4 Facility Requirements

4.0 Introduction

This section of the Master Plan Update identifies airside and landside facility requirements for The Ohio State University Airport through the year 2037. With a constantly evolving air transportation system, the Federal Aviation Administration (FAA) continually evaluates and updates their design standards, which may result in revised standards that also need to be taken into consideration when making changes at an airport. To identify the anticipated future facility requirements at KOSU, aviation forecasts developed in Chapter 3, along with community input (see **Appendix E** and **Appendix F**), are compared to the existing facilities and current FAA standards with the understanding that these standards may change over time.

Using quantitative and qualitative factors in conjunction, the airfield, airside, and landside facilities are reviewed to identify the anticipated future facility needs. The requirements for new or expanded facilities reflect the unique circumstances at KOSU and include, the runway (capacity and infrastructure), navigational aids, taxiways, marking and lighting, aircraft hangars, aircraft apron areas, fueling facilities, administrative facilities, auto parking, and ground access. The projected facility needs are based on the activity forecast for based aircraft, operations, and peak day activity. While this chapter identifies the potential facility needs, the alternatives analysis in the next chapter will review alternatives considering priority for development, benefits and costs, and ease of implementation.

4.2 Stakeholder Input

As summarized in Chapter 1, Section 1.10, a user survey was provided to university and community stakeholders and the detailed results are also shown in Appendix E. In general, for airport services (e.g., fueling, flight training, FBO, maintenance, etc.) most services were rated as good or excellent. The most common concern for respondents was the price of fuel at the airport. Users also suggested adding wireless internet in the hangars, offering multi-engine aircraft for rental, and providing more on-airport space for community use. Generally, the users consider the facilities good to average, with a large percentage of users never having utilized the T-hangars or corporate hangars. The air traffic control tower, instrument approach procedures, and runway length were rated excellent; however, a few individuals stated that an additional Instrument Landing System (ILS) and extended runway would be beneficial.

4.3 Wind Coverage

Wind patterns and runway crosswind conditions are an important meteorological factor in assessing runway utilization and determining runway design requirements in accordance with FAA aircraft category standards. Crosswind coverage is the component of wind speed and relative direction acting at right angles to the runway—the greater the angle, the more difficult the landing. The FAA desirable threshold for adequate crosswind coverage is 95 percent minimum.

The wind coverage for the airport (**Exhibit 4.3-1**) is computed using 10 historic years of data for KOSU retrieved from the FAA. From this data, the following historic crosswind components are calculated for Runway 9-27 (primary) and Runway 5-23 (secondary or parallel) in Instrument Flight Rules (IFR) and all-weather conditions.

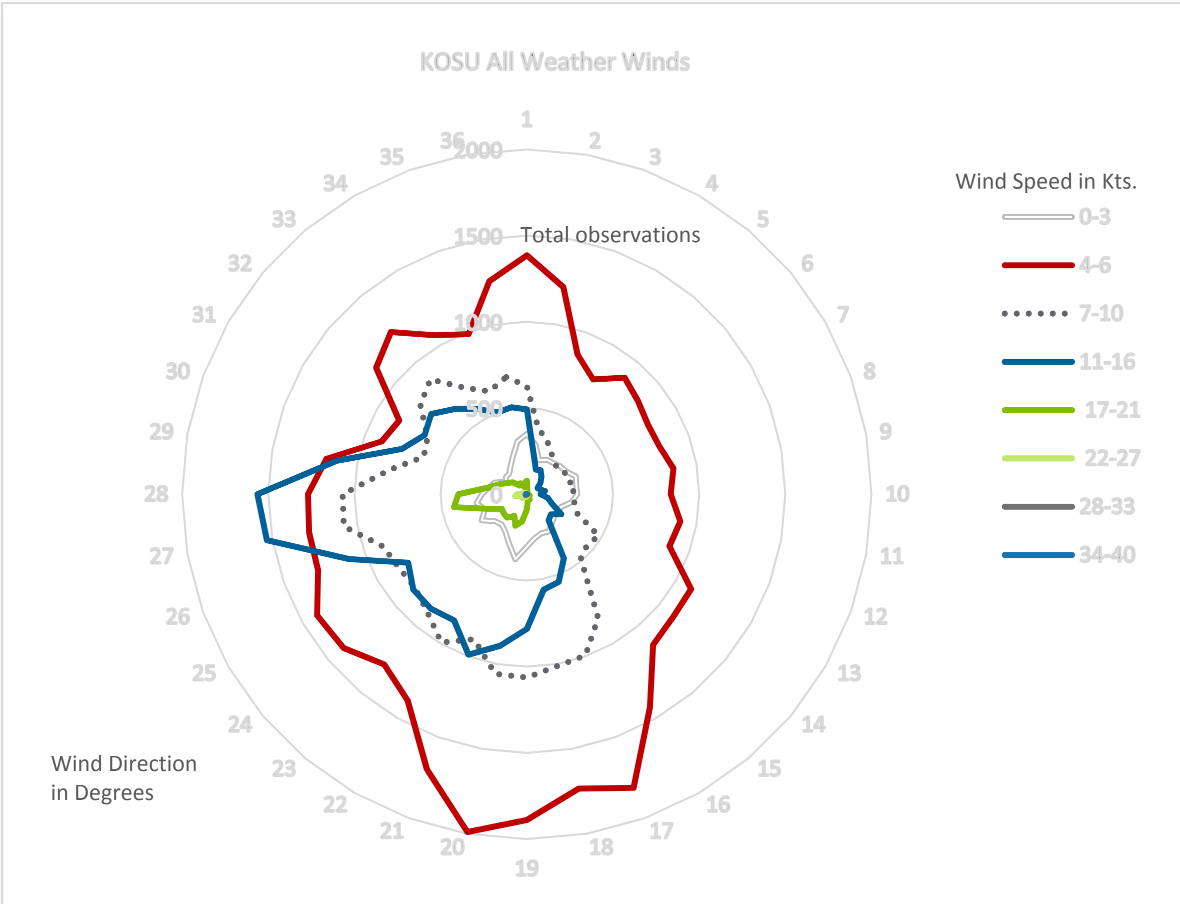
Exhibit 4.3-1: Crosswind Data Table

RUNWAY	10.5-KNOTS	13-KNOTS	16-KNOTS	20-KNOTS
All-Weather Wind Data Observations				
Runway 9-27 (Primary)	90.45 %	94.74 %	98.68 %	99.74 %
Runway 5-23	88.56 %	94.00 %	98.26 %	99.59 %
Combined	99.78 %	97.60 %	99.49 %	99.93 %
Instrument (IFR) Wind Data Observations				
Runway 9-27 (Primary)	91.45 %	95.50 %	99.0 %	99.84 %
Runway 5-23	90.95 %	95.44 %	98.86 %	99.78 %
Combined	95.88 %	98.45 %	99.74 %	99.98 %

Note: Crosswind component computed using runway true bearing (87.4 & 49.1)
Source: FAA Airport GIS – "Station 724288 Ohio State University Arpt Annual Period Record 2008 – 2017"

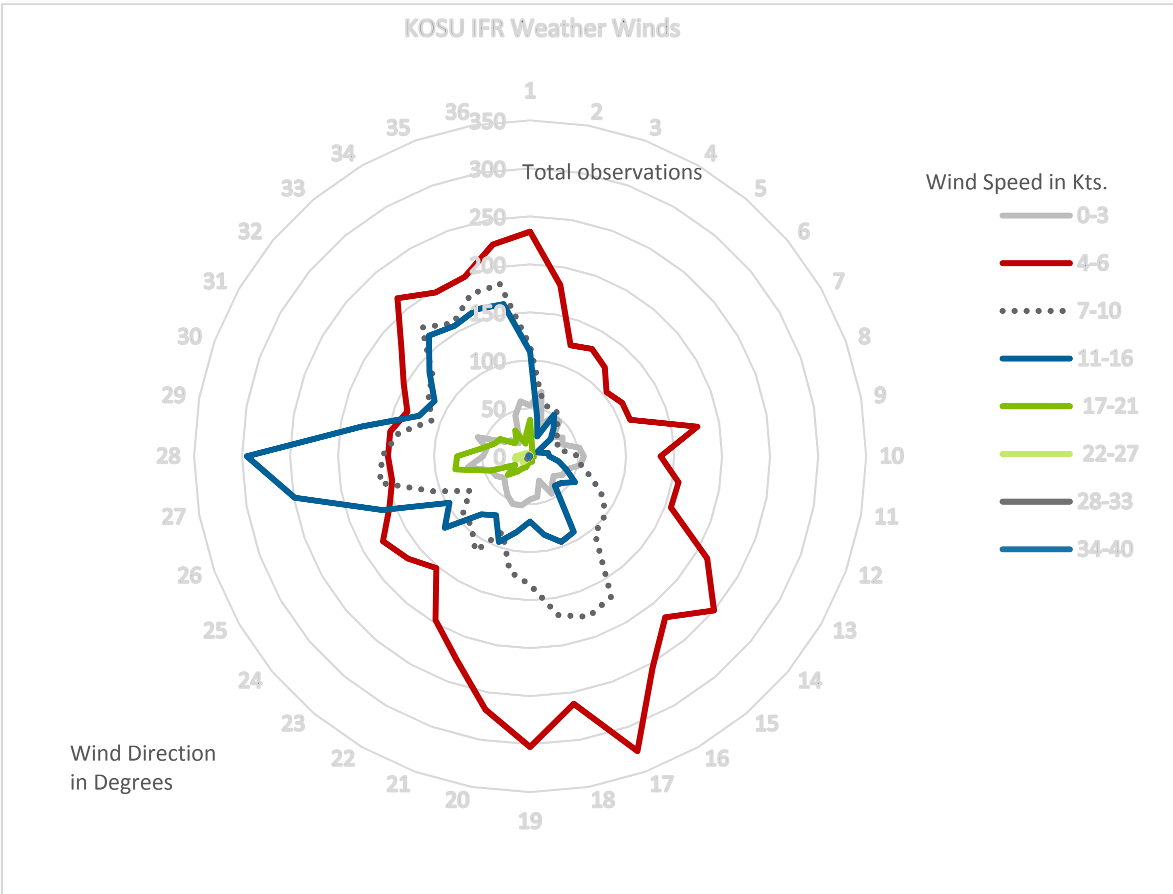
Exhibit 4.3-2 and 4.3-3 provide graphical depictions of the wind observations that were used to compute the above wind coverage percentages in all weather and instrument flight rules (IFR). The 95 percent wind coverage is computed on the basis of the crosswind component not exceeding the allowable value for the runway design code. As can be seen in Exhibit 4.3-1, 95 percent crosswind coverage is not met at KOSU with a single runway, but is achieved with the two existing runway orientations. (Note, the primary and parallel runway are in the same headings so the parallel is not included since it provides the same coverage as the primary.)

Exhibit 4.3-2: All Weather Winds



Source: FAA Airport GIS – "Station 724288 Ohio State University Arpt Annual Period Record 2008 – 2017"; Woolpert, 2017

Exhibit 4.3-2: IFR Winds



Source: FAA Airport GIS – "Station 724288 Ohio State University Arpt Annual Period Record 2008 – 2017"; Woolpert, 2017

4.4 Aircraft Rescue and Firefighting

Federal Aviation Regulation (FAR) Part 139, Certification of Airports, contains the requirements for commercial service airports. KOSU currently operates under a Class IV Part 139 Certificate. According to the regulations for Class IV certification, KOSU is not certified to serve scheduled air carrier aircraft, but it is certified to serve unscheduled passenger operations of aircraft designed for more than 31 passenger seats.

As a certificated FAR Part 139 airport, KOSU must comply with aircraft rescue and firefighting (ARFF) equipment, personnel, training and operational requirements. The airport meets these requirements by receiving ARFF service from the Columbus Fire Department (Station #11) located at the main entrance off West Case Road, which qualifies it as FAA Index A ARFF (aircraft less than 90 feet in length). The location of Station #11 directly adjacent to the apron allows it to quickly position for planned large aircraft flights and to respond to any aircraft emergencies. The ARFF truck is over 20 years old and should be considered for replacement as funding allows. No other improvements are needed at this time.

4.5 Airfield Capacity

Airfield capacity is the number of aircraft operations that can be conducted in a given period of time. Capacity is most often expressed as annual service volume (ASV) and hourly capacity. There is no universally adopted tool that must be used in airfield capacity analyses, so the level of analysis depends on the activity at the facility. At low activity airports, airfield capacity typically exceeds the anticipated level of demand and only a minimal analysis is necessary. In these cases, FAA AC 150/5060-5, *Airport Capacity and Delay*, commonly referred to as the "handbook methods," yields hourly capacities and ASVs using either a "long range planning" method or a "specific facility assessment." The handbook methods are typically used for long range planning. For airports with higher activity levels (e.g., Chicago O'Hare), several techniques for determining airfield capacity are often used in addition to FAA AC 150/5060-5, including computer simulation modeling.

Airport Cooperative Research Program (ACRP) Report 79: Evaluating Airfield Capacity provides another method for calculating capacity—the Prototype Airfield Capacity Spreadsheet Model. This is derived from the FAA Airfield Capacity Model (ACM) methodology described in the FAA Advisory Circular 150/5060-5. This methodology uses a series of tables and equations to calculate an airfield's hourly and annual capacity and applies variable separation, spacing, and clearance standards included in FAA JO 7110.65, *Air Traffic Control*, and FAA EM-78-8A, *Parameters of Future ATC Systems Relating to Airport Capacity/Delay*. The long-range planning method in FAA AC 150/5060-5, *Airport Capacity and Delay*, does not take into account things like meteorological conditions, operational peaking occurring at an airport, or the amount of touch and go activity like the Prototype ACSM does.

Capacity for KOSU was analyzed using the long-range planning method contained in FAA AC 150/5060-5 and the Prototype Airfield Capacity Spreadsheet Model approach detailed in ACRP Report 79. Each method and the variables applied are described below.

4.5.1 Airport Variables

Airfield Layout

The arrangement and interaction of airfield components (runways, taxiways, and apron/ramp entrances) refer to the layout or "design" of the airfield. The primary runway (Runway RW 9R-27L) is served by a full-length parallel taxiway with four exit taxiways. Due to its length of 5,004-feet and the availability of an instrument approach, this runway is the preferred runway used by jet and turboprop aircraft and the most itinerant operations occur on this runway. Runway 9L-27R is frequently used for flight training, touch and go's, and operations by single engine aircraft. The runway has a full parallel taxiway with taxiway exits at either runway end. The crosswind runway (Runway 5-23) is served with a partial parallel taxiway with two exit taxiways. The crosswind runway is used typically when weather patterns necessitate and during busy times.

The majority of the Airport's existing landside facilities are located south of Runway 9R-27L This includes the general aviation terminal, airport administration, operations and maintenance offices, FBO facilities, T-hangars/executive hangar facilities, apron areas, the Airport Traffic Control Tower (ATCT), and the Aircraft Rescue and Fire Fighting (ARFF) facility.

Weather Conditions

FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay* describes the categories of ceiling and visibility minimums for use in both capacity and delay calculations. Visual Flight Rules (VFR) conditions occur whenever the cloud ceiling is at least 1,000 feet about ground level and the visibility is at least three statute miles. Instrument Flight Rules (IFR) conditions occur when the reported cloud ceiling is at least 500 feet, but less than 1,000 feet and/or visibility is at least one statute mile, but less than three statute miles. Meteorological data from the FAA derived from the on-airport AWOS station (Station 724288 Ohio State University Airport) from 2008 to 2017 has been used to tabulate the information. VFR conditions occur at the Airport approximately 83 percent of the time and IFR conditions occur approximately 17 percent of the time.

Aircraft Mix Index

Aircraft mix for the capacity analysis is defined in terms of four aircraft classes. Classes A and B (described in in **Exhibit 4.5.1-1** below) consist of small and medium-sized propeller and some jet aircraft, all weighing 12,500 pounds or less. These aircraft are associated primarily with general aviation activity, but do include some air taxi, air cargo, and commuter aircraft. Class C consists of aircraft weighing between 12,500 pounds and 300,000 pounds, which include most business jets and some turboprop aircraft. Class D aircraft consists of large aircraft weighing more than 300,000 pounds. As shown in Exhibit 4.5.1-1, the majority of the aircraft operations at KOSU are by Class A and B aircraft that weigh less than 12,500 pounds. An estimated 6.3% of the airport operations are by Class C aircraft. There are no Class D aircraft operations occurring at the Airport.

Exhibit 4.5.1-1: Airport Fleet Mix Index

FAA Category	Aircraft Classification Category	Maximum Gross Takeoff Weight (MTOW)	KOSU Operational Allocation
A	Small-S	Less than 12,500 lbs. (Single Engine)	88.4%
B	Small T	Less than 12,500 lbs. (Twin Engine)	5.3%
C	Small +	Between 12,500 lbs. and 41,000 lbs.	5.9%
C	Large -TP	Between 41,000 lbs. and 255,000 lbs.	<0.1%
C	Large- Jet	Between 41,000 lbs. and 300,000 lbs.	0.4%
C	Large -757	Boeing 757 Series	0.0%
D	Heavy	More than 300,000	0.0%

Sources: FAA TFMSC database, FAA AC 150/5060-5, *Airport Capacity and Delay*, ACRP Report 79, *Prototype Airfield Capacity Spreadsheet Model.*

Touch-and-Go Activity

According to air traffic control, all airport operations recorded as local operations are considered touch-and-go in nature at KOSU because of the large population of student pilots practicing takeoffs and landings. Approximately 41 percent of operations were touch-and-go in 2017.

Peak Period Operations

Peak period operational projections were developed in Chapter 3.0 Aviation Activity Forecasts. The peak month at KOSU occurs each year in May during the NIFA SAFECON collegiate flying competition. However, it is recognized that even though operational capacity is constrained during the six-day event, SAFECON will not dictate the overall capacity needs of the Airport. Through an analysis of FAA tower count data, when operations associated with SAFECON are removed, June is the busiest month. For the airfield capacity analysis, average daily operations and average peak hour operations during the peak month of June were developed.

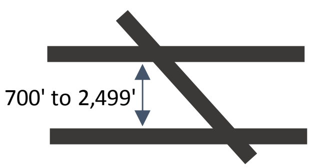
4.5.2 Capacity Analysis Methods

4.5.2.1 FAA AC 150/5060 Long Range Planning Method

The FAA's long-range planning method for determining airfield capacity described in AC 150/5060-5 utilizes the fleet mix index presented in Exhibit 4.5.1-1. The mix index is defined as the percent of Class C aircraft plus three times the percent of Class D aircraft, written as %(C+3D). According to FAA Traffic Flow Management System Counts, in 2017 KOSU had no operations by Class D aircraft and recorded 6,600 operations from Class C aircraft. This is approximately 6.3% of their annual operations for a mix index of 6.3 percent.

FAA Advisory Circular 150/5060-5, *Airport Capacity and Delay* provides sketches of runway-use configurations to assist in determining an airports capacity and ASV. The runway-use configuration that best represents the operations at KOSU would be dual parallel runways with a crosswind runway, as shown on **Exhibit 4.5.2.1-1**. With a mix index of 0-20, the long-range planning annual service volume (ASV) is estimated at 355,000 operations. The hourly capacity under visual flight rules (VFR) conditions is estimated at 197 operations per hour and under IFR at 59 operations per hour.

Exhibit 4.5.2.1-1: Capacity and Annual Service Volume based on Long Range Planning Method



	Hourly Capacity Ops/Hr		
Mix Index % (C+3D)	VFR	IFR	Annual Service Volume (ASV)
0 - 20	197	59	355,000
21 - 50	145	57	275,000
51 - 80	121	56	261,000
81 - 120	105	59	285,000
121 - 180	94	60	340,000

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

4.5.2.2 Prototype Airfield Capacity Spreadsheet Model Method

The Prototype ACSM utilizes a two-step process. The first step is to determine the hourly capacity of the airport's runway system, which is the maximum number of aircraft operations that can occur in one hour under specific operating conditions assuming a continuous demand for service. The second step of the model utilizes the hourly capacity developed in the first step to estimate an airport's annual service volume (ASV). Used by the FAA as an indicator of relative operating capacity, ASV is a reasonable estimate of an airport's annual capacity that accounts for differences in various conditions (i.e. runway use, aircraft fleet mix, weather conditions, level of touch-and-go operations, etc.) that would be encountered over a year's time. ASV assumes an acceptable level of aircraft delay as described in FAA AC 150/5060-5, *Airport Capacity and Delay*.

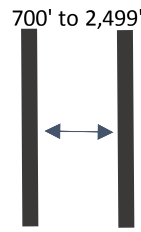
Applying information generated from the preceding discussion, capacity and demand in the Prototype ACSM are formulated in terms of hourly capacity of the runway system (VFR and IFR) and Annual Service Volume (ASV).

Exhibit 4.5.2.2-1 present the various inputs that were utilized when developing the hourly runway capacity in the model. Default values were used for several variables. Calculations of hourly capacity begin with an evaluation of each possible runway use configuration at KOSU. While the airport does have a crosswind runway, the this runway does not provide for additional operational capacity and the dual intersection runway configuration was used for the model.

Exhibit 4.5.2.2-1: Hourly Capacity Model Inputs and Runway Configuration

Variable	KOSU Input
Percentage VMC/IMC Occurrence	83% VMC/17% IMC
Runway Scenario Selection	Dual Parallel Scenario #2
Divergent Departure Routes	Yes
Runway Separation Distance	1,980’
Percentage of Touch and Go’s	41%
Operating Fleet Mix	Small-S- 88.4% Small T- 5.3% Small +- 5.9% Large-Jet- 0.4%
Runway Exit Availability	Excellent- 4 or more
Full Parallel Taxiway	Yes
Control Tower	Yes

Dual Parallel Runways



Source: ACRP Report 79, *Evaluating Airfield Capacity*, FAA TFMSC data, FAA AWOS weather data.

According to this methodology, the Airport’s visual meteorological conditions (VMC) hourly capacity is potentially as high as 141 operations, and the instrument meteorological conditions (IMC) hourly capacity is potentially as high as 95 operations per hour.

After determining the hourly VMC and IMC capacity, a weighted hourly capacity of the entire airport can be calculated. The weighted hourly capacity takes into consideration the aircraft mix index and meteorological conditions. The weighted hourly capacity for KOSU was calculated to be approximately 127.6 operations per hour using the Prototype ACSM. The Annual Service Volume (ASV) is calculated using the weighted hourly capacity in following formula:

ASV= Cw x D x H

Cw= weighted hourly capacity

D= ratio of annual demand to average daily demand

H= ratio of average daily demand to average peak hour demand

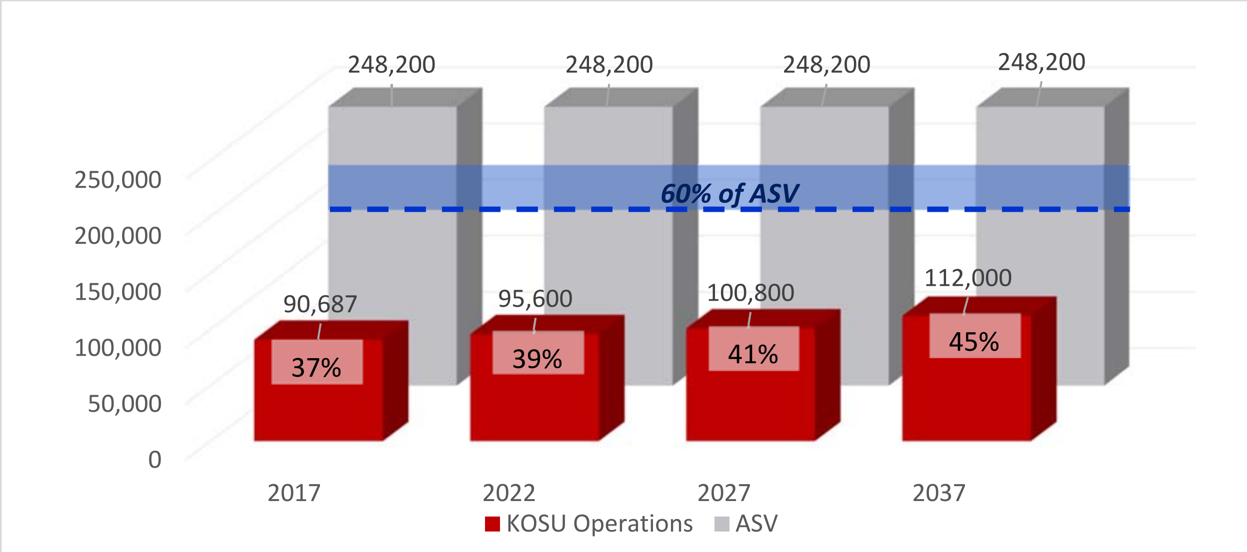
With the existing runway configuration and the existing utilization patterns, KOSU has a daily ratio (D) of 290.3 and an hourly ratio (H) of 6.7. This results in an ASV of approximately 248,200 operations according to the Prototype ACSM.

4.5.3-1 Summary

The rudimentary FAA AC 150/5060 Long Range Planning Method does not consider meteorological conditions, operational peaking occurring at the airport, or the amount of touch and go activity like the Prototype ACSM. For these reasons, the Prototype ACSM was selected as the preferred ASV calculation of 248,200 for the KOSU airfield capacity analysis.

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 annual service volume. This is an approximate level to begin the detailed planning of capacity improvements. At the 80 percent level, the planned improvements should be under design or construction. As shown in **Exhibit 4.5.3-1**. Based on the current and projected operations developed for this study, improvements specifically designed to enhance capacity are not necessary during the 20-year scope of this master plan (see Exhibit 4.5.3-1). By 2037, operations at KOSU are expected to be 45% of the total ASV.

Exhibit 4.5.3-1: Capacity Summary



Source: Marr Arnold, 2018

4.6 Airport Design Standards

Planning and development of airside facilities predominantly follow standards outlined in FAA AC 150/5300-13A, *Airport Design* and CFR Title 14, Part 77 *Safe, Efficient Use, and Preservation of The Navigable Airspace*. Dimensions of many of airspace and airport surfaces defined in this guidance depend on the type of instrument approach offered by the runway. For reference, Runway 9L-27R and Runway 5-23 currently accommodate visual approaches. Runway 9R (approaching the runway on a 90-degree heading) accommodates precision approaches and Runway 27L (approaching the runway on a 270-degree heading) accommodates non-precision approaches. Precision instrument approaches provide azimuth (left/right) information for alignment on a runway centerline, as well as glide slope or path information to the end of a runway. Non-precision instrument approaches provide only azimuth information to a runway centerline. The following sections summarize those design standards that are applicable to KOSU.

4.6.1 Design

The design standards found in AC 150/5300-13A that are applicable to an airport are determined by a coding system that factors in the physical and operational characteristics of the airport's largest aircraft that regularly use the facility with safety setback distances for the facility.[1] The critical design aircraft is the most demanding aircraft operating or forecast to operate at that facility on a regular basis. The characteristics of the critical aircraft used in airport planning are approach speed, wingspan, tail height, main gear width, cockpit to main gear length, aircraft weight, and takeoff and landing distances. Dimensions for the layout of the airport that are determined by the critical

[1] The terminology critical aircraft, design aircraft, and critical design aircraft are synonymous and are often used interchangeably by the FAA. The critical aircraft may be described in terms of its runway reference code (e.g., C-II), or it may be described as a specifically aircraft (e.g., Challenger 600).

aircraft include runways, taxiways, taxilanes, and aprons, and their associated setbacks and clearances. The critical aircraft may be a specific aircraft type, or a combination of aircraft characteristics. In most cases, the design aircraft for the purposes of airport geometric design is the composite aircraft representing a collection of aircraft classified by three parameters: Aircraft speed of aircraft on final approach (Approach Category (AAC)), aircraft tail height and wing span (Airplane Design Group (ADG)), and aircraft gear width and distance from cockpit to main gear (Taxiway Design Group (TDG). (See **Exhibits 4.6.1-1 through 4.6.1-3**.)

Each runway also has a runway design code (RDC) formed by the particular runway's combined AAC, ADG, and approach visibility minimums. The RDC determines the specific design standards that apply. The first component, depicted by a letter, is the AAC and relates to the operational characteristics regarding aircraft approach speed (see Exhibit 4.6-1).

Exhibit 4.6.1-1: Aircraft Approach Category (AAC)

AAC	Approach Speed
A	Approach speed less than 91 knots
B	Approach speed 91 knots or more but less than 121 knots
C	Approach speed 121 knots or more but less than 141 knots
D	Approach speed 141 knots or more but less than 166 knots
E	Approach speed 166 knots or more

Source: FAA AC 150/5300-13A, *Airport Design*, Change 1, February 2014

The second component, depicted by a Roman numeral, is the ADG and relates to the aircraft's physical characteristics (wingspan or tail height, whichever is most restrictive) of the largest aircraft expected to operate on the runway and taxiways adjacent to the runway (see Exhibit 4.6-2).

Exhibit 4.6.1-2: Airplane Design Group (ADG)

ADG	Tail Height	Wing Span
I	Less than 20 Feet	Less than 49 Feet
II	Greater than 20, but less than 30 Feet	Greater than 49, but less than 79 Feet
III	Greater than 30, but less than 45 Feet	Greater than 79, but less than 118 Feet
IV	Greater than 45, but less than 60 Feet	Greater than 118, but less than 171 Feet
V	Greater than 60, but less than 66 Feet	Greater than 171, but less than 214 Feet
VI	Greater than 66, but less than 80 Feet	Greater than 214, but less than 262 Feet

Source: FAA AC 150/5300-13A, *Airport Design*, Change 1, February 2014

The third component relates to the visibility minimums expressed by runway visual range (RVR) values in feet of 1200, 1600, 2400, 4000, and (see **Exhibit 4.6.1-3**.) The third component should read "VIS" for runways designed with visual approach use only. Generally, runway standards are related to aircraft approach speed, aircraft wingspan, and designated or planned approach visibility minimums.

Exhibit 4.6.1-3: Visibility Minimums or Runway Visual Range (RVR)

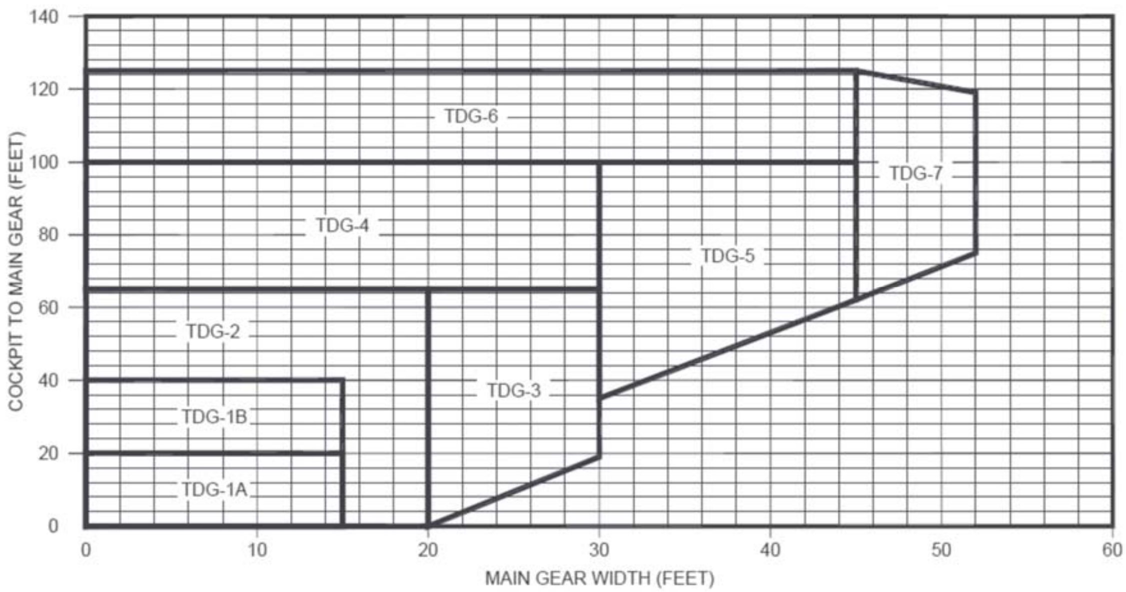
RVR (ft) *	Instrument Flight Visibility Category (statute mile)
5000	Not lower than 1 mile
4000	Lower than 1 mile but not lower than ¾ mile
2400	Lower than 3/4 mile but not lower than 1/2 mile
1600	Lower than 1/2 mile but not lower than 1/4 mile
1200	Lower than 1/4 mile

* RVR values are not exact equivalents.

Source: FAA AC 150/5300-13A, *Airport Design*, Change 1, February 2014

Runway to taxiway and taxiway/taxilane to taxiway/taxilane separation standards are related to ADG, TDG, and approach visibility minimums. TDG refers to the gear arrangement on the aircraft (width and distance from cockpit to main gear). (See Exhibit 4.6.1-4.)

Exhibit 4.6.1-4: Taxiway Design Group (TDG)



Source: FAA AC 150/5300-13A, *Airport Design*, Change 1, February 2014

The existing design codes for KOSU are shown in **Exhibit 4.6.1-5**. These are the codes shown on the as-built airport layout plan (ALP) completed for the airport in 2009.

Exhibit 4.6.1-5: Existing Design Codes

Runway	AAC	ADG	RVR
Primary Runway (9R-27L)	D	III	2400
Parallel Runway (9L-27R)	A	II	VIS
Crosswind (5-23)	B	I (Small)	VIS

Source: KOSU As-Build ALP, R.D. Zande & Associates, Inc., November 23, 2009

Reviewing aircraft operations discussed in Chapter 3: Aviation Activity Forecasts, the future critical design aircraft for the primary runway (existing Runway 9R-27L) falls within an AAC-ADG of C/D-II (it is currently designed for C/D-III aircraft). There is no one aircraft within this group that meets 500 operations, but cumulatively, they reach over 1,360 operations. The largest aircraft within this group is the Gulfstream 450, which is based at the airport. The runway design code of the primary runway on the previous ALP was a C/D-III, so this represents a slightly reduced design standard for the future than was previously shown for the airport.

For the parallel runway (existing Runway 9L-27R), the critical design aircraft for the future is the same as the existing, the Pilatus PC-12, which falls within an AAC-ADG of A-II. As show in the forecast chapter, there were almost 2,100 annual operations by the Pilatus PC-12 at the airport.

For the crosswind runway (Runway 5-23), the specific critical design aircraft for the future is the same as the existing (Cessna Citation CJ1), which falls within an AAC - ADG of B-I (small). There were over 500 operations by the Cessna

Citation CJ1 at the airport. (See **4.6.1-6** for proposed future design codes.) Future visibility minimums will be discussed in detail in subsequent sections.

Exhibit 4.6.1-6: Future Design Codes

Runway	AAC	ADG	RVR
Primary Runway (9R-27L)	C	II	2400
Parallel Runway (9L-27R)	A	II	VIS
Crosswind (5-23)	B	I (Small)	VIS

Source: Woolpert, 2018

4.6.2 Basic Design and Separation Standards Specific to KOSU

The major design and separation standards specific to KOSU associated with the above discussed design codes are shown in **Exhibit 4.6.2-1** and **Exhibit 4.6.2-2**.

Exhibit 4.6.2-1: C/D Design and Separation Standards (all standards in feet unless otherwise noted) Primary Runway

Standard	C/D-III (Existing)	C/D-II (Future)
Runway Width	150	100
Shoulder Width	25	10
RSA	500 wide 1000 beyond end	500 wide 1000 beyond end
ROFA	800 wide 1000 beyond end	800 wide 1000 beyond end
ROFZ	400 wide 200 beyond runway end	400 wide 200 beyond runway end
PROFZ	800 wide, 200 long (lower than ¾ mile only)	800 wide, 200 long (lower than ¾ mile only)
Approach RPZ	78.914 acres (lower than ¾ mile) 48.978 acres (not lower than ¾ mile) 29.465 acres (not lower than 1 mile or vis)	78.914 acres (lower than ¾ mile) 48.978 acres (not lower than ¾ mile) 29.465 acres (not lower than 1 mile or vis)
RW CTRLN to Hold Position	250	250
RW CTRLN to Parallel TW CTRNL	400	400
RW CTRLN to Aircraft Parking	500	500

RSA - Runway Safety Area; ROFA - Runway Object Free Area; ROFZ - Runway Obstacle Free Zone; PROFZ - Precision Runway Obstacle Free Zone; RPZ - Runway Protection Zone; RW - Runway; TW - Taxiway; CTRLN – Centerline
Items in parenthesis refer to approach visibility minimums

Source: FAA AC 150/5300-13A, *Airport Design*, Change 1, February 2014

Exhibit 4.6.2-2: A/B Design and Separation Standards (all standards in feet unless otherwise noted) for Parallel and Crosswind Runways

Standard	A/B-II	A/B-I (Small)
Runway Width	100 (lower than ¾ mile) 75 (all others)	75 (lower than ¾ mile) 60 (all others)
Shoulder Width	10	10
RSA	300 wide, 600 beyond end (lower than ¾ mile) 150 wide, 300 beyond end (all others)	300 wide, 600 beyond end (lower than ¾ mile) 120 wide, 240 beyond end (all others)
ROFA	800 wide, 600 beyond end (lower than ¾ mile) 550 wide, 300 beyond end (all others)	800 wide, 600 beyond end (lower than ¾ mile) 250 wide, 240 beyond end (all others)
ROFZ	400 wide 200 beyond runway end	400 wide 200 beyond runway end
PROFZ	800 wide, 200 long (lower than ¾ mile only)	NA
Approach RPZ	78.914 acres (lower than ¾ mile) 48.978 acres (not lower than ¾ mile) 13.770 acres (not lower than 1 mile or vis)	78.914 acres (lower than ¾ mile) 48.978 acres (not lower than ¾ mile) 8.035 acres (not lower than 1 mile or vis)
RW CTRLN to Hold Position	250 (lower than ¾ mile) 200 (all others)	175 (lower than ¾ mile) 125 (all others)
RW CTRLN to Parallel TW CTRNL	300 (lower than ¾ mile) 240 (all others)	200 (lower than ¾ mile) 150 (all others)
RW CTRLN to Aircraft Parking	400 (lower than ¾ mile) 250 (all others)	400 (lower than ¾ mile) 125 (all others)

RSA - Runway Safety Area; ROFA - Runway Object Free Area; ROFZ - Runway Obstacle Free Zone; PROFZ - Precision Runway Obstacle Free Zone; RPZ - Runway Protection Zone; RW - Runway; TW - Taxiway; CTRLN – Centerline
Items in parenthesis refer to approach visibility minimums

Source: FAA AC 150/5300-13A, *Airport Design*, Change 1, February 2014

There are also several airspace standards applied to the runways and the airport. These include dimensions of FAR Part 77 approach surface and the AC 150/5300-13A departure threshold siting surfaces. The major airspace surfaces associated with KOSU's runways are shown in **Exhibit 4.6.2-3.**

Exhibit 4.6.2-3: Airspace Standards (all standards in feet unless otherwise noted)

Airspace	Primary	Parallel	Crosswind
Part 77 Approach Surface	RW 9R: 50,000 L x 1,000 IW x 16,000 OW; 50:1 then 40:1 slopes RW 27L: 10,000 L x 1,000 IW x 3,500 OW; 34:1 slope	5,000 L x 500 IW x 1,500 OW at 20:1 slope	5,000 L x 250 IW x 1,250 OW at 20:1 slope
Threshold Siting Surface	9R: 800 IW x 3,800 OW x 10,000 L (200 from TH) at 34:1 slope with 300 IW x 1,520 OW x 10,000 L GQS at 30:1 slope 27L: 800 IW x 3,800 OW x 10,000 (200 From TH) at 20:1 slope	400 IW x 1,000 OW x 1,500 IL x 8,500 OL at 20:1 slope	400 IW x 1,000 OW x 1,500 IL x 8,500 OL at 20:1 slope
Departure Surface	1,000 IW x 10,200 L x 6,466 OW at 40:1 slope	1,000 IW x 10,200 L x 6,466 OW at 40:1 slope	1,000 IW x 10,200 L x 6,466 OW at 40:1 slope

L – Length; IW – Inner Width; OW – Outer Width; OL Outer Length; TH – Threshold

Taxiway design standards associated with ADG codes I, II, and III are listed in **Exhibit 4.6.2-4** (which cover all the runway's existing and future critical aircraft) while taxiway design standards associated with TDG 1A through 3 are listed in **Exhibit 4.6.2-5** (which cover all the airport's taxiways)**.**

Exhibit 4.6.2-4: Taxiway Design Codes for ADG Codes I, II, & III (all standards in feet unless otherwise noted)

DESIGN STANDARD	ADG I	ADG II	ADG III
Taxiway Safety Area Width	49	79	118
Taxiway Object Free Area (TOFA) Width	89 (44.5)	131 (65.5)	186 (93)
Taxilane Object Free Area (TOFA) Width	79 (39.5)	115 (57.5)	162 (81)
Taxiway Wingtip Clearance	20	26	34
Taxilane Wingtip Clearance	15	18	27
Runway-to-Taxiway Centerline	250	300	350
Runway Centerline-to-Holdline	250	250	250+
Runway Centerline-to-Parking Area	400	400	400

Source: FAA AC 150/5300-13A, *Airport Design*, Change 1, February 2014

Exhibit 4.6.2-5: Taxiway Design Codes for TDG 1A, 1B, 2, and 3 (all standards in feet unless otherwise noted)

DESIGN STANDARD	1A	1B	2	3
Taxiway Width	25	25	35	50
Taxiway Edge Safety Margin	5	5	7.5	10
Taxiway Shoulder Width	10	10	15	20
Taxiway/Taxilane Centerline to Parallel Taxiway/Taxilane Centerline W/ 180 Degree Turn	70	105	162	162

Source: FAA AC 150/5300-13A, *Airport Design*, Change 1, February 2014

4.7 Runway System

As a result of the various lengths of all the runways at the airport, each has a specific function within the operation of the airfield. Runway 9R-27L (the primary runway) is the preferred runway for use by turbine aircraft, due to the length, location to the south airfield landside facilities, and instrument landing system. Runway 9R-27L is also used extensively by piston aircraft. All actual IFR approaches and instrument training operations occur on this runway because of its IFR approach capability.

Runway 9L-27R (the secondary/parallel runway) is used for training by aircraft that remain in the local pattern most of the time. A sizable portion of the Airport's touch-and-go activity occurs on this runway. Runway 9L-27R only accommodates visual flight rule (VFR) traffic because it does not have IFR instrumentation.

Runway 5-23 (the crosswind runway) is used significantly less than the parallel runways. This runway is used only when wind patterns require, when requested specifically by the , or when the Air Traffic Control Tower (ATCT) requests its use for air traffic control purposes. Runway 5-23 only accommodates visual flight rule (VFR) traffic because it does not have IFR instrumentation.

4.7.1 Primary Runway

Length

Many factors go into determining the appropriate runway length for the runways at KOUS: airport elevation, temperature, elevation change in the runway centerline, dry or contaminated pavement, and density altitude to name a few. These factors are critical because aircraft performance declines as elevation, temperature, pressure altitude, runway gradient and contamination increases. FAA AC 150/5070-6B, *Airport Master Plans*, Section 805 Airfield and Airspace Requirements, tells us that the "length of a runway is a function of many factors, the most notable of which are the selection of an appropriate critical design aircraft and the longest nonstop distance to be flown by the critical aircraft from the airport."

The primary runway at KOSU is 5,004 feet long and 100 feet wide and serves both small piston aircraft and business jets. To determine the appropriate runway length for the existing and forecasted users of this runway, an analysis was made using FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*. AC 150/5325-4B states the following:

> General aviation (GA) airports have witnessed an increase use of their primary runway by scheduled airline service and privately-owned business jets. Over the years business jets have proved themselves to be a tremendous asset to corporations by satisfying their executive needs for flexibility in scheduling, speed, and privacy. In response to these types of needs, GA airports that receive regular usage by large airplanes over 12,500 pounds (5,670 kg) maximum takeoff weight (MTOW), in addition to business jets, should provide a runway length comparable to non-GA airports.

To determine appropriate runway lengths for an airport, FAA AC 150/5325-4B categorizes aircraft based on runway length needs as follows:

I. Maximum takeoff weight of 12,500 lbs. or less (Small)
   - Small airplanes with less than 10 passengers
   - Small airplanes with 10 or more passengers
II. Maximum takeoff weight of more than 12,500 lbs. up to and including 60,000 lbs. (Large)
   - Large airplanes that make up 75 percent of fleet
   - Large airplanes that make up the remaining 25 percent of the fleet (also known as 100 percent of fleet)
III. Maximum takeoff weight of more than 60,000 lbs.

The larger aircraft that use KOSU have been grouped based on these categories and are shown in **Exhibit 4.7.1-1**, and will be used in determining the primary runway's recommended length. The specific aircraft operations utilized in the analysis were collected from the FAA's Traffic Flow Management System Counts (TFMSC)[2].

Exhibit 4.7.1-1: KOSU Larger Aircraft Operations Grouped by AC 150/5325-4B Category

MAKE AND MODEL	AC 150/5325-4B Category	TFMSC Ops	Subtotal
C130 - Lockheed 130 Hercules	III - GT 60K LBS	2	
E170 - Embraer 170	III - GT 60K LBS	4	
GL5T - Bombardier BD-700 Global 5000	III - GT 60K LBS	6	
GLEX - Bombardier BD-700 Global Express	III - GT 60K LBS	18	
GLF4 - Gulfstream IV/G400	III - GT 60K LBS	88	
GLF5 - Gulfstream V/G500	III - GT 60K LBS	30	
GLF6 - Gulfstream	III - GT 60K LBS	2	150
C650 - Cessna III/VI/VII	II - 100%	28	
C750 - Cessna Citation X	II - 100%	74	
CL60 - Bombardier Challenger 600/601/604	II - 100%	104	
F2TH - Dassault Falcon 2000	II - 100%	358	
GALX - IAI 1126 Galaxy/Gulfstream G200	II - 100%	36	
H25B - BAe HS 125/700-800/Hawker 800	II - 100%	184	
H25C - BAe/Raytheon HS 125-1000/Hawker 1000	II - 100%	2	
HA4T - Hawker 4000	II - 100%	18	
LJ60 - Bombardier Learjet 60	II - 100%	42	846
BE40 - Raytheon/Beech Beechjet 400/T-1	II - 75%	176	
C25A - Cessna Citation CJ2	II - 75%	54	
C550 - Cessna Citation II/Bravo	II - 75%	180	
C551 - Cessna Citation II/SP	II - 75%	16	
C560 - Cessna Citation V/Ultra/Encore	II - 75%	168	
C56X - Cessna Excel/XLS	II - 75%	748	
C680 - Cessna Citation Sovereign	II - 75%	198	
CL30 - Bombardier (Canadair) Challenger 300	II - 75%	228	
CL35 - Bombardier Challenger 300	II - 75%	96	
F900 - Dassault Falcon 900	II - 75%	24	
FA10 - Dassault Falcon/Mystère 10	II - 75%	4	
FA20 - Dassault Falcon/Mystère 20	II - 75%	8	
FA50 - Dassault Falcon/Mystère 50	II - 75%	22	
LJ31 - Bombardier Learjet 31/A/B	II - 75%	18	
LJ35 - Bombardier Learjet 35/36	II - 75%	20	

[2] (TFMSC) includes traffic counts by airport flights that fly under Instrument Flight Rules (IFR) and are captured by the FAA's enroute computers. Most VFR and some non-enroute IFR traffic is excluded. (TFMSC Overview, aspmhelp.gaa.gov)

MAKE AND MODEL	AC 150/5325-4B Category	TFMSC Ops	Subtotal
LJ40 - Learjet 40; Gates Learjet	II - 75%	30	
LJ45 - Bombardier Learjet 45	II - 75%	152	
MU30 - Mitsubishi MU300/ Diamond I	II - 75%	4	
PRM1 - Raytheon Premier 1/390 Premier 1	II - 75%	26	2172
AC11 - North American Commander 112	I - LT 12.5K LBS	6	
AC50 - Aero Commander 500	I - LT 12.5K LBS	1072	
AC90 - Gulfstream Commander	I - LT 12.5K LBS	26	
AC95 - Gulfstream Jetprop Commander 1000	I - LT 12.5K LBS	2	
AEST - Piper Aero Star	I - LT 12.5K LBS	68	
BE10 - Beech King Air 100 A/B	I - LT 12.5K LBS	34	
BE58 - Beech 58	I - LT 12.5K LBS	66	
BE9L - Beech King Air 90	I - LT 12.5K LBS	86	
BE9T - Beech F90 King Air	I - LT 12.5K LBS	22	
C208 - Cessna 208 Caravan	I - LT 12.5K LBS	20	
C340 - Cessna 340	I - LT 12.5K LBS	32	
C414 - Cessna Chancellor 414	I - LT 12.5K LBS	40	
C421 - Cessna Golden Eagle 421	I - LT 12.5K LBS	128	
C425 - Cessna 425 Corsair	I - LT 12.5K LBS	36	
C441 - Cessna Conquest	I - LT 12.5K LBS	11	
C500 - Cessna 500/Citation I	I - LT 12.5K LBS	40	
C501 - Cessna I/SP	I - LT 12.5K LBS	18	
C525 - Cessna CitationJet/CJ1	I - LT 12.5K LBS	534	
E50P - Embraer Phenom 100	I - LT 12.5K LBS	14	
EPIC - Dynasty	I - LT 12.5K LBS	12	
HDJT - HONDA HA-420 HondaJet	I - LT 12.5K LBS	6	
NAVI - C335	I - LT 12.5K LBS	4	
P180 - Piaggio P-180 Avanti	I - LT 12.5K LBS	12	
PAT4 - Piper PA-31T3-500	I - LT 12.5K LBS	2	
PAY2 - Piper Cheyenne 2	I - LT 12.5K LBS	26	
PC12 - Pilatus PC-12	I - LT 12.5K LBS	2078	4395
B190 - Beech 1900/C-12J	TBD	12	
B350 - Beech Super King Air 350	TBD	760	
BE20 - Beech 200 Super King	TBD	222	
BE30 - Raytheon 300 Super King Air	TBD	46	
C25B - Cessna Citation CJ3	TBD	134	
C25C - Cessna Citation CJ4	TBD	32	
C25M - Cessna Citation M2	TBD	4	
C68A - Cessna Citation Latitude	TBD	172	
E135 - Embraer ERJ 135/140/Legacy	TBD	10	
E45X - Embraer ERJ 145 EX	TBD	4	
E545 - Embraer EMB-545 Legacy 450	TBD	10	
E55P - Embraer Phenom 300	TBD	240	
G150 - Gulfstream G150	TBD	14	
G280 - Gulfstream G280	TBD	6	
JS31 - BAe-3100 Jetstream	TBD	2	
LJ70 - Learjet 70	TBD	2	
LJ75 - Learjet 75	TBD	292	
SW3 - Fairchild Swearingen SA-226T/TB Merlin 3	TBD	4	
SW4 - Swearingen Merlin 4/4A Metro2	TBD	2	
WW24 - IAI 1124 Westwind	TBD	2	1970

GT = Greater than; LT = Less than; TBD = Yet To be determined in FAA AC 150/5325-4B

Sources: AC 150/5325-4B, *Runway Length Requirements for Airport Design;* FAA Traffic Flow (TFMSC) from Oct 2016- Sept 2017

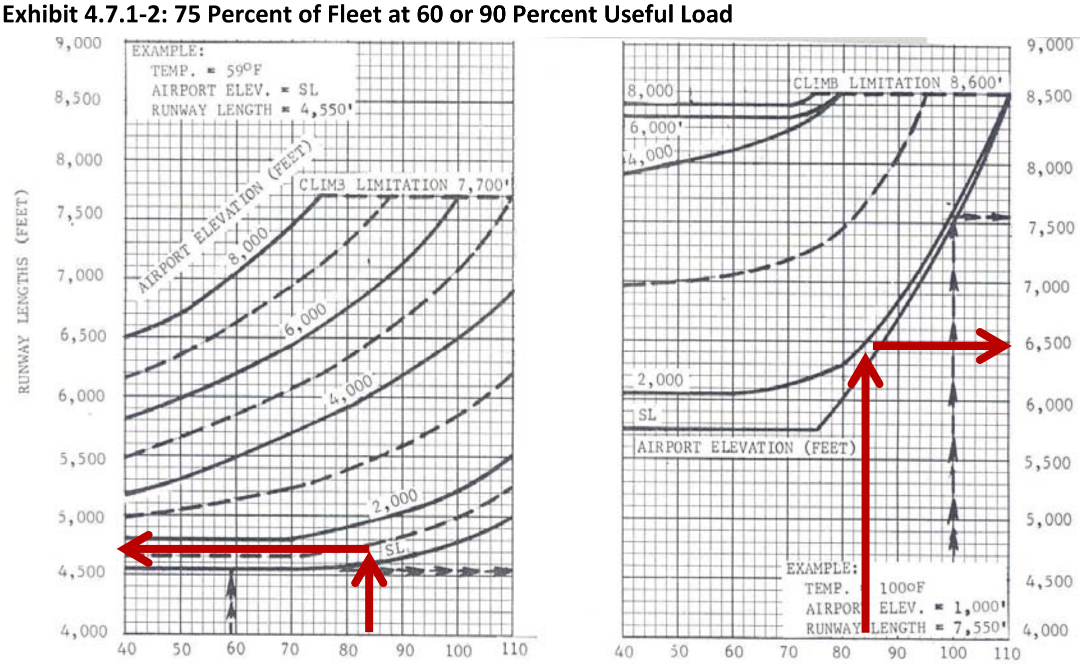
For primary runways, FAA AC 150/5325-4B states the following:

> The design objective for the main primary runway is to provide a runway length for all airplanes that will regularly use it without causing operational weight restrictions" (Note: The FAA defines regular use as having 500 annual operations.[3])

As previously examined, the larger aircraft that make regular use (at least 500 operations) of KOSU were analyzed in Chapter 3 and shown in Exhibit 4.7.1-1 above. According to this analysis, the airport experienced over 2,000 operations in the 75 percent fleet and over 800 operations in the 100 percent of fleet category. The aircraft that require the longest runway lengths at maximum certificated takeoff weight (MTOW)[4] are in the 100 percent fleet category. The recommended length for 75 percent and 100 percent groups of airplanes is found in Chapter 3 of FAA AC 150/5325-4B—specifically in Figures 3-1 and 3-2 respectively.[5]

Exhibit 4.7.1-2 shows the Figure 3-1 from FAA 150/5325-4B as applied to KOSU's primary runway for aircraft in 75 percent of the fleet and **Exhibit 4.7.1-3** shows Figure 3-2 for aircraft in 100 percent of the fleet. **Exhibit 4.7.1-4** provides a table with the resulting recommended runway lengths with the appropriate gradient and surface condition adjustments factored into the results.

Exhibit 4.7.1-2: 75 Percent of Fleet at 60 or 90 Percent Useful Load



Mean Daily Maximum Temperature of Hottest Month of the Year in Degrees Fahrenheit

75 percent of feet at 60 percent useful load **75 percent of feet at 90 percent useful load**

Follow red line for KOSU's primary runway specifically.

Sources: AC 150/5325-4B, *Runway Length Requirements for Airport Design;* WeatherSpark using OSU weather station data obtained from NOAA's Integrated Surface Hourly data set, falling back on ICAO METAR records as required, March 2018

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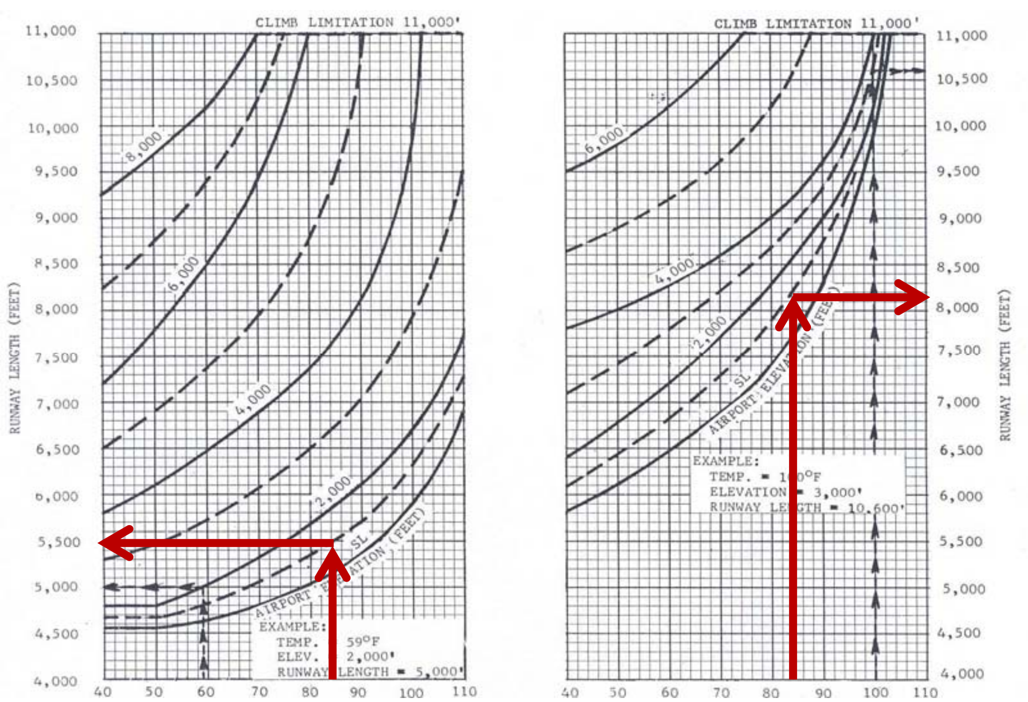
[3] FAA AC 150/5000-17, *Critical Aircraft and Regular Use Determination*, June 20, 2017

[4] In FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, July 1, 2005, the FAA notes that the MTOW is used "because of the of the significant role played by airplane operating weights in determining runway lengths

[5] Determining which figure to use requires first determining which one of the two "percentage of fleet" categories represents the critical design airplanes under evaluation: the "75 percent of the fleet" or the remaining 25 percent of the fleet that make up "100 percent of the fleet".

Exhibit 4.7.1-3: 100 Percent of Fleet at 60 or 90 Percent Useful Load



Mean Daily Maximum Temperature of Hottest Month of the Year in Degrees Fahrenheit

100 percent of feet at 60 percent useful load **100 percent of feet at 90 percent useful load**

Follow red line for KOSU's primary runway specifically.
Sources: AC 150/5325-4B, *Runway Length Requirements for Airport Design;* WeatherSpark using OSU weather station data obtained from NOAA's Integrated Surface Hourly data set, falling back on ICAO METAR records as required, March 2018.

Exhibit 4.7.1-4: Primary Runway Length Requirements

Airport and Runway Data			
Airport Elevation		906 ft. MSL	
Mean daily maximum temperature of the hottest month		84 F	
Maximum difference in runway centerline elevation (gradient)		12 ft.	
Runway Length Recommended for Airport Design	**Unadjusted**	**Gradient (Adjusted 12 ft.)**	**Wet Conditions**
Large airplanes of 60,000 pounds or less			
75% of these large airplanes at 60% useful load	4,700	4,820	5,405
75% of these large airplanes at 90% useful load	6,450	6,570	7,000
100% of these large airplanes at 60% useful load	5,500	5,620	5,620
100% of these large airplanes at 90% useful load	8,200	8,320	8,320

Note: The runway lengths obtained from curves are increased at the rate of 10 feet for each foot of elevation difference between the high and low points of the runway centerline. By regulation, the runway length for turbojet-powered airplanes obtained from the "60 percent useful load" curves are increased by 15 percent or up to 5,500 feet, whichever is less. By regulation, the runway lengths for turbojet powered airplanes obtained from the "90 percent useful load" curves are also increased by 15 percent or up to 7,000 feet, whichever is less. These adjustments are not cumulative. The lengths shown here differ from the previous master plan because Airport Design for Microcomputers (AD42D.EXE) was used then and it is no longer supported by the FAA.
Source: AC 150/5325-4B, Runway Length Requirements for Airport Design

Based on the 60 percent the 90 percent useful load curves for the 100 percent fleet, which is justified since there are over 500 operations by this grouping of aircraft, KOSU's primary runway is shorter than needed to adequately accommodate the current critical aircraft users. The existing length does not adequately accommodate the 75% fleet either. To verify the analysis from the general curves and ensure a future extension is needed at KOSU, a sample of individual aircraft manufacture manuals for aircraft known to operate at KOSU were reviewed for specific aircraft runway length needs. This analysis is shown in **Exhibit 4.7.1-5**.

Exhibit 4.7.1-5: Aircraft Operating Manuals Sampling for Runway Length

Hawker 800XP									
Takeoff (Flaps 15°)									
0° C							30°C		
Dry	Wet	Compact Snow	Standing Water	Slush	Wet Snow	Dry Snow	Dry	Wet	Standing Water
4951	5690	6761	11776	10609	9766	9822	6049	6677	13675

Airplane Flight Manual

Bombardier Challenger CL60	
Takeoff (Flaps)	
15° C	25°C
Dry	Dry
7700	9700

Manufacturer operating manual

LearJet 60						
Takeoff (Flaps 8°)						
40° F			60° F	90° F		
Dry	Wet	Slush (Flaps 20)	Standing Water	Dry	Wet	Standing Water (Flaps 20)
5820	6220	7810	8170	7150	7490	9560

Manufacturer operational manual

Bombardier Challenger CL30						
Takeoff (Flaps 10°)						
0° C			1 0° C	30° C		
Dry	Wet	Compact Snow	Standing Water	Dry	Wet	Standing Water
5230	5600	5700	6610	6020	6450	7230

Airplane flight manual

In addition to the analysis performed using FAA 150/5325-4B and a sampling of specific aircraft needs, correspondence from larger aircraft users supports the finding that KOSU's primary runway is shorter than required for many operators, which reduces their efficiency and utility of the airport. (See Appendix E.) Accommodating a runway footprint longer than 6,000 feet would likely necessitate land acquisition. Options for providing a longer primary runway are analyzed in the next chapter.

Width

The width for KOSU's primary runway is dictated by FAA AC 150/5300-13A, *Airport Design*. The runway is currently 100 feet wide, which meets a C/D-II standard. No change is warranted at this time.

Strength

The strength of airfield pavement is based on three factors: aircraft weight, aircraft gear type, and number of aircraft operations. The Primary Runway at KOSU has an FAA pavement strength rating of 45,000 pounds single wheel loading (SWL) and 60,000 pounds dual wheel loading (DWL). However, the airport director consistently receives requests for waivers over this weight to accommodate Gulfstream and Global Express aircraft. With 150 operations from aircraft over 60,000 pounds in 2017, consideration should be given to increasing the weight bearing capacity for this runway as funds allow because continued used by these heavier aircraft overtime will deteriorate the pavement at a faster rate than lower weight aircraft. The Pavement Classification/Condition Number (PCN)[6] for this runway is 72/F/B/X/T. (See **Appendix G**.)

Navigational Aids (NAVAIDS) and Instrument Approach Procedures

The best approach to the primary runway is the ILS into Runway 9R with a visibility minimum of ½ mile and cloud ceiling height of 200 feet. This approach includes a Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR). This meets the needs of the users, and no changes are proposed for this end of the runway.

Runway 27L is served by an RNAV (GPS) approach (with LPV) with a visibility minimum of one mile and cloud ceiling height of 250 feet. The greatest improvement for this runway end would be to improve the visibility to ¾ mile. Doing so would likely require some type of approach system.[7]

Basic Design, Separation, and Airspace Standards

The basic standards for the primary runway (as it currently constructed) for design, separation, and airspace are shown in **Exhibit 4.7.1-7** along with a determination of whether the standard is met or not. **Exhibit 4.7.1-6** shows the anticipated *future* design standards and if they are met or not.

[6] A numerical value that indicates the load-carrying capacity of the pavement. The first letter indicates the rigidity of the pavement; the second (R for rigid and F for flexible) the second letter: it expresses the strength of the subgrade (A for high, B for medium, C for low, D for ultralow), the third letter expresses the maximum tire pressure that the pavement can support, and the fourth letter indicates if the PCN value was determined by a technical evaluation or by using aircraft. From (FAA AC 150/5335-5B, *Standardized Method of Reporting Airport Pavement Strength PCN*)

[7] FAA AC 150/5300-13A, Table 3-4, recommends approach lights for ¾ to < 1-mile visibility.

Exhibit 4.7.1-6: Standards for Primary Runway as Currently Designed C/D-III **(all standards in feet unless otherwise noted)**

Standard	C/D-III	Standard Met
Runway Width	150	No
Shoulder Width	25	No
RSA	500 wide 1000 beyond end	No – Grading on North side of runway on both ends. Yes
ROFA	800 wide 1000 beyond end	Yes Yes
ROFZ	400 wide 200 beyond runway end	Yes Yes
PROFZ	800 wide, 200 long (lower than ¾ mile only) [RW 9R]	Yes
Approach RPZ	78.914 acres (lower than ¾ mile) [RW 9R] 48.978 acres (not lower than ¾ mile) 29.465 acres (not lower than 1 mile or vis) [RW 27L]	Yes NA Yes
RW CTRLN to Hold Position	250	Yes
RW CTRLN to Parallel TW CTRNL	400	Yes
RW CTRLN to Aircraft Parking	500	Yes
Primary Surface	1000 wide 200 beyond runway end	No – Trees*
Part 77 Approach Surface Slope	RW 9R: 50,000 L x 1,000 IW x 16,000 OW; 50:1 then 40:1 slopes RW 27L: 10,000 L x 1,000 IW x 3,500 OW; 34:1 slope	No – Trees*
Threshold Siting Surface	9R: 800 IW x 3,800 OW x 10,000 L [200 from TH] at 34:1 slope with 300 IW x 1,520 OW x 10,000 L GQS at 30:1 slope 27L: 800 IW x 3,800 OW x 10,000 [200 From TH] at 20:1 slope	No – Trees*
Departure Surface Slope	1,000 IW x 10,200 L x 6,466 OW at 40:1 slope	No – Trees*

RSA - Runway Safety Area; ROFA - Runway Object Free Area; ROFZ - Runway Obstacle Free Zone; PROFZ - Precision Runway Obstacle Free Zone; RPZ - Runway Protection Zone; RW - Runway; TW - Taxiway; CTRLN – Centerline
Items in parenthesis refer to approach visibility minimums.
L – Length; IW – Inner Width; OW – Outer Width; OL Outer Length; TH – Threshold
*Obstacle penetrations are shown on the Airport Layout Plan Sheet 9, Runway Obstacles Tables
Source: FAA AC 150/5300-13A, *Airport Design*, Change 1, February 2014; CFR Title 14, Part 77.

Exhibit 4.7.1-7: Standards for Primary Runway for Proposed C/D II (all standards in feet unless otherwise noted)

Standard	C/D-II	Standard Met
Runway Width	100	Yes
Shoulder Width	10	No
RSA	500 wide 1000 beyond end	Yes Yes
ROFA	800 wide 1000 beyond end	Yes Yes
ROFZ	400 wide 200 beyond runway end	Yes Yes
PROFZ	800 wide, 200 long (lower than ¾ mile only) [RW 9R]	Yes
Approach RPZ	78.914 acres (lower than ¾ mile) [RW 9R] 48.978 acres (not lower than ¾ mile) 29.465 acres (not lower than 1 mile or vis) [RW 27L]	Yes NA Yes
RW CTRLN to Hold Position	250	Yes
RW CTRLN to Parallel TW CTRNL	400	Yes
RW CTRLN to Aircraft Parking	500	Yes
Primary Surface	1000 wide extending 200 beyond runway end	No – Trees*
Part 77 Approach Surface Slope	RW 9R: 50,000 L x 1,000 IW x 16,000 OW; 50:1 then 40:1 slopes RW 27L: 10,000 L x 1,000 IW x 3,500 OW; 34:1 slope	No – Trees*
Threshold Siting Surface	9R: 800 IW x 3,800 OW x 10,000 L [200 from TH] at 34:1 slope with 300 IW x 1,520 OW x 10,000 L GQS at 30:1 slope 27L: 800 IW x 3,800 OW x 10,000 [200 From TH] at 20:1 slope	No – Trees*
Departure Surface Slope	1,000 IW x 10,200 L x 6,466 OW at 40:1 slope	No – Tree*

RSA - Runway Safety Area; ROFA - Runway Object Free Area; ROFZ - Runway Obstacle Free Zone; PROFZ - Precision Runway Obstacle Free Zone; RPZ - Runway Protection Zone; RW - Runway; TW - Taxiway; CTRLN – Centerline

Items in parenthesis refer to approach visibility minimums

*Obstacle penetrations are shown on the Airport Layout Plan Sheet 9, Runway Obstacles Tables

Source: FAA AC 150/5300-13A, *Airport Design*, Change 1, February 2014

In summary, the primary runway as currently designed meets the design and separation standards for everything except length, width for RDC C/D-III, and shoulder for RDC C/D-III. Paved shoulders are required for runways accommodating Airplane Design Group (ADG) IV and higher aircraft, and are recommended for runways accommodating ADG-III aircraft. Turf, aggregate-turf, soil cement, lime or bituminous stabilized soil are recommended adjacent to runways accommodating ADG-I and ADG-II aircraft. The shoulders provide resistance to blast erosion and accommodate the passage of maintenance and emergency equipment and the occasional passage of an aircraft veering from the runway. Changing to an RDC of C/D-II brings the runway into compliance for width, while the length remains inadequate. Existing trees that penetrate the airspace standards are mostly located on airport property and should be removed as soon as possible. (Note: Those trees penetrating existing standards would also penetrate future standards.)

4.7.2 Secondary (Parallel) Runway

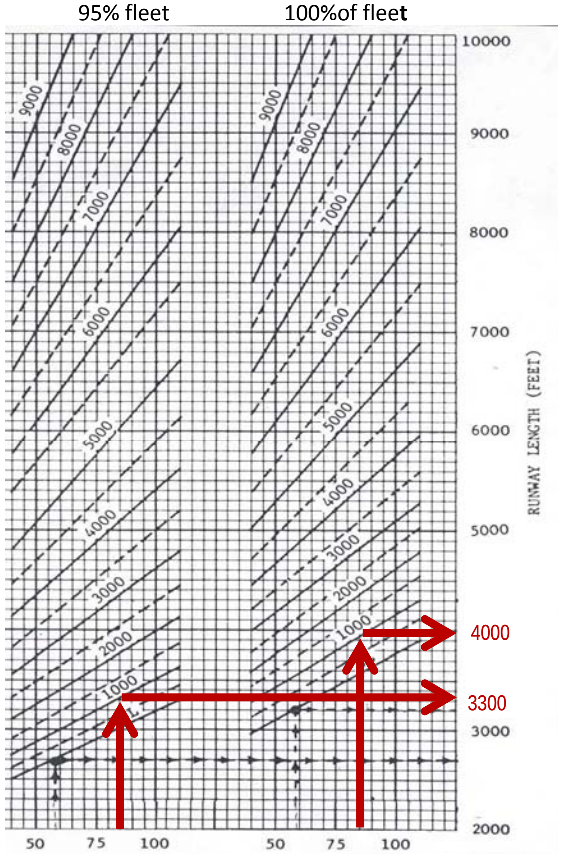
<u>Length</u>

The secondary runway (existing Runway 9L-27R) is 2,994 feet long and 100 feet wide. To determine the appropriate runway length for this runway, an analysis was also made using FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*. This runway is currently designed to A-II RDC standards. The largest aircraft that uses this runway in this category is the Pilatus PC-12 with over 2,000 operations. This is also the critical design aircraft for this runway. This airplane has a maximum takeoff weight of less than 12,500 pounds, so a different curve is used than what was appropriate for the primary runway, as shown in **Exhibit 4.7.2-1**.

Exhibit 4.7.2-1: Small Airplanes with Fewer Than 10 Passenger Seats

FAA AC 150/5325-4B, Figure 2-1. Small Airplanes with Fewer Than 10 Passenger Seats

95% fleet 100%of fleet



Mean Daily Maximum Temperature of Hottest Month of the Year in Degrees Fahrenheit

Follow red line for KOSU's parallel runway specifically.

Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

While the FAA's general curves recommend a longer runway than currently exists for KOSU's parallel (secondary) runway, a review of the Pilatus PC12 aircraft operation manual shows that the existing length will accommodate this airplane fully loaded in most temperatures. Since the existing Primary Runway is 5,005 feet, no additional length is recommended for the parallel unless capacity becomes an issue for the airport in the future.

Width

The width for KOSU's parallel runway is dictated by FAA AC 150/5300-13A, *Airport Design*. The runway is currently 100 feet wide, and it exceeds the A-II standard. Most of this runway was recently overlaid so the majority of the pavement is in good condition. Therefore, no change is warranted at this time.

Strength

The strength of airfield pavement is based on three factors: aircraft weight, aircraft gear type, and number of aircraft operations. The parallel Runway at KOSU has a pavement strength rating through the FAA of 25,200 pounds single wheel loading (SWL). This is considered adequate for the type of aircraft that is expected to use the airport on a regular basis. The Pavement Classification/Condition Number (PCN)[8] for this runway is 5/F/B/X/T.

Navigational Aids (NAVAIDS) and Instrument Approach Procedures.

There are no instrument approaches to the parallel runway. Because the primary runway is served by an ILS with a MALSR and GPS (RVAN) with LPV minimum, no additional instrument approaches are needed in this runway magnetic orientation which is the same as the Primary Runway.

Basic Design, Separation, and Airspace Standards

The basic standards for the parallel runway (as currently constructed) for design, separation, and airspace are shown in **Exhibit 4.7.2-2** along with a determination of whether the standard is met or not. Since there is no proposed change to the design code for the secondary runway, the current design standards are also the future standards.

[8] A numerical value that indicates the load-carrying capacity of the pavement. The first letter indicates the rigidity of the pavement; the second (R for rigid and F for flexible) the second letter: it expresses the strength of the subgrade (A for high, B for medium, C for low, D for ultralow), the third letter expresses the maximum tire pressure that the pavement can support, and the fourth letter indicates if the PCN value was determined by a technical evaluation or by using aircraft. (FAA AC 150/5335-5B, *Standardized Method of Reporting Airport Pavement Strength PCN.*)

Exhibit 4.7.2-2: Standards for Secondary Runway as A-II Current and Future **(all standards in feet unless otherwise noted)**

Standard	A/B-II	Standard Met
Runway Width	100 (lower than ¾ mile) 75 (all others)	Yes NA
Shoulder Width	10	Yes
RSA	300 wide, 600 beyond end (lower than ¾ mile) 150 wide, 300 beyond end (all others)	NA Yes
ROFA	800 wide, 600 beyond end (lower than ¾ mile) 500 wide, 300 beyond end (all others)	NA Yes
ROFZ	400 wide 200 beyond runway end	Yes Yes
PROFZ	800 wide, 200 long (lower than ¾ mile only)	NA
Approach RPZ	78.914 acres (lower than ¾ mile) 48.978 acres (not lower than ¾ mile) 13.770 acres (not lower than 1 mile or vis) [RW 9R & 27L]	NA NA Yes
RW CTRLN to Hold Position	250 (lower than ¾ mile) 200 (all others)	NA Yes
RW CTRLN to Parallel TW CTRNL	300 (lower than ¾ mile) 240 (all others)	NA Yes
RW CTRLN to Aircraft Parking	400 (lower than ¾ mile) 250 (all others)	NA Yes
Primary Surface	500 wide extending 200 beyond runway end	Yes
Part 77 Approach Surface Slope	5,000 L x 500 IW x 1,500 OW at 20:1 slope	Yes
Threshold Siting Surface	400 IW x 1,000 OW x 1,500 IL x 8,500 OL at 20:1 slope	Yes
Departure Surface Slope	1,000 IW x 10,200 L x 6,466 OW at 40:1 slope	No – Trees*

RSA - Runway Safety Area; ROFA - Runway Object Free Area; ROFZ - Runway Obstacle Free Zone; PROFZ - Precision Runway Obstacle Free Zone; RPZ - Runway Protection Zone; RW - Runway; TW - Taxiway; CTRLN – Centerline
L – Length; IW – Inner Width; OW – Outer Width; OL Outer Length; TH – Threshold
Items in parenthesis refer to approach visibility minimums.
*Obstacle penetrations are shown on the Airport Layout Plan Sheet 9, Runway Obstacles Tables
Source: FAA AC 150/5300-13A, *Airport Design*, Change 1, February 2014

In summary, the secondary runway meets all the design and separation standards now and in the foreseeable future. There are a few trees in the departure surface that should be removed as soon as possible. When a future major overlay or lighting improvements are planned for this runway, consideration should also be given to determining if a 75-foot wide runway would meet the needs of the users. (Note: the lights are at the maximum distance from runway edge now and would need to be relocated if the width were reduced.)

4.7.3 Crosswind Runway

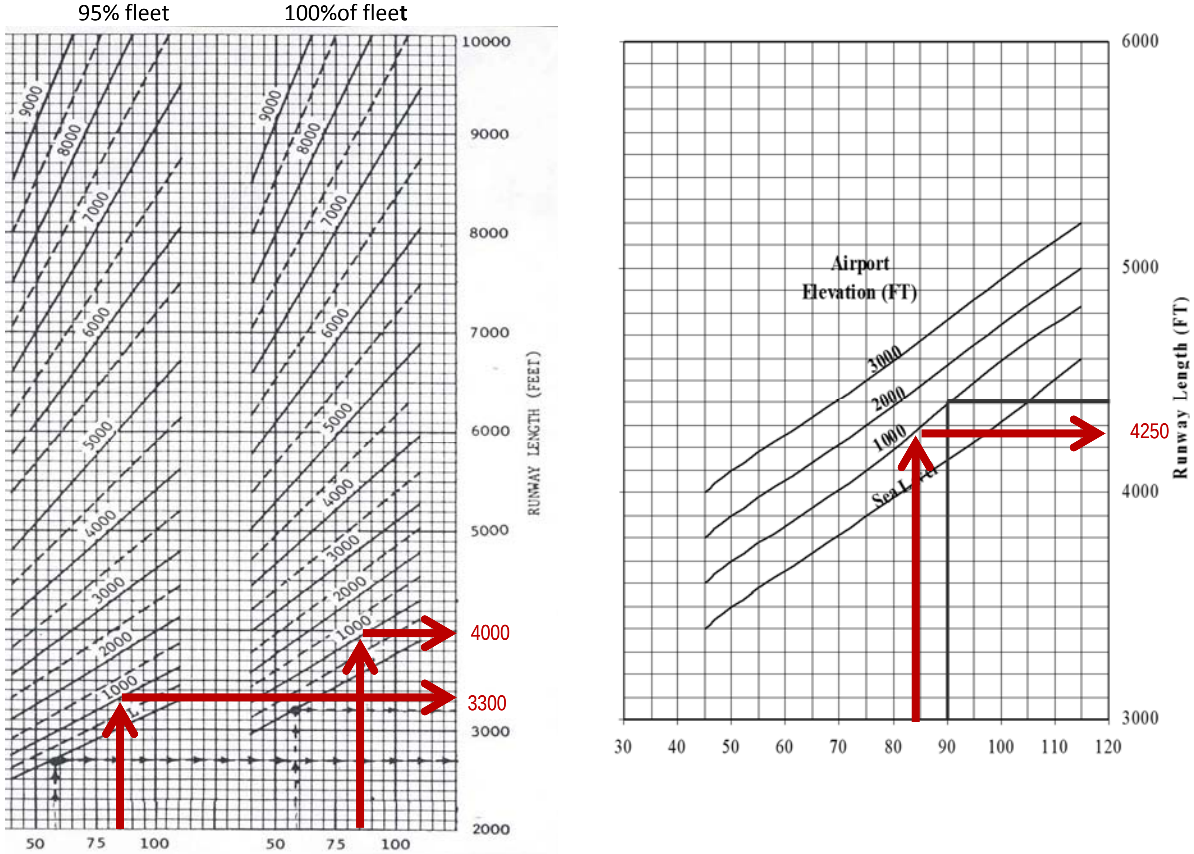
Length

The crosswind runway (existing Runway 5-23) is 3,562 feet long and 100 feet wide. This runway is currently designed to B-I(small) RDC standards. To determine the appropriate runway length for this runway, an analysis was made using FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*. Since the runway is designated as small (less than 12,500 pounds) the small aircraft curves are used for the length analysis, which are shown in **Exhibit 4.7.3-1**.

Exhibit 4.7.3-1: Small Airplanes with Fewer Than 10 Passenger Seats

Small Airplanes with Fewer Than 10 Passenger Seats **Small Airplanes Having 10 or More Passenger Seats**

95% fleet 100%of fleet



Mean Daily Maximum Temperature of Hottest Month of the Year in Degrees Fahrenheit

Follow red line for KOSU's crosswind runway specifically.

Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design

Using these curves, the recommended crosswind runway length for small airplanes with 10 passengers or less is approximately 3,300 feet for 95 percent of the fleet and 4,000 feet for 100 percent. The length increases to approximately 4,250 feet for small planes with over 10 passengers. As presently constructed, the runway meets the needs of 95 percent of the fleet with 10 passengers or less. That length appears sufficient for the existing utility of the airport and no change is warranted at this time

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Width

The width for KOSU's crosswind runway is dictated by FAA AC 150/5300-13A, *Airport Design*. The runway is currently 100 feet wide, and it exceeds the B-I(small) standard. No change is warranted at this time. Should the runway require reconstruction in the future, consideration of the width and lights would be warranted to determine if a 75-foot runway would meet the needs of the users more cost effectively.

Strength

The strength of airfield pavement is based on three factors: aircraft weight, aircraft gear type, and number of aircraft operations. The crosswind runway at KOSU has a pavement strength rating through the FAA of 21,000 pounds single wheel loading (SWL) and 32,000 pounds dual wheel loading (DWL). This is considered adequate for the type of aircraft that is expected to use the airport on a regular basis and no change is recommended at this time. The Pavement Classification/Condition Number (PCN)[9] for this runway is 12/F/B/X/T.

Navigational Aids (NAVAIDS) and Instrument Approach Procedures

There are no instrument approaches to the crosswind runway. Because the primary runway is the only runway served by an instrument approach, airport utility is reduced during crosswind conditions. Accordingly, a GPS (RVAN) approach is recommended for Runway 5 based on prevailing wind conditions (see Exhibit 4.3-2).

Basic Design, Separation, and Airspace Standards

The basic standards for the parallel runway (as currently constructed) for design, separation, and airspace are shown in **Exhibit 4.7.3-2** along with a determination of whether the standard is met or not. Since there is no proposed change in the design code for the secondary runway, the current design standards are also the future standards.

[9] A numerical value that indicates the load-carrying capacity of the pavement. The first letter indicates the rigidity of the pavement; the second (R for rigid and F for flexible) the second letter: it expresses the strength of the subgrade (A for high, B for medium, C for low, D for ultralow), the third letter expresses the maximum tire pressure that the pavement can support, and the fourth letter indicates if the PCN value was determined by a technical evaluation or by using aircraft. From (FAA AC 150/5335-5B, *Standardized Method of Reporting Airport Pavement Strength PCN.*)

Exhibit 4.7.3-2: Standards for Crosswind Runway as Currently Designed A-II **(all standards in feet unless otherwise noted)**

Standard	A/B-I(small)	Standard Met
Runway Width	75 (lower than ¾ mile) 60 (all others)	NA Yes
Shoulder Width	10	Yes
RSA	300 wide, 600 beyond end (lower than ¾ mile) 120 wide, 240 beyond end (all others)	NA Yes
ROFA	800 wide, 600 beyond end (lower than ¾ mile) 250 wide, 240 beyond end (all others)	NA Yes
ROFZ	400 wide 200 beyond runway end	Yes Yes
PROFZ	NA	NA
Approach RPZ	78.914 acres (lower than ¾ mile) 48.978 acres (not lower than ¾ mile) 8.035 acres (not lower than 1 mile or vis)	NA NA Yes
RW CTRLN to Hold Position	175 (lower than ¾ mile) 125 (all others)	NA Yes
RW CTRLN to Parallel TW CTRNL	200 (lower than ¾ mile) 150 (all others)	NA Yes
RW CTRLN to Aircraft Parking	400 (lower than ¾ mile) 125 (all others)	NA Yes
Primary Surface	250 wide extending 200 beyond runway end	Yes
Part 77 Approach Surface Slope	5,000 L x 250 IW x 1,250 OW at 20:1 slope	No – Trees*
Threshold Siting Surface	400 IW x 1,000 OW x 1,500 IL x 8,500 OL at 20:1 slope	Yes
Departure Surface Slope	1,000 IW x 10,200 L x 6,466 OW at 40:1 slope	No – Trees*

RSA - Runway Safety Area; ROFA - Runway Object Free Area; ROFZ - Runway Obstacle Free Zone; PROFZ - Precision Runway Obstacle Free Zone; RPZ - Runway Protection Zone; RW - Runway; TW - Taxiway; CTRLN – Centerline
Items in parenthesis refer to approach visibility minimums.
*Obstacle penetrations are shown on the Airport Layout Plan Sheet 9, Runway Obstacles Tables
Source: FAA AC 150/5300-13A, *Airport Design*, Change 1, February 2014

In summary, the crosswind runway meets all the design and separation standards except for having no instrument approach procedures. There are a few trees in the Approach and Departure Surfaces that should be removed as soon as possible. If an instrument approach is developed, a 75-foot runway width would meet FAA standards. Therefore, when the next major runway or lighting project is planned, the runway width should be reviewed to determine if reducing the width would save costs and still meet user needs. (Note: the lights are at the maximum distance from runway edge now and would need to be relocated if the width were reduced.)

4.7.4 Runway Pavement Condition

In 2018, the Ohio Department of Transportation (ODOT), Office of Aviation conducted a pavement inspection at KOSU. Pavement Condition Index (PCI) numbers for the runways ranged from 0 to 100. The more distress a pavement has, the lower the PCI number. Pavements with values of 70 and below require some type of maintenance; PCI values below 55 indicate a dramatic increase in project cost because reconstruction may be necessary. The typical useful life of bituminous pavement ranges from 20 to 30 years if properly maintained. The useful life for concrete pavement can extend to 40 years and beyond. A summary of the existing runway pavement conditions with recommendations is contained in **Exhibit 4.7.4-1**.

4.7.4-1: Runway Pavement Condition

Runway ID	Highest PCI	Lowest PCI	Action Plan
9R-27L (Primary)	99	40	Preventative maintenance is appropriate for most of the runway.
9L-27R (Secondary)	99	3	Most of this runway was rehabilitated in 2017; so routine preventative maintenance is appropriate for most of it. The section that was not rehabilitated (approximately 500 feet on the 9L end) should be reconstructed as soon as funds can be programmed, along with the last few hundred feet on the 27R end.
5-23 (Crosswind)	77	74	Preventative maintenance needed

Source: Ohio Department of Transportation, 2018

The primary runway was initially constructed in 1959. The surface is asphalt with the majority of it in good condition and only requiring routine maintenance. However, the last few hundred feet on the 9R end will require more intense maintenance, likely a reconstruction, which should be addressed as soon as funds can be programmed.

The secondary runway was originally constructed in 1974 and is mostly in good condition with the majority of the pavement being rehabilitated in 2017. However, approximately 500 feet on the 9L end still needs to be fixed and should be programmed as soon as possible. The very low PCI for this section suggests the potential for ever increasing FOD (foreign object debris) that is hazardous to aircraft engines and propellers.

The crosswind runway was initially constructed in 1943, is also asphalt, and is in generally good condition. Only preventative maintenance should be needed to keep this runway in operational condition.

4.8 Taxiway System

4.8.1 Basic Taxiway Standards

The taxiways at KOSU were originally designed for ADG III aircraft, which is why all the widths are 50 feet except for A1, which is 35 feet. Taxiway AI has a reduced width because it was constructed much later than the others. When all the other taxiways were built, the FAA did not have a TDG criteria. This criteria evolved from Change 13A around 2012. The current taxiway design codes appropriate for KOSU based on the new criteria and the existing aircraft operations by the critical aircraft are as follows:

- Gulfstream 450 ADG II TDG 2
- Cessna Citation CJ1 ADG I TDG 1A
- Pilatus PC-12 ADG II TDG 1A

An evaluation of the taxiway design standards applicable to these ADGs and TDGs based on which taxiways these aircraft predominantly use has been made and the major design standards are shown in **Exhibit 4.8.1-1**.

Exhibit 4.8.1-1: Taxiway Design Standard Evaluation for Proposed TDG/ADG

TWY	Width	TDG	ADG	Width		Safety Area		Object Free Area		Edge Safety Margin		Shoulder Width	
				Standard	Met*	Standard	Met	Standard	Met	Standard	Met	Standard	Met
A	50	2	II	35	Yes	79	Yes	131	Yes	7.5	Yes	15	Yes
A1	35	2	II	35	Yes	79	Yes	131	Yes	7.5	Yes	15	Yes
C	48	2	II	35	Yes	79	Yes	131	Yes	7.5	Yes	15	Yes
D	49	2	II	35	Yes	79	Yes	131	Yes	7.5	Yes	15	Yes
E	50	1A	II	25	Yes	79	Yes	131	Yes	5	Yes	10	Yes
F	50	2	II	35	Yes	79	Yes	131	Yes	7.5	Yes	15	Yes
G	50	1A	II	25	Yes	79	Yes	131	Yes	5	Yes	10	Yes
H	50	1A	I	25	Yes	49	Yes	89	Yes	5	Yes	10	Yes

Note: All taxiways that exceed with standard meet Edge Safety Margins Standards as a result. Paved shoulders are required for taxiways, taxilanes and aprons accommodating ADG-IV and higher aircraft, and are recommended for taxiways, taxilanes and aprons accommodating ADG-III aircraft. Turf, aggregate-turf, soil cement, lime or bituminous stabilized soil are recommended adjacent to paved surfaces accommodating ADG-I and ADG-II aircraft.

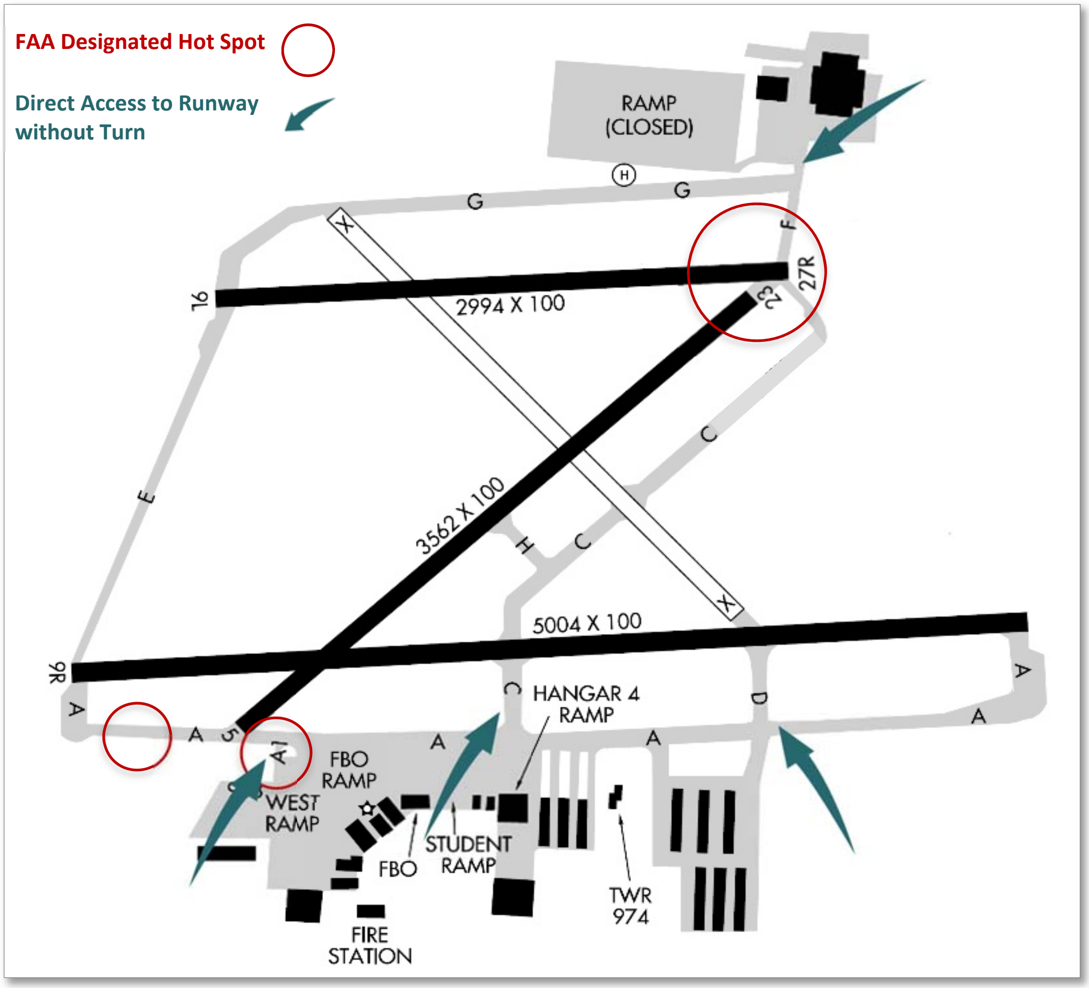
Source: FAA AC 150/5300-13A, *Airport Design*, Change 1, February 2014; Woolpert, 2018

Chapter 4 of AC 150/5300-13A also includes guidelines for optimal situational awareness for pilots as related to the taxiing of aircraft, such as avoiding confusing intersections. The major points are described below:

- designing turns to be 90 degrees wherever possible,
- avoiding wide expanses of pavement,
- limiting runway crossings,
- avoiding high energy and complex intersections,
- avoiding dual purpose pavements, and
- eliminating direct access to a runway from an apron without requiring a turn.

KOSU has several taxiway deficiencies as related to optimal situational awareness shown in **Exhibit 4.8-2** that will be redesigned to meet standards. Taxiways C, D, and F all provide direct access to the runway from an apron without requiring a turn. Additionally, as described in Section 1.5 of the Inventory chapter the FAA has identified three hotspots at KOSU where heightened attention by pilots and airport vehicle drivers is necessary. Options to help with situational awareness in these areas will be analyzed in the next chapter.

Exhibit 4.8-2: Taxiway Deficiencies (Situational Awareness)



Source: FAA Airport Diagram, 2017

4.8.2 Taxiway Pavement Condition

As with the runway pavement, the ODOT Office of Aviation also conducted inspections on KOSU's taxiways in 2011. KOSU PCI numbers for their taxiways ranged from 18 to 100 with new pavements rated at 100. A summary of the existing runway pavement condition with recommendations is contained in **Exhibit 4.8.2-1**.

4.7.4-1: Taxiway Pavement Condition

Taxiway ID	Highest PCI	Lowest PCI	Action Plan
A	90	68	Preventative maintenance
C	91	42	Reconstruct section with 42 PCI; preventative maintenance for the remainder
D	89	76	Preventative maintenance
E	31	0	Reconstruct
F	32	15	Reconstruct
G	0	0	Reconstruct
H	55	43	Overlay/Reconstruct

Source: Ohio Department of Transportation, 2018

Taxiway A, D, and the portion of C serving the primary runway are in good condition and should only require preventative maintenance in the coming years. However, the remaining taxiways serving the crosswind and secondary (parallel) runways should be reconstructed in the very near future. This especially applies to Taxiways G and E, which are likely developing hazardous FOD on a consistent basis.

4.9 Airfield Marking, Lighting and Signage

4.9.1 Runway Lighting

The primary runway is served by high intensity runway lights (HIRL) while the parallel and crosswind runways are served by medium intensity runway lights (MIRL). When the tower is not in operation, the HIRL on Runway 09R-27L and the MIRL on Runway 05-23 are preset to medium intensity in favor of the forecasted winds; otherwise the lights are on low intensity. The MIRL on Runway 09L-27R are set to low intensity. The lighting system should be upgraded to full pilot control through activation on the common traffic advisory frequency (CTAF) when the tower is closed. Additionally, an upgrade to LED lighting is recommended once the system has surpassed its useful life and is eligible for FAA/ODOT removal and replacement.

4.9.2 Taxiway Lighting

KOSU's taxiways are served by medium intensity taxiway lights (MITL). Upgrade to LED's is recommended once the system has surpassed its useful life and is eligible for FAA/ODOT removal and replacement in accordance with FAA LED implementation guidelines.

4.9.3 Airfield Marking and Signage

Pavement markings are used to assist pilots and airport personnel with visually identifying important features on the airfield. The FAA has defined several different pavement markings to foster safety and situational awareness though FAA AC 150/5340-1, *Standards for Airport Markings*, and AC 150/5340-18, *Standards for Airport Sign Systems*. The runways and taxiways are equipped with lighted guidance signs. Both ends of the primary runway are marked with precision runway markings. The former Runway 14-33 is marked with yellow X's. Additionally, consideration should be given to removing this pavement to increase the ability to differentiate it from an open runway. While there are no known deficiencies for KOSU's marking and signage, upgrade to LED lights is recommended.

4.9.4 Airport Beacon

Airport rotating beacons indicate the location of an airport by projecting beams of light spaced 180 degrees apart. These beacons are required for any airport with runway edge lights. Alternating white/green flashes are used to identify a lighted civil airport like KOSU and are normally operated from dusk until dawn. Beacons should be located to preclude interference with pilot or ATCT controller vision and should be within 5,000 feet of a runway. It should be mounted high enough above the surface so that the beam sweep, aimed two degrees or more above the horizon, is not blocked by any natural or manmade object. The airport beacon's current location is on top of Hangar 2 and pilot visibility is poor due to light pollution in this area. A new location is recommended away from highly lighted areas on the airport and will be analyzed in the next chapter.

4.9.5 MALSR Lighting

When the air traffic control tower is operating, the medium intensity approach lighting system (MALSR) lighting is controlled by tower personnel. When the tower is not operational, MALSR lighting is controlled by the pilot through the Common Traffic Advisory Frequency (CTAF). There are no known issues with how the MALSR lighting is controlled or activated at KOSU.

4.10 Aircraft Parking and Storage

4.10.1 Aircraft Hangars Overview

As detailed in Chapter 1, there are two typical types of hangars that exist at KOSU: T-hangars and conventional hangars. The larger hangars are classified as conventional hangars because they generally have the capability to house several aircraft. All future hangars should also be lighted. For planning purposes, an estimation of hangar and apron facilities is made based on forecast peak design periods. However, actual hangar and apron development should be based on the realized demand and financial conditions of KOSU. While actual utilization of hangar space varies across airports and climate regions, national trends are moving toward more sophisticated and expensive aircraft. As a result, owners want to protect their investments and thus prefer enclosed space rather than outside storage. **Exhibit 4.10.1-1** shows the additional aircraft that are forecasted to be stored over the planning period. Single- and multi-engine piston aircraft and "other" are planned to be stored in T-hangars while turbine (turbo prop and jet), and rotor are planned to be stored in conventional hangars.

Exhibit 4.10.1-1: Additional Aircraft to be Hangared

Type	5 years	10 years	15 years	20 years
Single Engine Piston* (T-hangars)	5	17	27	36
Multi Engine Piston (T-hangars)	1	2	4	6
Turbine Engine (Conventional)	2	5	10	14
Helicopter (Conventional)	1	4	7	10
Other (T-hangars)	2	5	9	13
TOTAL (not cumulative)	11	33	57	79

*Includes sport and experimental

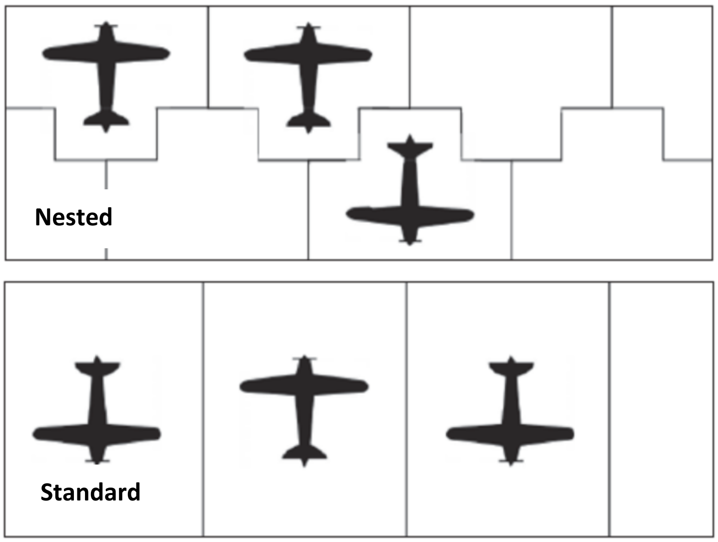
Source: Marr Arnold Planning, 2018

In addition to the forecasted demand for aircraft hangars at the airport, KOSU has documented actual demand for hangar space. The wait list for small hangar space, including both T-hangars and conventional hangars, currently contains 57 individuals. A weight list for larger hangar space contains upwards of 20 companies with corporate jets.

4.10.2 T-Hangars

Typical T-hangars sizes vary based on whether they are nested or standard. (See **Exhibit 4.10.2-1.**) The width and length needed to accommodate the same number of aircraft also varies depending on the T-hangar type.

Exhibit 4.10.2-1: T-Hangar Types



Source: ACRP Report 113: Guidebook on General Aviation Facility Planning

Exhibit 4.10.2-2 provides the typical number of aircraft that can be stored in nested and standard T-hangars and their associated expected length and widths.

Exhibit 4.10.2-2 T-hangar Building Dimensions (in feet) and Units

No. of Units	Nested T-hangar	Standard T-hangar
6	147 long by 52 wide	200 long by 36 wide
8	189 long by 52 wide	263 long by 36 wide
10	231 long by 52 wide	326 long by 36 wide
12	273 long by 52 wide	389 long by 36 wide
14	315 long by 52 wide	452 long by 36 wide
16	357 long by 52 wide	515 long by 36 wide
18	399 long by 52 wide	Not common
20	441 long by 52 wide	Not common

Source: ACRP Report 113: Guidebook on General Aviation Facility Planning

With 57 additional single- and multi-engine aircraft to be hangered during the planning period, an additional four to nine T-hangar buildings will be necessary, depending on the length and width of the buildings, or approximately 68,400 square feet. If these are to be hangered in conventional hangars, approximately 1,200 square feet per aircraft or 66,000 square feet. Alternatives for these will be reviewed in the next chapter.

In addition to the new T-hangars needed to accommodate future aircraft, existing T-hangars C and D need lighting.

4.10.3 Conventional Hangars

To determine the area needed to store the additional jets and helicopters, different aircraft sizes (with a 5-foot buffer for movements) have been averaged for a representative aircraft size to be stored in the conventional hangars. (See **Exhibit 4.10.3-1**.) This has resulted in a planning area of 3,100 square feet for each jet and rotor aircraft.

Exhibit 4.10.3-1: Representative Aircraft Size in Feet

Make	Model	Wingspan	Length
Jet			
Beech	King Air 350	58	47
Cessna	CJ1	47	43
Cessna	CJ3	54	52
Cessna	560	55	52
Cessna	Citation 550	52	48
Falcon	2000LXS	71	67
Gulfstream	G450	78	90
Lear	31	44	49
Lear	75	51	59
Piper	Cheyenne	43	35
Average		53	54
Square Feet with 5-ft Buffer			**3,277**
Helicopter			
Bell	206	32	34
Eurocopter	AS350	36	43
Average		34	39
Square Feet with 5-ft Buffer			**1,752**

Note: Approximate dimensions to cover multiple models rounded up to nearest whole number.

Source: FAA Aircraft Characteristic Database V2

An additional 14 jets and 10 helicopters are forecasted for the airport, which results in the need for approximately 61,000 square feet of additional conventional hangar space over the planning period. The locations and configurations of this space will further be evaluated under the alternatives section.

4.10.4 Flight Education Hangar

As student enrollments continue to grow to meet commercial pilot demands, the university training fleet needs to grow proportionately. Enrollment forecasts support an ultimate fleet of 30 aircraft (up 10 from the current fleet), including primary trainers, advanced trainers, multi-engine aircraft, and a turbo-prop/jet. A minimum 30,000 square-foot conventional hangar is needed to house the expected fleet.

4.10.5 Apron Areas

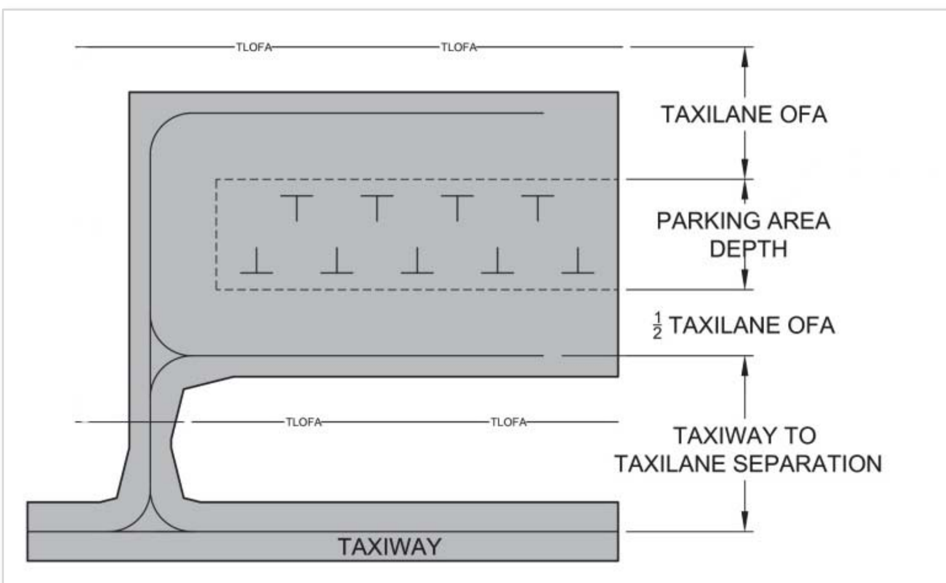
The apron areas (also known as ramps) currently have 131 paved tie-downs spots with about 40 aircraft on average parked in tie-down spots, leaving about 91 open spaces. However, when the new terminal is completed, tie-down spots directly in front of the building will be reduced. While the airport can accommodate special events like SAFCON today, additional space will be needed as traffic increases and after the terminal is built. Airport operations staff feel that approximately 150 tie-down spaces are needed to accommodate all events on the airport.

The airport should have enough apron space to accommodate the design day as determined in the forecast chapter. For KOSU this is forecast to be 201 (see Section 3.5.6 in the Aviation Activity Forecasts chapter). With approximately 51% of traffic being itinerant, about 102 parking spaces are needed. According to the Ohio State Airport Director, the National Intercollegiate Flying Association (NIFA) SAFECON events and competition brings an additional 90 aircraft to the airport.

An apron must accommodate the required aircraft parking positions in addition to the required maneuvering space based on FAA Airplane Design Group (ADG) standards. Aircraft maneuvering at KOSU must accommodate safety standards setbacks for FAA ADG-II wingspan aircraft for the terminal apron area and ADG-I for remote tie-downs and T-hangar areas.

The preferred apron design for general aviation apron space is a dual taxilane configuration to support taxi-in and taxi-out operations. (See **Exhibit 4.10.5-1** for dual taxilane example.) The main apron at KOSU is designed with dual taxilanes with some nested tail-to-tail and some single lane aircraft parking. The west apron has both nested and single lane parking, but with deadend taxilanes.

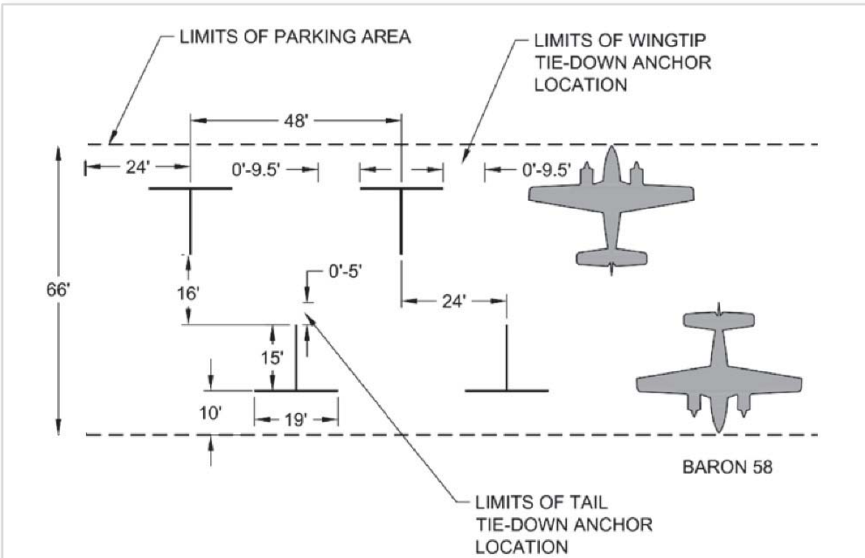
Exhibit 4.10.5-1: Dual Taxilane Example



Source: ACRP Report 113

FAA Advisory Circular 150/5300-13A (AC 13A) and Airport Cooperative Research Program (ACRP) Report 113, *Guidebook on General Aviation Facility Planning*, have been used for developing a future "base" tie-down schematic. AC 13A provides guidelines for laying out tie-down parking positions and suggests that the tie-down size should be based on the largest aircraft anticipated to be tied down at the airport. For KOSU, the largest existing aircraft is the Gulfstream 450, which is approximately 78 feet wide and 90 feet long. This aircraft is in the ADG II and TDG 2 categories. However, not all tie-downs need to meet this standard. Most aircraft that will be tied down fall in to the single-engine and multi-engine piston category. The larger aircraft simply need to be accommodated for parking, but are not generally "tied down" as they are heavier and less susceptible to movement from winds. Therefore, a twin-engine Beechcraft Baron 58 was used to determine a future "base" tie-down layout, which results in a tie-down position of 38 feet by 20 feet (see **Exhibit 4.10.5-12**).

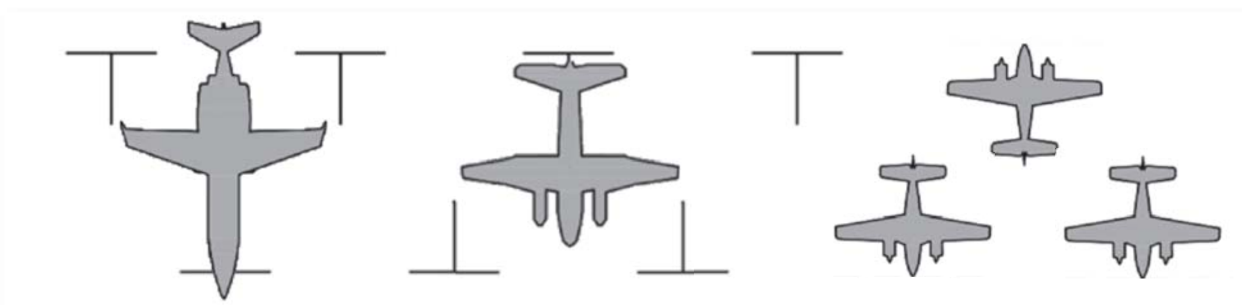
Exhibit 4.10.5-2: Tie-down Schematic



Source: ACRP Report 113

As detailed in Report 113, "basing a tie-down position on a larger aircraft will cause the area required to tie-down a similar number of aircraft to grow dramatically with only marginal benefits." (See **Exhibit 4.10.2-7**.)

Exhibit 4.10.2-7: Different Size Aircraft within the Base Tie-down Schematic



LEARJET 60 KING AIR 100 BARON 58

Source: ACRP Report 113

All ADG I aircraft should fit in the 66-foot-deep parking area shown in Exhibit 4.10.2-6, since the current longest Group I aircraft today is the Learjet 60 at just under 59 feet. For ADG II aircraft, a depth of 75 feet will accommodate approximately 80% of the existing ADG II aircraft in use today while a depth of 100 feet will accommodate 100% of the existing ADG II aircraft of those same aircraft. Approximately 26,400 square yards would accommodate the needed 150 tie-down positions. How to achieve these spaces with the new terminal will be analyzed in the next chapter.

4.10.6 Flight Education Apron

In addition to expanded hangar space to house the training aircraft, additional apron space is also needed to accommodate the flow of aircraft for each flight education flight slot. The apron should be located within proximity to the flight school to be able to stage the entire fleet, minimize walk time and safety concerns for the students, and provide easy access to the taxiway/runway system.

4.11 Terminal Facility

The terminal at KOSU accommodates students and general aviation aircraft users and includes the space required for pilot briefings, flight planning, airport management, passenger waiting, restrooms, vending machines and other miscellaneous needs. A new 29,000-square foot terminal is scheduled to open at KOSU in August 2018, which will house the airport administration, a modern flight terminal for the fixed base operations, and a new aviation education and research facility with state-of-the-art flight simulators, research labs and classrooms.

The terminal space generally needed at an airport is based on the number of customers expected to use the facility during peak operations, which in the case for KOSU also includes students. An area of 100 to 150 square feet of space per person is the industry standard for accommodating peak hour traffic.[10] Using these figures, the following formula provides a planning size for a GA terminal building for an airport layout plan (ALP): *(Peak-hour operations) × (2.5) × (100 sf. to 150 sf.) = Building sf.* In the previous chapter, Aviation Activity Forecasts, the peak-hour operations were estimated to be 201 by 2037. Typically, a factor of 2.5 people (pilots and passengers) is assumed, which results in a terminal space need of over 50,000 square feet. This size of building, however, would be swayed by SAFECON flights. The peak month without SAFECON is June, which has peak-hour operations of 47. Using the same formula with this month results in a terminal area space need of 11,750 to 17,625 square feet. KOSU's new terminal will come in just under this range at 29,000 square feet, and easily handle the 20-year terminal needs.

4.12 Access, Auto Parking, and Passenger Convenience to Airport Facilities

Section 131 of the FAA Modernization and Reform Act of 2012 (49 U.S.C. § 47101(g)(2)) requires airport master plans to consider passenger convenience, access to airport facilities, and ground access. Advisory Circular (AC) 150/5060-6B, Airport Master Plans, provides guidance that states that the master plan may evaluate considerations that "will improve the overall passenger experience – enhancing the passenger's sense of convenience and facilitating access to and from and through the airport complex."[11] At general aviation airports like KOSU, this includes considerations like ample auto parking and road access, restrooms, weather briefing areas, lobbies, Wi-Fi access, and meeting the Americans with Disabilities Act (ADA).

4.12.1 Passenger Convenience

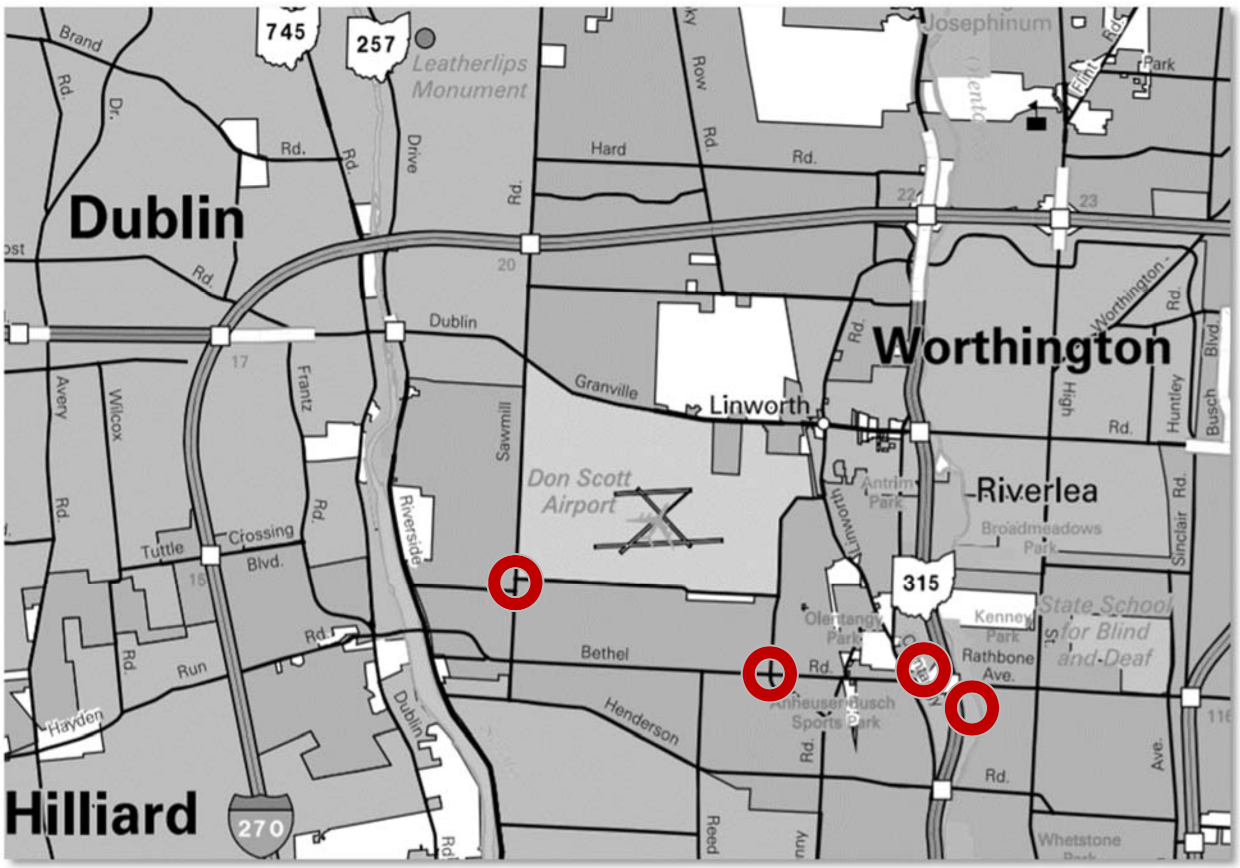
Passenger convenience is generally considered the ease of throughput and flow of passengers using the airport terminal and facilities. In terminal area planning there must be a balance between convenience, operating efficiency, cost and aesthetics. Since KOSU is not a commercial service airport (e.g., scheduled airlines), a major throughput of passengers does not exist. However, the new terminal will improve passenger throughput for the airport. Other passenger convenience measures more associated with general aviation airports include wayfinding (signage) and parking, which are discussed in the following sections.

[10] ACRP Report 113, Guidebook on General Aviation Facility Planning, TRB, 2014
[11] Advisory Circular (AC) 150/5060-6B, Airport Master Plans

4.12.2 Access

Access to an airport should be safe and efficient with good visibility along the road and in the parking lots. The airport terminal, administrative offices, and flight school are located on the south side of the airfield. Access is provided off West Case Road from either Sawmill Road or Godown Road. Airport notification directional signs can be found at the intersection of Case Road and Sawmill Road, on State Route 315 (north and southbound) at the Bethel Road exit; on Bethel and Godown Roads. (See **Exhibit 4.12.2-1**.) There are no signs to the airport from I-270, which makes locating it from outside the immediate area difficult. Adding signs to I-270 would improve wayfinding to the airport.

Exhibit 4.12.2-1: Road Signage Locations



Source: Ohio Department of Transportation; Woolpert

4.12.3 Auto Parking

Parking requirements for airports vary based on their size, the services they provide, the customers they service, and the land-side layout. While an airport many have an appropriate number of total parking spaces for its size and operation, those spaces may not be appropriately located. For airport parking lots, a general rule of thumb for the number of parking spaces at a terminal is 2.5 spaces per peak-hour operations, plus one space per 200 square feet of office space (five minimum), plus one space per vehicle bay, plus one space per 750 square feet of maintenance shop space (five minimum).[12] A rate of 2.5 spaces per peak hour operation alone would suggest the need for over

[12] Ibid.

500 parking spots at KOSU for operations alone. Again, this is skewed by SAFECON. Therefore, this rule of thumb is not appropriate for use at KOSU.

Previous analysis done during the new terminal building project indicated an existing terminal area parking need of 263 spots. Adding an estimated future growth based on the forecasts of 23 percent over the 20-year planning period would result in a need of 323 parking spots in the terminal area. (See **Exhibit 4.12.3-1**.) Existing space needs for the non-terminal area on the south side of the airport is 77 (existing spaces for the ATCT, paint house, fuel depot, snow removal and equipment storage building, the airport barn, and 45 spaces for T-hangars [50 percent of total units]). Applying 23% growth rate would result in a need of 95 parking spaces outside of the terminal area in the 20-year planning period. (Note: Buildings 0978, 1000, and 1001 on the north side of the airport were not include in the calculations since they have their own parking lots with ample space.) Buildings 0900 (Hangar 9) and 0256 (Hangar 8) have a total of 111 spaces now and if the same forecasted growth rate were applied, a total of of 137 would be needed over the planning period.

Exhibit 4.12.3-1

	Current Need	20-Year Planning Need 23% Growth
Terminal Area	263	323
Non-Terminal Area South Side	77	95
ATCT		
T-hangars		
0195 Storage		
0196 T-Hangar A West		
0197 T-Hangar A East		
0901 T-Hangar C		
0904 T-Hangar D		
1014 T-Hangar B		
1015 T-Hangar E		
1016 T-Hangar F		
1017 T-Hangar G		
0143 Paint House and Fuel Depot		
0164 Snow Removal and Equipment Storage Building		
0993 Airport Blue Barn		
Buildings with dedicated parking	111	137
Hangar 8 (0256)		
Hangar 9 (0900)		

While Exhibit 4.12.3-1 provides for a general number of parking spaces needed over the planning period, planning for the appropriate number of spaces in the correct locations is most important. Even without SAFECON, airport staff point to a valid parking shortage in the terminal area. The location of the new terminal building cancels out 30% of the existing parking spots for the airport, resulting in an immediate shortfall of parking. (Approximately 263 are needed and only 180 will exist in the terminal area.) Additionally, overflow parking is always needed for events, so any future improvements that impact existing overflow parking just south of the paved parking lot should also provide for additional future parking. Even though Exhibit 4.12.3-1 identifies general growth needs, any new hangars built should be planned with the appropriate number of spaces needed for the demand being met by the time of development. Future parking locations for existing needs and for future hangars will be analyzed further in the alternatives chapter.

4.13 Airport Fencing, Security and Lighting

Transportation Security Administration (TSA) Regulations Part 1542 regulates security that affects safety inflight. Although the regulation details the responsibilities airport operators must meet in order to serve certificated air carriers and air cargo carriers, security regulations for general aviation airports do not exist. Instead, the TSA, with input from industry partners, released Information Publication A-001 "Security Guidelines for General Aviation Airports" in May 2004. The guidelines recommend a number of security measures, based on the characteristics of the airport and the surrounding area.

4.13.1 Airport Characteristics Measurement Tool

In order to assess which security enhancements are most appropriate for a GA landing facility, consideration must be given to those elements that make the airport unique. To assist in this effort, TSA developed an Airport Characteristics Measurement Tool (**Exhibit 4.13.1-1)** that can be used to determine where in the risk spectrum the facility lies. The tool is a list of airport characteristics that potentially affect a facility's security posture. Each of the characteristics is assigned a point ranking, the idea being that certain characteristics may affect the security at one airport more so than other airports.

Exhibit 4.13.1-1: Airport Characteristics Measurement Tool

Security Characteristics	Assessment Scale Public Use Airports/Heliports	Assessment Scale Private Use Airports/Heliports	KOSU Score
Location			
Within 30 nm of mass population area	5	3	5
Within 30 nm of a sensitive site	4	2	4
Falls within outer perimeter of Class B airspace	3	1	3
Fall within the boundaries of restricted airspace	3	1	-
Based Aircraft			
Greater than 101 based aircraft	3	1	3
26-100 based aircraft	2	-	-
11-25 based aircraft	1	-	-
10 or fewer based aircraft	-	-	-
Based aircraft over 12,500 lbs	3	1	3
Runways			
Runway length greater than 5001 feet	5	3	5
Runway length less than 5000 feet, greater than 2001 feet	4	2	-
Runway length 2000 feet or less	2	-	-
Asphalt or concrete runway	1	-	1
Operations			
Over 50,000 annual aircraft operations	4	2	4
Part 135 operations	3	1	3
Part 137 operations	3	1	-
Part 125 operations	3	1	-
Flight training	3	1	3
Flight training in aircraft over 12,500 lbs.	4	2	-
Rental aircraft	4	2	4
Maintenance, repair, and overhaul facilities conducting long-term storage of aircraft over 12,500 lbs.	4	2	-
Total	55	24	38

Source: Transportation Security Administration, Ohio State Airport Director

4.13.2 Suggested Airport Security Enhancements

GA airports are extremely diverse and appropriate security measures can be determined only after careful examination of an individual airport. Once the airport's assessment measurement is determined, that number is compared to the Suggested Airport Security Enhancements chart (**Exhibit 14.13.2-1**) to determine which security measures are most appropriate for the airport.

Exhibit 14.13.2-1: Suggested Airport Security Enhancements

Points/Suggested Guidelines			
>45	25-44	15-24	0-14
• **Fencing** (Section 3.3.3) • **Hangars** (Section 3.3.1) • **CCTV** (Section 3.4.5) • **Intrusion Detection System** (Section 3.4.6)			
• **Access Controls** (Section 3.3.3) • **Lighting System** (Section 3.3.4) • **Personnel ID system** (Section 3.3.6) • **Vehicle ID system** (Section 3.3.6) • **Challenge Procedures** (Section 3.4.1)			
• **LEO Support** (Section 3.4.4) • **Security Committee** (Section 3.4.3) • **Transient Pilot Sign-In/Out Procedures** (Section 3.1.4)			
• **Signs** (Section 3.3.5) • **Documented Security Procedures** (Section 3.5.1) • **Positive Passenger/Cargo/Baggage ID** (Section 3.1.1) • **All Aircraft Secured** (Section 3.2) • **Community Watch Program** (Section 3.4.1) • **Contact List** (Section 3.5.3)			

Source: Transportation Security Administration

As shown in by the characteristic assessment of KOSU in Exhibit 4.13.1-1, the airport scored 38 out of a possible 55 points on the risk spectrum, placing it in the second highest tier of suggested security enhancements. While, KOSU exceeds the security recommendations for an airport with its point ranking, specifics on its security are omitted here. KOSU security procedures are detailed in an active Airport Security Plan (ASP), which is on file with the Ohio Office of Aviation.

4.13.3 Airport Fencing

Approximately 90% of the airport is enclosed with 10-foot fencing. A short section of fence along Case Road is only 5-7 feet in height. (See **Exhibit 4.13-1**.) Fencing is the best way to keep mammals off the airport. Since deer can easily jump the current FAA minimum standard 6-foot security fence, a 10 to 12-foot chain link fence with 3 strands of barbed wire outriggers and 2-feet buried to prevent digging under is the minimum recommended fencing for wildlife control. This also improves airport security (FAA CertAlert 04-16).

Exhibit 4.13-1: KOSU Airport Fencing

Source: Google Earth, accessed 4-2018

4.14 Airport Storage, Maintenance and Electrical Vault Buildings

KOSU is comprised of over 1,000 acres of land, so maintenance equipment needs are vast, as is the space needed to store that equipment. Airport maintenance equipment is currently stored and maintained in five buildings consisting of approximately 34,000 square feet of space. The previous Master Plan identified the need for an additional 16,500 square feet of covered maintenance/storage space for airport equipment.

FAA guidelines from FAA AC 150/5220-18A, *Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials*, provides guidance on the equipment safety zones recommended around this equipment. (See **Exhibit 4.14-1**.)

Exhibit 4.14-1: Typical Storage Space for Equipment

Minimum Equipment Space Allocations Using the Equipment Safety Zone Concept

Equipment	Minimum Clearances for Equipment Safety Zone (ESZ)			
Parked Equipment *Use the parked vehicle without attachments*	5 feet When next to side walls or other stationary objects.	4 feet When rear of parked equipment faces a wall or other stationary objects.	10 feet Parallel to other parked equipment (parallel parking)	10 feet From door opening.
Moving Equipment On	15 feet	Between moving equipment on dual drive-through lanes		
Single or Dual Drive-Through Lane *Assumes a 7-ft carrier vehicle width with attachments at 30-degree perpendicular to vehicle body*	From parked equipment that includes a safe walk around zone in front of at least 3 feet	10 feet Small Plows 10 ft or less	14 feet Intermediate Plows & Small Sweepers Over 10 feet up to 15 feet	20 feet Large Plows & Large Sweepers Over 15 feet up to 22 feet

Source: FAA AC 150/5220-18A

Based on a 5-foot equipment safety zone, **Exhibit 4.14-2** lists the equipment that KOSU is required to store when not in use:

Exhibit 4.14-2

The Ohio State University Airport Equipment		Dimensions (feet)				
Qty	**Item Description**	**Year**	**Length**	**Width**	**Safety Zone**	**Total Space SF**
Facilities						
1	Runway Snow Removal Broom	1987	39	18	5	851
1	Runway Snow Removal Broom	2002	36	21	5	905
1	ARFF Truck	1993	26	10	5	356
1	Runway Snow Blower	1987	29	11	5	425
1	Loader	1986	28	21	5	717
2	Runway Plow Trucks	1986	36	22	5	1887
1	Runway Spreader	1985	19	9	5	247
1	Tractor	1985	18	9	5	236
1	F350 Truck	1990	20	9	5	259
1	Pick-Up Truck	1986	19	8	5	226
1	Pick-Up Truck	1986	17	7	5	185
1	Pick-Up Truck	1997	21	9	5	270
1	Surburban	1999	20	8	5	236
1	Mower - pull behind tractor	2006	14	8	5	173
1	Mowers - pull behind tractor	2006	14	10	5	206
1	Mowers - pull behind tractor	2014	19	14	5	355
1	All Season Tractor	2002	13	8	5	163
1	All Season Tractor	2014	14	9	5	190
1	All Season Tractor	2005	13	7	5	147
1	Backhoe	2018	24	8	5	278
1	ForkLift	1991	13	6	5	132
1	ForkLift	1989	11	4	5	88
1	ForkLift	1988	13	6	5	132
1	Lawn Mower	2000	8	7	5	100
1	Lawn Mower	2017	7	7	5	90
1	Lawn Mower	2017	11	7	5	128
1	Crack Sealer	1988	19	7	5	204
Services						
1	Pick-Up Spreader	2011	5	9	5	86
2	Aircraft Tractor (Tug)	2018	10	6	5	213
1	Aircraft Tractor (Tug)	2015	11	5	5	101
1	Aircraft Tractor (Tug)	2002	11	6	5	115
1	Aircraft Tractor (Tug)		17	5	5	146
1	SUV	2012	17	9	5	224
1	SUV	2004	16	8	5	194
2	GPU	2018	9	6	5	196
1	GPU	1999	7	5	5	71
1	Aircraft De-ice truck	1997	32	10	5	431
1	Jet-A Fuel Truck	1999	32	10	5	431
1	Jet-A Fuel Truck		32	10	5	431
1	100LL Fuel Truck	2003	19	10	5	269
1	100LL Fuel Truck	1986	19	10	5	269

The Ohio State University Airport Equipment		Dimensions (feet)				
Qty	Item Description	Year	Length	Width	Safety Zone	Total Space SF
1	Alternative Fuel Truck		19	10	5	269
6	Aircraft Pre-Heater	Various	9	4	5	449
1	Lav Cart	2018	4	3	5	36
2	Vehicle - Crew Cars	2007	17	7	5	371
1	Spill Cart		10	4	5	81
1	Fuel Vacuum cart		10	5	5	94
TOTAL						**13,662**

Source: Ohio State Airport Assistant Airport Director

A general guide for determining the space needed for maintenance support items is based on the airport size. The term size "refers to a classification of airports according to the total paved runway area identified by the airport operator's winter storm management plan that will be cleared of snow, ice, and/or slush. This definition takes into account the practice where an airport operator closes a smaller runway, such as a GA runway, to focus its equipment fleet on the identified runway(s). In other words, airport size relates only to opened runways. The total paved area in turn determines the sizing of the building. The values provided below exclude paved taxiways and aprons/gate areas. Note: Landside operation areas do not contribute to the airport size definitions listed below."[13]

1. Small Airport: less than 420,000 square feet of total paved runway.
2. Medium Airport: at least 420,000 but less than 700,000 square feet of total paved runway.
3. Large Airport: at least 700,000 but less than 1,000,000 square feet of total paved runway.
4. Very Large Airport: at least 1,000,000 square feet of total paved runway.

By including only KOSU's primary runway, taxiways A, C, and F (approximately 960,000 square feet), it would be considered a large airport.

Guidelines for the total space allocation for support items is also contained in FAA AC 150/5220-18A, which are outlined in **Exhibits 4.14-3** through **4.14-5** as it relates to typical maintenance equipment, support items, special equipment items, and materials.

[13] FAA AC 150/5220-18A, Buildings for Storage and Maintenance of Airport Snow and Ice Control Equipment and Materials

Exhibit 4.14-3: Typical Storage Space Allocations for Support Items

Items under Support Area	Large / Very Large-Sized Airport	
	Low (SF)	High (SF)
Snow Desk	200	400
Supervisor's Office	140	140
Mechanic's Office	150	150
Administrative Area	400	400
Training Room and Emergency First Aid Room	475	475
Lunch room & Kitchen	800	800
Restroom	700	700
Lockers	700	700
Sleeping Quarters OPTIONAL (56 sf bunk area per person)	56	224
Parts Area associated with snow removal operation	1000	1000
Parts Area associated directly to snow vehicles	400	400
Lubrication, Oil, Grease Storage	150	200
Welding Area	400	400
Recycled Oil and Used Anti-freeze	200	200
Mechanic's Bench Area (along walls)	400	400
Repair Bay – Number of Bays and square footage	2-2,000	4-4,000
Cleaning Bay	1000	1000
Total	9,171	11,589
Source: FAA AC 150/5220-18A		

Exhibit 4.14-4: Typical Storage Allocations for Special Equipment Items

Items under Special Equipment Area	Range in Square Feet	
	Low	High
HVAC Area	300	800
Recycled Oil and Used Anti-freeze	150	300
Emergency Power Generation	100	300
Hydraulic Lift, Vacuum Pumps, and Air Compressor	100	200
Steam Generation	100	150
Major/Large Power Tools	100	200
Total	850	1,950
Source: FAA AC 150/5220-18A		

Exhibit 4.14-5: Typical Storage Allocations for Material Storage Items

Snow and Ice Control Material Types	Range in Square Feet	
	Low	High
Sand Storage	150	500
Bagged or Bulk Solid Deicer Storage	100	400
Salt Storage 3	100	300
Total	350	1,200
Note: Sizing needs are highly influenced by the approach used and the quantity of material or combination of materials applied to combat the type of winter storms encountered at the airport. Source: FAA AC 150/5220-18A		

When all of these allocations are added together, the typical size of storage for an airport like KOSU ranges from 24,003 square feet on the low end to 28,041 square feet on the high end. With approximately 34,000 square feet of existing storage space, no additional space is needed. However, heated storage for certain equipment is recommended. Fuel trucks, maintenance equipment, and snow removal equipment are recommended to be housed in a heated building to prolong the useful life of the equipment and to enable more rapid response to operational needs.

Vault Building

The vault building essentially serves as a distribution station for electrical power from the utility provider. Power enters the vault and is then transferred to multiple circuits to power various electrical components on the airport. The existing vault building is located in the T-hangar by the ATCT. Due to the age and conditions of the existing vault, a new vault location which takes into account its relationship to the existing airfield lighting and control tower should be considered. It is recommended that the vault be constructed of reinforced concrete, concrete masonry, or brick. It should provide adequate protection against weather elements, including rain, wind-driven dust, snow, ice and excessive heat. The vault should be ventilated to ensure that the interior room temperature and conditions do not exceed the recommended limits of the electrical equipment installed inside the structure. Locations for a new vault will be examined in the next chapter.

4.15 Equipment

KOSU maintenance equipment ranges in date of manufacture from 1985 to 2018. A rule of thumb for the useful life of equipment is 10 years.[14] Anything older than 10 years should be considered for replacement. (See **Exhibit 4.15-1**.)

Exhibit 4.15-1: Equipment that should be considered for replacement

Name	Date of Manufacture
Runway Spreader	1985
Tractor	1985
Loader	1986
Runway Plow Trucks	1986
Pick-Up Trucks (2)	1986
100LL Fuel Truck	1986
Runway Snow Removal Broom	1987
Runway Snow Blower	1987
ForkLift	1988
Crack Sealer	1988
ForkLift	1989
F350 Truck	1990
ForkLift	1991
ARFF Truck	1993
Pick-Up Truck	1997
Aircraft De-ice truck	1997
Surburban	1999
GPU	1999
Jet-A Fuel Truck	1999

[14] According to The FAA Airport Improvement Program Handbook (FAA Order 5100.38D, September 30) the useful life for all equipment and vehicles except ARFF is 10 years. ARFF is 15 years.

Name	Date of Manufacture
Lawn Mower	2000
Runway Snow Removal Broom	2002
All Season Tractor	2002
Aircraft Tractor (Tug)	2002
100LL Fuel Truck	2003
SUV	2004
All Season Tractor	2005
Mowers - pull behind tractor (2)	2006
Vehicle - Crew Cars	2007

Source: Ohio State Airport Assistant Airport Director

4.16 Services

4.16.1 Fueling

The existing fueling services and storage capabilities will need to be upgraded to meet the needs of KOSU users with respect to alternative fuel and self-fueling.

As the demand for alternative fuel, namely Swift Fuel, increases, the airport will need facilities and equipment to accommodate both the storage and distribution of the alternative fuel. Depending upon the future availability and demand for AvGas, this may require a new 12,000 gallon tank, or may be able to be phased in through a conversion of one 12,000 gallon AvGas tank dedicated solely to alternative fuel. A refueling truck is available to begin dispensing alternative fuel as soon as a storage facility is available.

The last master plan recommended utilizing self-fueling capabilities for smaller, piston-engine aircraft, thereby improving the operating efficiencies of the airport while lowering the cost to the customer. This still holds true today. A ramp just east of T-hangar G has been identified for self-fueling. As this pad is not currently lit, lighting is recommended. Additionally, spill containment should be developed for this pad. National Fire Prevention Association (NFPA) 415, Standard on Airport Terminal Buildings, Fueling Ramp, and Loading Walkways, 2016 Edition includes minimum requirements for the design and maintenance of the drainage system of an aircraft fueling ramp to control the flow of fuel that can be spilled on a ramp and to minimize the resulting possible danger.

4.16.2 Aircraft Anti/Deicing

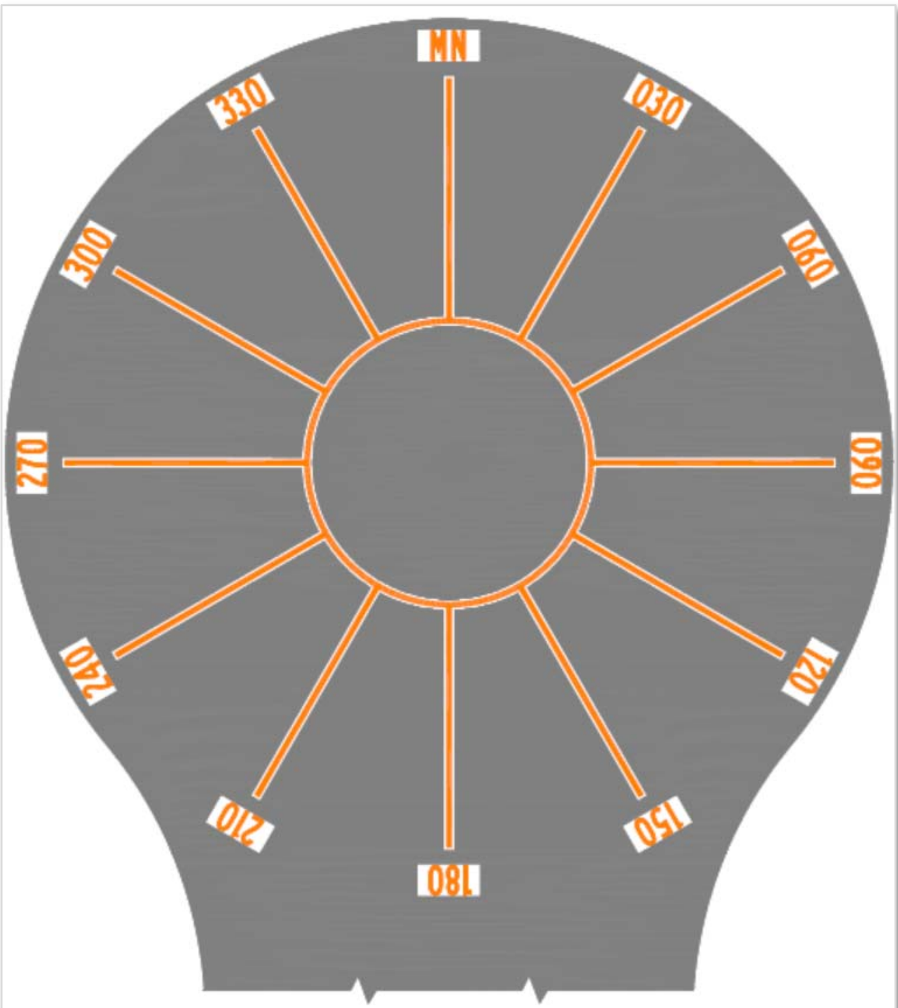
Aircraft anti/deicing is often desired by turbine aircraft prior to departure in cold weather operations. While there are no existing pavement markings designated for anti/deicing near Taxiway A1, KOSU conducts these services at this location near Taxiway A1. Due to the existing apron layout, this is the only available space on the apron for conducting this type of service. The aircraft anti/deicing process normally takes approximately 15-20 minutes. Due to the amount of anti/deicing services being conducted today, a dedicated non-movement area aircraft deicing area is recommended that accommodates the critical design aircraft. This area should have space for aircraft and wingtip clearance, mobile equipment maneuvering, access taxiway clearances, runoff containment/mitigation abilities, and lighting. Locations for properly marked deicing services will be analyzed in the next chapter.

4.17 Compass Calibration Pad

The airport staff has received requests for a compass calibration pad. A magnetic compass is a navigation instrument with certain inherent errors resulting from the nature of its construction. All types of magnetic compasses indicate direction with respect to the earth's magnetic field. Aircraft navigation using a compass is based on applying the appropriate angular corrections to the magnetic reading in order to obtain the true heading. The aircraft magnetic compass should be checked following pertinent aircraft modifications and on a frequent, routine schedule. One method of calibrating the compass is to use a compass calibration pad to align the aircraft on known magnetic headings and make adjustments to the compass and/or placard markings to indicate the required corrections.

The compass calibration pad consists of a series of 12 radial markings painted on the pavement with non-metallic paint. (See **Exhibit 4.17-1**.) The radials extend toward the determined magnetic headings every 30 degrees. Each radial should be marked with its magnetic heading at the end of the radial indicating the direction along which each line lies each heading will consist of three numerals, 24-inches high by 15-inches wide block numerals with a minimum 3.5-inch wide stroke, except for magnetic north which is marked with NM. The markings must be large enough to be easily read from the aircraft cockpit as the radial is being approached.

Exhibit 4.17-1: Compass Calibration Pad



Source: FAA AC 150/5300-13A

A typical calibration pad can be constructed of either concrete or asphalt pavement. The pavement thickness must be adequate to support the user aircraft and should be designed in accordance with AC 150/5320-6. For concrete pavements, joint type and spacing should conform to standard practices, with no magnetic (iron, steel or ferrous) materials used in its construction. Therefore, dowels (where required) and any other metallic materials must be aluminum, brass, bronze, or fiberglass, rather than steel.

Locate the center of the pad at least 600 feet from magnetic objects such as large parking lots, busy roads, railroad tracks, high voltage electrical transmission lines or cables carrying direct current (either above or below ground). The center of the pad must be located at least 300 feet from buildings, aircraft arresting gear, fuel lines, electrical or communication cable conduits when they contain magnetic (iron, steel, or ferrous) materials and from other aircraft. Runway and taxiway light bases, airfield signs, ducts, grates for drainage when they contain iron, steel, or ferrous materials should be at least 150 feet from the center of the pad. If a drainage pipe is required within 300 feet (91 m) of the center of the site, use a non-metallic or aluminum material. In order to prevent interference with electronic Navigation Aid (NAVAID) facilities located on the airport, be sure the required clearances are maintained in accordance with the requirements in Chapter 6.

The compass calibration pad must be located outside airport design surfaces to satisfy the runway and taxiway clearances applicable to the airport. At locations near heavy industrial areas, intermittent magnetic variations may be experienced. Appropriate magnetic surveys at various periods of time are necessary to determine if this situation exists. Potential locations for a compass calibration pad will be analyzed in the next chapter.

4.18 U.S. Customs Service

KOSU staff initiated discussions with the US Customs & Border Patrol officials to study the possibilities of having US Customs services at the airport. A survey was conducted in 2017 to gauge interest from both based tenants and transient users for this service at KOSU. Results indicated that a Customs facility would be beneficial for the airport.

Airport design standards for U.S. customs facilities are provided by the U.S. Customs and Border Protection but are considered sensitive security information so it will not be outlined here. In general for US Customs to provide services at KOSU, the airport must provide the following facilities to the Federal Government without cost:

- Cargo and passenger facilities.
- Warehousing space for the secure storage of imported cargo pending final CBP inspection and release.
- The commitment of optimal use of electronic data input equipment and software to permit integration with any CBP system for electronic processing of commercial entries.
- Administrative office space, cargo inspection areas, primary and secondary inspection rooms, and storage areas, storage areas and any other space necessary for regular CBP operations.
- Identification of location and distance of nearest CBP ports.

Airport staff have identified the existing flight school aircraft storage hangar building as a proposed location for the customs. This will require the removal of certain tie-down spots, which will have to be replaced. The impact of locating this facility on the apron will be analyzed in the next chapter.

4.19 Airship Tie-down

While not an everyday occurrence, airships do use KOSU and providing a more permanent tie-down location is desired. Goodyear's old airship models were approximately 192 feet long by 60 feet tall. These are being replaced by the new Wingfoot models that are approximately 246 feet long by 58 feet high.[15] The old models were staked down while the Wingfoot models are moored to a ground vehicle (approximately 64,000 pounds with four outriggers

[15] https://www.goodyearblimp.com/behind-the-scenes/current-blimps.html, accessed June 11, 2018

that extend from the truck).[16] Airship tie-down is currently being accommodated on the north apron and meets existing and anticipated future need.

4.20 Service Drives

An internal road system that provides service vehicles access to various portions of the airport decreases the need for these vehicles to cross active taxiways or runways. Airport perimeter roads are typically at least 15 feet wide and located outside of the safety areas. KOSU does not have a full perimeter road system within the boundary fence. A number of access roads for NAVAIDS and a few other areas are accessible from taxiways and other vehicular roadways, but circulating the full airport perimeter requires movement through multiple security gates, which can result in accidental openings and some off-road driving. A full airport perimeter road is recommended inside the boundary fence. Note that airport service roads, as long as they are not public roads and are directly controlled by the airport operator, can be located in the runway protection zones. Locations for service roads around the perimeter of the airport will be analyzed in the next chapter.

4.21 Academic & Research Support

As one of only three airports owned by a tier-1 research institution, The Ohio State University Airport is part of the larger Air Transportation & Aerospace Campus, a dedicated aviation academic & research support center aimed at enhancing aviation and aerospace education and research.

Upwards of 12 different departments and centers throughout the university are currently involved with aviation or aerospace related academic and research initiatives. These units incorporate engineering, business, and behavioral philosophies into a multi-disciplinary approach to the many components of the aviation and aerospace industries, supporting world class academic degree programs, research initiatives, and outreach activities on local, regional, national, and international levels.

4.21.1 Aviation & Aerospace Academics

Key areas of study include, but are not limited to:

- Aviation management
- Business aviation and FBO operations
- Flight education
- Aircraft Dispatch
- Aerodynamics
- Flight Vehicle structures, controls, and propulsion
- Subsonic, supersonic, and hypersonic flow
- Aeroacoustics
- Airport management & operations
- Airport planning & design
- Accident investigation

[16] CNN.com, *How to 'lasso' a Goodyear 'blimp'*, Thom Patterson, November 4, 2015.

4.21.2 Aviation & Aerospace Research

Expenditures in aviation and aerospace research at The Ohio State University exceeded $11 Million in 2018. Projects include, but are not limited to:

- Propulsion
- Aerodynamics and Acoustics
- Hypersonics
- Materials Research
- Advanced Manufacturing
- Aviation Operations and Safety
- UAS operations

4.21.3 Academic & Research Complex

Academic and research space requirements, in addition to that which already exists in the new Austin E. Knowlton Executive Terminal and Aviation Learning Center and in the Aerospace Research Center, include, at minimum, dedicated interior and exterior classrooms, offices, and laboratories, as follows:

- Teaching/research facility
  - Offices (16 @ 120 SF each)
  - Classrooms (4 @ 900 SF each)
  - Laboratories (6 @ 400 SF each)
  - Equipment repository/library (400 SF)
  - Storage (600 SF)
  - Flight simulation research lab (1,125 SF, two story)
- Aircraft safety and accident investigation lab – "bone yard" (15,625 SF)
- Unmanned aerial systems lab (10,000 SF, two story, netted)
- Hangar/MRO innovations hub (60,000 SF)
- Vertical take-off/landing pad (10,000 SF)
- Aircraft maintenance technology training facility
  - Office/classrooms (8,200 SF)
  - Hangar (26,000 SF)

4.21.4 Additional Facility/Operational Support

In addition to the facilities outlined above, the ability for the Air Transportation & Aviation Campus (ATAC) to function to its full potential is contingent upon the availability of the following:

- Regular transportation between main campus and the ATAC,
- Student housing, and
- ASOS weather data access.

4.22 Summary of Facility Needs

As aviation evolves and changes, so do the standards and requirements imposed by the FAA to ensure safety. KOSU must continue to maintain and improve its airport facilities to meet these standards and the growing demands of the university's students, business aviation users, and personal flyers. KOSU facility needs are summarized in **Exhibit 4.21-1**.

Exhibit 4.21-1: Facility Requirements Summary

RUNWAYS				
Primary Runway	C/D-II	6000 FT. X 100 FT.	LPV 1M / ILS ½ M	
Preventative maintenance is appropriate for most of the runway.				
The last few hundred feet on the 9R end should be reconstructed as soon as funds can be programmed.				
RSA Grading is be corrected				
Secondary Runway	A-II	2994 FT. X 100 FT.		
Routine preventative maintenance except for approximately 500 feet on the 9L end that should be reconstructed.				
Crosswind Runway	B-II Small	3562 Ft. X 100 FT.		
Consider GPS to RWY if runway is maintained.				
Preventative maintenance needed.				
Seek FAA to officially declare 2nd runway as a "secondary" runway. [1]				
TAXIWAYS				
Fix 3 Hot Spots [2]	**TWY**	**TDG**	**ADG**	**Recommendation**
Fix 4 taxiways with direct access to runway [2]	A	2	II	Preventative maintenance
	A1	2	II	Preventative maintenance
	C	2	II	Reconstruct & preventative maintenance
	D	2	II	Preventative maintenance
	E	1A	II	Reconstruct
	F	2	II	Reconstruct
	G	1A	II	Reconstruct
	H	1A	I	Overlay/Reconstruct
AIRFIELD MARKING AND LIGHTING				
Upgrade to LED lighting where possible when useful life is surpassed.				
Relocate airport beacon.				
Relocate electrical vault to midfield.				
AIRCRAFT HANGARS AND APRON				
4-9 additional T-hangars (55 spaces).				
61,000 SF. of additional conventional hangar.				
30,000 SF. Flight Education hangar and associated apron.				
Academic Maintenance Hangar				
150 total tiedowns.				
ACCESS AND AUTO PARKING				
Airport signage on I-270.				
Vehicle parking spaces for buildings without dedicated parking	Terminal Area 323 spaces	Non-Terminal Area South Side 112 spaces		
AIRPORT FENCING, SECURITY AND LIGHTING				
10 to 12-foot chain link perimeter fence with 3 strands of barbed wire outriggers and 2-feet buried where does not exist				
AIRPORT STORAGE, MAINTENANCE AND ELECTRICAL VAULT BUILDINGS				
Heated storage for fuel trucks, maintenance equipment, and snow removal equipment.				
New midfield electrical vault.				
EQUIPMENT				
Consider replacing equipment older than 10 years - KOSU has 30 pieces over 10 years old.				
SERVICES				
Self-fueling with spill containment.				
Dedicated deicing pad with runoff containment/mitigation.				

Exhibit 4.21-1: Facility Requirements Summary Cont.

ACADEMIC & RESEARCH SUPPORT		
Teaching/research facility for:	Offices (16 @ 120 SF each)	Classrooms (4 @ 900 SF each)
	Laboratories (6 @ 400 SF each)	Equipment repository/library (400 SF)
	Storage (600 SF)	Flight simulation research lab (1,125 SF, two story)
Aircraft safety and accident investigation lab – "bone yard" (15,625 SF)		
Unmanned aerial systems lab (10,000 SF, two-story, netted)		
Hangar/MRO innovations hub (60,000 SF)		
Vertical take-off/landing pad (10,000 SF)		
Aircraft maintenance technology training with Office/classrooms (8,200 SF) and Hangar (26,000 SF)		
OTHER		
Compass calibration pad.		
U.S. Customs Service.		
Completed perimeter road within fence.		

(1) Per FAA policy, the ADO can only fund a single runway at an airport unless the ADO has made a specific determination that an additional runway is justified. The requirements, justification and eligibility for a secondary runway includes 3 criteria:
(1) There is more than one runway at the airport.
(2) The non-primary runway is not a crosswind runway.
(3) Either of the following: (a) The primary runway is operating at 60% or more of its annual capacity, which is based on guidance developed by APP-400 as the threshold for considering when to plan a new runway, or (b) APP-400 has made a specific determination that the runway is required for operation of the airfield.

(2) Closing crosswind runway fixes all hot spots and 1 direct access.