of air cargo facilities should provide a large degree of flexibility, recognizing that the industry is subject to large changes in both traffic and technology. A major force in this change is the recent increasing demand for short term shipping from online retailers. It is anticipated that as one-day and same-day shipping becomes a greater expectation from online retail customers that the space requirements for air cargo facilities will increase.

Conversations with cargo operators indicate a strong cargo growth scenario expected across the industry, implying a need for additional space and an update to typically used metrics during cargo facility planning. The projected activity at SMF supports the high-growth scenario cargo forecast when determining future cargo facility needs; total air freight tonnage increasing from 109,197 tons in the baseline (2018) to 296,296 tons in PAL 4 (2038) with an annual growth rate of 5.1%.

Cargo Building Requirements

Using the metric of 3.5 square feet per annual enplaned ton of cargo, the estimated cargo volume for PAL4 will require warehouse capacity of approximately 1,037,036 square feet. Actual space requirements will depend primarily on the needs of individual carriers using the cargo facilities at the Airport and the type of cargo they process. For example, the express integrator carriers process time sensitive express freight, which is usually transported in full container loads passing through highly automated facilities. In contrast, passenger carrier belly hold cargo typically moves in smaller lot sizes and in break-bulk form, requiring more storage space per annual ton.

The projected air cargo building space requirements for the Airport are shown on **Table 3-23**.

Table 3-23 Air Cargo Building Requirements (High Growth Scenario)

Year	Annual Enplaned Cargo (tons)	Building Requirements (sq. feet)
2023	153,155	536,043
2028	200,167	700,585
2033	243,534	852,369
2038	296,296	1,037,036

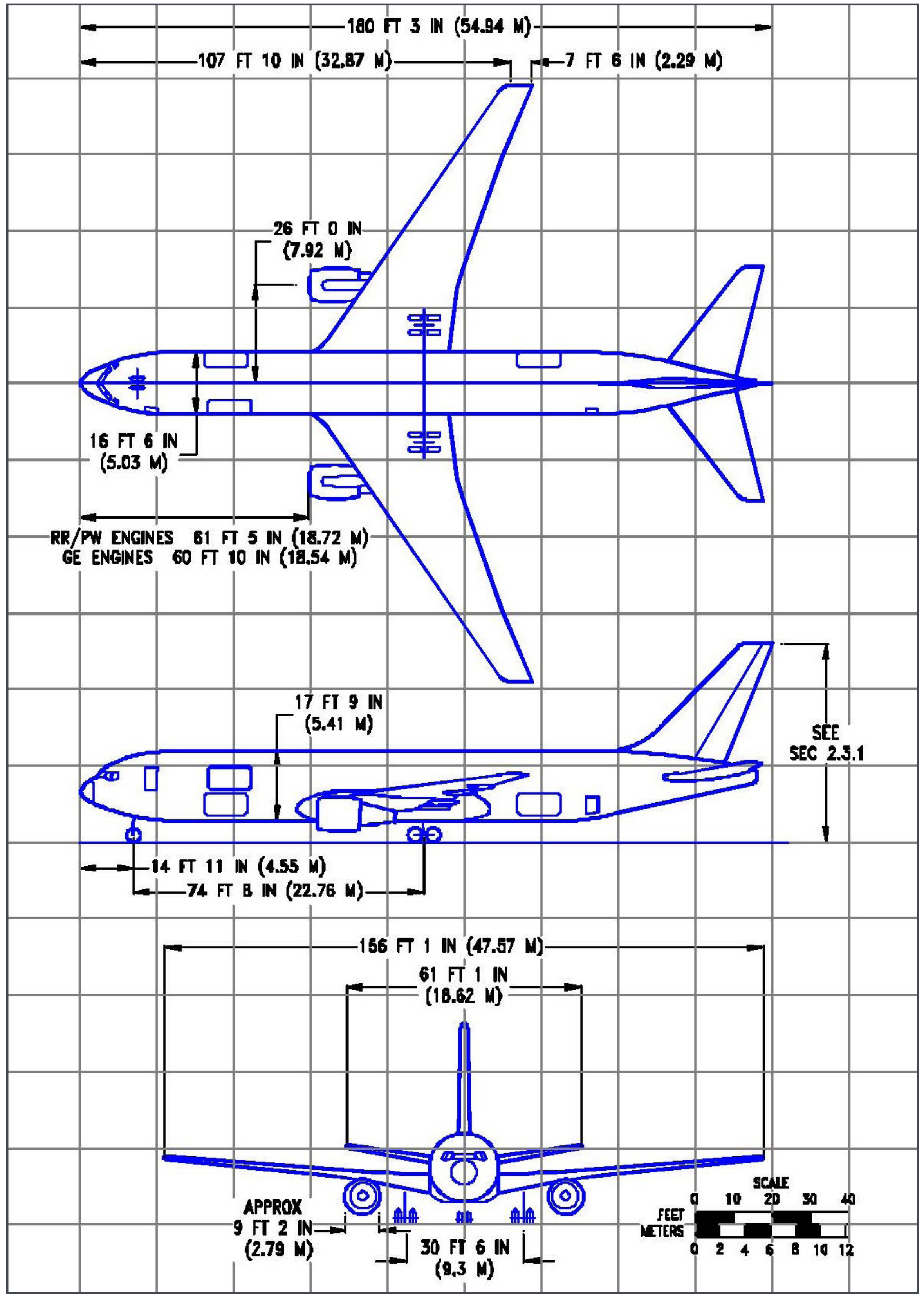
Source: Sacramento County Department of Airports, 2019.

Cargo Ramp Requirements

An air cargo apron must be sized to accommodate peak demand. The existing air cargo building aprons are in two locations: 1) the northern apron, which is 600 feet in length, and 2) the southern apron, which is 500 feet in length.

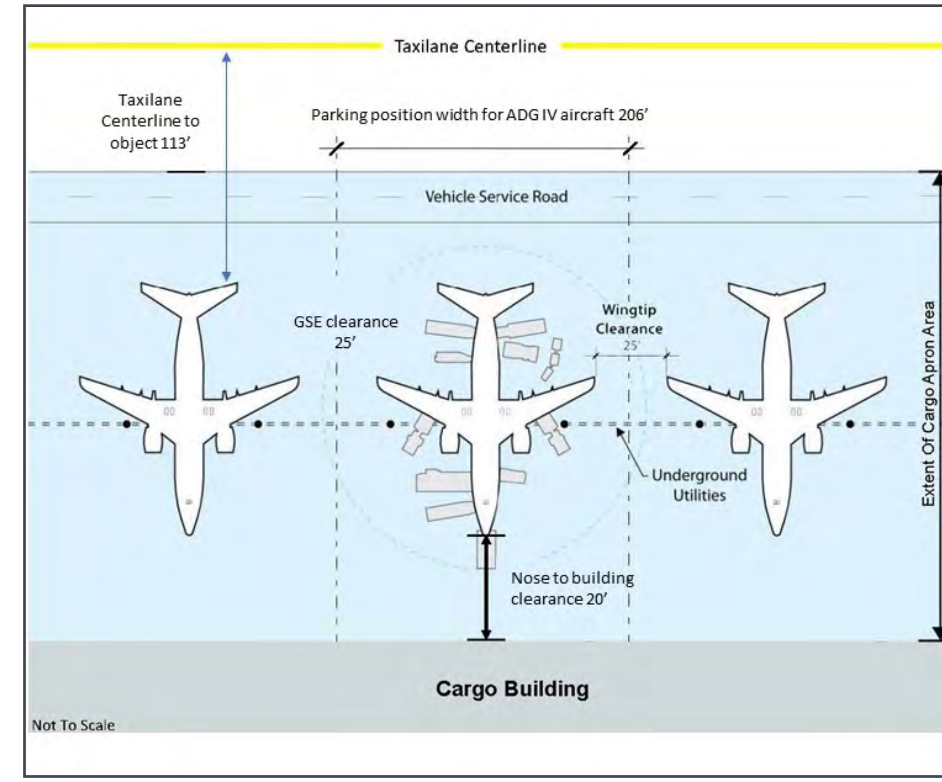
Based on discussions with cargo operators, to meet future demand, the apron should accommodate up to seventeen B-767F aircraft during a peak period. A B-767F is a typical air cargo aircraft and has a wingtip to wingtip width of 156 feet (**Figure 3-9**). ACRP Report 96, Apron Planning and Design Guidebook, defines the dimensional factors most relevant to the planning and design of apron facilities:

Figure 3-9 Boeing 767F Dimensions



Sources: Boeing 747-400 Airplane Characteristics for Airport Planning.

Figure 3-10 General Cargo Apron Layout



Sources: FAA Advisory Circular 150-5360, Airport Terminal Planning; Drawing by Jacobsen|Daniels.

- Wingspan: 156 feet for a B-767F aircraft (ADG IV)
- Clearance between the front of a parked aircraft and a building face to accommodate tug maneuvering or cargo nose loading in front of the aircraft: 20 feet nose-to-building distances of for ADG IV aircraft
- Separation between the wingtips of aircraft, as well as between wingtips and any fixed or movable object: 25 feet for ADG IV aircraft
- 5 feet of clearance between the wingtip of a parked aircraft and the edge of a marked service road
- Taxiway centerline to fixed or movable object for ADG IV: 130 feet
- Taxilane centerline to fixed or movable object for ADG IV: 113 feet

Considering these design guidelines, one B-767F requires a ramp width of approximately 206 feet. To accommodate seventeen B-767F aircraft, the required length of apron space is approximately 3,500 feet. A general apron layout is shown in **Figure 3-10**.

3-5 GENERAL AVIATION REQUIREMENTS

GA activity includes all flight operations by aircraft other than scheduled or charter passenger aircraft and military aircraft. GA covers a range of activity from recreational flights on small single-engine or multi-engine propeller-driven aircraft, to operations by larger corporate or business jet aircraft.

GA facility requirements, were developed considering the activity forecasts, current leases, discussions with the FBO and other GA operators, and SCDA policies. While GA facilities at the Airport include the Textron Aviation Sacramento Service Center, and a corporate hangar, the Airport's FBO, SACjet, handles the majority of local and itinerant GA traffic. SACjet occupies a site that consists of a 40,000-square-foot hangar used for aircraft storage and maintenance and a 6,500-square-foot building that accommodates the FBO's administrative offices, a pilots' lounge, and other crew and passenger amenities. SACjet also operates and maintains an additional 12,000 square feet of hangar space and 15,000 square feet of apron space.

Forecast Demand

The total number of general aviation operations at the Airport is forecast to increase an average of 0.3 percent per year from 2018 (8,881 operations) through 2038 (9,429 operations). Itinerant operations are forecast to grow from 6,820 in 2018 to 6,885 in 2038. Local operations are forecast to grow from 2,061 in 2018 to 2,404 in 2038. Eighteen aircraft are based at the Airport. This number is forecast to remain unchanged through PAL 4.

Requirements

As described in the FBO Lease and Development Agreement, a multi-phase expansion of the GA area at the Airport has been planned. The FBO development includes the facility needs of other GA operators on the airfield. The total land area identified for all phases of the planned expansion—including the existing site—is 1,280,000 square feet, or approximately 30 acres (planned expansion of 22 acres). Consultation with SCDA and representatives from SACjet indicates that the planned expansion of the GA site is sufficient to accommodate forecast GA demand through PAL 4.

In discussions for this master plan update, Textron has stated that while there are no defined plans regarding increasing building size or leasing additional facilities in the near term, needs may change over time as new Textron Aviation products are introduced to the market.

3-6 AIRLINE SUPPORT REQUIREMENTS

The requirements for each airline support facility area were based on discussions with SCDA staff, discussions with support facility operators, and examining forecast activity at the Airport. Fueling is a key element of airline support. The Airport's fuel farm is northeast of the ARFF station, on the east side of Earhart Drive. The fuel farm is owned by an airline consortium led by Southwest Airlines and is operated by Allied Aviation under contract with Southwest. Projected jet fuel requirements are presented in **Figure 3-11**.

Fuel Storage

The Airport's fuel farm is northeast of the ARFF station, on the east side of Earhart Drive. The fuel farm is supplied with a 12-inch-diameter pipeline owned and operated by Wickland Oil Company, and is connected to the Kinder Morgan pipeline in the City of West Sacramento.

The fuel farm includes one horizontal 2,000-gallon waste fuel storage tank, one self-contained 12,000-gallon AvGas storage tank, and three vertical 1,764,000-gallon jet fuel storage tanks. Fuel storage requirements are expressed in two ways: (1) in terms of gross tank storage volume so that SCDA can accommodate future demand for storage capacity without interfering with the business decisions of the passenger and all-cargo airlines, and (2) in terms of land area required so that SCDA can ensure that no other facilities encroach on the area required for future fuel storage development (**Figure 3-11**).

As shown on **Table 3-24**, the existing 4,762,800 gallons of jet fuel storage capacity, situated on approximately 1.7 acres of land, provides capacity well in excess of the required capacity through the end of the planning period regardless of whether the Airport designates a policy of storing three, five, seven, or nine days supply of jet fuel onsite. No additional fuel storage capacity or land area is required in the planning period. Assuming a maximum velocity of five feet per second, a common industry standard, a 6-inch supply line is sufficient to meet projected demands. Fuel is currently delivered by a 12-inch supply line, which is more than adequate to convey the Airport's projected jet fuel demands for the PALs.

In-Flight Catering

LSG Sky Chefs, which provides in-flight catering services to the passenger airlines serving the Airport, leases a 140,000-square-foot site with a 30,000-square-foot building in the area southwest of Terminal B, between the United Air Freight building and the USPS facility.

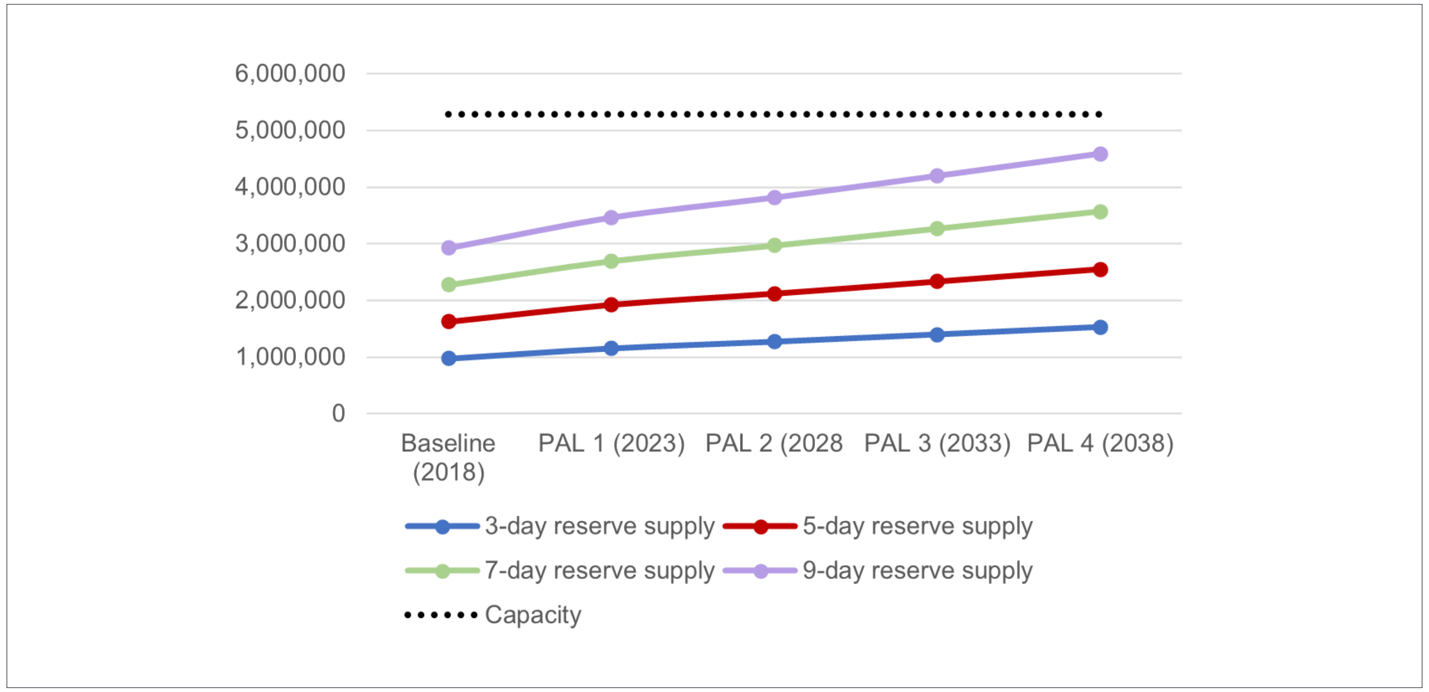
The existing flight kitchens at the Airport are adequately sized to serve forecast growth at the Airport.

Table 3-24 Projected ADPM Airline Jet Fuel Demand and Gross Storage Requirements

	Base (2018)	PAL 1 (2023)	PAL 2 (2028)	PAL 3 (2033)	PAL 4 (2038)
Annual aircraft operations	129,959	153,833	169,447	186,402	203,703
Peak month aircraft operations (8.4% of annual total)	11,436	12,866	14,172	15,590	17,038
Average day peak month (ADPM) aircraft operations	350	415	457	502	549
ADPM jet fuel dispensed per departure (gallons) (a)	1,670	1,670	1,670	1,670	1,670
ADPM jet fuel demand (gallons)	292,789	346,575	381,752	419,951	458,929
Jet fuel storage requirements (gallons) (b)					
3-day reserve supply	975,962	1,155,251	1,272,508	1,399,836	1,529,763
Land requirements (acres)	0.3	0.4	0.4	0.4	0.5
5-day reserve supply	1,626,604	1,925,418	2,120,847	2,333,061	2,549,605
Land requirements (acres)	0.5	0.6	0.7	0.7	0.8
7-day reserve supply	2,277,246	2,695,585	2,969,186	3,266,285	3,569,447
Land requirements (acres)	0.7	0.9	1.0	1.0	1.1
9-day reserve supply	2,927,887	3,465,752	3,817,525	4,199,509	4,589,289
Land requirements (acres)	0.9	1.1	1.2	1.3	1.5

(a) Based on peak-month (July 2018) activity
(b) Includes adjustment factor to account for "bottoms" in tank (90% of gross tank capacity contains usable fuel).
Source: Sacramento County Department of Airports, 2019.

Figure 3-11 Existing Capacity Compared to 3-, 5-, 7-, And 9-Day Reserves



Source: Sacramento County Department of Airports, 2019.

3-7 AIRPORT SUPPORT REQUIREMENTS

This analysis identifies additional airport support facilities space (this includes concourse space) and the replacement of some support facilities within the planning period. The facilities requiring replacement are near the end of their useful life for their originally intended purposes. Further analyses will be required to understand whether these facilities may still be utilized as storage space in lieu of demolition. However, staff and office space will need to be accommodated in a new facility.

Airport Traffic Control Tower (ATCT) is an aging facility that has been in operation since the airport's opening in 1967. A siting study, completed in 2009, recommended a new ATCT location site on the north side of the Airport (there exists a reserved plot of land on the north airfield, centrally located between the runways for a new ATCT). At this time, there are no plans to move forward with the construction of the new facility, mostly due to funding issues.

Airport Administration

SCDA occupies office space in both terminal buildings. Approximately 20,000 square feet of office space is provided across both levels of Terminal A, a portion of which houses the Communications Center as well as a large meeting room. Approximately 40 square feet of additional vacant administrative facilities are located on Level 01 of Terminal A.

SCDA administrative offices are located on Level 04 of Terminal B, occupying approximately 16,000 square feet. Other administrative spaces in Terminal B occupy approximately 3,300 square feet on Level 00; 2,000 square feet on Level 01; 8,700 square feet on Level 02; and, 600 square feet on Level 03.

- Other Airport administration staff are located outside of the terminal buildings

To keep pace with increasing levels of enplanements, it is estimated that by PAL 4, the Department of Airports will need to increase staff levels by approximately 40%. This high-level analysis is based on a ratio between existing enplanements and staff levels extrapolated to PAL 4, where it was determined that currently, administrative staff space equates to approximately 260 square feet per employee. Therefore, a 40% increase in staff will require an additional, approximately 35,000 square feet of administrative staff space.

Airport Maintenance

Airport maintenance functions are performed by a variety of groups at the Airport:

- The Call Center for maintenance requests
- Pride Industries cleans space in both terminals
- The Department of General Services (DGS) is responsible for maintenance fo SCDA facilities
- Airfield Maintenance is mainly responsible for maintenance of runways, taxiways, and ramp areas
- Equipment Maintenance
- Parks Maintenance is responsible for landscaping

Interviews with airport maintenance staff estimate that maintenance staff will grow from 79 to approximately 90 over the next five to ten year. Staffing levels are assessed annually in coordination with the budget and airport demand. Airport maintenance staff are provided accommodations at a variety of facilities on the Airport. Airport maintenance facilities include the following:

- The Physical Plant Maintenance Building
- The Airport Maintenance Building
- Electrician and Painter Trailers

Building and airfield maintenance facility needs do not necessarily increase proportionally with aviation activity, but are more a function of the overall pavement, grassy areas, terminal square footage requiring maintenance, and climatic conditions. Therefore, Airport maintenance requirements were developed based on information provided by SCDA staff, who identified a total land requirement of 18 acres, or 784,080 square feet of land for expansion in support of airport operations (which includes storage, maintenance, and refuse/recycling yards).

Aircraft Rescue and Firefighting

Sacramento County Airport Fire currently has 33 members providing Aircraft Rescue and Firefighting (ARFF), structural and wildland fire suppression, and emergency medical services (EMS). It is staffed by a crew of seven, manning two ARFF apparatus and a Type 1 engine company.

ARFF requirements and facility recommendations are provided in Title 14, Code of Federal Regulations, Part 139 (14 CFR Part 139), Certification and Operations: Land Airports Serving Certain Air Carriers. Airports certificated under 14 CFR Part 139 must comply with specific ARFF criteria, including response time requirements and extinguishing agent requirements. The regulations within 14 CFR Part 139 are used to determine the ARFF Index (A through E) for airports serving certificated air carriers. The five ARFF indices are listed in **Table 3-25**, with details of specific requirements to meet each index.

The Airport's ARFF station is currently classified as Index C.

The regulations in 14 CFR Part 139 state that Index C relates to airports where the operating aircraft are at least 126 feet long, but less than 159 feet long, with at least five daily departures. With the projected fleet mix for the Airport taken into account, it was determined that the ARFF facility will continue to be required to meet Index C standards throughout the planning period. Because the ARFF station already operates five vehicles (excluding a command vehicle), exceeding Index C requirements, it is not expected that additional ARFF equipment will be required through the planning period. However, the existing facility is nearing the end of its useful life requires replacement in the immediate future. An approximately 20,000 square foot replacement facility is currently planned with construction beginning in 2020 and anticipated completion within one year, to adequately support ARFF operations.

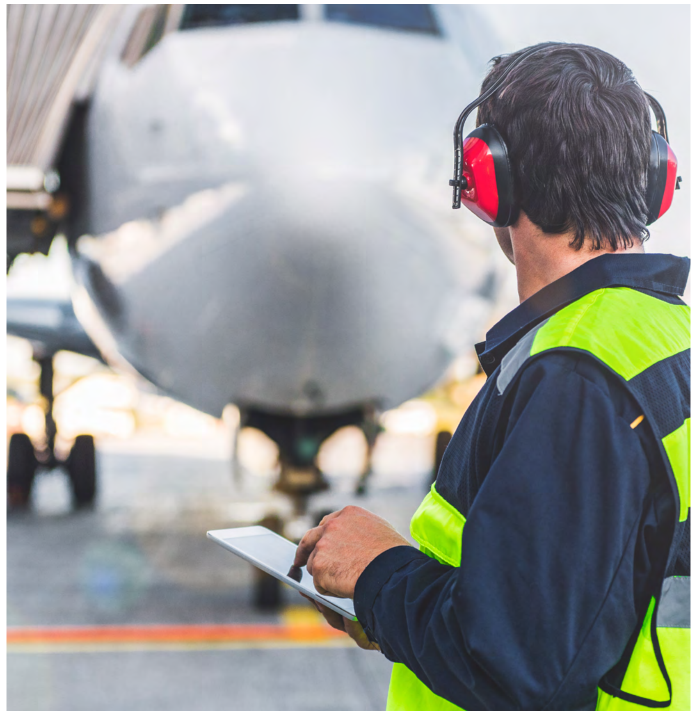


Table 3-25 Aircraft Rescue and Fire Fighting Index Classifications

Airport ARFF Index	Required number of vehicles	Aircraft length (feet)	Scheduled daily departures	Agent plus water for foam
A	1	Less than 90	More than 1	500# sodium-based DC or Halon 1211 or clean agent; or 450# potassium-based DC plus water to produce
		Greater than or equal to 90, but less than 126	Less than 5	100 gallons of AFFF.
B	1 or 2	Greater than or equal to 90, but less than 126	More than or equal to 5	
		Greater than or equal to 126, but less than 159	Less than 5	Index A plus 1,500 gallons of water
C	2 or 3	Greater than or equal to 126, but less than 159	More than or equal to 5	
		Greater than or equal to 159, but less than 200	Less than 5	Index A plus 3,000 gallons of water
D	3	Greater than or equal to 159, but less than 200	More than or equal to 5	
		Greater than or equal to 200	Less than 5	Index A plus 4,000 gallons of water
E	3	Greater than or equal to 200	Greater than or equal to 5	Index A plus 6,000 gallons of water

AFFF = Aqueous Film Forming Foam
DC = Dry Chemical
Source: Advisory Circular 150/5220-10E, Guide Specifications for Aircraft Rescue and Firefighting (ARFF) Vehicles, June 2011.

3-7 UTILITIES REQUIREMENTS

Utility service requirements were assessed for water, sanitary sewer, storm sewer, electrical, communications (telephone, internet, and cable), natural gas, and jet fuel. Existing demand was estimated based on a review of historical records of utilities provided by SCDA. Future demands were then estimated by scaling existing demands based on projected passenger demand. The capacity of the existing infrastructure was then compared against estimated future demands.

Water

The Airport obtains its potable water from the City of Sacramento Water Treatment Plant. Water for domestic and fire protection demands is delivered to a water storage and pumping facility near the intersection of Power Line Road and Bayou Road, on the south side of Interstate 5. The projected maximum daily demand of 5.34 million gallons per day (MGD) for PAL 4 was used to determine requirements through the planning period. There is currently a 24-inch water pipeline in place originating at the SCWA off-site water storage and pumping facility and connecting to the Airport at the southern border of the site. The current 24-inch supply pipe is adequate to convey the Airport's projected water flows through PAL 4.

Sanitary Sewer

The Airport receives waste water collection service from the Sacramento Area Sewer District (SASD). Due to the general flat slope of the site, the on-site sanitary sewer collection system is relatively shallow but provides enough slope to convey sewage primarily by gravity flow. The projected daily peak flow of 0.34 MGD for PAL 4 was used to review capacity. Assuming a pipe slope of 0.5 percent, the current 18-inch-diameter Meister Way Connection has a capacity of 7.4 MGD, adequate to convey the Airport's projected wastewater flows through PAL 4.

Storm Drainage

The Airport's existing storm drainage is a gravity flow system that is bifurcated at the center of the Airport. Water on the western side of the property flows to the Airport West Ditch and water on the eastern side of the property flows to the Airport East Ditch. Once in the Ditch system, the water is then transported off the Airport property via gravity flow southward to the Reclamation District 1000 (RD 1000) West Drainage Canal to the existing RD 1000 pumping plant Number 5, where it is discharged into the Sacramento River.

Increased surface runoff and soil erosion are often associated with airport expansion. An increase in impermeable surfaces will have an effect on future storm drainage demands. Specifically, an increase in the impermeable surface area of the Airport site will cause less rainfall to percolate into the groundwater and direct more water into the drainage network increasing flows on-site and downstream of the Airport. To reduce the percent of impervious surfaces and runoff volumes on-site and off-site, it is recommended that future improvement projects use Low Impact Development (LID) and Best Management Practices (BMPs) wherever practical and effective. An example of this kind of practice would be using bioretention systems. Bioretention systems consist of depressed vegetated areas with porous engineered soils designed to capture and treat urban runoff and infiltrate treated water to the subsurface where existing site soils allow.

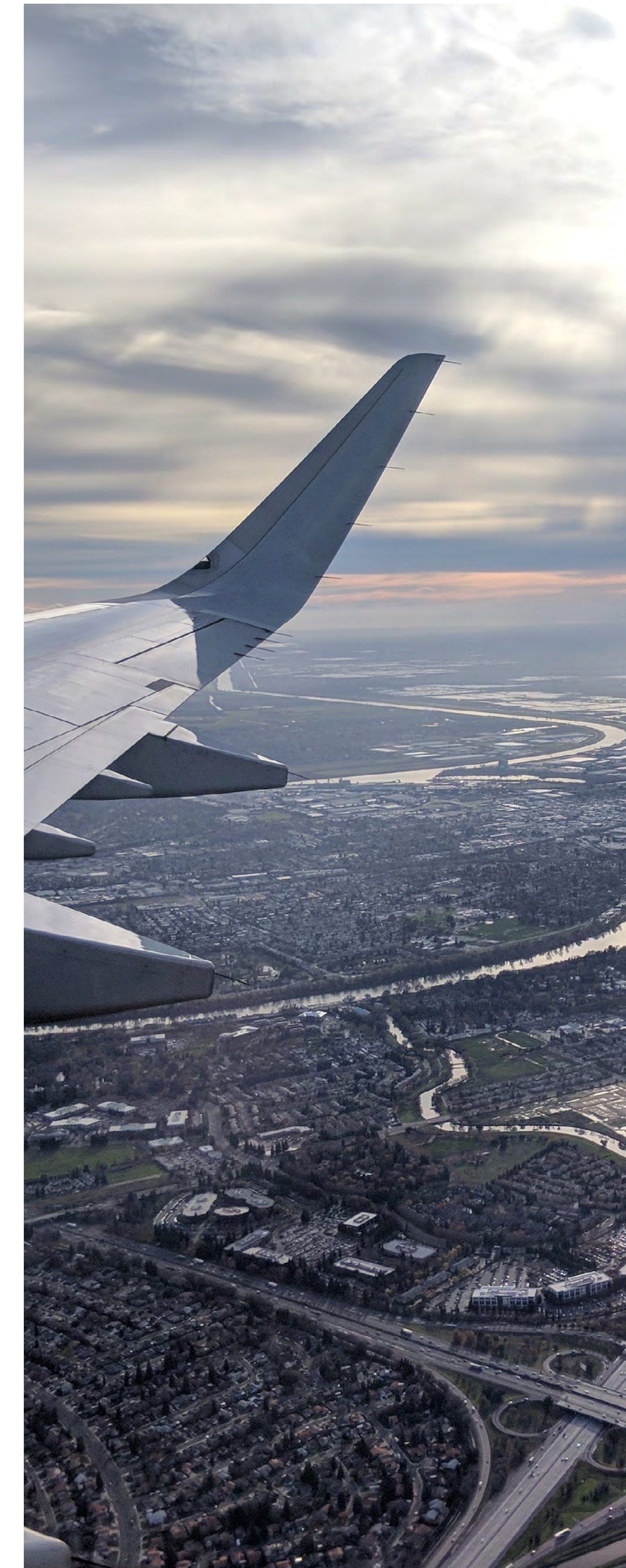
Electrical and Communications

The Airport obtains its electrical service from Sacramento Municipal Utility District (SMUD) and an on-site photovoltaic (PV) facility. During the peak month in 2018 the Airport used an average of 121 megawatt-hours (MWh) each day, this equates to an average hourly demand of 5.04 megawatts. This is well below the capacity of the two 69 kV feeder lines and PV facility currently installed. In addition to the existing electrical supply lines, spare electrical conduits have been provided along the Airport's main utility corridor for any future expansions. Given that capacity currently far exceeds demand, it is anticipated that the existing distribution system will serve all Airport facilities as needed through PAL 4.

Natural Gas

The Airport receives natural gas service from Pacific Gas & Electric Company (PG&E). The Airport is connected to a 6-inch diameter, 60-psi (pounds per square inch) PG&E distribution pipeline, which supplies a 4-inch on-site distribution line.

It was determined that the on-site 4-inch distribution loop can supply approximately 30,000 CFH, sufficient to serve all Airport facilities beyond PAL 4.



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