4. Demand/Capacity and Facility Requirements

Demand/Capacity Analysis - Introduction

This Airport Master Plan's demand/capacity analyses are based on Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5060-5, *Airport Capacity and Delay*, and are presented in the following:

- Airfield Capacity Analysis -includes an analysis of the primary aircraft operations area that examines airside facilities (including runways and taxiways) to determine, based on their configuration and other applicable factors, their ability to efficiently process existing and future aircraft operations with acceptable levels of delay.
- Landside Capacity Analysis – includes an analysis of the passenger terminal, general aviation facilities, and automobile parking facilities and their ability to meet existing and future demands.

The findings of these demand/capacity analyses are used later in this chapter to identify future facility development requirements for COS throughout the 20-year planning period.

Airfield Capacity Analysis

The potential implications of future activity levels on airfield capacity, congestion, and delay are important considerations in identifying future facility development plans at COS. Airfield capacity is defined as the maximum number of aircraft operations that an airfield configuration can accommodate during a specified interval of time when there is continuous demand for service (i.e., an aircraft is always waiting to depart or land). This is referred to as the airfield's ultimate capacity or the maximum throughput rate. In layman's terms, this refers to how many aircraft operations a particular airport can accommodate before delays in taking off or landing becomes problematic or unreasonable. The methodology used in this Airport Master Plan focuses on the Annual Service Volume (ASV), a term commonly used by FAA as a quantifiable measure of an airport's annual operating capacity as well as its hourly capacity. The calculation and analysis of ASV is an important tool in the short- and long-range planning process.

Specifically, this section assesses COS's ability to accommodate existing and future demand for aviation activity in the following categories:

- Airfield Layout and Configuration
- Weather Conditions
- Runway Usage

- Aircraft Fleet Mix
- Touch-and-Go Operations
- Peak Hour Activity
- Airfield Capacity Model

These factors have been examined in the following sections as well as their potential to influence the Airport's existing and future operational capacity. Of particular interest is the last section that contains an assessment of COS's airfield capacity based on an FAA methodology. This considers several of the noted factors for the purpose of comparing the Airport's airfield capacity with the projected future operational levels identified in Chapter Three, *Aviation Activity Forecast*, to determine if any potential capacity shortfalls may exist today or in the future.

Airfield Layout and Configuration

A primary factor for determining the operational capacity of an airport's airfield lies in the layout and geometry of its runways and taxiways. The identification of this layout will contribute to the determination of COS's overall airfield capacity, discussed in a later section. COS currently operates a parallel runway system with an additional crosswind runway. The Airport's parallel runways, Runway 17L-35R and Runway 17R-35L, are, at 13,501 and 11,022 feet long respectively, while the crosswind runway, Runway 13-31, is 8,269 feet long. All three runways are 150 feet wide. The centerline-to-centerline separation of the parallel runways is approximately 8,600 feet. Note that Runway 13-31 does not physically intersect either of the parallel runways, although the Runway Safety Area (RSA) for Runway 13 overlaps that of Runway 17R-35L, creating a coupled runway configuration and is identified by the FAA as a Hot Spot. Further, flight paths to/from the crosswind runway intersect flight paths of aircraft on the parallel runways, creating an operational dependency of one runway on the another. The impacts that the COS's current runway configuration and runway separation have on its operational capacity are also dependent on other factors such as operational fleet mix and weather conditions, both of which are addressed below.

COS's three runways are each served by full-length, parallel taxiways. Taxiways and their exits also have an impact on the operating capacity of an airfield in that runways served by an adequate taxiway system with appropriately spaced exits minimize the time an aircraft spends on its associated runway. When aircraft can efficiently exit an active runway, it enables that runway to process another aircraft operation, thereby minimizing or eliminating any possible delay. The taxiway system at COS is illustrated in **Figure 4-1**.

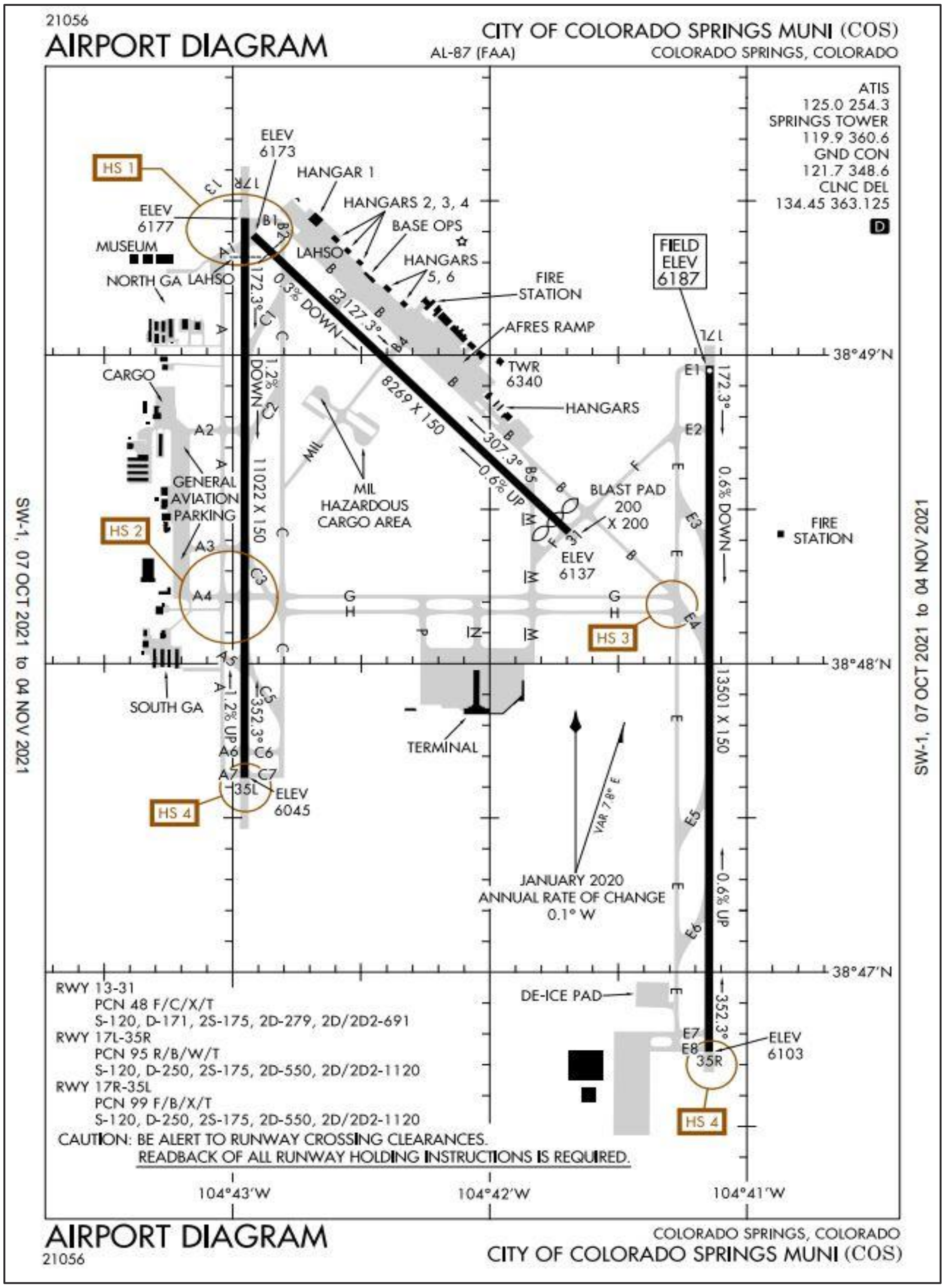
In addition to the parallel taxiways, numerous connector taxiways support all three of COS's runways. As shown in **Figure 4-1**, Taxiways A and C are the full-length parallel taxiways supporting Runway 17R-35L. Access between Runway 17R-35L and Taxiway A is provided by five right-angled exit taxiways (A2, A3, A4, and A7) and two acute-angled, or high-speed, exit taxiways (A1 and A5). Access between Runway 17R-35L and Taxiway C is provided by four right-angled exit taxiways (B1, G, C6, and C7) and four acute-angled exit taxiways (C1, C2, C3, and C5). Connector Taxiways G and H provide access between Taxiway C and the passenger terminal apron area. Connector Taxiways A2, A3, and A4 provide access between Taxiway A and the general aviation apron area.

Aircraft operations on Runway 17L-35R are supported by full-length, parallel Taxiway E. Four right-angled taxiways (E1, E2, E7, and E8) and four acute-angled taxiways (E3, E4, E5, and E6) support aircraft movement between the runway and the taxiway. In addition, taxiways (B, F, G, H, and M) extend beyond Taxiway E and provide access between Runway 17L-35R, Taxiway E, and the commercial passenger terminal area.

Crosswind Runway 13-31 is served by full-length, parallel Taxiway B, which runs adjacent to the apron serving Peterson Space Force Base (PSFB). Four right-angled taxiways (B1, B3, B4, and F) and two acute-angled taxiways (B2 and B5) support aircraft movement between Runway 13-31 and Taxiway B. Additionally, other taxiways (C, MIL, and M) extend beyond Runway 13-31 and provide access to other areas of the airfield. PSFB facilities on the north side of the airfield are supported by Taxiway B and associated exit taxiways from Runway 13-31.

For the purposes of this demand/capacity analysis, the number and location of the exit taxiways is an important consideration since having enough adequately separated exit taxiways reduces the occupancy time of an arriving aircraft on the active runway thereby increasing that runway's capacity. An input in the FAA's methodology for examining airfield capacity is the number of taxiway exits (separated by at least 750 feet) available on the runway(s) within a prescribed range of the runway threshold. This range is based on the mix index of the aircraft that use the runway. For the purposes of determining the estimated airfield capacity at COS, all runways were credited with having at least four exit taxiways, meeting the FAA demand/capacity criteria. (Note that later sections of this chapter examine how the taxiway system may be enhanced to meet FAA taxiway design standards and considerations.)

Figure 4-1: Airport Diagram



Source: FAA

Weather Conditions

Weather conditions can impact airfield capacity by either slowing down the pace of aircraft operations, or even closing the airport itself. As related to aviation, weather conditions are divided into three categories: visual meteorological conditions (VMC), instrument meteorological conditions (IMC), and low instrument meteorological conditions (LIMC).

Different rules govern the operation of aircraft during each of these conditions. Visual Flight Rules (VFR) are applicable during VMC, which is when weather conditions are such that aircraft can maintain safe operations by visual means. VMC are classified as those times when the cloud ceiling is 1,000 feet or more above the airport elevation and visibility is at least three statute miles. Instrument Flight Rules (IFR) apply during IMC, when cloud ceiling height or sight distance visibility falls below the minimum prescribed for VFR operations. During periods of LIMC, navigation is primarily dependent on aircraft instruments. Low Instrument Flight Rules (LIFR) conditions apply during VMC and when the ceiling is lower than 500 feet or sight distance visibility falls below one mile.

The distinction between IFR and VFR operations is important because the separation distance required by the FAA between aircraft conducting IFR operations is greater than that required during VFR operations. Consequently, fewer aircraft operations can occur during IMC than during VMC. Based on historic climatic conditions at COS, the following assumptions have been identified for use in this demand/capacity analysis:

- VFR conditions occur at COS approximately 87.2 percent of the time
- IFR conditions occur at COS approximately 8.1 percent of the time
- LIFR conditions occur at COS approximately 4.7 percent of the time

The effect that these different meteorological conditions have on aircraft operations at COS is an important factor in determining the Airport’s estimated capacity. Calculations shown in a following section of this chapter identify the Airport’s hourly capacity in meteorological conditions and utilizes that data as input in the process of quantifying COS’s estimated total annual capacity.

Runway Usage

Runway usage relates to the way in which an airfield is operated and takes into account the number, location, and orientation of an airport’s active runways, whether those runways are operated simultaneously, and whether they primarily support arrivals, departures, or both. A single airfield layout can have numerous operating configurations given different traffic flows, weather conditions, and activity levels. An understanding of runway usage characteristics at COS is necessary for examining the ability of the existing airfield to efficiently accommodate existing and projected future activity levels.

To maximize its operational capacity, all of COS’s runways are used whenever possible. Note that operational requirements warrant aircraft to land and takeoff in the direction having the greatest headwind possible. Due to this, prevailing wind conditions typically dictate the flow of air traffic and runways utilized. For COS, the overall runway-use patterns, based on FAA flight track data, have been modeled and presented below in **Table 4-1**.

Table 4-1: Overall COS Runway Use

Runway	Percent Use
North Flow	
35L	18%
35R	18%
31	4%
Total	**40%**
South Flow	
17R	29%
17L	26%
13	5%
Total	**60%**

Source: FAA Data

The previous table notes that COS's typical direction or flow of operations is to the south 60 percent of the time, with the remaining 40 percent of the time being to the north (or north flow). During south flow conditions, arrivals and departures occur on Runway 17R and Runway 17L with 29 and 26 percent utilization respectively. In north flow, traffic is distributed equally between the two parallel runways. Finally, each end of Runway 13-31 experiences five percent or less of overall operations.

To better understand how specific categories of aircraft use each runway at COS,

Table 4-2 and **Table 4-3** provide a summary of departure and arrival runway utilization by aircraft category for daytime and nighttime operations.

Table 4-2: Runway Use by Aircraft Category - Departures

	Runway							
	Daytime							
	North Flow				**South Flow**			
Category	**35L**	**35R**	**31**	**Total**	**17R**	**17L**	**13**	**Total**
Air Carrier	6%	33%	<1%	39%	6%	55%	<1%	61%
Air Taxi	10%	31%	1%	42%	16%	41%	1%	58%
General Aviation	29%	2%	9%	40%	44%	3%	13%	60%
Military	13%	8%	9%	30%	44%	17%	9%	70%
	Nighttime							
	North Flow				**South Flow**			
Category	**35L**	**35R**	**31**	**Total**	**17R**	**17L**	**13**	**Total**
Air Carrier	13%	60%	<1%	73%	4%	23%	<1%	27%
Air Taxi	11%	65%	1%	77%	3%	20%	<1%	23%
General Aviation	64%	1%	12%	77%	20%	1%	3%	23%
Military	24%	33%	5%	62%	10%	26%	2%	38%

Source: FAA Data

Table 4-3: Runway Use by Aircraft Category - Arrivals

	Runway							
	Daytime							
	North Flow				South Flow			
Category	**35L**	**35R**	**31**	**Total**	**17R**	**17L**	**13**	**Total**
Air Carrier	5%	33%	<1%	38%	7%	55%	<1%	62%
Air Taxi	10%	28%	1%	39%	20%	41%	<1%	61%
General Aviation	25%	3%	4%	32%	53%	9%	6%	68%
Military	15%	11%	5%	31%	28%	34%	7%	69%
	Nighttime							
	North Flow				South Flow			
Category	**35L**	**35R**	**31**	**Total**	**17R**	**17L**	**13**	**Total**
Air Carrier	26%	42%	1%	70%	6%	24%	<1%	30%
Air Taxi	6%	53%	1%	61%	8%	31%	<1%	39%
General Aviation	58%	6%	10%	74%	18%	5%	3%	26%
Military	39%	34%	3%	77%	5%	14%	4%	23%

Source: FAA Data

In reviewing the data presented above, several important facts about COS runway utilization can be gleaned:

- Daytime operations are predominantly south flow, while nighttime operations are largely north flow.

- The largest percent of Air Carrier and Air Taxi operations occur on Runway 17L-35R; this is likely the result of that runway being the longest on the Airport.

- General aviation aircraft primarily use Runway 17R-35L; this is likely due to its proximity to the Airport's general aviation facilities in addition to general aviation aircraft typically being less sensitive to differences in longer runway lengths.

- Military and general aviation aircraft are the primary users of Runway 13-31; this is likely due to its due to its proximity to military and general aviation facilities, as well as general aviation aircraft typically being more sensitive to prevailing wind conditions. Additionally, it is understood that C-130 military aircraft commonly use Runway 13-31 primarily for training purposes, while larger and/or faster military aircraft will more often use COS's longer runways.

Aircraft Fleet Mix

The aircraft operational fleet mix is an important factor in determining an airport's operational capacity since aircraft following each other on takeoff or landing are spaced according to the differences in their airspeeds. In most instances, as the diversity of aircraft and the range of requisite approach speeds increases, overall operational capacity will tend to decrease as faster aircraft must make allowances for slower aircraft. Additionally, while all aircraft create wake vortices that must be considered in providing separation between aircraft to help ensure safety, greater separation is required for smaller aircraft following larger aircraft that generate larger vortices. Thus, the larger the difference in size and speed of the aircraft in the fleet, the greater the separation required between aircraft, resulting in a lower operational capacity. For the purposes of calculation, the aircraft fleet is categorized by aircraft weight, and an airport's fleet mix index is determined through application of the following equation:

Airport Fleet Mix Index = % C + 3D

Within this formula, "C" represents a category of aircraft weighing greater than 12,500 pounds but less than 300,000 pounds and "D" indicating those aircraft weighing greater than 300,000 pounds.

The operational fleet mix for COS was developed as part of Chapter Three, *Aviation Activity Forecast*. Pre-pandemic 2019 forecast data was evaluated to determine the percentage of operations conducted by Category C and Category D aircraft. **Table 4-4** presents operations by category of aircraft and determines the Airport Mix Index for COS.

Table 4-4: Airport Fleet Mix Index

FAA Approach Category	Maximum Gross Takeoff Weight (MTOW)	2019 Operations	COS Operational Allocation
A	Less than 12.500 lbs. (Single Engine)	3,850	9.35%
B	Less than 12,500 lbs. (Twin Engine)	8,937	21.70%
C	Between 12,500 and 300,000 lbs.	23,961	58.19%
D	More than 3,000 lbs.	4,428	10.75%
Total		41,176	100%
% C + 3D		**37,245**	**90.45%**

Source: FAA Traffic Flow Management System Count (TFMSC) database

It has been assumed that the future fleet mix at COS will remain consistent with or similar to that experienced in 2019. Note that Category C operations at COS represent all air carrier operations as well as most business class general aviation operations. Any operations conducted by Category D aircraft at the Airport are assumed to be associated Boeing 767 or larger aircraft. Based on the Airport Master Plan's projections of aviation demand and the analysis summarized above, it is estimated that the Airport's Airport Mix Index is 90.45 percent, which may increase slightly over the planning period. This fleet mix percentage is key in estimating the overall airfield capacity later in this chapter.

Touch-and-Go Activity

Touch-and-go operations are defined as operations by a single aircraft that lands and departs on a runway without exiting. Pilots conducting touch-and-go operations usually remain in the airport's traffic pattern as they are generally performing training exercises. Airport capacity increases with the ratio of touch-and-go operations to total operations primarily since aircraft in a training pattern are continually available for approaches. Touch-and-go operations may, however, reduce the availability of the runway for other types of operations. Based on a review of historical traffic data, it is estimated that touch-and-go operations historically have accounted for approximately 25 to 30 percent of total annual aircraft operations at COS.

Forecasts of aviation activity developed in this Airport Master Plan anticipate that touch-and-go activity will continue to account for between 25 and 30 percent of the Airport's total activity in each year of the 20-year planning period. For demand/capacity planning purposes, the FAA develops ranges for categorizing the percentage of touch-and-go operations occurring at an airport. Based on the projections of aviation demand developed for COS and the ranges identified in FAA AC 150/5060-5, the Airport exceeds the assumed touch-and-go percentages used in the capacity model. To account for this, estimated capacity volumes may have to be adjusted or touch-and-go activity reduced to reduce potential delays during peak periods.

Peak Hour Activity

Peak hour airfield capacity is defined as the maximum number of aircraft operations that can be processed at an airport in an hour. This capacity level varies under VFR and IFR conditions, reflecting the fact that local prevailing wind and weather conditions fluctuate over the course of the year. The peak hour airfield capacity at COS is estimated based on the configuration of the airfield and the operational fleet mix at the Airport. Estimates are determined using a detailed analysis prescribed in FAA AC 150/5060-5 that considers touch-and-go operations and runway/taxiway configuration to produces an estimate of an airport's hourly operational capacity.

Forecasts of aviation activity in this Airport Master Plan result in COS's estimated peak hour operations demand to increase from 80 operations per hour in 2021 to 98 by the year 2041. Note that this peak hour demand is utilized later in this chapter as part of the capacity model.

Airfield Capacity Model

The FAA's long-range planning model for determining airfield capacity is described in FAA AC 150/5060-5. This model combines standardized runway-use configurations with the Airport Fleet Mix Index to determine airport capacity and Annual Service Volume (ASV).

Based on the formula provided on the previous page and the Airport's Fleet Mix (**Table 4-4**) of Group C and D aircraft, the Mix Index is determined to be 90.45 percent. The runway-use configuration that best represents the operations at COS would be dual parallel runways (separated by more than 4,300 feet) with a crosswind runway, as shown below in **Table 4-5**. With an Airport Fleet Mix Index of 81 to 120 percent, the long-range planning ASV for COS is estimated to be 315,000 operations. The hourly capacity under VFR conditions is estimated to be

111 operations per hour, and under IFR conditions, it is estimated to be 105 operations per hour.

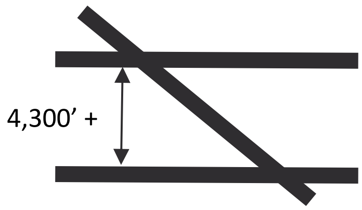


Table 4-5: Runway-Use Configuration and Capacity

Airport Fleet Mix Index % (C+3D)	Hourly Capacity Ops/Hr		Annual Service Volume (ASV)
	VFR	IFR	
0 – 20	197	119	370,000
21 – 50	149	114	320,000
51 – 80	126	111	305,000
81 – 120	**111**	**105**	**315,000**
121 – 180	103	99	370,000

Source: FAA AC 150/5060-5, Airport Capacity and Delay, Figure 2.1

FAA Order 5090.3B, *Field Formulation of the National Plan of Integrated Airport Systems* (NPIAS), indicates that improvements for airfield capacity purposes should begin to be considered once operations reach 60 to 75 percent of the ASV (note that this is an approximate level to begin the detailed planning of capacity improvements). Upon reaching the 80 percent of ASV level, it is recommended that the planned improvements undergo design or construction. **Table 4-6** compares the current (estimated) and projected level of operations at COS against the ASV over the planning period.

Table 4-6: Airfield Demand vs. Capacity

Year	Projected Operations	ASV	Ratio of Annual Demand to ASV
2021	146,322	315,000	46%
2026	153,787	315,000	49%
2031	161,631	315,000	51%
2036	169,875	315,000	54%
2041	178,541	315,000	57%

Source: FAA AC 150/5060-5, Airport Capacity and Delay, Jviation

Based on the forecasted annual operations of 178,541 by 2041, COS's ASV capacity of 315,000 annual operations will not be reached within the planning period. In fact, annual operations are expected to reach only 57 percent of capacity by 2041. When considering peak hour aircraft operations, it is projected that COS will experience a peak of 98 VFR hourly operations by 2041; this too falls short of the IFR and VFR hourly maximum capacities as referenced in **Table 4-5.** Therefore, based on the current and projected operations developed for this Airport Master Plan, improvements specifically designed to enhance airfield capacity are not required for the 20-year planning period. Some improvements, however, may be recommended to enhance the efficiency and accessibility of the airfield.

Landside Capacity Analysis

The demand/capacity analysis conducted for the airfield areas at COS examined the ability of existing airfield facilities to efficiently process existing and anticipated future aircraft operational demands. The following sections present similar analyses conducted for key landside facilities at the Airport. It is important that landside facilities at the Airport be developed in a manner that allows them to not only accommodate current and future demand levels, but also in a manner that promotes the continued synergy between airside and landside facilities.

Demand/capacity analyses are presented for the following COS landside facilities:

- Passenger Terminal
- General Aviation Facilities
- Automobile Parking

Note that the findings of the landside demand/capacity analyses are used later in this chapter to identify the facility requirements and recommended facility improvements that may be necessary to allow them to accommodate anticipated demand through the planning period.

Passenger Terminal

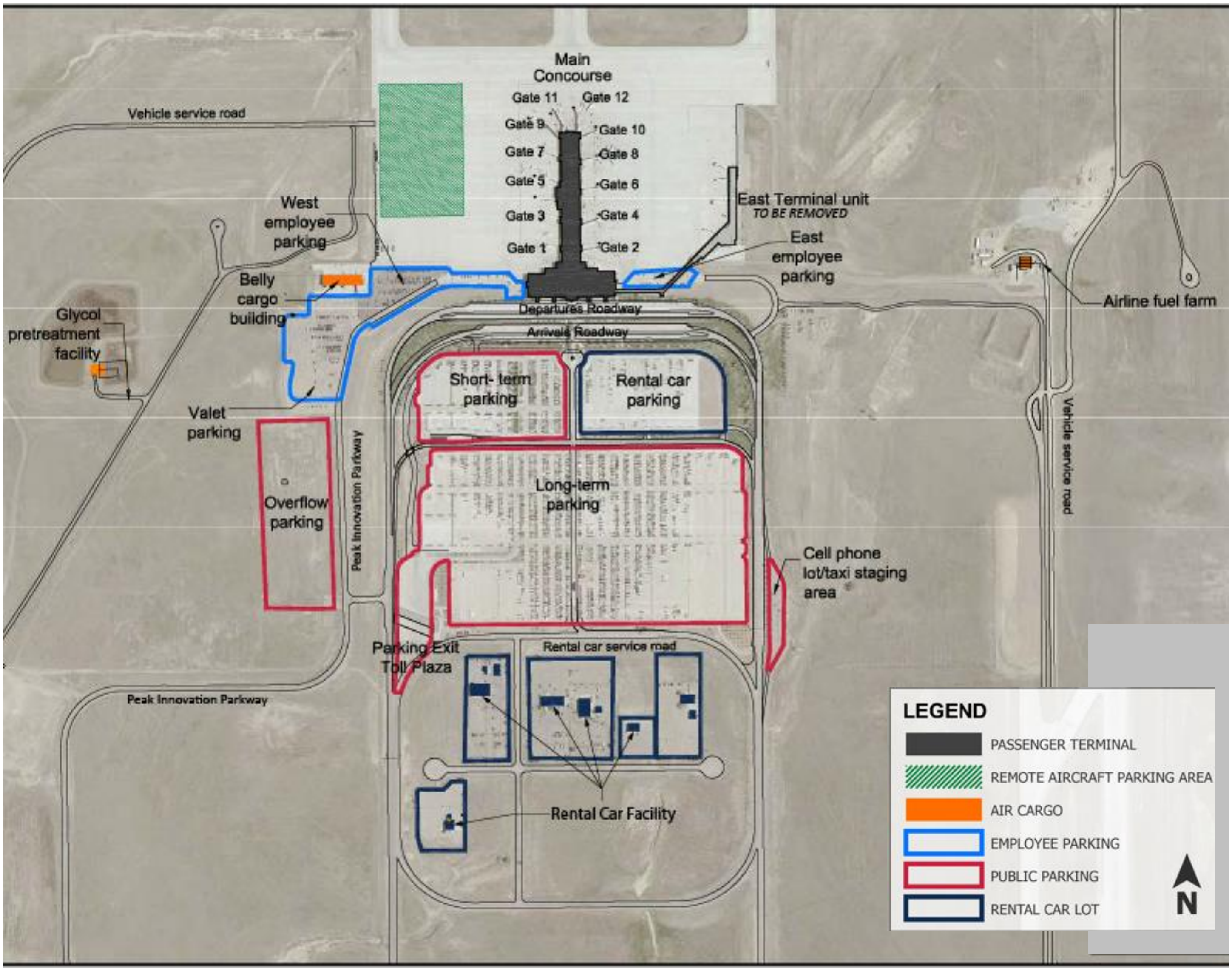
A passenger terminal facility is comprised of multiple subsections; the amalgamation of each of these results in the totality of the terminal's ability to meet demands. The capacity of each element of a terminal facility can vary depending on the acceptable level of crowding and processing time. For example, a passenger traveling on business may be less tolerant of congestion or delay than a passenger traveling for pleasure. In many cases, the degree of acceptability itself may also vary depending on the configuration of the terminal space and the level of amenities provided. Thus, beyond just simple space and throughput modeling, there are elements of a terminal's "capacity" that can be rather subjective, and the preservation of passenger convenience remains an important criterion.

The following areas of the passenger terminal building are evaluated based on a comparison of their existing capacities to demand:

- Aircraft Gates
- Airline Functional Areas
- Concession Space
- Public Space
- Security, Administrative and Other Support Areas

Figure 4-2 shows key functional areas of the COS terminal area. A detailed breakdown of passenger terminal facilities required to meet future air carrier and passenger demand will be provided in this chapter. This section will focus on determining whether or not existing capacities satisfy current demand as well as identifying parameters to be used in calculating future facility requirements.

Figure 4-2: COS Terminal Area



Source: Airport Records

Aircraft Gates

Aircraft gates are fundamental elements of a commercial terminal building in that they facilitate connecting aircraft with passengers; thus, the number of gates required at a terminal will drive the sizing requirements of many other elements of the overall building. In order to standardize the definition of "gate" and to provide a consistent means for evaluating apron utilization, the Narrow Body Equivalent Gate (NBEG) index has been employed for this analysis. This index normalizes the gate requirements of a diverse range of aircraft (e.g., small commuters to large aircraft) so they are effectively equivalent to the apron capacity of a typical narrowbody aircraft gate. The amount of space each aircraft requires is based on maximum wingspan. Aircraft are classified according to Aircraft Design Groups as shown in **Table 4-7**.

Table 4-7: Narrow Body Equivalent (NBEG) Index

Aircraft Design Group		Maximum Wingspan	Typical Aircraft	NBEG Index
I	Small Commuter	49'	Metro, Cessna, Pilatus	0.4
II	Medium Commuter	79'	SF340, CRJ, ERJ	0.7
III	Narrowbody	118'	A319, A320, B737, MD80	1.0
IIIa	Large Narrowbody	125'	B757	1.1
IV	Widebody	171'	B767, MD11, DC10	1.4
V	Jumbo	214'	A330, A340, B777, B747	1.8
VI	New Large Aircraft	262'	A380, B747-800	2.2

Source: Jviation
Note: Group IIIa has been added to account for the Boeing 757 which has a wider wingspan than Group III but is smaller than a typical Group IV aircraft.

Aircraft gates at COS are grouped by relative aircraft size as shown below in **Table 4-8**. The aircraft size groupings are based on the maximum aircraft permitted to park at each gate.

Table 4-8: COS Narrow Body Equivalent Gate (NBGE)

Aircraft Design Group	NBEG Index	2021 Gates	NBGE Calculation
Cessna	0.4	0	0
Turboprop	0.4	0	0
Regional Jet	0.7	0	0
Narrowbody	1.0	0	0
Large Narrowbody	1.1	10	11
Widebody	1.4	0	0
Jumbo	1.8	2	3.6
New Large Aircraft	2.2	0	0
Total Gates		12	14.6

Source: Airport Management, Jviation

As shown in **Table 4-8**, gate facilities at COS can accommodate two jumbo or widebody aircraft and 10 large narrowbody aircraft. In terms of NBGE, the main terminal has the equivalent of 14.6 narrowbody gates. All usable gates at COS are equipped with jet bridges designed to accommodate aircraft ranging from large jets to regional jets. In total, there are 12 usable air carrier gates at the Airport with a total NBEG Index of 14.6.

The FAA maintains an online database that reports daily delays for commercial service airports throughout the country. This database, known as OPSNET, measures aircraft operational delays by:

- Category – departure, arrival and enroute, and traffic management.
- Class – air carrier, air taxi, general aviation, and military; and
- Cause – weather, terminal volume, center volume, equipment, runway, and other.

For purposes of gate demand/capacity evaluation, delays associated with terminal volume in the "Cause" group are the most relevant. At COS for the years 2001 to 2020, the OPSNET database reports that commercial aircraft operating at the Airport experienced no terminal-related delays. This implies that there were no gate-related delays experienced since an inadequate number of gates would have resulted in terminal delays, and possibly requiring additional gate capacity. Therefore, it can be reasonably concluded that existing gates at COS are adequate to accommodate current demand. However, as activity levels continue to increase at the Airport, additional gates may be required in the future; this analysis will be presented later in this chapter.

Airline Function Areas

Areas for airline operations represent the heart of the terminal complex. This section examines key areas typically required and leased by airline tenants to support their operations. Airline functional area characteristics are primary factors in determining the size, configuration, and functional relationship of areas in the passenger terminal. Existing airline functional areas and their ability to meet current demand levels are presented below.

Ticket Counter (area) – The ticket counter area refers to the area occupied by the ticket counters, ticket agents, and the ticket counter baggage belts. Based on the industry standard depth of 10.5 feet and the typical planning factor of 3.6 square feet per peak hour enplaned passenger, the ticket counter area at COS should be approximately 1,800 square feet to accommodate existing passenger demand (COS peak hour passenger enplanement projections have been previously provided in Table 3-17 of Chapter Three, *Aviation Activity Forecast. For 2021, the peak hour enplanement projection was 510)*. The Airport's existing ticket counter area measures approximately 6,700 square feet reflecting an existing utilization factor of 13.1 square feet per peak hour enplaned passenger; this is deemed to be adequate to accommodate existing peak hour demand. In fact, the ticket counter area could reasonably be expected to accommodate additional activity without increases in delay. It is also worth noting that a 3.6 square feet per peak hour enplaned passenger planning factor is common for application to airports like COS and has been used to calculate future ticket counter area requirements.

Ticket Counter (length) – The ticket counter itself is used to facilitate direct passenger to agent/kiosk interaction for the purpose of processing passenger boarding passes and outbound baggage. There are 29 agent ticketing positions currently used for processing passengers and their baggage at COS. In addition, there are 20 self-ticketing kiosks within the ticketing counter area. Eight ticket counters are vacant and not currently leased to airlines. Existing ticket counters at COS have an overall length of 330 linear feet. Like the ticket counter area, ticket counter linear footage currently exceeds the existing peak hour demand requirements and can accommodate additional demand without disproportionate increases in delay or inconveniences to passengers. Using the existing passenger profile and peak hour enplanements, the current space has a planning factor of 0.65 linear feet per peak hour enplaned passenger, where a planning factor of 0.30 feet per peak hour enplaned passenger is the standard at similar airports. This standard will be applied to future COS requirements presented later in this chapter.

Ticket Counter Queuing – This space is comprised of the passenger queuing area directly in front of airline ticket counters. At COS, this area measures approximately 10,000 square feet and includes areas for circulation and self-serve airline ticketing kiosks. Assuming the industry standard depth of 15 feet in front of the ticket counters, an area of approximately 4,950 square feet is needed to meet current demand. This result concludes that there is more than enough space at COS to meet current demand. Future requirements are presented later in this chapter.

Airline Ticket Office – This area is located directly behind the ticket counters and is leased to the airlines as office space. Because this is exclusive space for each airline, the space required in this area is a function of the number of airlines serving COS. Existing office areas measure approximately 8,300 square feet and sufficiently accommodate existing airlines at COS. This assessment has been based on an industry standard depth of 25 feet and a factor of 8.5 square feet per peak hour enplaned passenger used to calculate requirements for airline ticket office space. These standards will be applied to future COS requirements presented later in this chapter.

Departure Lounges – The amount of space required for departure lounges or hold rooms is a function of the number and size of aircraft operating during the peak hour. There are currently 12 aircraft gates within the COS main terminal having approximately 28,319 square feet of area. This exceeds the existing requirement of 21,600 square feet based on the industry standard planning factor of 1,800 square feet per gate; thus, the existing COS departure lounges are currently adequate to meet demands during peak periods. Future requirements are presented later in this chapter.

Baggage Claim Area – This space category represents the area occupied by the baggage claim devices and the queuing area for active bag claiming measures approximately 15 feet out from the devices. At COS, the total baggage claim area measures 15,300 square feet, which results in a ratio of 30 square feet per peak hour deplaning passenger. Based on industry standards, a planning factor of 20 square feet per peak hour deplaned passenger is adequate to meet current peak hour demand. This difference indicates that the existing area is adequate to meet current demand and can accommodate additional future demand. The standard will be applied to future requirements presented later in this chapter.

Baggage Claim Frontage – This area represents the length of the baggage claim devices and is typically designed to accommodate the peak 20 minutes of baggage claim time. There are six baggage claim belts at COS with an estimated total overall length of 600 linear feet. The existing planning factor of 0.45 linear feet per peak hour deplaning passenger is acceptable and will be used to estimate future needs for this space later in this chapter.

Baggage Service – Baggage service offices are leased to the airlines for assisting passengers with lost/stolen baggage issues. COS currently has a total of approximately 1,300 square feet of baggage service office space in the baggage claim area occupied by several air carriers; this is adequate to meet existing needs. Additionally, the ratio of leased area to peak hour deplaned passengers was identified as 2.4, which was deemed to be consistent with industry standards and therefore has also been applied to future requirements later in this chapter. Note that the final allocation of space will largely depend on the needs of airlines and will likely be refined as terminal concepts are developed and airline requirements change.

Outbound Baggage – This area is located directly behind the airline offices and is used for the accumulation, storage, and make up of outbound baggage from the ticket counter areas. The current outbound baggage area at COS measures approximately 11,400 square feet and is inadequate for meeting existing peak hour enplaned passenger demand, based on airline input and oversized baggage requirements. The industry standard of 20 square feet per peak hour enplaned passenger is inadequate for COS standards based on the Airport's higher level of baggage. A level of 30 square feet per peak hour enplaned passenger will be used in future facility requirement calculations later in this chapter. However, continued evaluation should be conducted to maximum available baggage handling space and provide for future solutions.

Inbound Baggage – The inbound baggage area is used to feed bags to the baggage claim devices. There are six baggage delivery belts in the claim area, with each delivery belt measuring approximately 45 linear feet for a total of 270 feet. The existing belts are adequate to meet the existing peak hour demand based on standard industry planning metrics. The existing ratio of 0.53 linear feet per peak hour deplaned passenger has also been used to calculate future inbound baggage belt requirements later in this chapter.

Airline Operations – This space is located on the lower level of the concourse and is used by the airlines for operations, flight coordination, equipment/materials storage, and employee break/meeting areas. At COS, this area measures approximately 20,250 square feet and is adequate to accommodate existing demand. The existing planning factor for this function is estimated at 0.02 square feet per annual enplaned passenger (identified as 1 million that may be achieved in the short-term), higher than the ration of 0.01 square feet per annual enplaned passenger observed at comparable airports. This standard planning factor will be used to calculate space needed for future demand later in this chapter.

Concession Space

This component of the terminal complex includes those areas dedicated to commercial concessions that generate revenue for the airport. These areas can include food/beverage, news/gift/sundry, rental car, as well as other revenue-generating functions such as advertising. The space in this category provides amenities that serve two vital functions: they provide passengers with desirable services, and they provide revenue to the airport.

Food/Beverage – This area represents the total space for the SSP Stores and Food Court concessions at COS. The existing area occupied by this category totals approximately 12,200 square feet (note this does not subdivide areas into individual shops or pre-security/post-security) and is deemed adequate to meet existing demand. This results in an existing planning factor of 0.012 square feet per annual enplaned passenger (based on 1 million annual enplanements), or slightly lower than the industry standard of 0.02. The future facility space requirements analysis for the concessions area utilizes the industry standard and the results are presented later in this chapter.

Retail – This area includes existing general concession space utilized by Paradies newsstands, gift shops, and other sundry retailers. The existing area used for this function at COS measures approximately 6,250 square feet and does not include 30 square feet of vending space. An additional 1,720 square feet is used for storage space to support these shops. Based on average supply/demand ratios at comparable airports of 0.003 square feet per annual enplaned passenger, this area at COS is deemed to be adequate to meet the current demand. This ratio has also been applied to identify future space requirements later in this chapter.

Rental Car – The rental car area consists of counters and supporting offices for the on-Airport rental car agencies, located near the baggage claim area for the convenience of arriving passengers. The existing area at COS totals approximately 3,120 square feet and is adequate to accommodate the existing demand. Based on comparable airports, a typical planning factor of 0.002 square feet per annual deplaned passenger is anticipated for rental car areas, which is less than the existing COS available space. The standard factor has been used to project future requirements and are presented later in this chapter.

Other Concession Space – This category includes the total area of other concession related space at COS such as additional storage/office space and advertising. This space totals approximately 5,000 square feet (approximately half of which is currently vacant) and is deemed to be adequate to meet the existing demand. Supply/demand ratios observed at comparable airports (0.001 square feet per annual enplaned passenger) have been used to calculate future space needs and are presented later in this chapter.

Public Space

Circulation – This category represents the public circulation area to allow for movement of passengers, visitors, tenants, and employees within the terminal building. It consists of circulation areas in the concourse, in the vicinity of the departure lounges, movement areas within the check-in areas, corridors leading to functional areas, and other public movement areas. In total, COS has approximately 77,775 square feet of public circulation space and based on the summary of planning calculations in **Table 4-9**, it is deemed adequate for current levels of activity. Note that the planning factors indicated below have been also used to determine future circulation space needs and are presented later in this chapter.

Table 4-9: Terminal Circulation Space Demand

Circulation Space	Planning Factor	Current Demand
General	0.06 sq ft per annual enplaned passenger	45,900
Ticketing	2.8 sq ft per peak hour enplaned passenger	1,400
Gate Area	1,600 sq ft per gate	19,200
Other	10 sq ft per peak hour enplaned passenger	5,100
Total		**71,600**
Current Space		**77,775**

Source: Jviation

Restrooms – Restrooms at COS are located both before security (located near the center of the main terminal complex) and beyond security (located in the concourse near the departure lounges). In total, restrooms at the airport total approximately 7,475 square feet which translates to a planning factor of 14.7 square feet per peak hour enplanement; this is deemed to be adequate for current levels of activity. Note that the standard planning factor observed at other airports is 5.0 square feet per peak hour enplaned passenger, which is significantly lower than the existing factor, implying that there is unutilized capacity currently at COS. The standard planning factor has been used to determine future circulation space needs and is presented later in this chapter.

Security, Administrative and Other Support Areas

Security – This area is dedicated for the Transportation Security Administration (TSA) security checkpoints necessary to screen enplaning passengers, inspect outbound baggage through the Airport's Checked Baggage Inspection System (CBIS), and to provide space for TSA employees whose job functions require them to work in the secure public and non-public areas. The overall TSA space at COS measures approximately 28,500 square feet and includes 17,500 square feet of space for CBIS operations, 8,000 square feet for screening, and 3,000 square feet of office space. Included in the screening area is a queuing area in front of the Xray devices and magnetometers, areas occupied by the equipment and its operators, as well as a modest area beyond security for passengers to collect their belongings and orient themselves.

The existing security area was allocated to the TSA following the terrorist attacks of September 11th, 2001. COS experiences a throughput of 150 passengers per hour in the standard checkpoint stations and 240 passengers per hour in the pre-check station. Using that rate and applying it to the existing checkpoint configuration, the existing checkpoint should be able to screen 690 passengers per hour. Considering the current peak hour enplanement volume is approximately 510 passengers, the existing checkpoint has enough capacity to support the current demand. This checkpoint screening rate and existing space required for each screening position will also be applied to future enplanements.

Administrative and Other Support Areas - This category of space includes the "back of the house" area that is generally not accessible to the public. It consists of airport administration, airport police, and identification/badging offices as well as areas for utilities and building mechanical functions. Administrative and support area space requirements at an airport can be quantified by assuming that a certain percentage of the terminal building's total area should be reserved to support the administrative function. However, to more accurately reflect the impact that passenger activity levels have on these space requirements, this analysis uses an approach that relates administrative and support space requirements to the annual number of passengers using the terminal.

It is assumed that most of this non-public space at COS is currently considered to be at capacity based on 1 million annual enplanements. This would indicate that the existing factor of square feet per annual enplaned passenger is adequate to accommodate current needs, but that as future activity levels grow additional administrative/support space will likely be needed. The existing ratios of square feet per annual enplaned passenger are used to determine future requirements for each category of space. Space needed for these areas can be re-examined through interviews with appropriate agencies when terminal design is underway.

Airport Administration – Most of this area at COS is located on the third floor of the terminal building and includes approximately 28,700 square feet of space devoted to administration functions. Administrative areas consist of a reception area, offices, break rooms, conference rooms, storage areas, and work areas. Requirements for airport administration are a function of staffing and are generated by COS and the services provided by COS staff. For planning purposes, the future space required in this area is generated for the forecast activity levels based on the existing planning factor for the airport administration area (0.03 square feet per annual enplaned passenger).

Utility/Mechanical – This category includes the support areas for the terminal building and consists of mechanical rooms, electrical rooms, telephone closets, communications rooms, energy control rooms, etc. There is currently a total of approximately 28,000 square feet of utility and mechanical space in the terminal building. For planning purposes, the required areas for the forecast years are derived based on the existing ratio of 0.03 square feet per annual enplaned passenger.

Passenger Terminal Summary

Identifying potential demand/capacity issues related to the ability of the passenger terminal to effectively process passenger demand is critical to ensure an appropriate level of service for existing and future passengers. The analysis conducted herein has determined that, from an overall perspective, the existing terminal complex adequately accommodates the current demand levels for passengers, airlines, concessions, and other COS needs. This analysis has also demonstrated the methodology and parameters by which future space requirements have been determined and that are presented later in this chapter.

General Aviation Facilities

The ability of general aviation facilities to accommodate existing and anticipated future demand is another important consideration in identifying facility development needs for the Airport. For this analysis, the current capacity of specific COS general aviation facilities has been compared to current demand for them in the following categories:

- Aircraft Storage
- Aircraft Fuel Storage

The findings of the demand/capacity analyses related to the aircraft storage, tiedown positions, and fuel storage facilities will serve as the baseline from which existing and anticipated future facility requirements are identified. A detailed examination of future facility requirements related to general aviation facilities has been conducted and is presented later in this chapter.

Aircraft Storage

Existing general aviation aircraft storage facilities at COS include apron tiedown positions, T-hangars, and conventional hangars, most of which are operated and managed by the Airport's FBOs. There are currently 215 based general aviation aircraft stored in these facilities. It should be recognized that based aircraft numbers can fluctuate at a given airport throughout any year. General aviation aircraft projections were for COS based on the aircraft count that was current during the inventory effort of this study. Since those projections have been approved by the FAA (see Chapter Three), they will not be revised; however, the most current based aircraft data available has been utilized for the following general aviation demand/capacity analysis and the ensuing facility requirements determination. The capacities of each facility type and current demand for each are summarized as follows:

Apron Tiedown Positions – COS has tiedown positions that are used to store based general aviation aircraft as well as to provide temporary storage positions for transient general aviation and military aircraft within the 580,000 square foot west apron. There are currently over 50 aircraft tiedown positions for based and transient aircraft in that area of which approximately 15 are used for based aircraft and the remaining being available to meet needs for both based and transient aircraft. Based on the current aircraft storage preferences at the Airport, it has been deemed that the existing apron tiedown facilities provide sufficient capacity for existing levels of based aircraft and transient demand. Note that additional apron area may be needed to accommodate expanded services to aircraft as well as movement area to access newly developed areas of the west side of the Airport.

T-Hangars – COS currently has four T-hangar structures (a total of 294,400 square feet) that have can accommodate a total of 175 aircraft with each individual T-hangar unit being capable of accommodating a single aircraft. While they typically store single-engine piston aircraft, smaller, multi-engine piston aircraft can also be accommodated. Currently, the existing COS T-hangar facilities are at capacity, and it is understood that there is a need for additional T-hangars at the Airport.

Conventional Hangars – Conventional or box hangars at COS are used to store general aviation aircraft and are typically operated by the FBO. These can be operated as either as a storage unit for the aircraft of a single owner, or as community storage facilities that may house a multitude of aircraft with different owners. The Airport currently has 14 box hangars (with a total area of 321,200 square feet) that range in size from 10,800 to 100,000 square feet. These storage facilities are at maximum capacity. The FBOs and other airport businesses have indicated that they wish to construct additional conventional hangar storage facilities to meet current and future demand.

Based on the analysis of current based aircraft storage characteristics, it has been established that existing general aviation hangar storage facilities are insufficient to meet current demand. Projected growth in based general aviation aircraft at the Airport will only exacerbate the current deficiency. Facility requirements associated with future hangar needs will be presented later in this chapter.

Aircraft Fuel Storage

COS's primary fuel storage facility (fuel farm) is located between the commercial terminal and Runway 17L-35R. Note that this fuel farm is directly supplied by the NuStar Terminal, and Pipeline facility located in the Airport's east side development area with a pipeline capacity of 20 million barrels per day. This facility provides fuel receiving, storage, and distribution services for the Airport and the region; it has been determined that the facility has adequate capacity to meet existing needs.

The Westside Development Area has separate aircraft fuel storage facilities at FBO tenant sites including Cutter Aviation, LLC; Colorado jetCenter, and the JHW Hangar Complex. There are also aircraft fuel tanks with Jet A and 100LL fuel located in the COS Business Airpark. While these facilities meet their individual existing demand, it is recommended that a consolidated fuel farm be constructed to distribute aircraft fuel more efficiently to all operators on the west wide of the Airport and add more capacity to meet future demand. Specific expansion needs and potential locations for the development of additional fuel storage facilities have been identified in later sections of this chapter and the Airport Master Plan.

Automobile Parking

The ability of automobile parking facilities at COS to accommodate existing and anticipated future demand is an important consideration in the master planning process. Auto parking facilities support not only the passengers using commercial air carrier service but also those working at the Airport as well as the needs of rental car operators serving Airport customers. A summary of the existing parking facilities at COS and the number of spaces available in each is provided **Table 4-10**.

Table 4-10: Existing Terminal Area Auto Parking Facilities

Location	Function	Spaces
Short-Term Lot	Short-term passenger parking	711 (694 standard, 17 ADA)
Long-Term Lot	Long-term passenger, flight crew parking	3,875 (3,790 standard, 85 ADA)
Overflow Lot	Long-term passenger parking	875 (estimated)
Sub Total	**Passenger parking**	**5,461**
East Manager Lot	Employee parking	40
West Manager Lot	Employee parking	41
West Auxiliary Lot	Employee parking	193
Sub Total	**Employee parking**	**274**
Rental Car Parking	Ready/Return rental cars	768
Cell Phone Lot	Temporary meter/greeter parking	60
Total	**All terminal area parking**	**6,563**

Source: Airport records

Public Parking

As shown in **Table 4-10**, there are approximately 711 short-term and 4,750 long-term public parking spaces at COS. Parking demand is typically determined by applying ratios of spaces required per 1,000 annual enplanements to current and projected enplanement levels at an airport. The ratios used in this analysis for COS assume a demand ratio that uses the busiest parking day in any year (peak month average day + 25 percent) as the design day and assumes a 10 percent cushion to support parking needs even on the busiest days, assuming relatively longer search times for parkers. Because parking demand has historically been growing faster than enplanements at COS, this analysis assumes that the ratio of parking demand to 1,000 enplanements will increase from approximately 3.5 in 2021 to approximately 3.75 in future years.

Based on these assumptions, this analysis indicates that the overall existing public parking spaces are sufficient for current demand. However, through discussions with airport management, it is understood that the short-term parking lot experiences capacity issues at certain times of the year. This and other anticipated deficits of public parking spaces have been addressed later in this chapter.

Employee Parking

Spaces for employee parking are available in the east and west manager lots as well as the west auxiliary lot. Currently, there are 274 parking spaces allocated for employee parking. Demand for employee parking spaces is typically determined by applying a ratio of demand per 1,000 annual enplanements and assumes a ratio of 0.4 spaces per 1,000 annual passenger enplanements. Based on an annual enplanement level of 1 million passengers, there appears to be a deficiency of employee parking spaces. Based on Airport observations and feedback, however, there is adequate parking to meet current demand. As annual enplanements and the number of employees increase, the demand for employee parking spaces is projected to increase throughout the planning period and will be presented later in this chapter.

Rental Car Ready/Return

The Airport's rental car agencies have a total of 768 ready/return spaces in the lot located directly south of the terminal area. Existing and projected demand for rental car ready/return spaces is typically estimated based on projections of passenger deplanements and a planning ratio of ready/return spaces per 1,000 annual deplanements. Using a ratio of 0.5 spaces per 1,000 annual deplanements at COS, it is estimated that the existing supply of rental car ready/return spaces is adequate to meet the current demand levels. This standard planning factor has been used to determine future rental car parking needs and is presented later in this chapter.

Automobile Parking Summary

The findings of the demand/capacity analysis conducted for parking facilities at COS are further refined and facility requirements for parking facilities are presented later in this chapter. Based on requirements identified for parking facilities at the Airport, the Airport Master Plan will evaluate alternatives for addressing future parking needs. Note that alternatives for meeting future parking needs at the Airport could include reallocating parking spaces from one category to another and constructing additional parking facilities.

Demand/Capacity Summary

Based on aviation activity at COS and the analyses conducted in the preceding sections, the ability of existing Airport facilities to accommodate current demand has been identified. The findings of the demand/capacity analysis for major components of Airport infrastructure can be summarized as follows:

Airfield – The airfield capacity analysis indicates that COS is currently functioning at approximately 46 percent of its capacity or annual service volume. The airfield is expected to reach approximately 57 percent of its operating capacity by 2041. FAA Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems (NPIAS)*, dated December 4, 2000, recommends the initiation of planning for capacity enhancement projects at an airport when the airport reaches between 60 percent and 75 percent of its ASV. Thus, the analysis concluded that the Airport is not projected to reach the 60 percent benchmark within the 20-year planning horizon, and that no action to enhance capacity is warranted.

Passenger Terminal – The demand/capacity analysis conducted for the passenger terminal examined the ability of existing functional areas in the terminal to accommodate current passenger activity levels. The analysis indicated that the existing passenger terminal generally provides sufficient capacity to accommodate current activity. This analysis also demonstrated the methodology and parameters by which future space requirements have been determined later in this chapter.

General Aviation Facilities – The ability of aircraft storage and aircraft fuel storage facilities to accommodate current demand was analyzed based on current based aircraft counts and storage characteristics. Based on the analysis of current based aircraft storage characteristics and existing facilities at COS, it was determined that, with the exception of apron tiedown positions, the capacity of existing general aviation aircraft storage facilities is insufficient to meet current demand levels. Future growth in based general aviation aircraft at the Airport will only amplify the current deficiency.

Aircraft Fuel Storage - The analysis of existing and planned fuel storage facilities at the Airport indicates that they provide sufficient capacity to meet current demand but that future demands may require fuel storage facility expansion. In addition, the potential consolidation of fuel storage tanks could enhance the effectiveness and efficiency of fuel storage and delivery services.

Automobile Parking – The analysis of automobile parking facilities at COS examined the current supply of parking in the following categories: public, employee, and rental car ready/return. By comparing the existing supply of spaces to anticipated demand in each category, it was estimated that a deficiency in short-term and employee parking spaces exists today, which will only worsen as activity increases in future years.

Current and anticipated future facility requirements at COS are identified in the next section of this chapter. Based on the Airport's projections of future aviation demand, the findings of the demand/capacity analyses summarized in this chapter, and other factors, the facility requirements analysis identifies the scope and potential timing of facility improvements needed at the Airport as activity grows.

Facility Requirements - Introduction

Existing and future facility requirements and development standards are identified based on current Airport strategic development initiatives and by comparing the Airport's existing facilities to future facility needs based on forecasts of aviation demand presented in Chapter Three, *Aviation Activity Forecast,* as well as those analyses conducted in the *Demand/Capacity Analysis* sections above. Recommended existing and future facility requirements are presented in the following sections:

- Strategic Development Initiatives
- Airfield Requirements
- Passenger Terminal Requirements
- General Aviation Requirements
- Air Cargo Requirements
- Support Facility Requirements
- Facility Requirements Summary

Note that the FAA provides guidance for planning and design of airport facilities through Advisory Circulars that promote airport safety, economy, efficiency, and longevity. Many of the facility requirements identified for COS incorporate FAA planning and design standards presented in AC 150/5300-13A, *Airport Design*. Chapter Five, *Alternatives Analysis & Development Plan* of this master plan examines alternatives for developing Airport facilities based on the facility requirements and development standards identified for COS in this analysis.

Strategic Development Initiatives

Strategic development initiatives identified in previous studies that are potentially relevant to this Airport Master Plan include the following:

- Airport Master Plan (2013)
- COS General Aviation Area Plan (2016)
- Peak Innovation Park Master Plan (2017)
- PlanCOS – Colorado Springs Comprehensive Plan (2019)
- COS Land Use Study (2019)

These studies are summarized in the following sections. The relevant findings, recommendations, and development plans included in each of these studies and the role that they may play in the current master planning process are also presented.

Airport Master Plan (2013)

COS's previous Airport Master Plan was completed in 2013 and followed a similar process and methodology to the 2022 planning effort. Many of the same factors that impacted the 2013 plan will ultimately be considered in the 2022 plan and may impact the study's future development recommendations. The 2013 plan identified a program for Airport development over a planning period from 2013 to 2033, including short-term, intermediate, and long-term facility development recommendations. Recommendations were based on trends, activity levels, and future activity projections that were present at COS in 2013.

Major development items identified for COS in the previous master plan included the following:

- Decoupling Runway 17R-35L from Runway 13-31 by effectively shifting Runway 17R-35L south and relocating the Runway 13 threshold
- Redevelopment and shifting of Taxiway A to provide a 500-foot separation between Runway 17R-35L and the taxiway
- Expansion of the general aviation apron and additional general aviation hangar facilities
- Construction of an east aircraft deicing pad and snow removal equipment (SRE) storage facility
- Expansion of air cargo and World War II aviation museum facilities
- Enhancements to taxiway connectors

Many of these major development items listed have not been enacted and remain valid. Critical activity thresholds for some of the projects identified in the 2013 plan have not yet been experienced at COS. While the broader, long-term development vision identified for the Airport as part of that plan continues to be valid, elements of that vision may be considered or reconsidered for future facility requirements identified in this Airport Master Plan.

COS General Aviation Area Plan (2016)

With increased interest in its general aviation area (also known as the Westside Development Area), COS developed a General Aviation Area Plan for the westside to provide a longer term plan for use by both the Airport and its potential tenants/developers. An objective of the plan was to analyze potential infrastructure impacts of increased activity. Key elements of this analysis included the following:

- The Westside Development Area's ability to accommodate Very Large Aircraft (VLA), such as the Boeing 747- 8 or the A380
- A master plan of potential development zones, the capacity of those zones, and their potential associated infrastructure impacts
  - Design impacts
  - Topographical impacts (cut and fill)

  - Drainage impacts
  - Utility impacts (not included in this document)
- Cost estimates that provide Capital Improvement Program (CIP) guidance to COS for the Westside Development Area

The Plan was consistent with the 2013 COS Airport Master Plan but provided enhanced detail within the Westside Development Area that allows for implementation of the goals of the Airport. Many of the recommendations of the COS General Aviation Area Plan have been incorporated into this Airport Master Plan.

Peak Innovation Park Master Plan (2017)

A master plan was developed for Peak Innovation Park to identify opportunities for development on the 900 acres of land located south of the COS airfield. The design goals for the Peak Innovation Park Master Plan were to:

- Create a vibrant environment for travelers, companies, employees, and residents
- Strongly integrate airport and business park systems
- Support connectivity with strong regional, local, neighborhood and pedestrian circulation patterns that re-enforce western views
- Create two Mixed-Use Zones connected through amenity streets and green-way patterns and focus amenities on unique user groups

The goals established in the Peak Innovation Park Master Plan are currently being realized through development initiatives by key tenants. The plans and objectives of the Peak Innovation Park Master Plan have been incorporated into this Airport Master Plan.

PlanCOS (2019)

PlanCOS is the physical development plan for the City of Colorado Springs and is intended to be used and referenced as the community grows over the coming decades. In a broad sense, the PlanCOS is intended to establish a vision for land use, infrastructure, transportation, landscaping, and other elements within the community. One of the strategies of PlanCOS is to support a smart growth approach for the Colorado Springs Airport that enables it to maintain its economic value as an air service provider for the City and the region, as well as to strengthen its role as an integrated economic development generator.

PlanCOS focuses on multimodal transportation improvements to/from the Airport to enhance connectivity to various communities throughout Colorado Springs. Elements of PlanCOS have been incorporated into this Airport Master Plan to the extent possible and reasonable, understanding that regional transportation access as it relates to the Airport will also be analyzed within the Airport Master Plan.

COS Land Use Compatibility Study (2019)

To meet the anticipated continued robust growth associated with the City of Colorado Springs and COS, the COS Land Use Compatibility Study analyzed existing and planned land uses on and around the Airport to help ensure that both the Airport and community can continue to grow and develop in a smart and compatible manner. This study also analyzed the ability of the surrounding governmental jurisdictions to implement land use policies, zoning, and building ordinances that balance the current and projected future needs of the Airport with the needs of the community and property owners.

Recommendations from the COS Land Use Compatibility Study will ultimately be presented to the City of Colorado Springs for adoption and integration into ReToolCOS, the City's zoning ordinance update. Recommendations from this Airport Master Plan will be consistent with the COS Land Use Compatibility Study to protect against any future noise, safety, and airspace concerns.

Conclusion: Many aspects of these previous planning efforts will be incorporated into this Airport Master Plan where appropriate.

Airfield Requirements

Airfield facilities are needed at COS to accommodate existing activity levels as well as those projected to be needed through application of applicable FAA standards and various other airfield component requirements. Airfield facilities generally include those that support the transition of aircraft from flight to ground or the movement of aircraft from parking/storage areas to their departure and flight. Note that the planning and design of an airport are primarily based on an airport's role, number of annual and peak hour operations, and the design aircraft that use the facility.

This section of the Airport Master Plan examines the existing layout and design of airfield facilities in order to identify current and future facility requirements. Airfield facility requirements have been developed for the following airfield functional components:

- Critical Design Aircraft and Airport Reference Code (ARC)
- Runway System
- Taxiway System
- Airfield Safety Areas
- Part 77 Surfaces
- Navigational Aids
- Airfield Marking, Lighting, and Signage

Critical Design Aircraft and Airport Reference Code (ARC)

The Critical Design Aircraft is defined by the FAA as the largest aircraft or aircraft family anticipated to utilize an airport on a regular basis. The FAA further defines "regular basis" as those conducting at least 500 annual operations. The Airport Reference Code (ARC) is a coding system used to relate airport design criteria to the operational and physical characteristics of the types of aircraft intended to operate at an airport. Note that the combination of the design aircraft and the ARC serves as the basis for establishing existing and future design standards.

Chapter Three, *Aviation Activity Forecast*, identified the recommended Critical Design Aircraft and ARC for COS to be that of a D-IV. With respect to identifying a particular aircraft model to serve as the representative of the Airport's Critical Design Aircraft, there is not one D-IV aircraft model that operates frequently enough at COS to meet the 500-annual operation threshold. However, through examination and application approach and design components independently, a composite critical design aircraft with an ARC and Runway Design Code (RDC) designation of D-IV was well supported and approved by the FAA. Common aircraft within this ARC include the Boeing 757, Boeing 767, and MD-11. For the purposes of this study, and based on the results of the Forecast, the Boeing 767-400 will serve as the Critical Design Aircraft and will be used as the basis of the existing and future ARC and RDC of D-IV.

The ARC for COS is designated as D-IV. This will serve as an important factor when assessing existing and future facility requirements associated with FAA airport design standards.

Runway System

Runway system facilities required for COS to adequately meet existing and future aviation activity are based on the types and numbers of aircraft projected to use the runway system. Components of the runway system examined in this facility requirements analysis include the following:

- Runway Configuration and Orientation
- Runway Length
- Runway Width
- Runway Pavement Strength

At a minimum, all components of the runway system should be designed and constructed in accordance with the airport design standards developed by the FAA. It should also be noted that while FAA design standards can be exceeded, any costs associated with that exceedance could not be reimbursed by the FAA (i.e., the airport sponsor or other local sources typically would have to fund that portion that exceeds the federal standards). The following sections discuss specific requirements for components of the existing and future runway system at COS.

Runway Configuration and Orientation

As presented in the demand/capacity analysis conducted earlier in this chapter, runway configuration is a primary factor in impacting overall airfield operational capacity. That analysis compared current activity levels and projections of future aviation demand to the existing airside configuration's estimated Annual Service Volume (ASV). The findings of the airfield demand/capacity analysis indicated that COS is projected to experience acceptable ranges of average delay per aircraft operation through the planning period and not reach capacity limits whereby airfield capacity enhancement need to be planned. Thus, based on that analysis, the planning for or construction of any major airfield capacity enhancement projects (i.e., a new runway) is not required during the planning period.

Beyond configuration, runway orientation requirements at COS are determined by comparing the alignments of the runways to the prevailing winds in the Airport-area. The orientation of an airport's runway system to the prevailing wind direction is critical to the safe operation of aircraft and the maximum utilization of the airport facilities. Crosswinds, or winds not parallel to the runway or the path of an aircraft, affect the flight of approaching and departing aircraft, especially light aircraft. During the flight planning process, pilots examine forecasted wind speed and direction at their departure and arrival airports to determine their ability to safely operate at the airports. Proper planning of airport facilities, including runway alignment to prevailing wind conditions, can minimize the frequency with which pilots must deviate from their preferred flight plans as a result of wind conditions.

FAA Advisory Circular 150/5300-13A, states that "the desirable wind coverage for an airport is 95 percent, based on the total numbers of weather observations during the record period, typically 10 consecutive years." Listed in **Table 4-11** are the FAA allowable crosswind component speeds for each RDC. Based on the traffic that typically operates at COS, all four levels of crosswind components (10.5 – 20 knots) must be considered for planning at this Airport.

Table 4-11: Crosswind Components

Airport/Runway Design Code	Allowable Crosswind Component
A-I and B-I (including small aircraft)	10.5 knots
A-II and B-II	13 knots
A-III, B-III, C-I through D-III, D-I through D-III	16 knots
A-IV and B-IV, C-IV through C-VI, D-IV through D-VI	20 knots
E-I through E-VI	20 knots

Source: FAA Advisory Circular 150/5300-13A

Wind data was downloaded directly from the National Climate Data Center (NCDC) from the Automated Surface Observing System (ASOS) located at COS.

The downloaded data contained wind direction and speed for every hour of the past ten complete calendar years (2011 – 2020). Wind coverage percentages for the runway system are provided for VFR, IFR, and All-Weather conditions in **Table 4-12.**

Table 4-12: Wind Coverage

	10.5 Knots	13 Knots	16 Knots	20 Knots
All Weather				
Runways 17L-35R and 17R-35L	91.98%	95.42%	97.90%	99.23%
Runway 13-31	88.92%	93.27%	96.80%	98.86%
All Runways	96.42%	98.12%	99.19%	99.75%
IFR				
Runways 17L-35R and 17R-35L	93.93%	97.10%	99.02%	99.70%
Runway 13-31	93.55%	96.46%	98.64%	99.61%
All Runways	98.36%	99.37%	99.79%	99.92%
VFR				
Runways 17L-35R and 17R-35L	91.77%	95.23%	97.77%	99.17%
Runway 13-31	88.39%	92.91%	96.59%	98.78%
All Runways	96.19%	97.98%	99.12%	99.74%

Source: NCDC, On-Site ASOS

A review of the data indicates that no single runway at COS provides 95 percent coverage for a 10.5 knot crosswind component. Since the two primary runways (17L-35R and 17R-35L) have the same heading, they provide the same level of coverage whether individual or together. Only when the crosswind runway is added to the primary runways does the wind coverage improve to the recommended 95 percent for a 10.5-knot crosswind. Combined, the three runways exceed the recommended 95 percent wind coverage for all three weather conditions.

A heat map is another way to visually interpret the persistency of wind data. As shown in **Figure 4-3**, each column represents 100 percent of the observations of wind in that speed category (such as, 0 to 3 knots or 4 to 6 knots). Blue highlighting represents the least common wind directions, red is the most common, and green is in-between. The heat map visualizes how at lower speeds the wind is directions are well distributed and come from all directions. **Figure 4-3** shows the strongest winds at COS, 22 knots and higher, primarily come from the north.

Figure 4-3: All Weather Wind Heat Map

Wind Direction	Wind Speed (knots) 0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	22+
0 - 10°	4.1%	6.5%	5.0%	4.1%	4.9%	4.7%
10 - 20°	4.1%	5.8%	4.8%	3.0%	3.1%	2.8%
20 - 30°	3.2%	4.1%	4.1%	2.6%	2.2%	1.8%
30 - 40°	3.1%	3.0%	2.3%	2.0%	1.6%	1.4%
40 - 50°	3.2%	2.4%	1.9%	1.9%	1.5%	0.6%
50 - 60°	3.1%	2.5%	2.1%	1.7%	1.0%	1.2%
60 - 70°	3.0%	2.3%	2.2%	1.4%	0.9%	0.3%
70 - 80°	3.1%	2.4%	2.0%	1.2%	0.6%	0.1%
80 - 90°	2.9%	2.6%	2.0%	1.2%	0.5%	0.1%
90 - 100°	3.3%	2.6%	2.0%	1.1%	0.3%	0.3%
100 - 110°	3.0%	2.9%	2.3%	1.2%	0.6%	0.3%
110 - 120°	3.4%	3.1%	2.9%	1.8%	0.6%	0.2%
120 - 130°	3.1%	3.7%	4.5%	3.0%	1.2%	0.6%
130 - 140°	3.2%	4.0%	5.9%	4.9%	2.1%	0.5%
140 - 150°	3.7%	4.9%	7.1%	6.8%	3.6%	0.5%
150 - 160°	2.7%	4.5%	6.8%	8.0%	4.2%	1.1%
160 - 170°	2.1%	3.4%	5.1%	5.9%	4.2%	1.2%
170 - 180°	2.6%	2.9%	3.9%	3.6%	2.8%	1.0%
180 - 190°	2.2%	2.3%	2.8%	2.7%	1.9%	1.4%
190 - 200°	1.9%	1.8%	1.6%	1.8%	2.1%	2.4%
200 - 210°	1.6%	1.3%	1.1%	1.7%	2.8%	4.0%
210 - 220°	1.6%	0.9%	0.8%	1.3%	2.7%	4.3%
220 - 230°	1.3%	0.8%	0.5%	1.0%	1.7%	1.9%
230 - 240°	1.6%	0.8%	0.5%	0.8%	1.3%	1.5%
240 - 250°	1.5%	0.8%	0.5%	0.7%	1.4%	2.3%
250 - 260°	1.7%	0.7%	0.4%	0.7%	1.2%	2.3%
260 - 270°	1.7%	0.9%	0.5%	0.7%	1.1%	2.2%
270 - 280°	2.2%	1.0%	0.6%	0.8%	1.6%	2.3%
280 - 290°	2.2%	1.2%	0.9%	1.3%	2.2%	4.0%
290 - 300°	2.6%	1.8%	1.2%	1.8%	2.8%	5.0%
300 - 310°	2.2%	2.1%	1.9%	2.3%	2.9%	2.4%
310 - 320°	3.1%	2.6%	2.8%	3.6%	4.3%	2.8%
320 - 330°	3.1%	3.2%	4.4%	5.7%	8.2%	9.0%
330 - 340°	4.4%	3.6%	4.4%	6.6%	10.1%	14.5%
340 - 350°	3.8%	4.4%	3.9%	5.8%	8.9%	11.0%
350 - 360°	4.1%	6.1%	4.5%	5.3%	6.9%	8.0%
	100.00%	*100.00%*	*100.00%*	*100.00%*	*100.00%*	*100.00%*

Source: On-Site AWOS

The existing configuration for COS's runway layout provides adequate wind coverage per FAA guidance, no orientation alternatives will be considered for the 20-year planning period. Note that without Runway 13-31, the Airport would not meet the 95 percent wind coverage recommendation.

Runway Length

The purpose of this section is to analyze the Airport's various runway lengths to determine if they are adequate to accommodate the aircraft fleet currently operating and projected to operate at COS, and if not, what those lengths should be. Runway 17R-35L and Runway 17L-35R at COS have lengths of 11,022 feet and 13,501 feet respectively, while Runway 13-31 has a length of 8,269 feet. These current runway lengths allow the Airport to serve a full range of military, air carrier, cargo, and general aviation aircraft. It should be noted that in practical application, specific runway length requirements must be generated for each flight that originates at any airport.

At COS, along with all other airports, these requirements are dependent on a wide range of variables, many of which can vary dramatically daily or even hourly. Nevertheless, the primary factor in determining runway length is the critical design aircraft, which, as previously identified for COS in this Airport Master Plan, is the Boeing 767-400, a civilian air carrier aircraft often used for hauling cargo. With a maximum takeoff weight of 450,000 pounds and wingspan over 170 feet, this is the largest aircraft that frequents the Airport. The largest scheduled air carrier aircraft that regularly operates at COS is the late model Boeing 737. It is anticipated that cargo aircraft (those similar to the 767-400) will continue to represent the largest aircraft regularly using COS.

The method for determining the recommended runway lengths at COS has been based on the characteristics of aircraft included in the Airport's design aircraft (ARC D-IV) family, as well as other large aircraft currently operating at the Airport or anticipated to operate there in the future. In order to determine the ultimate required length of runways, several issues must be considered, including the characteristics of the critical aircraft types that will use the runway, the typical stage length being flown by the critical aircraft, and common atmospheric conditions at the Airport. In general, longer stage lengths require aircraft to carry more fuel thereby increasing the aircraft's weight at takeoff and increasing the runway length required for takeoff. Similarly, warmer air temperatures and the corresponding impacts to air density result in increased runway takeoff length requirements for most aircraft.

FAA Advisory Circular 150/5325-4, *Runway Length Requirements for Airport Design*, and the FAA's Airport Design computer program provide guidance on determining runway length requirements for various classes of aircraft. For this analysis, runway length requirements were examined for a range of aircraft, including the Airport's critical design aircraft as well as specific types of military, air carrier, cargo, and general aviation aircraft that regularly use the Airport.

In determining the required runway length for the Airport, the daily mean maximum temperature of the hottest month (84.8 degrees Fahrenheit) and the Airport's elevation (6,187 feet above mean sea level, or MSL) were applied. In addition, a stage length of approximately 1,600 nautical miles (NM) was used in the analysis to represent a flight from COS to anywhere within the continental US. Flights to Europe, Hawaii and Alaska may were also considered as records show flights to those destinations from COS have occurred and are within the limits of cargo and military aircraft serving the Airport (note that for European destinations, a stage length of 5,000 NM was used).

Table 4-13: General Runway Length Requirements

Input		
Airport Elevation	6,187' MSL	
Mean Daily Maximum Temp. in Hottest Month	84.8° F	
Maximum Difference in Runway Centerline Elevation	131'	
Estimated Stage Length	1,600 mi / 5,000 mi	
Runway Lengths Recommended for Airport Design		
	1,600 mi	5,000 mi
Small airplanes with approach speeds of less than 30 knots:	490'	490'
Small airplanes with approach speeds of less than 50 knots:	1,290'	1,290'
Small airplanes with less than 10 passenger seats:		
75 percent of these small airplanes:	5,280'	5,280'
95 percent of these small airplanes:	7,450'	7,450'
100 percent of these small airplanes:	7,450'	7,450'
Small airplanes with 10 or more passenger seats:	7,450'	7,450'
Large airplanes of 60,000 pounds or less:		
75 percent of these large airplanes at 60 percent useful load:	8,340'	8,340
75 percent of these large airplanes at 90 percent useful load:	9,910'	9,910'
100 percent of these large airplanes at 60 percent useful load:	12,310'	12,310'
100 percent of these large airplanes at 90 percent useful load:	12,310'	12,310'
Airplanes of more than 60,000 pounds	10,000'	15,000'

Source: FAA Airport Design Software

As previously described, stage lengths of 1,600 and 5,000 miles were used to determine runway length requirements at COS. Using this FAA model, the 13,501-foot length of Runway 17L-35R can appropriately accommodate the Airport's existing and projected aircraft fleet mix. At 11,022 feet, Runway 17R-35L is 1,288 feet deficient in meeting the recommended runway length of 12,310 feet to accommodate all large aircraft. When applying this methodology to Runway 13-31, the need to accommodate smaller aircraft for wind coverage is important. As shown in the table above, a minimum of 7,450 feet would be required to accommodate all small civilian aircraft on Runway 13-31. That said, a number of large airplanes use Runway 13-31 and utilize it full length. For that reason, and for more detailed analyses, aircraft specific runway length requirements should be evaluated further.

In addition to using the FAA model, a review of estimated runway length requirements for common larger aircraft can be beneficial in reviewing runway length requirements. Actual runway length requirements for any aircraft operating at COS can be determined by a wide variety of factors including, but not limited to, air temperature, wind speed, runway condition (dry/wet), aircraft model, engine types, pilot ability and experience, and operator policies and preferences. The estimated, general runway length requirements presented in **Table 4-14** provide an order-of-magnitude estimate of runway length requirements for relevant aircraft in the air carrier fleet.

Table 4-14: Common Large Aircraft Runway Length Requirements

Aircraft	Maximum Takeoff Weight (lbs.)	Approximate Runway Requirement - 60% Maximum Takeoff Weight	Approximate Runway Requirement - 80% Maximum Takeoff Weight	Approximate Runway Requirement - 100% Maximum Takeoff Weight
C-130	164,000	1,800'	2,600'	4,500'
Airbus A319	169,000	4,000'	5,200'	13,200 *
Airbus A320	172,000	4,500'	6,800	14,700 *
Boeing 737-900	174,200	6,000'	8,200'	14,100' *
Boeing 757-200	255,000	4,800'	8,200'	12,700' *
Boeing 767-400	450,000	6,800'	9,400'	15,700' *
Boeing 747-400	875,000	5,900'	10,000'	16,200' *

Source: Aircraft Manufacturer Planning Manuals
Notes: *Maximum takeoff weight reduced due to airport elevation
Assumptions: Approximate runway length requirements are based on the following inputs:

- Standard day + 27 or 59 degrees F temperature (hot day); C-130 Standard Day
- Zero wind
- Zero runway gradient, wet surface where available

While actual runway length requirements will vary based on a number of factors, the data presented above indicate that a runway length of approximately 13,500 feet is generally sufficient to accommodate each of these aircraft at close to their maximum takeoff weight, on a hot day, and in the other conditions identified. It should be noted that most air carrier operations occurring at COS are conducted by several models of Boeing 737 aircraft, whose runway length requirements are typically less demanding than the general requirements presented in **Table 4-14**. Nevertheless, the current runway length of 13,501 on Runway 17L-35R has been deemed to be adequate for accommodating the current and anticipated future needs of aircraft operating at COS. Additionally, Runway 17R-35L should be extended from its existing 11,022 feet to as close to 12,300 feet as possible. Finally, Runway 13-31 should be maintained as close to its existing length of 8,269 feet as possible to accommodate a reasonable range of small- and medium-sized aircraft, when wind conditions require it.

Runway 17L-35L and Runway 13-31 are currently adequate in length to accommodate most of the aircraft using those runways. Runway 17R-35L should be extended to as close to 12,300 feet as possible.

Runway Width

The required width of a runway is determined essentially by the wingspan dimensions of that runway's critical design aircraft and that runway's approach visibility minimums. Based on its existing and anticipated design aircraft, runway width requirements at COS have been based on the design standards for Aircraft Design Group IV. **Table 4-15** presents the runway width requirements with the lowest approach visibility minimums for the various Aircraft Design Group categories used in FAA AC 150/5300-13A:

Table 4-15: Runway Width Design Standards

Aircraft Design Group	Wingspan	Runway Width
I	< 49'	100'
II	49' - < 79'	100'
III	79' - < 118'	100'
IV	118' - < 171'	150'
V	171' - < 214'	150'
VI	214' - < 262'	200'

Source: FAA Advisory Circular 150/5300-13A

All runways at COS currently have a width of 150 feet. Based on current runway width design standards of Aircraft Design Group IV, the existing widths of both runways are sufficient to accommodate the Airport's existing and anticipated future design aircraft.

The width of 150 feet should be maintained on all runways.

Runway Pavement Strength

Runway pavement strength represents the load-bearing capacity of the pavement. To ensure safe aircraft operations and minimize pavement damage, it is important that runway pavement strength be sufficient to support the heaviest aircraft expected to use the runway on a regular basis. Runway pavement strength is typically expressed based on common landing gear configurations. A listing of these configurations (and example aircraft) include the following:

Single-wheel – each landing gear unit has a single tire, example aircraft include light general aviation aircraft and some business jet aircraft.

Dual-wheel – each landing gear unit has two tires, example aircraft include the Boeing 737, Boeing 727, MD-80, CRJ 100/200, and the Dash 8.

Dual-tandem – each main landing gear unit has four tires arranged in the shape of a square, example aircraft include the Boeing 757, 767 and the KC-135.

Double dual-tandem – the main landing gear units have the same configuration as the dual-tandem configuration, however, there are twice as many main landing gear units. Boeing 747 aircraft have a double dual-tandem landing gear configuration.

The aircraft gear type and configuration dictates how aircraft weight is distributed to the pavement and determines pavement response to loading. The published pavement strengths of the COS runways are presented in **Table 4-16**.

Table 4-16: Runway Pavement Strength (lbs.)

Landing Gear Configuration	Runway 17L-35R	Runway 17R-35L	Runway 13-31
Single-wheel	120,000	120,000	120,000
Dual-wheel	250,000	250,000	171,000
Dual-tandem	550,000	550,000	279,000
Double dual-tandem	1,120,000	1,120,000	691,000

Source: FAA 5010 Airport Master Record

As shown above, the pavement strength of all runways at COS exceed the maximum takeoff weight of common large aircraft (referenced in **Table 4-14)**. The runways can currently accommodate regular operations by aircraft with maximum weights ranging from 120,000 pounds for aircraft with single-wheel gear configurations up to 1,120,000 pounds for aircraft with double dual-tandem landing gear configurations. While the existing pavement strength of runways at COS are sufficient to meet existing and future demands, on-going maintenance is critical to preserve strength and accommodate aircraft operations.

The pavement strengths of all runways are adequate for the aircraft serving them and should be maintained as such throughout the planning period.

Taxiway System

Taxiway system facility requirements for COS to adequately serve existing and future aviation activity are primarily based on the aircraft projected to use the taxiway system, the 2016 COS General Aviation Area Plan, and the design standards prescribed in the FAA AC 150/5300-13A. Components of the taxiway system examined in this facility requirements analysis include the following:

- Runway/Taxiway Separation Requirements
- Taxiway Dimensional Standards
- Taxiway Efficiency

Specific facility requirement recommendations for these components are identified in the following sections.

Runway/Taxiway Separation

All runways at COS have full length parallel taxiways. Taxiway A supports Runway 17R-35L and has a 400-foot centerline separation with that runway. The runway/taxiway separation between Runway 17L-35R and its parallel taxiway, Taxiway E, is 500 feet. Runway 13-31 is served by Taxiway B and has a centerline separation of over 500 feet. Applicable runway/taxiway separation standards as delineated in FAA AC 150/5300-13A allow for a distance satisfying the requirement that no part of an aircraft (wing tip, tail tip) traveling along a taxiway centerline is within the runway safety area or penetrates the obstacle free zone of the runway. These imaginary runway surface areas are examined and evaluated in a following section of this chapter.

Table 4-17 presents the minimum separation standards considering the aircraft design group and approach visibility minimums that apply to COS.

Table 4-17: Runway/Taxiway Separation Standards
Approach Categories C & D

Runway Centerline to Taxiway Centerline	Airplane Design Group					
	I	II	III	IV	V	VI
Not lower than ¾-mile minimums	300'	300'	400'	**413'**	500'	500'
Lower than ¾-mile minimums	400'	400'	400'	**413'**	500'	550'

Source: FAA Advisory Circular 150/5300-13A
Note: Based on COS Airport elevation

It should be noted that general runway/taxiway separation standards are based on airports located at sea level. FAA AC 150/5300-13A provides adjustments to these values to account for airports located at higher elevations. Specifically for COS, as a Group IV airport, the separation requirement based on clearing the inner-transitional OFZ (discussed later in the chapter) is 413 feet. Additionally, FAA guidance recommends that (ideally) aircraft holding at a runway have adequate separation to hold at a 90-degree angle relative to the runway centerline. With a 312-foot runway centeline to hold line separation requirement (corrected to COS elevation) most aircraft using Runway 17R-35L will hold at a 90-degree angle with a 500-foot runway/taxiway separation. As such, it is recommended that Taxiway A be separated from Runway 17R-35L by an additional 100 feet to achieve that 500-foot separation.

The separation between Taxiway A and Runway 17R-35L should be increased from 400 feet to 500 feet.

Taxiway Dimensional Standards

Taxiway dimensional standards include measurements that account for physical taxiway characteristics as well as safety related areas. The following taxiway-related dimensional standards are important to the design of the taxiway and safety of the aircraft using them:

Taxiway Width - Pavement width of the taxiway is intended to support the weight of the aircraft while taxiing to or from the runway.

Taxiway Shoulder - The taxiway shoulder reduces the possibility of blast erosion and engine ingestion problems associated with jet engines that may overhang the edge of taxiway pavement. Soil with turf not suitable for this purpose requires a stabilized or low-cost paved surface.

Taxiway Safety Area - The taxiway safety area is a defined surface alongside the taxiway suitable for reducing the risk of damage to an airplane unintentionally departing the taxiway. The taxiway safety area must be clear of ruts or humps, graded to provide water run-off, capable of supporting snow and emergency equipment, and free of objects (objects over 3 inches must be supported on frangible mounts).

Taxiway Object Free Area - The taxiway object free area is an area around the taxiway intended to enhance the safety of aircraft by having the area free of objects, except those objects that need to be located in the area for air navigation or aircraft ground maneuvering purposes.

COS falls under the Taxiway Design Group 5 and Airplane Design Group IV dimensional standards as shown in **Table 4-18**.

Table 4-18: Taxiway Dimensional Standards

Item	Taxiway Design Group							
	1A	1B	2	3	4	5	6	7
Taxiway Width	25’	25’	35’	50’	50’	**75’**	75’	82’
Taxiway Shoulder	10’	10’	15’	20’	20’	**30’**	30’	40’

	Airplane Design Group					
	I	II	III	IV	V	VI
Taxiway Safety Area Width	49’	79’	118’	171’	214’	262’
Taxiway Object Free Area Width	89’	131’	186’	259’	320’	386’

Source: FAA Advisory Circular 150/5300-13A

All the taxiways at COS meet current taxiway dimension standards. All primary taxiways are at least 75 feet wide and have the appropriate safety clearances. In the future, the Taxiway Design Group and Airplane Design Group will remain 5 and IV, respectively, and taxiways will not require dimensional standards beyond what currently exists. Any future taxiway development should be designed to these standards to provide an adequate margin of safety to airfield operations.

The designation of Taxiway Design Group 5 requires a taxiway width of 75 feet. Taxiway safety and object free areas at COS are designated as Airplane Design Group IV as determined by the critical design aircraft. These design standards should be applied and maintained on all taxiways at COS.

Taxiway Efficiency

As discussed above, the taxiway system at COS is adequate and readily configurable to meet current FAA standards. The prime objective would be to realign Taxiway A to provide greater separation from Runway 17R-35L. As far as other changes that are required, the FAA has a variety of taxiway design requirements identified in FAA AC 150/5300-13A that are intended to enhance the overall safety of taxiway operations and minimize opportunities for runway incursions. Many of these requirements are relatively new (circa 2012) and were not in effect when most of COS's pavements were constructed. These design principles for taxiway system layouts are identified in **Table 4-19**.

Table 4-19: FAA Taxiway Design Principles

Design Principle	Summarized Definition
Steering Angle	Design taxiways such that the nose gear steering angles is < 50 degrees
Fillet Design	Traditional fillet design standards have been replaced. New fillet design more effectively reflects aircraft wheel tracks
Standardize Intersection Angles	90-degree turns are standard 30, 45, 60, 90, 120, 135, and 150-degree preferred intersection standard angles
Concepts to Minimize Runway Incursions	
Increase Pilot Situational Awareness	Utilize the "three-node concept". Pilot should have three or fewer choices at an intersection (left, right, straight)
Avoid Wide Expanses of Pavement	Wide pavement requires placing signs far from a pilot's eye
Limit Runway Crossings	Reduces the opportunity for human error
Avoid "High Energy" Intersections	Located in the middle third of the runways. Limit the runway crossings to the outer thirds of the runway
Increase Visibility	Provide right angle intersections for best pilot visibility. Acute angle runway exits should not be used as runway entrance or crossing
Avoid "Dual Purpose" Pavements	Runways used as taxiways and taxiways used as runways can lead to confusion
Indirect Access	Eliminate taxiways leading directly from an apron to a runway
Hot Spots	Limit the number of taxiways intersecting in one spot

Source: FAA Advisory Circular 150/5300-13A

As it relates to taxiway design, COS has two areas of special concern (or "Hot Spots") as identified by the FAA.

- *Hot Spot 2 (HS 2)*: Intersection of Taxiway A4 and Taxiway G at Runway 17R-35L: "High volume" crossing point.
- *Hot Spot 3 (HS 3)*: Large concrete area at the intersection of Taxiway E4, Taxiway G, Taxiway H and Taxiway E. High risk of entering wrong taxiway.

To remedy these Hot Spots, the taxiway configurations in these areas will have to be redeveloped to reduce the number of converging taxiways. Specifically, for HS 2, the direct connection between the General Aviation Apron and Taxiway A will be removed to not only address the high-volume crossing point, but also eliminate the direct apron-to-runway access. For HS 3, to reduce number of multiple taxiways converging in one location, high-speed exit Taxiway E4 will be shifted south, and a short section of Taxiway B will be realigned to create a 90-degree angle with Taxiway E.

Presently at COS, the taxiway system is primarily made up of right and acute angle entrance and exit taxiways to/from the runways. There are several taxiway-

taxiway intersections that may impede the flow of aircraft during peak travel periods; however, there are multiple routes aircraft may take to the terminal area and the GA apron that may be utilized to bypass any congestion that may exist. The following is a list of additional recommended taxiway system enhancements that will reduce the time aircraft spend taxiing to/from the runways and/or intended to meet taxiway design principles.

High-Speed Exit Taxiways – The FAA suggests that when the design peak hour has fewer than 30 operations (takeoffs and landings), a properly located right-angle exit taxiway will achieve an efficient flow of traffic. However, as demonstrated in Chapter Three, *Aviation Activity Forecast*, the design peak hour is currently 80 operations and the projected level of operations in the peak hour will reach approximately 98 operations by the end of the planning period. The Airport has several high-speed exit taxiways serving both parallel runways. To improve their efficiency, adhere to taxiway design principles, and to meet the needs of future runway configurations, several high-speed exit taxiways will be shifted or new high-speed exits installed.

Entrance Taxiways – Air traffic personnel at busy airports encounter occasional bottlenecks when moving aircraft ready for departure to the desired takeoff runway. Bottlenecks result when a preceding aircraft is not ready for takeoff and blocks the access taxiway. Bypass taxiways provide flexibility in runway use by permitting ground maneuvering of steady streams of departing airplanes, resulting in enhanced traffic flow. Primary Runways 17R-35L and 17L-35R should have bypass taxiways installed to improve runway accessibility.

Intersecting Taxiways – Taxiway intersections designed to accommodate cockpit-over-centerline steering require more pavement than other designs but enable more rapid movement of traffic with minimal risk of aircraft excursions from the pavement. The FAA has created new taxiway fillet design standards for intersecting taxiways to improve the flow of aircraft to/from the runways and to reduce the risk of aircraft exiting the taxiway pavement. All taxiway intersections and fillets should be designed to accommodate cockpit-over-centerline steering.

All proposed improvements to the taxiway system are illustrated on the proposed Airport Layout Plan (ALP).

Recommended taxiway modifications include shifting high-speed exit Taxiway E4, realigning a short section of Taxiway B, adding a bypass taxiway to the approach end of Runway 17L, revising the connectors to the approach end of Runway 13, and realigning taxiway connectors and high-speed exits associated with the increase in the Runway 17L-35R and Taxiway A separation.

FAA Airport Design Criteria

This section presents a review of selected FAA airport design criteria as detailed in FAA AC 150/5300-13A. In general, FAA airport design criteria can be designated airfield areas with specified dimensions and requirements that promote the safe movement and operation of aircraft at an airport. Many of these pertain to runways and their immediate surroundings. For this analysis, the selected criteria include the following:

- Runway Protection Zone (RPZ)
- Runway Safety Area (RSA)
- Runway Object Free Area (ROFA)
- Obstacle Free Zone (OFZ)
- Accident Potential Zone (APZ)

Runway Protection Zone

The Runway Protection Zone (RPZ) is trapezoidal in shape and is centered on the extended runway centerline. The function of the RPZ is to enhance the protection of people and property on the ground. The RPZ begins 200 feet beyond the end of the runway pavement that is usable for takeoffs and landings. If runway pavement is used for either takeoffs or landings, the start of the RPZ remains at the 200-foot standard. The actual length and width of the RPZ is contingent on the size of the runway's critical design aircraft, as well as the type of instrument approach available on that runway. Note that in general, as aircraft size increases and the approach minimums decrease, the dimensions of the RPZ increase. **Table 4-20** presents a summary of the RPZ dimensions at COS as well as the acreages for each.

Table 4-20: Runway Protection Zone (RPZ) Dimensions

Approach Visibility Minimums	Dimensions for C&D Category Aircraft				COS Runway Approach Ends
	Length	Inner Width	Outer Width	RPZ Acres	
Visual and not lower than 1-mile	1,700'	500'	1,010	29.465	Rwy 13, 31
Not lower than ¾-mile	1,700'	1,000'	1,510	48.978	Rwy 17R, 35R
Lower than ¾-mile	2,500'	1,000'	1,750'	78.914	Rwy 17L, 35L
Departure RPZ	1,700'	500'	1,010'	29.465	All Runways

Source: FAA Advisory Circular 150/5300-13A

The FAA Memorandum, *Interim Guidance on Land Uses Within a Runway Protection Zone*, indicates that existing incompatible land uses within an RPZ should be removed when those uses would enter the limits of the RPZ as the result of:

- An airfield project (e.g., runway extension, runway shift)
- A change in the critical design aircraft that increases the RPZ dimensions
- A new or revised instrument approach procedure that increases the RPZ dimensions
- A local development proposal in the RPZ (either new or reconfigured)

Although the RPZs for Runways 13 and 17R have incompatible uses, they are existing conditions and not as a result of the actions mentioned above. Without other mitigating circumstances, these conditions are effectively "grandfathered" and allowed to exist until any one of the terms mentioned above are met.

It has been suggested by airport management and discussed in the previous master plan that approach visibility minimums to Runway 35R be lowered to below ¾ mile in the future. Lowering approach visibility minimums to this runway would increase the size of the RPZ to 2,500 feet in length, 1,000 feet in inner width, and 1,750 feet in outer width. There are no conflicting land uses within the future RPZ for Runway 35R.

No action is required regarding the COS RPZs.

Runway Safety Area

The Runway Safety Area (RSA) is a defined surface surrounding the runway that is specifically prepared and suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the paved surface. According to the FAA's definition, the RSA should be cleared and graded and have no potentially hazardous ruts or surface variations. This area should also be drained through grading or by storm sewers and capable, under dry conditions, of supporting snow removal equipment, aircraft rescue and firefighting equipment and the occasional passage of aircraft without causing structural damage. General requirements for grading of the RSA are 0 to –3-degree grade for the first 200 feet from the runway end, with the remaining longitudinal grade ensuring that no part of the RSA penetrate the approach surface or drop below a –5-degree grade.

At COS, which has an ARC of D-IV for all runways, the RSA is required to be 500 feet wide and extend 1,000 feet beyond the runway end. It should also be noted that when RSAs of two runways intersect, this creates a "coupled" runway condition that results in the runways being dependent on one another and may cause confusion for pilots. In such situations, the FAA aggressively seeks to reduce coupled runway conditions where they can be effectively mitigated.

Hot Spot 1 at COS is such a condition:

> *Hot Spot 1 (HS 1)*: Runway threshold 13 and 17R are next to each other; wrong runway departure and landing potential. Runway 17R connector Taxiway B1; tower line of sight limited. Maintain close communication with ATCT when in this area.

In addition to HS 1, a Modification to Standards (MOS) was filed with the FAA on November 3, 2011, to request deviation from the RSA gradient requirement for Runway 13. Currently, the RSA for Runway 13 exceeds the 0 to –3-degree grade requirement for the first 200 feet from the runway end.

To resolve HS 1 and eliminate the MOS, a shift of Runway 17R was recommended as part of the 2013 Airport Master Plan. That recommendation called for relocating the Runway 17R approach end 1,790 feet to the south and extending the Runway 35L approach end by 2,500 feet also to the south while maintaining RPZ land use requirements. Completing this project would eliminate the HS 1 issue, allow for the opportunity to regrade the RSA for Runway 13, thereby eliminating the MOS, as well as provide a longer runway as recommended in the previous Runway Length section.

The 2013 Airport Master Plan also recommended a project to relocate the Runway 13 approach end and displace the threshold to clear the associated RPZ and meet RSA standards. Based on review of the existing conditions, standards, and requirements, relocating and displacing the Runway 13 threshold is not required. Without changes in the approach, threshold location or new roads developed in it, the RPZ for Runway 13 meets current and interim RPZ guidance. Further, the current RSA meets clearing standards and does not require a threshold relocation or displacement.

The recommendation from the previous Master Plan cited above will be considered in the study of alternative solutions to address HS 1. Additional options will be developed and evaluated as well, in an effort to provide a comprehensive study of the issue. Alternatives are presented/evaluated and a recommendation provided in the next chapter.

Runway Object Free Area

The runway OFA is a two-dimensional ground area surrounding the runway and centered on the runway centerline. The runway OFA should be cleared of above ground objects protruding above the runway safety area edge elevation. Except where precluded by other clearing standards, it is acceptable to place objects that need to be in the OFA for air navigation or aircraft ground maneuvering purposes and to taxi and hold aircraft in the OFA. Objects non-essential for air navigation or aircraft ground maneuvering purposes are not to be placed in the OFA. For all runways at COS, the OFAs extend 1,000 feet beyond each runway end and have a width of 800 feet.

No action is required regarding the COS ROFAs.

Obstacle Free Zone

The Obstacle Free Zone (OFZ) is a volume of airspace intended to protect aircraft in the early and final stages of flight. OFZ clearance standards prohibit taxiing and parked airplanes and other objects, except frangible NAVAIDs or fixed-function objects, from penetrating this zone. At COS, the OFZs associated with all runways have a width of 400 feet and extend 200 feet beyond each end of the runway. In addition, because of existing approach lighting systems and precision instrument approaches to the approach ends of Runway 17L and 35L, inner approach OFZ, inner-transitional OFZ, and precision OFZ requirements apply.

The inner-approach OFZ is a defined volume of airspace centered on runways with approach lighting systems. The inner-approach OFZ begins 200 feet from the runway threshold, at the same elevation as the runway threshold, and extends 200 feet beyond the last unit in the approach lighting system. It is the same width as the OFZ and rises at a slope of 50 to 1 away from the runway end.

The inner-transitional OFZ is a defined volume of airspace along the sides of the runway and the inner-approach OFZ and applies only to runways having precision instrument approaches with visibility minimums of lower than 3/4-statute mile. In addition, separate inner-transitional OFZ criteria apply to Category I and Category II/III precision instrument approach runways.

For runways having a Category II precision approach, such as Runways 17L and 35L at COS, the inner-transitional OFZ begins at the edges of the runway OFZ and inner-approach OFZ, then rises vertically for a height “H”, and then extends at a slope of 5:1 out to a distance “Y” from runway centerline, and then slopes 6:1 out to a height of 150 feet above the established airport elevation. For these runways, “H” and “Y” are calculated using the following equation where “S” is the wingspan of the most demanding aircraft using the airport and “E” is the runway threshold elevation above sea level:

Table 4-21: Runway 17L & 35L Inner-Transitional OFZ

Runway 17L	Runway 35L
$H_{feet} = 53 - 0.13(S_{feet}) - 0.0022(E_{feet})$, where	$H_{feet} = 53 - 0.13(S_{feet}) - 0.0022(E_{feet})$, where
$H_{feet} = 53 - 0.13(125) - 0.0022(6{,}187)$, and	$H_{feet} = 53 - 0.13(125) - 0.0022(6{,}145)$, and
$H_{feet} = 23.1$ feet	$H_{feet} = 23.2$ feet
$Y_{feet} = 440 + 1.08(S_{feet}) - 0.024(E_{feet})$, where	$Y_{feet} = 440 + 1.08(S_{feet}) - 0.024(E_{feet})$, where
$Y_{feet} = 440 + 1.08(125) - 0.024(6{,}187)$, and	$Y_{feet} = 440 + 1.08(125) - 0.024(6{,}145)$, and
$Y_{feet} = 426.5$ feet	$Y_{feet} = 427.5$ feet

Source: FAA Advisory Circular 150/5300-13A

Based on these calculations, the recommended 500-foot runway/taxiway separation will allow for the clearance of the 767-400 aircraft tail while taxiing on the full-length taxiways serving the parallel runways at COS. The design of future runway end elevations should consider this calculation to clear potential aircraft using the parallel taxiway.

The precision obstacle free zone (POFZ) is defined as a volume of airspace above an area beginning at the runway threshold, at the threshold elevation, and centered on the extended runway centerline, 200 feet long by 800 feet wide. The POFZ surface and its requirements are only in effect when all of the following operational conditions are met:

- Vertically guided approach
- Ceiling below 250 feet and/or visibility less than ¾ statute mile
- Aircraft on final approach within two miles of the runway threshold

Based on these factors, POFZ requirements are only currently applicable to the approach ends of Runways 17L and 35L but could be applicable to future runways ends as approach minimums are lowered. When the POFZ is in effect, a wing of an aircraft holding on a taxiway waiting for runway clearance may penetrate the POFZ; however, neither the fuselage nor the tail may infringe on the POFZ.

Based on these requirements and review of the existing holdline locations at COS, POFZ requirements are currently being met. Future runway/taxiway configurations should avoid taxiing aircraft into the POFZ at inappropriate times while arriving aircraft are on approach.

No action is required regarding OFZs for all runways at COS. This includes POFZ requirements for precision approach runways.

Accident Potential Zones (APZs)

Although they are not standards or criteria applied by the FAA, APZs are in place at COS as a result of the operations performed by PSFB. Below is a description of the two types of APZs in place at COS.

- Accident Potential Subzone (APZ – 1): The APZ-1 is an area located immediately beyond the runway protection zone (or clear zone) and possess a higher potential for aircraft accidents. The City of Colorado Springs restricts ground level development up to the maximum height of the base zone in these areas. This zone is not recognized by the FAA but is by the military standards.

- Accident Potential Subzone (APZ – 2): The APZ-2 is an area beyond the APZ-1 that has a measurable potential for accidents. The City of Colorado Springs restricts ground level development up to the maximum height of the base zoning district. This zone is not recognized by the FAA but is by the military standards.

No action is required regarding the COS APZs. Future development should preserve and protect the APZs.

Airspace Surfaces

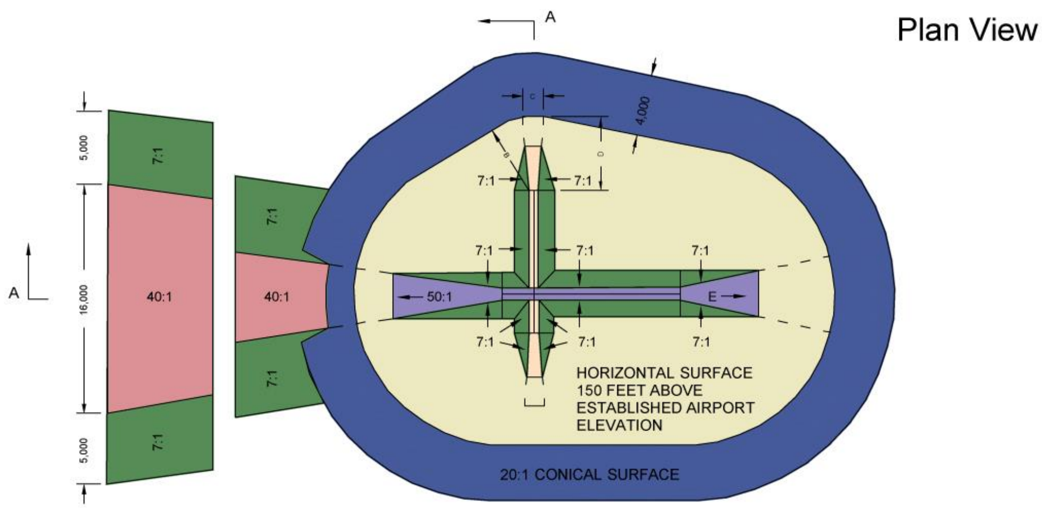
Federal Aviation Regulation (FAR) Part 77, *Objects Affecting Navigable Airspace*, establishes standards for determining which structures pose potential obstructions to air navigation. Airspace areas around an airport that cannot contain any protruding objects are referred to as "Imaginary Surfaces." Objects affected include existing or proposed objects of natural growth; terrain; or permanent or temporary construction, including equipment, which is permanent or temporary in character.

The imaginary surfaces outlined in FAR Part 77 consist of the following:

- Primary surface
- Transitional surface
- Horizontal surface
- Conical surface
- Approach surface

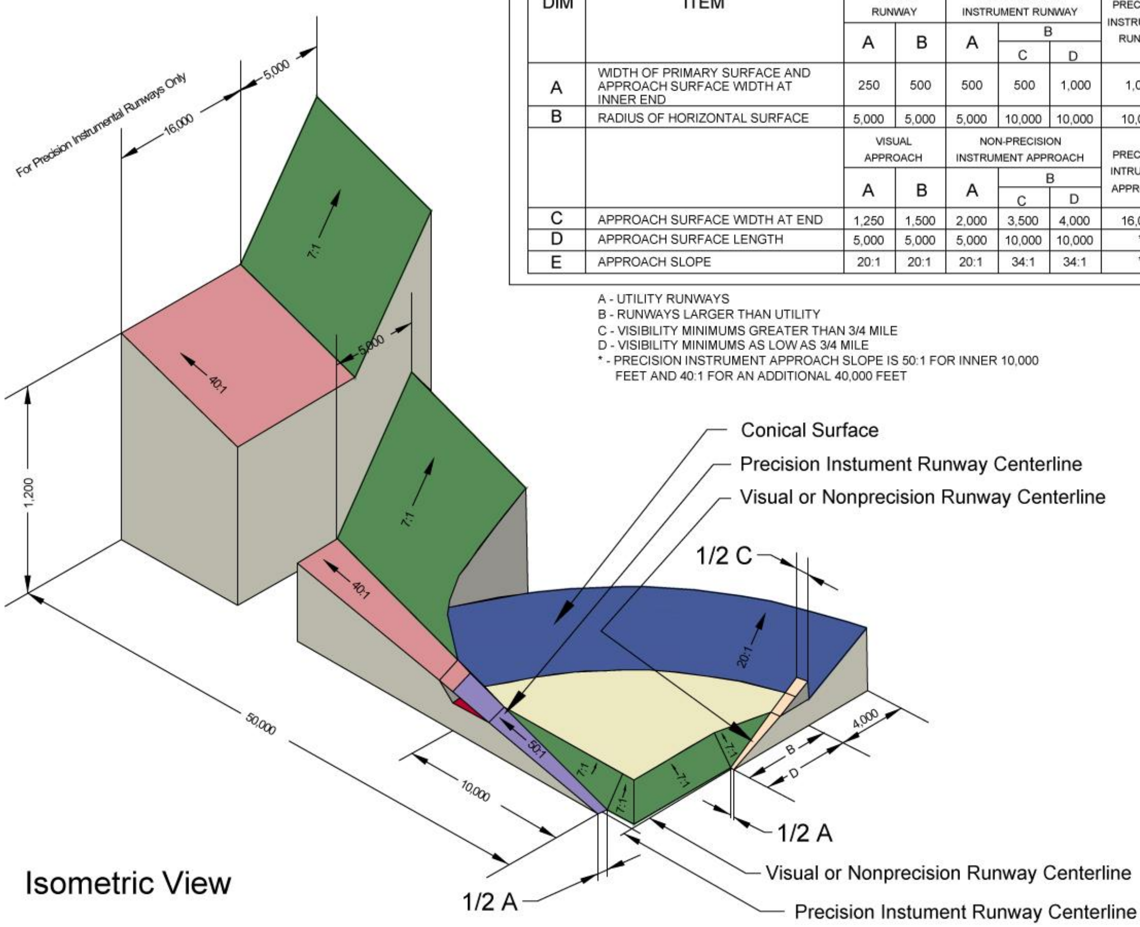
Dimensions of FAR Part 77 surfaces, like RPZs, vary depending on the type of runway approach. At COS, Runways 17L, 35L and 35R accommodate precision approaches while Runways 17R and 31 accommodate non-precision approaches. Runway 13 has a visual approach only. Precision approaches provide aircraft with horizontal (left/right) information for alignment on a runway centerline, as well as vertical glide slope information to the end of a runway. Non-precision approaches provide only horizontal information to a runway centerline. **Figure 4-4** graphically illustrates the FAR Part 77 “Imaginary Surfaces” in both plan view and profile view representations.

Figure 4-4: Typical Airport Part 77 Surfaces



DIM	ITEM	DIMENSIONAL STANDARDS (FEET)					
		VISUAL RUNWAY		NON-PRECISION INSTRUMENT RUNWAY			PRECISION INSTRUMENT RUNWAY
		A	B	A	B: C	B: D	
A	WIDTH OF PRIMARY SURFACE AND APPROACH SURFACE WIDTH AT INNER END	250	500	500	500	1,000	1,000
B	RADIUS OF HORIZONTAL SURFACE	5,000	5,000	5,000	10,000	10,000	10,000
		VISUAL APPROACH		NON-PRECISION INSTRUMENT APPROACH			PRECISION INTRUMENT APPROACH
		A	B	A	B: C	B: D	
C	APPROACH SURFACE WIDTH AT END	1,250	1,500	2,000	3,500	4,000	16,000
D	APPROACH SURFACE LENGTH	5,000	5,000	5,000	10,000	10,000	*
E	APPROACH SLOPE	20:1	20:1	20:1	34:1	34:1	*

A - UTILITY RUNWAYS
B - RUNWAYS LARGER THAN UTILITY
C - VISIBILITY MINIMUMS GREATER THAN 3/4 MILE
D - VISIBILITY MINIMUMS AS LOW AS 3/4 MILE
* - PRECISION INSTRUMENT APPROACH SLOPE IS 50:1 FOR INNER 10,000 FEET AND 40:1 FOR AN ADDITIONAL 40,000 FEET



Source: FAA

Although the FAA can determine which structures are obstructions to air navigation, it is not authorized to regulate tall structures. Under FAR Part 77, an aeronautical study can be undertaken by FAA to determine whether the structure in question would be a hazard to air navigation. However, there is no specific authorization in any statute that permits the FAA to limit structure heights or determine which structures should be lighted or marked. In fact, in every aeronautical study determination, the FAA acknowledges that state or local authorities have control over the appropriate use of property beneath an airport's airspace.

Definitions for the FAR Part 77 surfaces and the current dimensions of those surfaces at COS are presented in the following sections.

Primary Surface - The primary surface is longitudinally centered on a runway. When the runway has a hard surface, the primary surface extends 200 feet beyond each end of the runway. The width of a primary surface ranges from 250 feet to 1,000 feet, depending on the existing or planned approach and runway type (e.g., visual, non-precision, or precision). For all runways at COS, the primary surface has a width of 1,000 feet.

Transitional Surface - Transitional surfaces extend outward and upward at right angles to the runway centerline, with the runway centerline extended at a slope of seven feet horizontally for each foot vertically (7:1) from the sides of the primary and approach surfaces. The transitional surfaces extend to where they intercept the horizontal surface at a height of 150 feet above the runway elevation. Transitional surfaces for those portions of the precision approach surface, which project through and beyond the limits of the conical surface, extend a distance of 5,000 feet horizontally from the edge of the approach surface and at right angles to the runway centerline.

Horizontal Surface - The horizontal surface is a horizontal plane located 150 feet above the established airport elevation, covering an area from the transitional surface to the conical surface. The perimeter is constructed by swinging arcs from the center of each end of the primary surface and connecting the adjacent arcs by lines tangent to those areas. For all approaches to runways supporting large aircraft, the case for all runways at COS, the radius of each arc used to construct the horizontal surface is 10,000 feet.

Conical Surface - The conical surface is a surface extending upward and outward from the periphery of the horizontal surface at a slope of one foot for every 20 feet (20:1) for a horizontal distance of 4,000 feet.

Approach Surface - Longitudinally centered on the extended runway centerline, the approach surface extends outward and upward from the end of the primary surface. An approach surface is applied to each end of each runway based on the type of approach. The approach slope of a runway is either 20:1, 34:1, or 50:1, depending on the sophistication of the approach. FAA approach surfaces are 20:1 for visual approaches, 34:1 for non-precision approaches, and 50:1 for precision approaches.

The approach slopes for Runways 17L, 35L and 35R are 50:1. The approach slopes for Runways 17R and 31 are 34:1. The visual approach on Runway 13 calls for an approach slope of 20:1. It is important to note that these are Part 77 approach surfaces related to obstruction clearances for specific runway ends based on available approach types, they are not aircraft approach angles.

Part 77 Surfaces Summary - An important component of the Airport Layout Plan (ALP) that is developed for COS during the Airport Master Plan process includes a depiction of the obstructions to existing and future Part 77 surfaces. The Airspace Plan and the Inner Portion of the Approach Surface Plan included in the ALP identify those objects, both natural and man-made, that penetrate Part 77 surfaces and identifies recommended means for mitigating their impacts.

An obstructions analysis has been conducted as part of this Airport Master Plan and will be reflected in the Airport Layout Plan (ALP) set. To help ensure safe operations on and around the Airport, and in conformance with its grant assurances, it is recommended that COS continue to be diligent in preventing and removing obstructions from its critical airspace surfaces. The Airport Advisory Commission actively reviews and makes recommendations on land use proposal submitted by the city when they involve the Airport Overlay Area.

Navigational Aids (NAVAIDs)

Navigational aids (NAVAIDs) are any visual or electronic devices, airborne or on the ground, that provide point-to-point guidance information or position data to aircraft in flight. Airport NAVAIDs can provide guidance to the airport or to a specific runway end at the airport. An airport is equipped with NAVAIDs providing specific capabilities; for example, precision, non-precision, or visual approaches, based on airport operational needs, safety considerations, and planning/design standards. The type, mission, and volume of aeronautical activity in association with meteorological, airspace, and capacity considerations determine an airport’s eligibility and need for various NAVAIDs.

Existing NAVAIDs at COS and their respective capabilities are presented in the following sections:

- Instrument NAVAIDs
- Visual Landing Aids

NAVAID facility requirements are primarily determined by the needs of aircraft operators frequently using the airport and typical weather-related and operational characteristics in the airport area. These factors as they relate to COS and the potential instrument NAVAID and visual land aid facility requirements identified for the Airport are examined in the following sections.

Instrument NAVAIDs - This category of NAVAIDs provides assistance to aircraft performing instrument approach procedures at an airport. An instrument approach procedure is defined as a series of predetermined maneuvers for guiding an aircraft under instrument flight conditions from the beginning of an initial approach to a landing, or to a point from which a landing may be made visually. Instrument NAVAIDs also facilitate aircraft departures during inclement weather conditions. Instrument approaches are categorized as either precision or non-precision with precision approaches providing both vertical and horizontal guidance to aircraft on final approach to a runway, while non-precision approaches only provide horizontal data.

The standard type of precision approach available today is the instrument landing system (ILS) approach. A Category I (CAT I) ILS provide precision approach capability in weather conditions with cloud ceilings as low as 200 feet and visibility of one-half mile. Category I ILS approaches are available to Runway 17L. Existing precision approach capabilities at COS also include a more advanced, Category II with special authorization (CAT II SA) ILS. The existing CAT II SA ILS approach to Runway 35L and 17L at COS allows a descent and landing in cloud ceilings as low as 123 and 150 feet above ground level (AGL), respectively. Air crew and aircraft must be specially certified to follow CAT II SA ILS approach procedures.

RVR values are derived from a series of transmissometers consisting of transmitters and receivers that determine visual range values electronically and then convert these values to horizontal distance equivalents. Typically, on runways greater than 8,000 feet, transmissometers are placed at the touchdown, mid-point, and roll-out areas of the runway. This equipment provides pilots with real-time, electronic data that facilitates their decision-making process related to instrument approach procedures.

Non-precision approaches are also available to most runway ends at COS. Non-precision approaches include VHF (Very High Frequency) Omni-directional Radio-range (VOR), Nondirectional Radio Beacon (NDB), and Global Positioning System/Area Navigation (GPS/RNAV) facilities which generally have minimum decent altitudes of 600 to 800 feet and visibility minima of ¾ mile to two miles. All available approaches and their current decision height and sight distance minimums at COS were presented in Chapter Two, *Inventory of Existing Conditions.*

Any shifts in runway thresholds require the localizer and glide slope antenna for the ILS to be relocated. Additionally, based on discussions with airport management, frequency of instrument conditions, and types of operations at COS, it is recommended that approach minimums to Runway 35R lowered to ¼ mile. To achieve this, additional equipment and approach lighting may be necessary. Approaches to Runway 13-31 are adequate throughout the planning period.

Visual Landing Aids - Visual landing aids provide aircraft guidance to and alignment with a specific runway end, once the airport is within a pilot's sight. Visual landing aids typically include equipment associated with approach lighting and visual approach aids. Approach lighting systems provide the basic means to transition from instrument flight to visual flight for landing. The variety of approach lighting systems are similar in that each provides a series of signal lights starting in the approach area and extending for 2,400 feet to 3,400 feet to the runway threshold. The visual landing phase of flight, in both visual and instrument conditions, is also facilitated by visual approach aids which provide pilots with basic visual glideslope information during final approaches.

Existing visual landing aids at COS include the following:

> *Wind Cones* – The Airport has wind cones located near the end of each runway to provide pilots with wind direction and velocity information as they land or takeoff. With the completion of the Runway 17R-35L shift project, associated wind cones should be relocated. Although sufficient for the planning period, wind cones should be routinely inspected and replaced when tattered or torn.
>
> *Approach Lighting System (ALS)* – Current ALS at the Airport includes a medium intensity approach lighting system with runway alignment indicator lights (MALSR) for Runway 17L and 35L.
>
> *Visual Approach Aids* – Visual glide slope indicators (VGSI), examples of which include visual approach slope indicators (VASIs) and precision approach path indicators (PAPIs) are common types of visual approach aids. A VGSI is a system of lights located adjacent to a runway that provide a pilot with proper approach angle information. Using the VGSI light system, a pilot can determine if the aircraft is high or low on the approach path and take corrective action. All runway ends at COS are equipped with PAPIs. All runway ends, except those with MALSRs, are equipped with runway end identifier lights (REILs) consisting of one high intensity flashing strobe light on each side of the runway threshold. REILs are not necessary for runways equipped with ALS.

Existing visual landing aids at COS are adequate based on the current airfield configuration, instrument approach capabilities, and activity characteristics. It is recommended that a MALSR or ALSF-2 combined with in-runway centerline lighting and touchdown zone lighting be added to Runway 35R to provide enhanced identification of the runway environment to support a future CAT II ILS approach. Should the development of this or any other precision approach procedures be pursued, it would be necessary to install ALS to support those precision approaches. Any shifts in thresholds or runway extensions require the visual landing aids to be shifted accordingly to maintain approach capabilities.

It is recommended that a MALSR or ALSF-2 combined with in-runway centerline lighting and touchdown zone lighting be added to Runway 35R to provide enhanced identification of the runway environment to support a future CAT II ILS approach.

Airfield Marking, Lighting, and Signage

The safe movement of aircraft and other airport vehicles about the airfield is facilitated by airfield marking, lighting, and signage. Airfield areas that are properly marked, lighted, and signed allow pilots to efficiently and safely navigate to their destinations. The Airport Traffic Control Tower's (ATCT's) ability to safely manage ground traffic is also aided by these facilities.

Runway Markings - Runway markings are designed according to the type of approach available on the runway. FAA AC 150/5340-1M, *Standards for Airport Markings*, provides guidance related to airport pavement markings. Runways 17L-35R and 17R-35R at COS currently have precision runway markings that include runway designations, centerlines, threshold markings, aiming points, touchdown zones, and side stripes. Runway 13-31 has non-precision markings that includes runway designations, centerline, threshold markings, and aiming points.

The markings on all runways are currently in good condition and are compliant with existing standards. The airport airfield maintenance crew should actively monitor, inspect, and repaint markings as they degrade over time. Any runway or taxiway development should incorporate re-striping to meet/maintain current FAA marking standards.

Airport Lighting - Airport lighting systems aid pilots in locating an airport and safely conducting aircraft operations during nighttime and other low-visibility conditions. Existing airport lighting systems at COS include the following:

> *Airport Rotating Beacon* – Since it is a lighted, land-based airport, COS is equipped with a beacon consisting of alternating white and green light that is visible for several miles at night. It serves as a universal identifier of an airport and operates during evening hours as well as instrument meteorological conditions. The Airport's rotating beacon was recently relocated to the midfield, near Taxiways M and F.
>
> *Runway Edge Lighting* – Runways 17R-35L and 17L-35R are equipped with high intensity runway edge lighting (HIRL) providing pilots with further identification of runway pavement limits during periods of reduced visibility. Runway 13/31 is equipped with medium intensity runway edge lighting (MIRL).
>
> *Touchdown Zone Lighting* – Runway 17L-35R has touchdown zone lighting (TDZL) that help pilots identify the touchdown zone.

Taxiway Edge Lighting - Like runway edge lighting, taxiway edge lighting identifies the limits of paved taxiway areas and facilitates the effective movement of aircraft on the ground during periods of reduced visibility. Taxiways serving all runways at COS are equipped with medium intensity taxiway lighting (MITL).

Existing lighting systems at the Airport are sufficient for the planning period. Any new or updated runway or taxiway facilities at COS should be equipped with comparable lighting systems.

Airfield Signage - Airfield signage provides pilots with directional ground instruction to enable them to identify their location on the airfield as well as directions to other airport facilities. Signage also facilitates the airport traffic control's responsibility of safe and efficient ground control on the airfield. Directional signage aids pilots in locating runways, taxiways, apron areas, and mandatory holding positions. Review of the existing airfield signage layout drawings shows that COS meets current airfield signage requirements. On-site inspection of these signs should be conducted on a routine basis to ensure that these signs are properly maintained and meet FAA standards. Future airfield facilities should include corresponding signage to properly direct pilots and aid ATCT in the management of ground movement on the airfield.

COS's existing airfield lighting, markings and signage meet current FAA standards and are in good condition; no action is required beyond maintaining in good condition.

Passenger Terminal Requirements

This section focuses on the terminal space requirements for COS. Space programming seeks to establish gross size requirements for various components of the terminal facilities and to identify potential improvement projects necessary to maintain efficient operation in the future. The following topics have been examined to identify those facilities required to meet future demands.

- Planning Activity Levels (PAL)
- Terminal Space Requirements
- Gate Requirements
- Terminal Area Aircraft Apron
- Automobile Parking and Rental Car

Planning Activity Levels (PAL)

Terminal space, as well as other volume or activity derived facility requirements, are typically identified based on the maximum number of people traveling through specific functional areas during that airports' peak (busiest) time period. Derived from aviation activity forecasts, PALs represent the demand variable used to calculate space requirements.

Forecasts of enplaned passengers, air cargo tonnage, aircraft operations, and aircraft based at COS were developed for the forecast horizon years. However, many variables can affect the achievement of forecasts such as regional, national, and international economic conditions as well as changes in airline service patterns. For this section of the Master Plan, it is prudent to use a strategic planning approach whereby PALs, rather than forecast horizon years, are used to determine the timing for future airport development projects.

Table 4-22 depicts the PALs for major forecasted activity components. PAL 1, PAL 2, PAL 3 correspond to the aviation demand forecast years for 2026, 2036, and 2041. PAL 4 reflects the higher growth scenario projection of activity at COS that may be considered for ultimate requirements. The aviation demand associated with each planning activity level is summarized in **Table 4-22**.

Table 4-22: Summary of Planning Activity Levels

	2021	PAL 1	PAL 2	PAL 3	PAL 4 (High Growth)
Enplanements					
Peak Hour	510	607	698	748	1,058
Annual	**764,627**	**1,055,606**	**1,201,148**	**1,281,280**	**1,586,497**
Cargo					
Landed Weight (lbs.)	**104,047,500**	**110,988,729**	**126,291,270**	**134,716,427**	**142,924,213**
Operations					
Category					
Air Carrier	13,169	16,917	22,084	24,996	26,523
Air Taxi	14,632	13,841	11,891	10,712	11,367
General Aviation	86,330	86,121	91,733	94,627	100,409
Military	32,191	36,909	44,168	48,206	51,151
TOTAL	**146,322**	**153,787**	**169,875**	**178,541**	**189,450**
Local vs. Itinerant					
Local Operations	39,507	41,522	45,866	48,206	51,151
Itinerant Operations	106,815	112,265	124,009	130,335	138,299
Peak Hour	**80**	**85**	**93**	**98**	**104**
Based Aircraft					
Type					
Single Engine	154	164	175	189	230
Multi-Engine	35	32	44	42	51
Jet/Turboprop	22	34	60	72	87
Helicopter	2	6	10	15	18
Glider/Other	2	2	3	4	5
Military	12	26	44	57	69
TOTAL	**227**	**265**	**336**	**378**	**460**

Source: Master Plan Forecasts, Jviation

Conclusion: PALs help establish key development milestones based on activity levels rather than years. This provides the Airport with the flexibility to consider the expansion of facilities based on the actual timing that passenger demand levels are achieved rather than forecasted.

Terminal Space Requirements

Projected space requirements necessary to accommodate future travelers and other terminal users at COS are included in this section. The appropriate passenger demand variable has been applied to various terminal elements to assess the need for additional space in functional areas. Specifically, existing space is compared to existing and future space requirements and used to identify the need for additional capacity in specific functional areas. Facility space requirements for a terminal are a function of variables unique to each airport. The number of airlines, types of aircraft, airline schedules, operating characteristics, and airport supporting activities are all important factors used to determine space requirements. However, annual and peak hour passenger activity, a derivative of all these variables, plays the key role in determining most of the minimum space requirements.

Most functional elements of the terminal building at COS, including airline, concession, public, and administrative/support areas, are sized based on peak hour enplanement characteristics, and projections of annual enplanements/deplanements (for this study, deplanements area considered to be equal to enplanements) for each of the PALs. (Note that specific methodologies and planning factors applied in the development of individual space calculations were discussed earlier in the demand/capacity section of this chapter.) **Table 4-23** summarizes facility requirements for each major component or functional area of the passenger terminal building and its operation.

Table 4-23: Terminal Space Requirements

Functional Area	Existing Space (ft²)	Planning Factor (ft²)	Planning Factor Variable	PAL 1	PAL 2	PAL 3	PAL 4
Airline Space							
Airline Ticket Counter	6,700	3.6	PHEP	1,836	2,185	2,513	3,809
Ticket Counter Queuing	10,000	12.6	PHEP	6,426	7,648	8,795	13,331
Airline Ticket Office	8,300	8.5	PHEP	4,335	5,160	5,933	8,993
Baggage Service Office	1,300	2.4	PHDP	1,224	1,457	1,675	2,539
Outbound Baggage Service Area	11,400	30.0	PHEP	15,300	18,210	20,940	31,740
Baggage Claim Area	15,300	20.0	PHDP	10,200	12,140	13,960	21,160
Operations Space	20,250	0.01	AEP	7,646	10,556	12,011	15,865
Hold rooms	28,319	1,800	Gate	15,887	17,228	17,350	20,464
Sub Total	**101,569**			**62,854**	**74,584**	**83,177**	**117,901**
Concession Space							
Food/Beverage	12,200	0.01	AEP	7,646	10,556	12,011	15,865
Retail	6,250	0.005	AEP	3,823	5,278	6,006	7,932
Rental Car	3,120	0.002	ADP	1,529	2,111	2,402	3,173
Other Concession Space	5,000	0.004	AEP	3,059	4,222	4,805	6,346
Sub Total	**26,570**			**16,057**	**22,168**	**25,224**	**33,316**
Public Space							
Restrooms	7,475	5.0	PHEP	5,100	6,070	6,980	10,580
Circulation (secure and non-secure)	77,775	0.06	AEP	45,878	63,336	72,069	95,190
TSA Baggage Inspection Stations	17,800	20.0	PHEP	10,200	12,140	13,960	21,160
TSA Checkpoint (station screen rate = 190 combined pax/hr)	8,000	1,500	Checkpoint & PHEP	4,026	4,792	5,511	8,353
Minimum Number of Checkpoints (not in sub total)	*4*	190	PHEP	*3*	*3*	*4*	*6*
Sub Total	**111,050**			**65,204**	**86,338**	**98,519**	**135,282**
Administrative and Other Support Areas							
Administration Offices	28,700	0.03	AEP	22,939	31,668	36,034	47,595
DEA, Police, ID/Pass, TSA Offices	3,000	0.002	AEP	1,529	2,111	2,402	3,173
Utility/Mechanical Space	28,000	0.03	AEP	22,939	31,668	36,034	47,595
Sub Total	**59,700**			**47,407**	**65,448**	**74,471**	**98,363**
Grand Total	***298,889***			***191,522***	***248,537***	***281,391***	***384,863***

Source: Existing space provided by Airport Management, space requirements derived from Master Plan Forecasts, Jviation

Notes: PHEP: Peak Hour Enplaned Passengers; PHDP: Peak Hour Deplaned Passengers; AEP: Annual Enplaned Passengers; ADP: Annual Deplaned Passengers

Based on the analysis above, the overall terminal building has adequate space to accommodate over 1.2 million annual enplaned passengers (PAL 3). Individual areas, however, may experience capacity issues before reaching that level as evidenced by comparing existing space to various PAL values above. These functional areas include baggage service office, outbound baggage service, administrative office, and utility/mechanical spaces. While most of these areas could become deficient by the PAL 3 level of activity, areas that have an abundance of space could be redeveloped to make up for deficiencies. By the time COS achieves PAL 4, many areas of the terminal building may require expansion to include a terminal-wide redevelopment effort.

Sections of the existing terminal building may require reconfiguration and/or expansion prior to reaching PAL 3. While realignment of existing facilities may aid in capacity issues, by PAL 4, most terminal building areas will require expansion.

Gate Requirements

Projected gate requirements necessary to accommodate forecasted aircraft activity have been identified in this section. These requirements focus on the future gate demand for air carriers and are derived from aviation activity forecasts and current and anticipated operational characteristics.

Similar to terminal space requirements, gate requirements are unique to every airport and are a function of many factors. The volume of passengers, number and frequency of flights, and the type of aircraft serving the airport are some of the determining factors used for gate demand analyses. In this gate analysis, the number of gates required for the planning activity levels are given.

The following methodology was used in determining gate demand for each benchmark year:

- The planning activity levels (PAL) are used to provide annual enplanements.
- The number of peak hour passengers in each PAL were determined by applying the average day-peak month percentages found in the COS passenger activity profile presented in this chapter.
- The projected fleet mix for each PAL was used to determine the average seats per aircraft. In effect, this weights the aircraft type to create an Equivalent Aircraft Index (EQA) allowing each type of aircraft to be represented in the calculation while accounting for its size relative to the others.
- The number of departures per day was obtained by applying the estimated load factor percentage (seats actually occupied during a flight) and dividing it by the peak hour PAL passenger calculation. Current airline schedule data was obtained from Airport management to confirm actual daily scheduled departures and calculation methods.

- The number of daily departures per gate was then multiplied by the number of departures per day. In certain circumstances the EQA rule was reduced in the gate calculation to account for inefficiencies in an exclusive-use gate environment. In a common-use gate environment, the percentage of flights in the peak hour was utilized to calculate gate demand and remove the inefficiencies found in exclusive-use facilities. Note that shared use gates are usually found at airports with numerous air carriers and a limited number of gates to serve them; they are typically configured with almost no airline-specific distinguishing signage or features in order to allow multiple carriers to operate at one gate. Given the nature of operations and the preferential-use facilities to which air carriers have become accustomed at COS, it is possible that preferential -use gates will be provided to each airline throughout the planning period, although shared use will be considered as an option if it becomes necessary to manage air carrier demand in the future.

- The length of dwell time (average time an aircraft is occupying a gate) was applied to the number of peak hour departures, resulting in the number of gates required. For this analysis, an average dwell time of 1 hour was used for each PAL. Some airlines may have lower dwell times, but this conservative approach allows for possible delays and operational contingencies.

Table 4-24 presents the existing and future gate requirements calculated for COS based on projected demand. As the table illustrates, the 12 gates currently in place in the COS main terminal provide sufficient capacity to accommodate existing demand. Additionally, it is anticipated that these gates will be adequate to satisfy gate requirements throughout the planning period. It is important to remember, however, as COS gets closer to reaching capacity, new development should be planned and designed in order to accommodate demand as the Airport gets closer to (not exceeding) demand.

Table 4-24: Gate Requirements

	Existing Gates	PAL 1	PAL 2	PAL 3	PAL 4
Air Carrier Gates	12	9	10	10	11

Source: Jviation

The number of existing gates in the COS main terminal is adequate. As the Airport nears PAL 4, planning and design for gate expansion should be considered.

Terminal Area Aircraft Apron

Utilization of terminal area apron space is a crucial aspect of the passenger service operation at COS. Recommendations to maintain and expand the functionality of this space have been provided in this section.

The gate and apron areas at COS were designed to accommodate a full range of aircraft including narrow and widebody aircraft. The apron also accommodates deicing of passenger aircraft. As discussed earlier, a significant share of passenger aircraft serving COS are regional jet and commuter aircraft, which require less apron area than narrow and widebody aircraft. While the size of passenger aircraft serving COS is expected to increase throughout the planning period, the existing apron area and its current gate configuration will accommodate the type and size of aircraft expected.

However, the Airport has also expressed concern over continued use of the apron for deicing as they serve larger aircraft. As a means of maintaining adequate space for larger aircraft on the terminal apron, it is recommended that a dedicated deicing apron be constructed adjacent to the terminal area. This will eliminate deicing operations from occurring on the terminal apron, allowing for larger aircraft movement and circulation, as well as the potential for overnighting aircraft.

The Airport would benefit from additional apron space. Constructing a dedicated deicing would provide some operational relief for the terminal apron, providing additional capacity for overnight aircraft parking or other uses.

Automobile Parking and Rental Car

Providing sufficient parking facilities to meet growing and changing Airport passenger, tenant, and employee needs is a key component of the planning process. An analysis of current and anticipated future parking requirements is presented within this section. From an overall perspective and using current supply demand ratios, **Table 4-25** presents a summary of the total number of spaces needed based on PALs. Note that based on Airport reports, this analysis is based on the assumption that the existing overall parking system is currently largely operating at capacity and is experiencing occasional issues due to lack of available space. The realignment and allocation of parking spaces by type could remedy some of these capacity issues while an overall expansion will ultimately be required to resolve this issue. The expansion and reallocation of parking facilities will be discussed in the following sections.

Table 4-25: Parking Facility Requirements

PAL	Supply	Demand	Surplus/(Deficit)
Existing	6,563	6,563	0
PAL 1	6,563	9,132	(2,569)
PAL 2	6,563	10,390	(3,827)
PAL 3	6,563	11,084	(4,521)
PAL 4	6,563	13,724	(7,161)

Source: Jviation

As shown above, based on the assumption that the overall parking system is generally operating largely at capacity, the Airport will experience a deficiency in parking space within the short term. By PAL 4, and based on current ratios, the Airport will require more than twice as many parking spaces as it has today.

Because the Airport's parking system serves multiple users with different requirements and preferences, it is important to examine parking facilities separately to account for their unique characteristics and requirements. Independent evaluations were conducted for each of the following categories of parking facilities:

- Public Parking
- Employee Parking
- Rental Car Facilities

Public Parking

Public parking facilities at COS are located in lots directly in front of the terminal building and represent the greatest share of parking spaces at the Airport. Airport data indicates that there are currently 4,586 spaces between the short-term and long-term lots (not including the overflow lot). The short-term lot has 711 spaces and frequently reaches capacity. The long-term lot has 3,875 spaces, and although it occasionally reaches capacity, that primarily occurs during the heavy period of peak activity (holidays). During those events, the overflow lot (875 spaces) is used. To address short-term lot issues, the reallocation of rental car parking is recommended through the development of a consolidated rental car (CONRAC) facility. This would provide an additional 768 parking spaces in the short-term lot, effectively doubling its capacity. To address long-term public parking issues, it is recommended that one or more long-term or economy lots be developed of equal size to the existing lot. This would provide adequate public parking capacity to PAL 4.

Employee Parking

Between the east and west employee parking lots, there are 275 parking spaces available for employees, vendors, tenants, etc. Similar to the public lots, these lots can reach capacity during peak periods. As suggested by Airport management, to address the issues, overflow employee parking can be assigned to the long-term lot since there is little to no room to expand or redesign the existing employee lots without impacting other important passenger terminal facilities.

Rental Car Facilities

Existing rental car facilities at COS include counter and office space (examined previously in the terminal space analysis) as well as parking and service facilities. Facility requirements related to rental car parking areas and service facilities are presented below. It should be noted that the analysis of rental car parking facilities focuses on ready/return parking spaces located proximate to the terminal that support customers picking up or returning their rental cars.

Rental car ready/return parking spaces are located in front of the Airport terminal building and adjacent to the short-term lot. There are a total of 768 ready/return spaces available to meet the needs of the Airport's on-airport rental car operators. The supply of ready/return spaces at COS is considered adequate throughout the planning period, with no reported capacity issues. However, as suggested previously, the reallocation of this lot to short-term parking would provide much needed space for public parking. The development of a CONRAC, as suggested above, would provide rental car agencies with consolidated and dedicated facilities outside the public parking venue. A future CONRAC should include combined services and activities performed by the rental car agencies including ready/return parking, service facilities, and rental car counters and offices. Alternative locations for the CONRAC will be studied further in the next chapter.

Development of a CONRAC will effectively double the space for short-term public parking. The CONRAC should be designed to incorporate all rental car services and facilities. Additional long-term or economy parking is recommended.

Passenger Terminal Summary

The existing terminal area is adequate to accommodate existing, short, and intermediate-term passenger activity levels. It should be noted, however, a concourse modernization project taking place in the next 3 to 5 years will increase the hold room space while decreasing the retail concession space. It is recommended that COS consider ultimate terminal expansion to be prepared for the highest levels of passenger service. This expansion could include an increased number of gates, additional hold rooms, wider concourses, additional space for concessions, among other elements. Development of a dedicated deicing apron for passenger aircraft will preserve apron space for aircraft movement and storage. When the main terminal is expanded, it is recommended that the East Terminal Unit be removed to provide additional apron space for aircraft maneuvering and storage. While a recommended terminal layout will be provided in the next chapter, additional study and architectural services are the next steps in carrying out terminal expansion.

General Aviation Requirements

Existing general aviation facilities at COS are located west of the passenger terminal complex in an area referred to as the Westside Development Area. Facility requirements related to general aviation facilities at the Airport are developed based on an analysis of existing facilities, current and planned utilization of those facilities, projected aviation demand, and the ultimate development potential of the Westside Development Area.

Requirements are identified for the following general aviation facilities:

- FBO Facilities
- Corporate Aviation Facilities
- Aircraft Storage

Projections of aviation demand developed in Chapter Three estimated that the number of general aviation aircraft based at the Airport, the vast majority of which are stored in hangars, will increase from 227 to approximately 378 by the end of the planning period. This facility requirement analysis examines the ability of general aviation facilities at COS to accommodate current and anticipated activity levels, and identifies those development needs necessary to adequately support the Airport's general aviation users.

Options for the development of general aviation facilities were examined in the 2016 COS General Aviation Area Plan and have been incorporated into this Airport Master Plan. Note that the 2016 plan included expansion of the apron and hangars as well as large facilities to accommodate the maintenance of aircraft of all sizes.

FBO Facilities

FBO facilities at COS primarily consist of aircraft maintenance hangars, aircraft storage hangars, and fuel storage facilities. (Aircraft storage hangar requirements and fuel storage requirements have been addressed in separate sections of this chapter.) The Airport's FBOs intend to maximize development in the existing general aviation area prior to relocating or developing additional facilities in other areas of the Airport. The existing general aviation facilities are constrained, and it is anticipated that they will reach their capacity potential within the planning period. Projections of general aviation activity anticipate growth in based aircraft, including based jet aircraft. An important consideration in the master planning process is also reserving sufficient space for potential FBO development needed to support the Airport's growing based aircraft fleet.

Space for FBO expansion should be made available to the FBOs as demand increases.

Corporate Aviation Facilities

Corporate hangar facilities are frequently constructed by businesses and corporations needing aircraft storage facilities for their corporate aircraft. In most cases, the corporations lease land from an airport then fund the construction of the hangar and flight support facilities necessary to meet their needs. Under such an arrangement, the airport sponsor may be responsible for some infrastructure development, such as taxiway construction, to support the needs of the corporate tenant. As illustrated by historic and projected national trends, as well as the COS forecasts of aviation activity, corporate aviation will continue to be an important and growing component of general aviation activity at the Airport.

The potential development of corporate facilities at the Airport is an important consideration in the master planning process. Based aircraft projections developed for COS anticipate an increasing number of jets based at the Airport. Some of the growth in based jets is anticipated to be driven by the development of corporate aviation facilities. The development of corporate aviation facilities at COS will be driven by the interest of specific tenants. Examining development alternatives and having adequate planning in place will allow the Airport to more efficiently complete infrastructure development that may be necessary to support potential corporate hangar tenants at COS.

In-fill development and expansion of hangar areas for corporate aviation should be included in the future development plan of the Airport.

Aircraft Storage

Storage needs for general aviation aircraft generally reflect local climatic conditions in combination with the size and sophistication of the airport's-based aircraft fleet. Typically, the more valuable the aircraft, the more likely it is to be stored in large, secure facilities.

Apron Tiedown Storage - Approximately 8 percent (18, currently) of COS's based aircraft are stored on the general aviation apron with the remainder of the based aircraft stored in hangars. Given the regional climatic conditions and the types of general aviation aircraft that frequent COS, this is a reasonable ratio. If that ratio were to be maintained, approximately 30 aircraft will ultimately be based on apron tiedowns by the end of the planning period.

In addition to providing permanent storage for based aircraft, aircraft tiedown positions managed by the Airport's FBOs also support the temporary storage of transient general aviation and military aircraft at COS. Transient, or visiting, aircraft tiedown requirements are impacted by the number of transient operations occurring at an airport. As the number of operations increase, the demand for itinerant apron tiedown space will also increase. In order to calculate the demand for transient aircraft tiedown positions at COS, the following methodology was used:

- Estimated the number of itinerant operations.
- The number of annual itinerant operations was then multiplied by 50 percent (50 percent of the operations equal departures), divided by 12 (12 months per year), and divided again by 30 (days in peak month). This number is assumed to be the average daily number of itinerant arrivals.
- This number was then increased by 10 percent to account for busy periods.
- It has also been assumed that 35 percent of the busy day arrivals will be on the apron at any given time.

The results of this methodology, based on the planning activity levels developed for COS, are summarized in **Table 4-26.**

Table 4-26: Tiedown Requirements

	Total Itinerant GA and Military	Average Daily Number of Itinerant Arrivals	Required Transient Tiedowns	Required Based Aircraft Tiedowns	Total Required Tiedown Spaces
2021	106,815	148	57	18	75
PAL 1	112,265	156	60	21	81
PAL 2	124,009	172	66	24	90
PAL 3	130,335	181	70	27	97
PAL 4	138,299	192	74	30	104

Source: Jviation

Given that COS only has approximately 84 tiedowns on the general aviation apron, COS will need to expand the tiedown apron before reaching PAL 2 or 120,000 itinerant operations.

Hangar Storage – Approximately 209 aircraft, or 92 percent of the based aircraft at COS are stored in hangars. Like many other airports, most of the single-engine piston general aviation aircraft at COS are stored in smaller hangar facilities such as T-hangars. Most multi-engine piston aircraft and all jets and helicopters are stored in community and conventional hangars.

To estimate future hangar storage needs at COS, current storage characteristics by aircraft type have been applied to the general aviation based aircraft projections developed in Chapter Three, and are summarized in **Table 4-27**. All military based aircraft at COS are stored in hangars at Peterson Space Force Base and have not been considered in this calculation.

Table 4-27: General Aviation Fleet Breakdown

	Single Engine	Multi-Engine	Jet	Helicopters	Glider/Other	Total
2021	154	35	22	2	2	215
PAL 1	164	32	34	6	2	238
PAL 2	175	44	60	10	3	292
PAL 3	189	42	72	15	4	322
PAL 4	230	51	87	18	5	391

Source: Jviation

Table 4-28 presents estimates of future general aviation hangar storage requirements at COS based on current and anticipated future storage preferences and projections of based general aviation aircraft at the Airport. This approach assumes 10 percent of multi-engine aircraft will be stored in T-hangars, the remainder will be stored in conventional or community hangars.

Table 4-28: Aircraft Storage Requirements

	Stored on Apron	Stored in T-Hangar	Stored in Conventional/ Community Hangar	Total
2021	18	140	58	215
PAL 1	21	146	71	238
PAL 2	24	155	113	292
PAL 3	27	166	129	322
PAL 4	30	205	156	391

Source: Jviation

As mentioned in Chapter Two*, Inventory of Existing Conditions*, T-hangars at COS currently accommodate 175 aircraft. By interpolating the analysis above, additional T-hangars will likely be required by the time the Airport reaches 330 total based aircraft.

Considering feedback from Airport management, as well as tenants and users, it is understood that existing conventional and community hangar space at COS is extremely limited. By the time COS reaches PAL 2, the Airport will require double the amount of current conventional/community hangar space available today. Accommodating this level of expansion will require prioritization of aeronautical development space with access to the taxiway/runway system. The Westside Development Area has limited in-fill development opportunity as shown in the General Aviation Area Plan. Recommendations from that plan will be carried forward in this Master Plan. Additional area for conventional/community hangar development lies along Taxiway E with convenient access to Runway 17L-35R.

Hangars and aircraft maintenance facilities capable of servicing all aircraft types should be shown in the Westside Development Area as well as the development area along Taxiway E.

Air Cargo Requirements

The Airport maintains two air cargo facilities: a belly cargo facility for passenger airlines and a facility capable of serving air cargo airlines. An 11,000 square foot belly cargo facility is located west of the terminal facility for easy access by airline staff and ground handlers. FedEx occupies facilities located in the Westside Development Area, operating out of several buildings that total approximately 45,000 square feet.

Total air cargo landed weight at COS has shown almost no growth over the past 10 years. Chapter Three presented forecasts of future air cargo volumes that indicated total landed weight is projected to increase over the next 20 years, spurred by growth in regional employment, population, and economic development. Although it is not certain at this time, the Amazon distribution facilities located in the Airport's Peak Innovation Park may generate additional growth in air cargo activity. Air Cargo projections show as much as 143 million landed pounds at COS within the planning period, representing a 40 percent increase over current activity levels. This level of growth would require the development of additional air cargo facilities at COS.

Increased cargo volumes and the corresponding needs for expanded sort facilities and additional ground delivery equipment could result in increased building, parking, and vehicular circulation requirements at COS. Increased air cargo volumes, employment growth, and a rise in ground-based cargo activity being processed at facilities at COS would result in an increased need for vehicular parking and circulation areas.

The apron, building space, vehicular parking, and circulation requirements of the air cargo area will ultimately be determined by the preferences of the individual operators and their respective network characteristics. Expansion of selected air cargo facilities at COS may be identified as a facility requirement based on tenant needs, but specific future space requirements have not been identified. The alternatives analysis for the Westside Development Area will incorporate apron development to accommodate air cargo facility expansion at the Airport while promoting continued safe and efficient operations. Additionally, hangar and apron development along Taxiway E on the east side of the Airport may also accommodate air cargo activity.

Air cargo facility development should include additional building and apron space near the existing cargo facilities and along Taxiway E.

Support Facility Requirements

Current conditions at the Airport and potential future developments may impact aviation support facilities. The following sections examine facility requirements related to the aviation support facilities at COS:

- Regional Transportation Access
- General Aviation Fuel Storage
- Deicing Operations
- Airport Traffic Control Tower / Airport Surveillance Radar
- Airfield Maintenance Facility

Potential facility requirements associated with these support facilities address current deficiencies and/or allow them to meet the future needs of airport users.

Regional Transportation Access

Access to the regional roadway network is crucial to the success of the Airport. As the City of Colorado Springs attracts residents and business, access to Interstate 25, Peak Innovation Park, Peterson Space Force Base, and planned development to the east of the Airport are important factors that will shape the Airport. PlanCOS is an on-going planning effort designed to address access to the Airport and all other areas within the City. Elements of that plan are integral to this Airport Master Plan, although this plan takes a more focused view of transportation and access as it relates to the Airport and its interests.

Considering its importance in the planning process and wide range of topics and issues, the study of Regional Transportation Access has been included in an appendix of this Airport Master Plan. The findings and recommendations of PlanCOS will be integrated into the Airport Layout Plan. PlanCOS should be considered to be a standalone document with any further review and consideration being beyond the bounds of the Airport.

The appendix of this Master Plan includes a detailed Regional Transportation Plan (PlanCOS) as it relates to the Airport. Recommendations from PlanCOS will be incorporated into Airport Layout Plan set a necessary.

General Aviation Fuel Storage

Fuel storage for passenger air carriers is located between the commercial terminal building and Runway 17L-35R. This fuel farm is directly supplied by the NuStar Terminal and Pipeline facility located within the Airport's Eastside Development Area. This facility provides fuel receiving, storage, and distribution services for the Airport and the region. Because the air carrier fuel farm is supplied on-demand by a much larger facility, additional capacity is not required within the planning period.

The Westside Development Area has separate aircraft fuel storage facilities at FBO tenant sites including Cutter Aviation, LLC, Colorado jetCenter, and the JHW Hangar Complex. Among the various fuel providers in the Westside Development Area, there are over 120,000 gallons of fuel stored. There are also Jet A and 100LL aircraft fuel tanks located in the COS Business Airpark.

Discussions with airport management related to general aviation fuel storage and distribution facilities indicate that there could be significant benefits and efficiencies in consolidating the multiple fuel farms located in the Westside Development Area into a single, consolidated fuel farm. Based on that premise, the Airport should engage the FBOs and other fuel providers in the Westside Development Area to discuss the benefits and challenges of constructing a consolidated fuel farm. Considerations with respect to this effort include the location of the existing storage sites, costs/benefits of consolidating the systems, potential environmental implications, and potential development sites. A potential new fuel storage site should include above-ground storage tanks with at least 125,000 gallons of overall capacity and be in an area providing sufficient airside and landside access to all users. Chapter Five examines potential fuel storage sites and identifies a recommended location for future development.

It is recommended that consideration be given to the potential development of a consolidated general aviation fuel farm to be located within the Westside Development Area.

Deicing Operations

Deicing fluids, deicing equipment, and airline ground support equipment (GSE) are currently stored on the west side of the terminal apron. Deicing operations are conducted on this area as well, which can cause congestion on the terminal apron during peak operations in icing conditions. To partially address this, a deice apron was constructed at the south end of Runway 17L-35R in 2020 and used in deicing operations. To address further address the terminal area congestion and provide apron area for parked or overnighting aircraft, deicing equipment and operations should be moved to an alternate site.

Due to frequent icing conditions and the long distance between runways (which call for long taxi times and affect deicing effectiveness), it is recommended that two deicing aprons be constructed, one serving the Westside Development Area and the other serving air carriers and others that frequently use Runway 17L-35R.

The Alternatives Analysis conducted in Chapter Five examines potential locations and general design requirements for deicing operations areas for the Airport. Some key factors that are considered in identifying a recommended location for deicing operations and equipment could include roadway and airfield access; proximity to both general aviation and air carrier apron areas; and containment/ environmental requirements.

An east deicing apron designed to accommodate six to seven air carrier aircraft (sized to a Boeing 737) should be constructed along the taxi route to Runway 17L-35R. Additionally, expansion of Westside Development Area apron space could serve as deicing space for aircraft on that side of the field and using Runway 17R-35L.

Airport Traffic Control Tower / Airport Surveillance Radar

The current airport traffic control tower (ATCT) at COS is located on Peterson Space Force Base, north of the airfield. Due to the location and height of the existing tower in combination with the Airport's airfield layout, ATCT controllers experience reduced visibility to some southern areas of the airfield, including the approach ends to Runway 35L and Runway 35R. This condition has been classified by the FAA as a Hot Spot, which is described in the following:

> *Hot Spot 4 (HS 4) The approach ends of Runway 35R and Runway 35L are very far from the control tower. Small aircraft may not be readily visible to the controller. Maintain strict communication with ATCT when in this area.*

As discussed earlier in this chapter, it has been recommended that Runway 17L-35R be shifted south, which would further exacerbate this Hot Spot issue. To resolve this existing and possibly worsening issue, it is recommended that the ATCT be relocated. Factors in re-siting the COS ATCT include height, visibility, line of sight, sun glare, security, access, infrastructure, and others. Chapter Five provides an evaluation of the four potential sites. Although a recommendation is provided as part of this Airport Master Plan, it is important to note that a further siting analysis will have to be conducted by the FAA before a final determination can be made.

The airport surveillance radar (ASR) at COS is located along the Airport's eastern boundary. To promote the highest and best use of land on and adjacent to the ASR, it is recommended that the radar be relocated. A key design and siting consideration includes a 1,500-foot radius critical area which surrounds the radar and prohibits buildings or structures from interfering with radar signals. Like the ATCT, a recommended ASR site has been provided in the next chapter, but it should be noted that collaboration between the Airport and FAA will help determine an ultimate location for the ASR.

It is recommended that the ATCT be relocated to address Hot Spot issues, and that the ASR be relocated within the airfield to allow for a more appropriate use of the land where it currently resides.

Airfield Maintenance Facility

The Airport's existing maintenance facility is located near the Airport's western boundary, south of the Westside Development Area. This facility includes five separate buildings that serve as airport vehicle maintenance and storage facilities. Collectively, these buildings comprise approximately 50,000 square feet of indoor space. There is additional outdoor space used for vehicle storage. It is surrounded by non-aviation related development and the location of this facility does not provide efficient access to the airfield and is over capacity

The construction of a new maintenance facility, located on a new site with improved airfield access, is recommended. It should be noted that the Airport's Snow Removal Equipment (SRE) and airfield maintenance equipment should be maintained and stored here. The existing maintenance facility could be removed or used for an alternate purpose.

FAA design standards include guidance on the layout and space required for consolidated airport maintenance and equipment storage facilities, contained in FAA AC 150/5220-18. A consolidated airport maintenance facility based on FAA standards and equipment currently used by COS calls for a total building size of at least 62,000 square feet. A recommended location and layout of future facilities, based on Airport management input, is shown in the following chapter.

It is recommended that the existing airfield maintenance facility be relocated and enlarged into a consolidated airfield maintenance and storage facility.

Emerging Technologies

There is significant focus on emerging technologies within the aviation industry. Advanced Air Mobility (AAM) is defined by the National Aeronautics and Space Administration (NASA) as "an air transportation system that moves people and cargo between places previously not served or underserved by aviation – local, regional, intraregional, urban – using revolutionary new aircraft that are only just now becoming possible." While AAM supports the transportation of people and goods between many geographic areas, Urban Air Mobility (UAM) focuses specifically on urban and suburban environments. The FAA envisions UAM as a "safe and efficient aviation transportation system that will use highly automated aircraft that will operate and transport passengers or cargo at lower altitudes within urban and suburban areas."

UAM is widely seen as the largest component of AAM and the one that has received the largest investment to date. Beyond UAM, AAM would incorporate use cases outside of urban environments, including commercial inter-city, cargo delivery, public services, and private vehicle travel. Both concepts include not only the aircraft themselves but also the framework for operation, access to airspace, infrastructure, and engagement with community members.

This transformative airborne technology is focused is on commercial passenger-carrying electric vertical takeoff and landing (eVTOL) aircraft and their support systems. eVTOL is the most discussed and reported segment of AAM to date. Innovations in distributed electric propulsion systems, electronic controllers, and battery systems have made this type of aircraft possible, which represents a move from a single rotor to multiple that increases handling and safety. With zero source emissions, they are more environmentally friendly.

eVTOL aircraft have numerous motors and propellers or rotors that propel the aircraft vertically and horizontally. Designs differ substantially among developers, with some aircraft featuring wings with propellers for horizontal flight and rotors for vertical flight and others featuring rotors alone for both vertical and horizontal flight. There are three main types of eVTOL systems that can be expected in significant volume if the eVTOL original equipment manufacturers (OEMs) deliver on their promise of safe, efficient, and cost-saving aircraft:

Multicopter – looks and flies much like a helicopter except with multiple rotors.

Lift and cruise – uses rotors for vertical flight and transitions to propellers for horizontal flight.

Vectored thrust – uses rotors or fans for both vertical and horizontal flight.

Most eVTOL OEMs currently seeking FAA certification are doing so in the small aircraft category (i.e., less than 12,500 pounds). The certification process involves a review of the proposed aircraft design, ground tests, and flight tests to demonstrate safety, an evaluation of the aircraft's required maintenance and operation suitability, and collaboration with other civil aviation authorities.

At the beginning of 2021, the Vertical Flight Society eVTOL Aircraft Directory included over 500 entrants to the electric and hybrid-electric vertical takeoff and landing market. The certification process involves a review of proposed designs, methods used to show the designs, and overall compliance with FAA regulations. The process also includes ground tests, flight tests, and an evaluation of the aircraft's required maintenance and operational suitability. Because this process is arduous and time-consuming, only a small percentage of these will likely achieve FAA certification. FAA aircraft certification procedures include three separate approvals that the eVTOL OEMs will need to achieve:

1. Type certification – approval of the aircraft design and all its component parts.

2. Production certification – approval to manufacture duplicate products under the approved design, which includes approval of the manufacturing facilities, personnel, and quality control systems.

3. Airworthiness certification – approval to operate the aircraft.

As of January 2022, no eVTOL aircraft had received FAA's type certification. While the timeline for certification of these aircraft is fluid, many OEMs are optimistic for entry into service in the U.S. as early as 2024. For COS, this segment of the aviation market represents a unique opportunity and one that the Airport may certainly want to be a part of. This may bring added passenger, cargo, and maintenance activity to the Airport which could call for additional apron space, electrical capacity, and airspace considerations.

Emerging technologies are rapidly developing. COS should continue to monitor it and prepare to respond appropriately when things are more definitive, and opportunities present themselves. Developing and maintaining apron, electrical and airspace capacity will be important to COS in playing a key role in this new aviation business environment.

Facility Requirements Summary

A summary of the facility improvements that need to be addressed during the planning period is provided below in **Table 4-29**. Selected improvements will be examined further in Chapter Five, *Alternatives Analysis & Development Plan*, to create and evaluate options to accommodate these facility requirements.

Table 4-29: Facility Requirements Summary

Facility	Identified Requirement
Airfield Facility Requirements	
Airfield Demand Capacity	- No action required
Airport Design Standards	- Decouple Runway 17R-35L from Runway 13-31
Runways	- Decouple Runway 17R-35L from 13-31, extend Runway 35L south
Taxiways	- Separate Taxiway A from Runway 17R-35L to 500 feet - Shift high-speed exit Taxiway E4 - Realign a short section of Taxiway B - Reconfigure taxiways to Runway 17R and 13 with runway decoupling - Realign taxiway connectors with Taxiway A separation
Airfield Pavement	- No action required
Airport Visual Aids	- No action required
Navigational Aids (NAVAIDS)	- MALSR or ALSF-2 approach lighting system on Runway 35R
Obstruction Removal	- Recommendations to be incorporated into the ALP set
Airfield Marking, Lighting, Signage	- No action required
Passenger Terminal Requirements	
Terminal Space	- Reallocation of interior space to meet intermediate demands - Ultimate terminal expansion
Gates	- No intermediate requirements - Expansion of additional gates for ultimate development
Terminal Area Apron	- Development of deicing aprons to make room on existing apron
Auto Parking and Rental Car	- Develop CONRAC to add short-term parking capacity - Develop long-term/economy parking lot(s)
General Aviation and Cargo Requirements	
FBO	- Preserve space for FBO expansion
Corporate Aviation	- Additional corporate and maintenance hangar facilities
Aircraft Storage	- Expand apron in Westside Development Area consistent with GA Area Plan. In-fill and hangar expansion throughout Westside Development Area
Cargo	- Expand air cargo building and apron areas
Support Facility Requirements	
Regional Transportation Access	- Recommendations provided in Regional Transportation Access Study, see appendix
General Aviation Fuel Storage	- Construct consolidated general aviation fuel farm in Westside Development Area
Deicing Operations	- Construct deicing apron on east and make use of expanded west apron developed for deicing when needed on that side of airfield
ATCT / ASR	- Relocate ATCT and ASR, coordinate with FAA
Airfield Maintenance Facility	- Relocate existing maintenance facility to a larger consolidated maintenance/storage facility
Emerging Technologies	- Develop and maintain apron, electrical and airspace capacity to accommodate new technologies

Source: Jviation