KANSAS CITY
Aviation

## Airport Master Plan

# KANSAS CITY DOWNTOWN AIRPORT – WHEELER FIELD

## Chapter 3

# Facility Requirements

## Airport Master Plan

# KANSAS CITY DOWNTOWN AIRPORT–WHEELER FIELD

## Chapter 3

# FACILITY REQUIREMENTS

The objective of this section is to identify, in general terms, the adequacy of the existing facilities at the Kansas City Downtown Airport – Wheeler Field (MKC) and outline what facilities may be needed to accommodate future demands. Airport facilities include both airside and landside components. Airside components include the runway system (runways and taxiways), navigational aids, lighting, and marking. Landside components include terminal facilities, storage and maintenance hangars, auto parking, surface road access, and support facilities. Having established these facility needs, alternatives for providing these facilities will be evaluated in the following chapter.

This chapter will examine several components of the airport and their respective capacities to determine future facility needs over the planning period. The identified deficiencies will then be examined in the alternatives evaluation.

The facility requirements were evaluated using guidance contained in Federal Aviation Administration (FAA) publications, including:

- Advisory Circular (AC) 150/5300-13B, *Airport Design*
- AC 150/5060-5, *Airport Capacity and Delay*
- AC 150/5325-4B, *Runway Length Requirements for Airport Design*
- 14 Code of Federal Regulations (CFR) Part 77, *Objects Affecting Navigable Airspace*
- Order 5090.5, *Formulation of the National Plan of Integrated Airport Systems (NPIAS) and the Airports Capital Improvement Plan (ACIP)*

## PLANNING HORIZONS

An updated set of aviation demand forecasts for the airport has been established, with a summary of the primary forecasting elements presented previously on Exhibit 2H These activity forecasts include annual operations, based aircraft, based aircraft fleet mix, and peak activity periods. With this information, specific components of the airfield and landside systems can be evaluated to determine their capacity to accommodate future demand.

Cost-effective, efficient, and orderly development of an airport should rely more upon actual demand at an airport than upon a time-based forecast figure. To develop a study that is demand-based rather than time-based, a series of planning horizon milestones are established. The planning horizons presented in **Table 3A** are segmented as the Short Term (approximately years 1-5), the Intermediate Term (approximately years 6-10), and the Long Term (years 11-20).

**TABLE 3A | Planning Horizon Activity Levels**

| | | PLANNING HORIZON | | |
|---|---|---|---|---|
| | **Base Year 2022** | **Short Term** | **Intermediate Term** | **Long Term** |
| **ENPLANEMENTS** | 5,055 | 5,422 | 5,815 | 6,689 |
| **ANNUAL OPERATIONS** | | | | |
| **Itinerant** | | | | |
| Air Carrier | 321 | 360 | 400 | 480 |
| Air Taxi | 21,592 | 28,508 | 29,069 | 30,222 |
| General Aviation | 50,661 | 52,721 | 57,630 | 66,540 |
| Military | 930 | 984 | 984 | 984 |
| *Total Itinerant Operations* | *73,504* | *82,574* | *88,082* | *98,226* |
| **Local** | | | | |
| General Aviation | 40,549 | 50,705 | 53,294 | 58,735 |
| Military | 41 | 47 | 47 | 47 |
| *Total Local* | *40,590* | *50,752* | *53,341* | *58,782* |
| **Total Annual Operations** | **114,094** | **133,326** | **141,423** | **157,008** |
| **BASED AIRCRAFT** | **196** | **206** | **213** | **226** |

*Source: Coffman Associates analysis*

Actual activity at the airport may be higher or lower than what the annualized forecast portrays. By anticipating needs according to planning horizon milestones, the resultant plan can accommodate unexpected shifts or changes in the area's aviation demand so that airport officials can respond to such unexpected changes in a timely fashion.

Utilizing milestones allows airport management the flexibility to make decisions and develop facilities according to needs generated by actual demand levels. The demand-based schedule provides flexibility in development, as development schedules can be slowed or expedited according to demand at any given time over the planning period. The resultant plan provides airport officials with a financially responsible and needs-based program.

Throughout this chapter, references to "current" mean the base year of 2022. References to "future" mean within the next five years. References to "ultimate" mean sometime in the next five to 20 years. The purpose of this differentiation is that any potential projects identified for the "current" or "future" timeframe must include actual justification. Projects that may be needed beyond the five-year timeframe likely will not be justified at present but will require justification prior to implementation.

## AIRFIELD CAPACITY

An airfield's capacity is expressed in terms of its annual service volume (ASV). ASV is a reasonable estimate of the maximum level of aircraft operations that can be accommodated in a year without incurring significant delay factors. As operations near or surpass the ASV, delay factors increase exponentially. Guidance on calculating ASV is found in FAA AC 150/5060-5, *Airport Capacity and Delay*.

### FACTORS AFFECTING ANNUAL SERVICE VOLUME (ASV)

Many factors are considered in the calculation of an airport's ASV, including airfield characteristics, meteorological conditions, aircraft mix, and demand characteristics (aircraft operations). These factors are described below and in **Exhibit 3A**.

#### Airfield Characteristics

The layout of runway and taxiways directly affects an airfield's ASV. This not only includes the orientation of the runway, but also the percentage of time that the runway is in use. Additional airfield characteristics include the length, width, load-bearing strength, and instrument approach capability of each runway at an airport, all of which determine the type of aircraft that may operate on the runway, as well as if operations can occur during poor weather conditions.

- **Runway Configuration -** The existing runway configuration at MKC consists of primary Runway 1-19 and crosswind Runway 4-22.

- **Meteorological Conditions -** Weather conditions have a significant effect on airfield capacity. Airfield capacity is usually highest in clear weather when flight visibility is at its best. Airfield capacity is diminished as weather conditions deteriorate and cloud ceilings and visibility are reduced. As weather conditions deteriorate, the spacing of aircraft must increase to provide allowable margins of safety. The increased distance between aircraft reduces the number of aircraft that can operate at the airport during any given period. Consequently, this reduces overall airfield capacity.

  There are three categories of meteorological conditions, each defined by the reported cloud ceiling and flight visibility. Visual Flight Rule (VFR) conditions exist whenever the cloud ceiling is greater than 1,000 feet (ft) above ground level and visibility is greater than three statute miles. VFR flight conditions permit pilots to approach, land, or take off by visual reference, and to see and avoid other aircraft.

## AIRFIELD LAYOUT

Runway Configuration

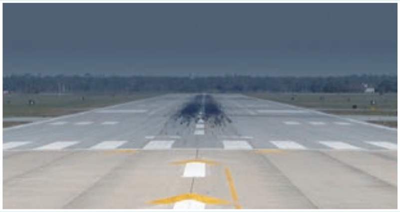
Runway Use

Number of Exits

## WEATHER CONDITIONS

VMC- Visual Meteorological Conditions

IMC- Instrument Meteorological Conditions



PVC- Poor Visibility Conditions

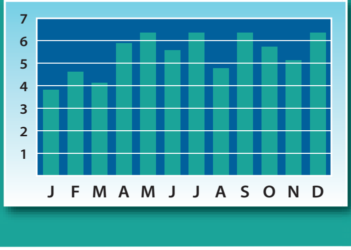
## OPERATIONS

Arrivals

Departures

Touch-and-Go Operations

Total Annual Operations



## AIRCRAFT MIX

### Class A & B Aircraft

Single Engine

Small Turboprop

Twin Piston

### Class C Aircraft

Business Jet

Regional Jet

Commuter

Commercial Jet

### Class D Aircraft

Wide Body Jets

Exhibit 3A
AIRFIELD CAPACITY FACTORS

Instrument Flight Rule (IFR) conditions exist when the reported cloud ceiling is less than 1,000 feet above ground level and/or visibility is less than three statute miles. Under IFR conditions, pilots must rely on instruments for navigation and guidance to the runway. Safe separations between aircraft must be assured by following air traffic control rules and procedures. This leads to increased distances between aircraft, which diminishes airfield capacity.

Poor Visibility Conditions (PVC) exist when cloud ceilings are less than 500 feet above ground level or visibility is less than one mile.

MKC has an on-field automated surface observing system (ASOS). According to the last 10 years of data retrieved from the ASOS weather station, VFR conditions have been in effect 95.25 percent of the time, IFR conditions have been in effect 3.77 percent of the time and PVC conditions have been in effect 0.98 percent of the time. **Table 3B** summarizes the annualized meteorological conditions at MKC.

**TABLE 3B | Meteorological Conditions**

| Condition | Criteria | | MKC ASOS | | | |
|---|---|---|---|---|---|---|
| | Cloud Ceiling | Visibility | Time (minutes) | Percent | Observations | Percent |
| VFR | Greater than 1,000' and | Greater than 3-miles | 5,007,213 | 95.25% | 100,482 | 90.31% |
| IFR | Between 1,000' and 500' or | Between 1-3 miles | 198,075 | 3.77% | 8,122 | 7.30% |
| PVC | Less than 500' or | Less than 1-mile | 51,799 | 0.98% | 2,659 | 2.39% |
| **Total** | | | **5,257,087** | **100%** | **111,263** | **100%** |

ASOS - Automated Surface Observing System; VFR - Visual Flight Rules; IFR - Instrument Flight Rules; PVC - Poor Visibility Conditions

*Source: ASOS data from January 1, 2013 - December 31, 2022*

- **Instrument Approach Procedures** – Instrument approach capabilities of a runway factor into the airfield capacity determination. The lower the cloud ceiling minimums and visibility minimums, the more capable a runway is, thus resulting in greater airfield capacity. Runways 19 and 4 have an Instrument Landing System (ILS) instrument approach with 250-foot cloud ceiling height minimum and ¾-mile visibility minimums. Runway 22 has GPS approach with 416-foot cloud ceiling height minimum and 1-mile visibility minimums. Runway 1 is available for visual approaches only.

- **Runway Use -** Runway use is normally dictated by wind conditions. The direction of takeoffs and landings is generally determined by the speed and direction of wind. It is generally safest for aircraft to depart and land into the wind, avoiding a crosswind or tailwind component during these operations. Prevailing winds favor the use of Runway 1-19 in all-weather conditions and account for an estimated two-thirds of total operations.

  When runways are not dimensioned equally, their use by aircraft operating at the facility may vary. Some runways may be able to accommodate the entire fleet mix operating at the facility and other runways may only be sufficient for smaller aircraft.

  Airfield capacity is directly affected by the runways in use. Ideally, maximum runway capacity would be achieved if both runways were able to accommodate the entire mix of aircraft. Since certain aircraft operations are restricted to specific runway configurations, the capacity of the existing runway system is lower than if there were no use restrictions. Runway 1-19 is designed to accommodate the entire fleet mix currently operating at the airport. Runway 4-22, however, is somewhat limited to medium and small general aviation (GA) aircraft due to its length.

In general, airplanes will take off and land facing into the prevailing wind direction. If the wind is coming from the north, the airport will use North Flow and if the wind is from the south, the airport will use South Flow.

Under visual flight rule (VFR) conditions, Runways 19 and 22 are generally in use and account for 46 percent of annual operations when winds are from the south (South Flow). In North Flow conditions, Runways 1 and 4 are generally in use, accounting for approximately 45 percent of annual activity. In instrument flight rule (IFR) conditions, Runway 4 accounts for approximately three percent of annual operations and Runway 19 accounts for approximately four percent of annual operations. In poor visibility conditions, either Runway 19 or 4 is available, which accounts for approximately two percent of annual operations.

- **Exit Taxiways -** Exit taxiways have a significant impact on airfield capacity since the number and location of exits directly determine the occupancy time of an aircraft on the runway. Based upon the aircraft mix using the airport, taxiways located between 3,000 and 5,500 feet from the landing threshold and separated by at least 750 feet are factored in the exit rating for the airfield. The greater the number of appropriately spaced taxiway exits, the lower the runway occupancy time for an aircraft, which contributes to a higher overall capacity for the airfield. Under this criterion, the airport generally has two taxiway exits that contribute to airfield capacity.

- **Aircraft Mix -** Aircraft mix refers to the speed, size, and flight characteristics of aircraft operating at the airport. As the mix of aircraft operating at an airport increases to include larger aircraft, airfield capacity begins to diminish. This is due to larger separation distances that must be maintained between aircraft of different speeds and sizes.

  Aircraft mix for the capacity analysis is defined by the FAA in terms of four aircraft classes, only three of which are reflected in the mix at MKC. Classes A and B consist of single- and multi-engine aircraft weighing less than 12,500 pounds. Aircraft within these classifications are primarily associated with GA operations, but this classification also includes some air taxi aircraft. Class C consists of aircraft weighing over 12,500 pounds but not exceeding 300,000 pounds. Class D aircraft are those over 300,000 pounds, which do not operate at the airport and thus are not included in the aircraft mix calculation.

  For the capacity analysis, the percentage of Class C aircraft operating at the airport impacts the ASV, as these classes include the larger and faster aircraft in the operational mix. The existing and projected operational fleet mix was previously shown in Table 2NN, which showed that more activity by larger business jets and turboprops is anticipated. By the long-term planning period, activity by aircraft weighing more than 12,500 pounds is estimated to represent 21.76 percent of overall operations. In the capacity model, capacity begins to be constrained when operations by aircraft in Class C exceed 20 percent. **Table 3C** summarizes the aircraft operational fleet mix as classified for the capacity model.

**TABLE 3C | Aircraft Operational Fleet Mix**

| Weather | Term | A & B[1] | C[2] |
|---|---|---|---|
| VFR (Visual) | Existing | 79.38% | 20.62% |
| | Short Term | 78.21% | 21.79% |
| | Intermediate Term | 78.24% | 21.76% |
| | Long Term | 78.24% | 21.76% |
| IFR (Instrument) | Existing / Future | 30.00% | 70.00% |

[1]Aircraft 12,500 lbs. or less
[2]Aircraft greater than 12,500 lbs. and less than 300,000 lbs.

*Source: Coffman Associates analysis using FAA AC 150/5060-5, Airport Capacity and Delay*

### Demand Characteristics

Operations—not only the total number of annual operations, but also the way in which they are conducted—have an influence on airfield capacity. Peak operational periods, touch-and-go operations, and the percentage of arrivals impact the number of annual operations that can be conducted at the airport.

- **Peak Period Operations -** For the airfield capacity analysis, average daily operations during the peak month are determined based upon airport traffic control tower (ATCT) data**.** Typical operational activity is important in the calculation of an airport's ASV, as "peak demand" levels occur sporadically. The peak periods used in the capacity analysis are representative of normal operational activity and can be exceeded at various times throughout the year. The design day of 405 operations is utilized for 2022. By 2042, the design day is estimated at 557 operations.

- **Touch-and-Go Operations -** A touch-and-go operation involves an aircraft making a landing and then an immediate takeoff without coming to a full stop or exiting the runway. Touch-and-go activity is counted as two operations, as both an arrival and a departure are involved. A high percentage of touch-and-go traffic normally results in a higher operational capacity because one landing and one takeoff occur within a shorter time period than individual operations. These operations are normally associated with GA training operations and are included in local operations data. Touch-and-go operations at the airport have historically averaged approximately 39 percent of total annual operations.

- **Percent Arrivals -** Under most circumstances, a lower percentage of arrivals correlates to a higher capacity. Except in unique circumstances, the aircraft arrival/departure split is typically 50/50.

## ESTIMATION OF ANNUAL SERVICE VOLUME

The preceding information was used in conjunction with the airfield capacity methodology developed by the FAA to determine airfield capacity for MKC.

**Table 3D** shows the calculation of the ASV, which is C (x) D (x) H. Following this formula, the current airfield capacity is estimated at 191,000 annual operations. With the increase of operations projected over time and the increasing number of operations by larger aircraft (requiring greater separation distances on landing), the ultimate ASV is estimated at 185,000 annual operations.

**TABLE 3D | Annual Service Volume Calculation**

| ASV Calculation Input | 2022 | Short Term | Intermediate Term | Long Term |
|---|---|---|---|---|
| C = Weighted hourly capacity | 92 | 92 | 91 | 90 |
| D = Ratio of annual demand to average daily demand during the peak month | 114,094 annual operations/405 design day operations = 282 | 133,326 annual operations/473 design day operations = 282 | 141,423 annual operations/502 design day operations = 282 | 157,008 annual operations/557 design day operations = 282 |
| H = Ratio of average daily demand to peak hour demand during the peak month | 405 design day operations/55 design hour operations = 7.36 | 473 design day operations/64 design hour operations = 7.36 | 502 design day operations/68 design hour operations = 7.36 | 557 design day operations/76 design hour operations = 7.36 |
| **Annual Service Volume = C x D x H** | **191,000** | **192,000** | **189,000** | **185,000** |
| *Note: ASV is rounded to nearest 1,000 and C/D/H ratios have fractions.* | | | | |

## Delay

As the number of aircraft operations approaches the airfield's capacity, increasing amounts of delay begin to occur for arriving and departing aircraft in all-weather conditions. Arriving aircraft delays result in aircraft holding outside the airport traffic area, while departing aircraft delays result in aircraft holding at the runway end until they can safely take off.

Currently, total annual delay at the airport is estimated at 456 hours (0.24 minutes per aircraft) (reference Figure 2.2, FAA AC 150/5060-5). If no capacity improvements are made, total annual delay can be expected to reach 837 hours (0.32 minutes per aircraft) by the long-term planning horizon. At times, delays five to ten times the average could be experienced by individual aircraft.

## Conclusion

**Table 3E** provides a comparison of the ASV at the operational levels for each planning horizon. The current level of operations represents 60 percent of the ASV. In 20 years, the percentage is projected to reach 85 percent of the ASV.

**TABLE 3E | Annual Service Volume Summary**

| | Annual Operations (rounded) | Weighted Hourly Capacity | Annual Service Volume (rounded) | Percent of Capacity |
|---|---|---|---|---|
| **EXISTING CONFIGURATION** | | | | |
| Existing | 114,000 | 92 | 191,000 | 60% |
| Short Term | 133,000 | 92 | 192,000 | 70% |
| Inter. Term | 141,000 | 91 | 189,000 | 75% |
| Long Term | 157,000 | 90 | 185,000 | 85% |

*Source: Coffman Associates analysis using FAA AC 150/5060-5, Airport Capacity and Delay*

FAA Order 5090.5, *Formulation of the NPIAS and ACIP*, indicates that improvements for airfield capacity purposes should be considered when operations reach 60 percent of the ASV and should have been implemented by the time operations reach 80 percent of the ASV. Therefore, this master plan study will consider future and ultimate projects that can increase airfield capacity.

## AIRSIDE REQUIREMENTS

The following section will examine the projected airside requirements, including runway length, runway width, pavement strength, line-of-sight, and gradient. The taxiway system will be examined with respect to current and future design standards for safety, including separation and wingtip clearances.

### RUNWAY CONFIGURATION

Runway 1-19 is the primary runway and is oriented in a north/south manner. For the operational safety and efficiency of an airport, it is desirable for the primary runway to be oriented as close as possible to the direction of the prevailing winds, which reduces the impact of wind components perpendicular to the direction of travel of an aircraft that is landing or taking off.

According to FAA Order 5100.38D, *Airport Improvement Handbook*, only one runway at any NPIAS airport is eligible for ongoing maintenance and rehabilitation funding unless the FAA Airport District Office (ADO) has made a specific determination that a crosswind or secondary runway is justified. A runway that is not a primary runway, crosswind runway, or secondary runway, is an *additional* runway, which is not eligible for FAA funding. It is not unusual for a two-runway airport to have a primary runway and an additional runway, and no crosswind or secondary runway. **Table 3F** presents the eligibility requirements for runway types.

**TABLE 3F | Runway Eligibility**

| For the following runway type… | Must meet all of the following criteria… | And is… |
|---|---|---|
| Primary Runway | 1. A single runway at an airport is eligible for development consistent with FAA design and engineering standards. | Eligible |
| Crosswind Runway | 1. The wind coverage on the primary runway is less than 95% | Eligible if justified |
| Secondary Runway | 1. There is more than one runway at the airport.<br>2. The non-primary runway is not a crosswind runway.<br>3. Either of the following:<br>a) The primary runway is operating at 60% or more of its annual capacity.<br>b) FAA has made a specific determination that the runway is required. | Eligible if justified |
| Additional Runway | 1. There is more than one runway at the airport.<br>2. The non-primary runway is not a crosswind runway.<br>3. The non-primary runway is not a secondary runway. | Ineligible |

*Source: FAA Order 5100.38D, AIP Handbook*

FAA AC 150/5300-13B, *Airport Design,* recommends a crosswind runway when the primary runway orientation provides for less than 95 percent wind coverage for specific crosswind components. The 95 percent wind coverage is computed based on wind not exceeding a 10.5-knot (12 mph) component for runway design code (RDC) A-I and B-I; 13-knot (15 mph) component for RDC A-II and B-II; 16-knot (18 mph) component for RDC A-III, B-III, C-I through C-III, and D-I through D-III; and 20 knots for wider wingspans.

It is preferable to analyze weather data that is local to the airport being studied. The ASOS weather sensor currently located at MKC is connected to the National Oceanic and Atmospheric Administration (NOAA) and the data is therefore available for analysis.

According to FAA guidelines, the most recent 10 years of wind data should be analyzed to determine various facility requirements, including the appropriate runway configuration. **Exhibit 3B** shows wind rose analysis of 10 years of wind data from MKC. A wind rose is a graphic tool that gives a succinct view of how wind speed and direction are historically distributed at a location. The table at the top of the wind rose indicates the percent of wind coverage for the runway at specific wind intensity.

Runway 1-19 provides 94.44 percent wind coverage at 10.5 knots and 97.21 percent wind coverage at 13 knots. Runway 4-22 provides 92.40 and 96.15 percent wind coverage at 10.5 and 13 knots, respectively. Combined, both runways provide for greater than 95 percent wind coverage at 10.5 knots and above. Because the primary runway provides less than 95 percent total wind coverage, a crosswind runway is justified. The crosswind runway is currently designed to RDC B-II-4000 standards.

Based on the primary runway's wind coverage falling below 95 percent at 10.5 knots, there is justification for applying A/B-I design standards to the crosswind runway today. Runway 4-22 is equipped with an ILS approach to Runway 4 which allows for IFR approaches from the south. This is an important capability, as Runway 1 does not have an instrument approach and many aircraft that might normally utilize Runway 1 can utilize Runway 4.

The FAA has indicated that Runway 4-22 is eligible as a secondary runway for the following reasons:

1. Runway 4-22 has regular use (500 or more annual operations) by aircraft greater than B-I (i.e. B-II/III and possibly C/D-II/III); and
2. Since the airport's ASV is currently 60 percent capacity, Runway 4-22 is needed as an eligible secondary runway for capacity purposes.

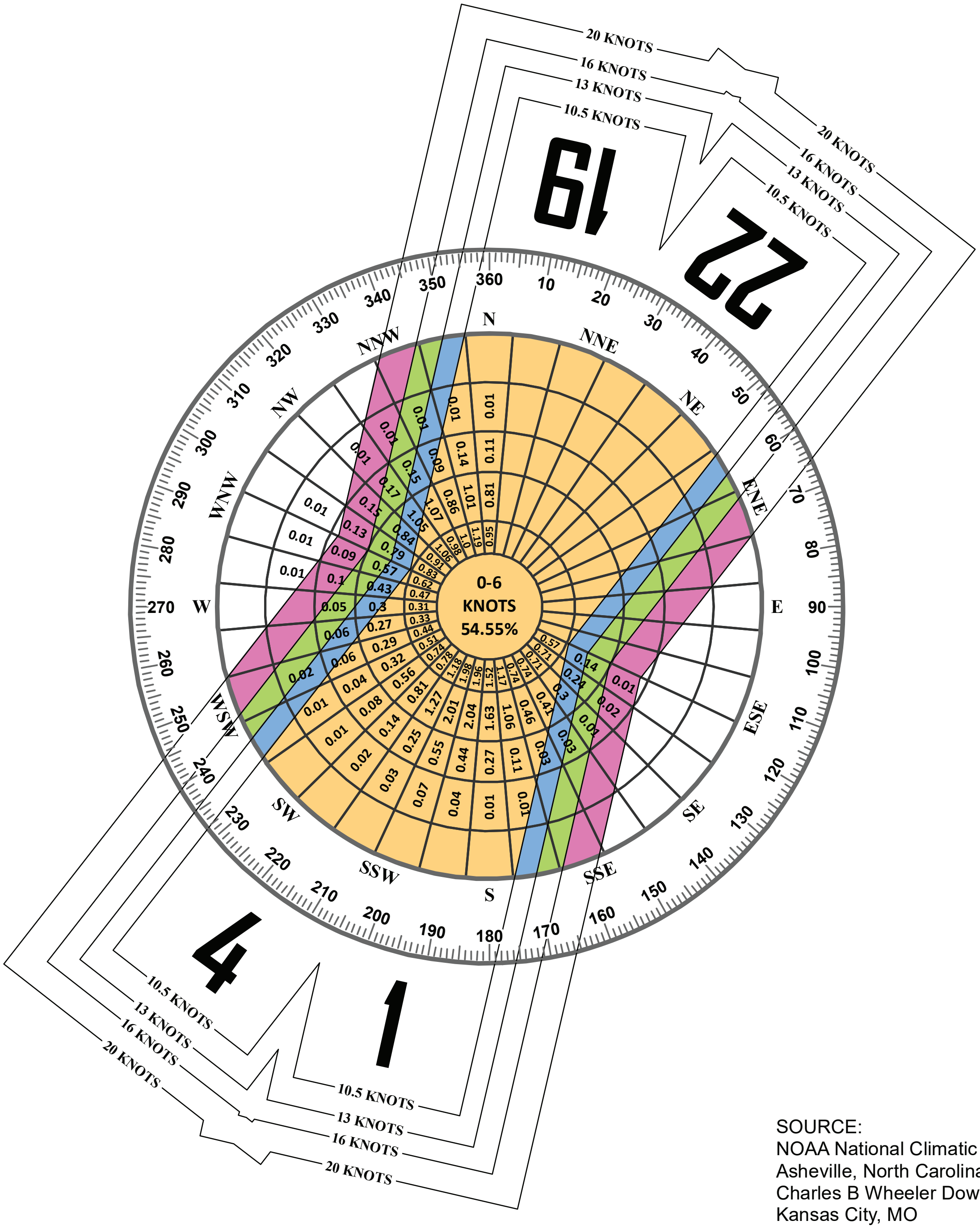
It is recommended that airport management maintain Runway 1-19 as RDC D-III-4000 to meet the needs of the current and future critical aircraft. Crosswind Runway 4-22 should be maintained as RDC B-II-4000 to allow usage by the critical aircraft that might normally utilize Runway 1 and to enhance overall airport operational capacity.

## PAVEMENT CONDITION

The Missouri Department of Transportation (MODOT), Multimodal Operations – Aviation Section, inspected pavements at airports across the state, including MKC, as part of the Missouri Airport Pavement Management System. MODOT performs this service as a benefit to airports so that they can meet their FAA obligations under Grant Assurance number 11, which requires airports to "implement an effective airport pavement maintenance-management program."

## ALL WEATHER WIND COVERAGE

| Runways | 10.5 Knots | 13 Knots | 16 Knots | 20 Knots |
|---|---|---|---|---|
| Runway 1-19 | 94.44% | 97.21% | 99.31% | 99.87% |
| Runway 4-22 | 92.40% | 96.15% | 99.08% | 99.83% |
| All Runways | 95.74% | 98.08% | 99.57% | 99.94% |



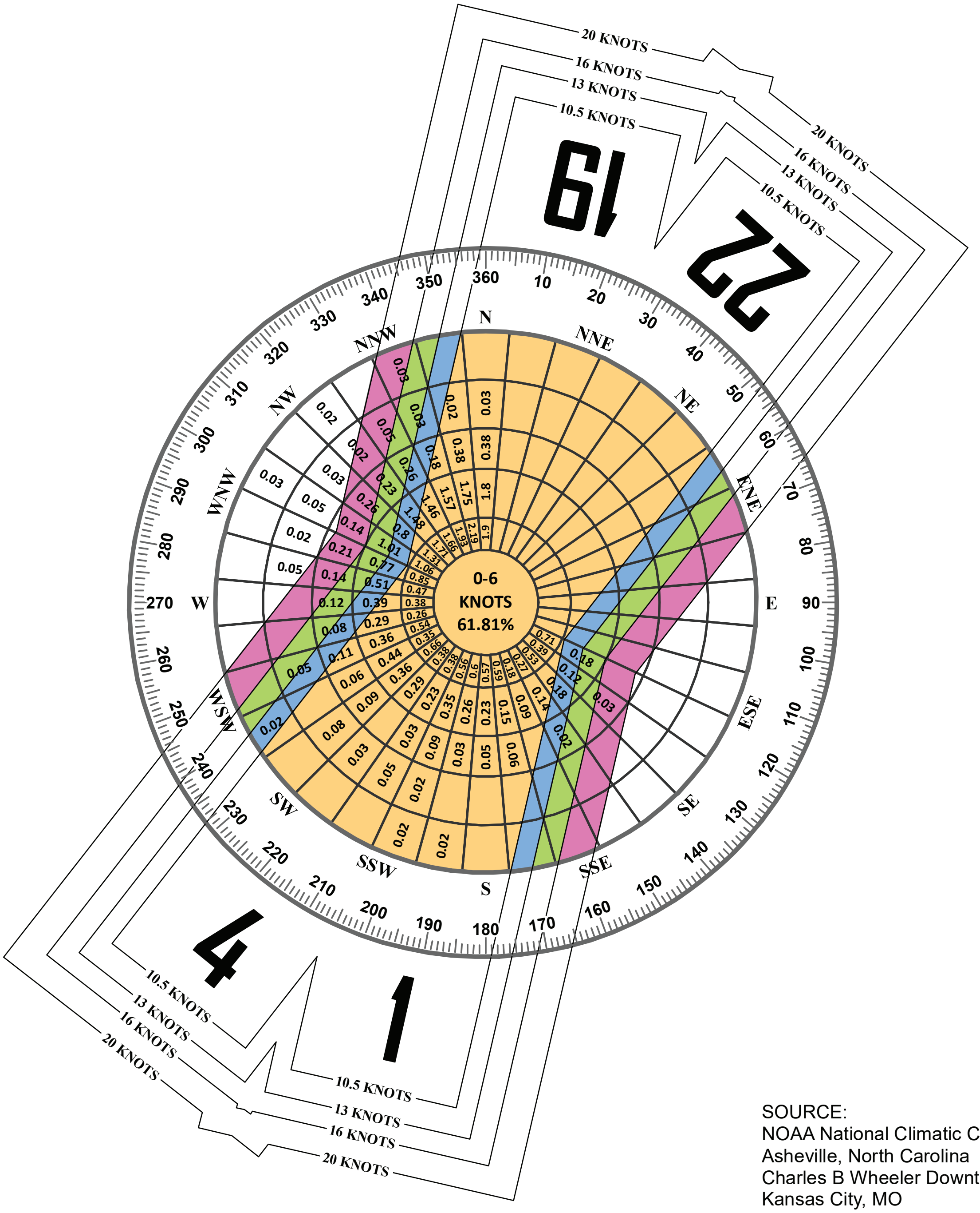
SOURCE:
NOAA National Climatic Center
Asheville, North Carolina
Charles B Wheeler Dowtown Airport
Kansas City, MO

OBSERVATIONS:
103,774 All Weather Observations
Jan. 1, 2013 - Dec, 31 2022

**Exhibit 3B**
**WINDROSES**

## IFR WIND COVERAGE

| Runways | 10.5 Knots | 13 Knots | 16 Knots | 20 Knots |
|---|---|---|---|---|
| Runway 1-19 | 93.61% | 96.67% | 99.01% | 99.74% |
| Runway 4-22 | 92.70% | 96.11% | 98.89% | 99.70% |
| All Runways | 95.54% | 97.89% | 99.40% | 99.86% |



SOURCE:
NOAA National Climatic Center
Asheville, North Carolina
Charles B Wheeler Downtown Airport
Kansas City, MO

OBSERVATIONS:
11,728 IFR Observations
Jan. 1, 2013 - Dec, 31 2022

In the summer of 2021, MODOT undertook airport pavement condition assessments. The assessment serves as a tool to identify system pavement needs, shape programming decisions for federal and state grant aid, provide information for legislative decision-making, and assist airport sponsors in making informed planning decisions. The assessment also develops accurate pavement inventories and identifies necessary maintenance, repair, rehabilitation, and reconstruction projects.

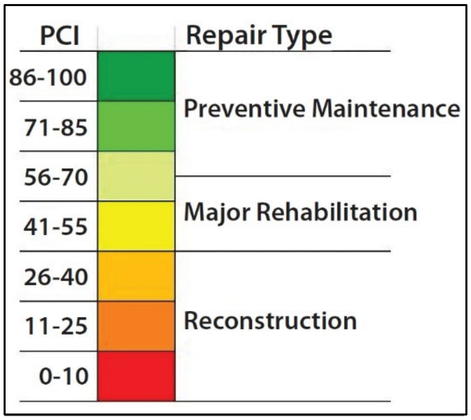
The assessment is conducted using the pavement condition index (PCI) procedure documented in the following publications:

1. FAA AC 150/5380-6B, *Guidelines and Procedures for Maintenance of Airport Pavements*
2. FAA AC 150/5380-7B, *Airport Pavement Management Program (PMP)*
3. American Society for Testing and Materials (ASTM) D-5340, *Standard Test Method for Airport Pavement Condition Index Surveys*

The PCI procedure is the standard used by the aviation industry to visually assess pavement condition. It was developed to provide engineers with a consistent, objective, and repeatable tool to represent the overall pavement condition. During a PCI survey, visible signs of deterioration within a selected sample area are identified, recorded, and analyzed.

The results of a PCI evaluation provide an indication of the structural integrity and functional capabilities of the pavement. However, it should be recognized that during a PCI inspection, only the top layer of the pavement is examined, and no direct measure is made of the structural integrity of the pavement system. Nevertheless, the PCI does provide an objective basis for determining maintenance and repair needs, as well as for establishing rehabilitation priorities in the face of constrained resources. Furthermore, the results of repeated PCI monitoring over time can be used to determine the rate of deterioration and to estimate the time at which certain rehabilitation measures can be implemented.

Exhibit 1K, previously presented in Chapter One – Inventory, shows the PCI map produced for the airport following the 2021 inspections. PCI pavement condition values are rated on a 0-100 scale, with zero being failed pavement and 100 being new pavement. The map colors generally indicate various levels of maintenance or reconstruction that may be needed and/or should be planned. The color-coding system is outlined in **Figure 3-1**.



| PCI | | Repair Type |
|---|---|---|
| 86-100 | 🟩 | Preventive Maintenance |
| 71-85 | 🟩 | |
| 56-70 | 🟨 | Major Rehabilitation |
| 41-55 | 🟨 | |
| 26-40 | 🟧 | Reconstruction |
| 11-25 | 🟧 | |
| 0-10 | 🟥 | |

*Figure 3-1: PCI Rating*

Primary Runway 1-19 has PCI values ranging from 91 to 99. Crosswind Runway 4-22 has PCI values below 52; however, this runway is scheduled for major rehabilitation in the summer of 2023, at which time it will be re-marked as Runway 4-22, as previously noted. The taxiway segments have a wide range of PCI values, with some in need of reconstruction and others being in very good shape. Several apron areas are currently in a failed condition. Later in this master plan, the capital improvement program will include a schedule for pavement maintenance, rehabilitation, or reconstruction based on the PCI values of the airport pavements.

## DECLARED DISTANCES

Declared distances are used to define the effective runway length for landing and takeoff when a standard safety area cannot be achieved. The declared distances include:

- Takeoff Run Available (TORA) – the runway length declared available and suitable for the ground run of an aircraft taking off (factors in the positioning of the departure RPZ);
- Takeoff Distance Available (TODA) – the TORA plus the length of any remaining runway or clearway beyond the far end of the TORA; the full length of the TODA may need to be reduced because of obstacles in the departure area;
- Accelerate-Stop Distance Available (ASDA) – the runway plus stopway length declared available and suitable for the acceleration and deceleration of an aircraft aborting a takeoff (factors in the length of RSA/ROFA beyond the runway end); and
- Landing Distance Available (LDA) – the runway length declared available and suitable for landing an aircraft (factors in the length of RSA/ROFA beyond the runway end and the positioning of the approach RPZ).

At MKC, declared distances are currently in effect for both runways to achieve standard safety areas (to be described in the next section) and/or to eliminate penetrations to the departure surface. The existing declared distances are outlined in **Table 3G** and illustrated on **Exhibit 3C**.

**TABLE 3G | Existing Declared Distances**

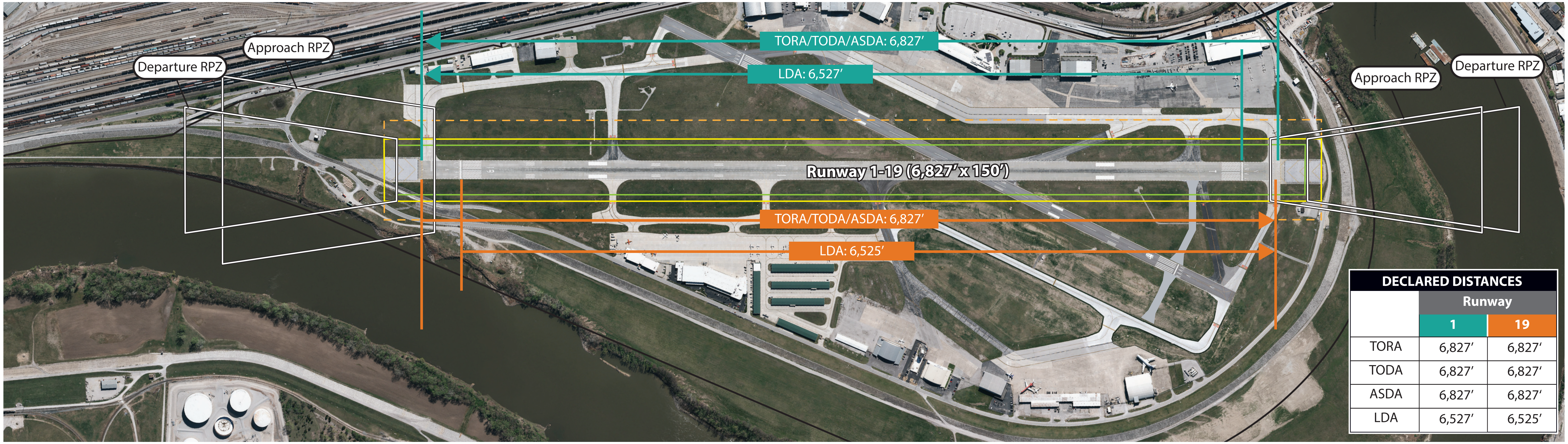
| Declared Distance | Runway 1 | Runway 19 | Runway 4 | Runway 22 |
|---|---|---|---|---|
| TORA | 6,827 feet | 6,827 feet | 5,050 feet | 5,050 feet |
| TODA | 6,827 feet | 6,827 feet | 5,050 feet | 5,050 feet |
| ASDA | 6,827 feet | 6,827 feet | 4,770 feet | 5,050 feet |
| LDA | 6,527 feet | 6,525 feet | 4,270 feet | 4,351 feet |

*Source: Advisory Circular (AC) 150/5300-13B, Airport Design*

The TORA and TODA do not involve consideration of the RSA beyond the runway ends. The ASDA and LDA must include the standard RSA beyond the ends of the runway. Where EMAS is present, it provides the equivalent level of safety as a standard RSA. As noted previously the standard RSA for Runway 1-19 extends 1,000 feet beyond the runway ends except where EMAS is present, in which case it ends at the back end of the EMAS bed. The standard RSA for Runway 4-22 extends 300 feet beyond the runway ends. The following documents how the declared distances are determined and applied at MKC currently:

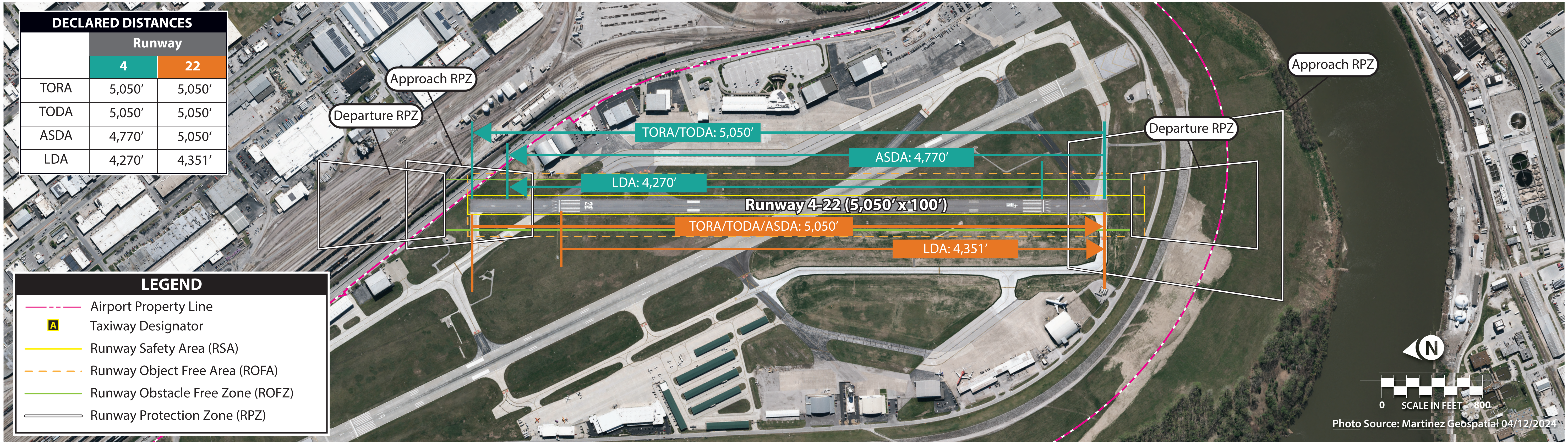
### Runway 1

- **TORA/TODA:** Full pavement length 6,827’.
- **ASDA:** Measured from the back end of Runway 1 and extends 6,827’ to the other pavement end. The presence of EMAS at the far end of Runway 1 departures (behind Runway 19) assumes full RSA equivalency even though it is less than 1,000’ in length (the RSA standard length beyond the runway end). ***The ASDA is published at 6,827’, which is correct by the mathematical calculation.***



**DECLARED DISTANCES**

| | Runway | |
|---|---|---|
| | 1 | 19 |
| TORA | 6,827′ | 6,827′ |
| TODA | 6,827′ | 6,827′ |
| ASDA | 6,827′ | 6,827′ |
| LDA | 6,527′ | 6,525′ |



**DECLARED DISTANCES**

| | Runway | |
|---|---|---|
| | 4 | 22 |
| TORA | 5,050′ | 5,050′ |
| TODA | 5,050′ | 5,050′ |
| ASDA | 4,770′ | 5,050′ |
| LDA | 4,270′ | 4,351′ |

**LEGEND**

- -·-·- Airport Property Line
- A Taxiway Designator
- ── Runway Safety Area (RSA)
- – – – Runway Object Free Area (ROFA)
- ── Runway Obstacle Free Zone (ROFZ)
- ═ Runway Protection Zone (RPZ)

Photo Source: Martinez Geospatial 04/12/2024

## Exhibit 3C
## EXISTING DECLARED DISTANCES

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- **LDA:** The Airport Facility Directory (AFD) states that the landing threshold to Runway 1 is displaced by 299’. It also states that the LDA is 6,527’. ***It should be 6,528’ by the mathematical calculation which is likely the result of rounding.***

**Runway 19**

- **TORA/TODA:** Full pavement length 6,827’
- **ASDA:** Measured from the back end of Runway 19 and extends the full length of the pavement because of the presence of EMAS on the Runway 1 end which provides the full RSA equivalency. The ASDA is 6,827’. ***The ASDA is published at 6,827, which is correct by the mathematical calculation.***
- **LDA:** The landing threshold to Runway 19 is displaced by 302’ according to the AFD. Therefore, the LDA calculated as 6,827’ – 302’ = 6,525’. ***The LDA is published as 6,525’, which is correct by the mathematical calculation.***

**Runway 4**

- **TORA/TODA:** Full pavement length 5,050’
- **ASDA:** The ASDA for Runway 4 is published at 4,770’ which would indicate that the far end of the runway is declared to be 280 feet short of the pavement end. The reason for declaring the runway to be shorter than the pavement is the ASDA must include an RSA that meets standard by extending obstruction free 300’ beyond the declared end. There are only 20 feet of unobstructed RSA beyond the Runway 22 pavement end, therefore, for pilot calculation of available takeoff length (i.e. ASDA), the runway is declared to be 280 feet shorter than the end of the runway (5,050’ – 280’ = 4,770’). ***The ASDA is published as 4,770’, which is correct by the mathematical calculation.***
- **LDA:** The Runway 4 LDA is published at 4,270 feet. The landing threshold is displaced by 500 feet as published. The LDA must also provide for the full 300 feet of RSA beyond the runway end, therefore the LDA calculation includes the 500-foot displaced landing threshold and the 280-foot declared end of the runway (5,050’ - 500’ - 280’ = 4,270’). ***The LDA is published as 4,270’, which is correct by the mathematical calculation.***

**Runway 22**

- **TORA/TODA:** Full pavement length 5,050’
- **ASDA:** The ASDA for Runway 22 is published at 5,050’, the full runway length. This is correct as the RSA extends the full 300’-foot standard obstruction free beyond the runway end (behind Runway 4). ***The ASDA is published at 5,050’, which is correct by mathematical calculation.***
- **LDA:** The landing threshold to Runway 22 has a published displacement of 699’ (5,050’ – 699’ = 4,351’). ***The LDA is published as 4,351’, which is correct by the mathematical calculation.***

As part of this master plan, a new aerial survey of the airport has been undertaken. This data will be uploaded to the official FAA Airport Geographic Information System (AGIS) and the FAA Airport Data Information Portal (ADIP). This survey is developed following FAA protocol, and it will ultimately serve as the official survey data for the airport. It is not uncommon for the AGIS survey to improve upon past surveys of the airport and for certain elements to change, including the length of the runway. In subsequent chapters and on the airport layout plan, the new survey data will be applied to the future condition of the airport. Where appropriate, adjustments to the current declared distances will be made.

## RUNWAY DESIGN STANDARDS

The FAA has established several imaginary surfaces to protect aircraft operational areas and keep them free from obstructions that could affect their safe operation. These include the runway safety area (RSA), runway object free area (ROFA), runway obstacle free zone (OFZ), and runway protection zone (RPZ).

The RSA and OFZ areas must be owned by the airport, be maintained free of obstacles, and be readily accessible by maintenance and emergency personnel. If either of these two runway protection surfaces cannot meet the FAA standard, then other options must be considered, including shortening runways. The ROFA should also be under the ownership of the airport. Under certain special conditions that are approved by the FAA, some ROFA deficiencies may be permissible.

It is not required that the RPZs be under airport ownership, but it is strongly recommended by the FAA. An alternative to outright ownership of the RPZs is the purchase of avigation easements (acquiring control of designated airspace within the RPZ) or having land use control measures in place (i.e., zoning) to ensure the RPZ remains free of incompatible development.

Dimensional standards for the various safety areas associated with the runways are a function of the type of aircraft expected to use the runways, as well as the instrument approach visibility minimums. Runway 1-19 should meet the design standards for RDC D-III-4000, at a minimum, in the current and ultimate conditions. Consideration will also be given to the potential for visibility minimums below ¾-mile to Runway 1, which would be reflective of RDC D-III-2400. The Alternatives chapter will include additional information about establishing an instrument approach procedure to Runway 1. Runway 4-22 should meet the design standards for RDC B-II-4000 in the current and ultimate conditions. **Exhibit 3D** presents the runway design standards for both runways in the current and ultimate conditions. **Exhibit 3E** shows the imaginary surfaces associated with both runways.

### Runway Safety Area (RSA)

The RSA is defined in FAA AC 150/5300-13B, *Airport Design*, as a “surface surrounding the runway prepared or suitable for reducing the risk of damage to aircraft in the event of undershoot, overshoot, or excursion from the runway.” The RSA is centered on the runway and dimensioned in accordance with the approach speed of the critical aircraft using the runway. The FAA requires the RSA to be cleared and graded, drained by grading or storm sewers, capable of accommodating the design aircraft and fire and rescue vehicles, and free of obstacles not fixed by navigational purpose.

| | Runway 1-19 | | | | Runway 4-22 | | | |
|---|---|---|---|---|---|---|---|---|
| | Current/Ultimate Design Standard | | Current Condition | | Current/Ultimate Design Standard | | Current Condition | |
| Airport Design Aircraft | D-III-2B / D-III-3 | | D-III-3 | | B-II-2B | | B-II-2B | |
| Runway Design Code | D-III-4000 | | D-III-4000 | | B-II-4000 | | B-II-4000 | |
| Visibility Minimums | ¾-mile | | ¾-mile | | ¾-mile | | ¾-mile | |
| **RUNWAY DESIGN** | | | | | | | | |
| Runway Width | 100' / 150' | | **150′** | | 75′ | | **100′** | |
| Runway Shoulder Width | 20′ | | 20′ | | 10′ | | 10′ | |
| Blast Pad Length/Width (if provided) | 200′ x 140′ | | 200′ x 140′ | | 100′ x 80′ | | 100′ x 80′ | |
| EMAS Length/Width | 263′ x 170′ (Rwy 1)<br>287′ x 170′ (Rwy 19) | | 263′ x 170′ (Rwy 1)<br>287′ x 170′ (Rwy 19) | | NA<br>NA | | NA<br>NA | |
| **RUNWAY PROTECTION** | | | | | | | | |
| Runway Safety Area (RSA) | | | | | | | | |
| Width | 500′ | | 500′ | | 150′ | | 150′ | |
| Length Beyond Departure End | 1,000′ | | 1,000′[1] | | 300′ | | 300′ | |
| Length Prior to Threshold | 600′ | | 600′ | | 300′ | | 300′ | |
| Runway Object Free Area (ROFA) | | | | | | | | |
| Width | 800′ | | 800′ | | 500′ | | 500′[2] | |
| Length Beyond Departure End | 1,000′ | | 1,000′[1] | | 300′ | | 300′[2] | |
| Length Prior to Threshold | 600′ | | 600′ | | 300′ | | 300′ | |
| Runway Obstacle Free Zone (OFZ) | | | | | | | | |
| Width | 400′ | | 400′ | | 400′ | | 400′[3] | |
| Length Beyond End | 200′ | | 200′ | | 200′ | | 200′[3] | |
| Approach Runway Protection Zone (RPZ) | Rwy 1 | Rwy 19 | Rwy 1 | Rwy 19[4] | Rwy 4 | Rwy 22 | Rwy 4 | Rwy 22[4] |
| Length | 1,700′ | 1,700′ | 1,700′ | 1,700′ | 1,700′ | 1,000′ | 1,700′ | 1,000′ |
| Inner Width | 500′ | 1,000′ | 500′ | 1,000′ | 1,000′ | 500′ | 1,000′ | 500′ |
| Outer Width | 1,010′ | 1,510′ | 1,010′ | 1,510′ | 1,510′ | 700′ | 1,510′ | 700′ |
| Departure Runway Protection Zone (RPZ) | Rwy 1 | Rwy 19 | Rwy 1[4] | Rwy 19 | Rwy 4 | Rwy 22 | Rwy 4[4] | Rwy 22 |
| Length | 1,700′ | 1,700′ | 1,000′ | 1,700′ | 1,000′ | 1,000′ | 1,000′ | 1,000′ |
| Inner Width | 500′ | 500′ | 500′ | 500′ | 500′ | 500′ | 500′ | 500′ |
| Outer Width | 1,010′ | 1,010′ | 700′ | 1,010′ | 700′ | 700′ | 700′ | 700′ |
| **RUNWAY SEPARATION** | | | | | | | | |
| Runway Centerline to: | | | | | | | | |
| Holding Position | 258′ | | **250′[5]**/258′ | | 200′ | | **250′** | |
| Parallel Taxiway | 400′ | | 400′/**413′[6]** | | 240′ | | **358′** | |

Note: All dimensions in feet. **BOLD** figures are non-standard.

[1] RSA and ROFA dimensions meet standard due to the presence of EMAS.

[2] The ROFA length and width are penetrated by the perimeter fence, Richards Rd., and Highway 169.

[3] The OFZ length and width are penetrated by the perimeter fence, Richards Rd., and Highway 169.

[4] RPZs contain incompatible land uses; primarily public roads.

[5] Holdlines on westside Taxiways K and E are 250' from centerline.

[6] Parallel portion of Taxiway G is 413' from centerline.

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

**Exhibit 3D**
**RUNWAY DESIGN STANDARDS**

In accordance with FAA Order 5300.1G, *Modifications to Agency Airport Design, Construction, and Equipment Standards*, the FAA will not consider a modification of standards to address non-standard RSA dimensions. RSA dimensional standards remain in effect regardless of the presence of natural or man-made objects or surface conditions that preclude meeting full RSA standard dimensions.

A Modification of Standard (MOS) may be considered for RSA grading where existing conditions may not allow for a feasible cost-beneficial solution. Such is the case at MKC where the RSA at the northwest boundary rises approximately four feet from the runway end elevation. This rise is required as it is part of the levee system surrounding the Missouri River. Previous planning and environmental studies undertaken in 2008-2010, in association with the installation of the EMAS, documented that modifications to the levee were not permitted because of the "no-rise" requirement for the river, which means that no fill could be placed outside of the levee within the Missouri River floodway.

### *Runway 1-19 RSA*

For Runway 1-19, the D-III RSA design standard calls for it to be 500 feet wide as centered on the runway and extending 1,000 feet beyond the ends of the runway. On the current footprint of the runway, the standard RSA on the Runway 19 end would extend over public roads and would thus be non-standard. On the Runway 1 end, the standard RSA would extend across a public road and through the Missouri River levee, which would be non-standard. In lieu of shortening the runway to achieve the standard RSA, the FAA and the airport installed an Engineered Materials Arresting System (EMAS) on both ends of the runway. EMAS is crushable concrete that is designed to slow to a stop an aircraft that overruns the runway. According to FAA AC 150/5300-13B, *Airport Design*, "EMAS is an acceptable alternative where it is not practicable to obtain the standard RSA dimensions." Therefore, the RSA length beyond the runway ends is the back edge of the EMAS bed. The AC also states, "The presence of EMAS does not diminish the standard RSA width."

On the Runway 19 end, the RSA is 500 feet wide and extends 298 feet from the end of the runway. This distance includes a 35-foot paved lead-in area and the EMAS bed, which is 263 feet long. This EMAS bed is not a standard rectangle shape because of the location of the river levee, which required that the northwest corner of the EMAS bed be truncated. On the Runway 1 end, there is a 35-foot paved lead-in area followed by the EMAS bed, which is 287 feet long. Therefore, the RSA beyond Runway 1 extends 322 feet beyond the end of the runway pavement.

Because EMAS is not a substitute for RSA width, the width of the RSA remains 500 feet as centered on the runway. The northwest corner of the RSA on the Runway 19 end does not technically meet RSA grading standards, which call for the first 200 feet of the RSA to be level with the runway end elevation or slope gently downward between zero to three percent. The northwest corner slopes upward approximately four feet due to the presence of the river levee. The perimeter fence in this location is also an RSA penetration. On the Runway 1 end, the southeast corner of the RSA extends across NW Lou Holland Drive, a public roadway.

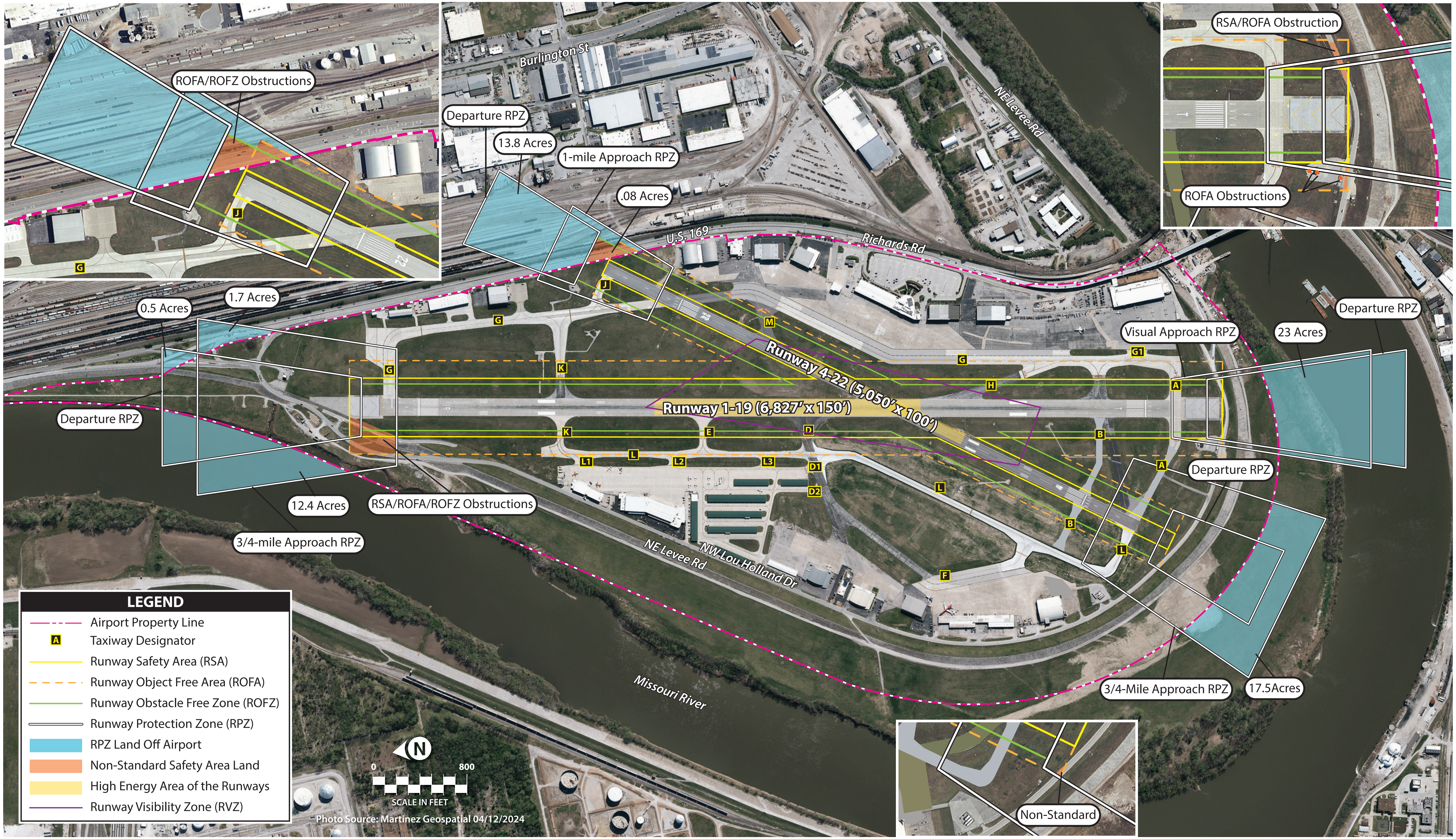

Photo Source: Martinez Geospatial 04/12/2024

Exhibit 3E
AIRFIELD SAFETY AREAS

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These non-standard RSA conditions were evaluated in detail when installation of the EMAS beds was being considered. FAA Order 5200.8, *Runway Safety Area Program*, outlines FAA procedures for evaluating RSAs. The procedure includes a formal determination from the FAA regarding RSA. The possible determinations are:

1. The existing RSA meets current standards.
2. The existing RSA does not meet current standards but can be improved to meet standards.
3. The existing RSA can be improved to enhance safety, but the RSA will still not meet standards.
4. The existing RSA does not meet current standards, and it is impracticable to improve the RSA.

At the time, the FAA determined that option number 3 was the most appropriate with the installation of the EMAS beds. Since nothing has changed since the installation of the EMAS beds, the same determination for the RSA can be applied today. Nevertheless, if opportunities to improve and enhance the RSA for Runway 1-19 are identified during the alternatives evaluation process in this master plan, those will be explored. However, no option that would shorten the runway to such a length as to negatively impact operations of the critical aircraft will be carried forward. This follows guidance contained in FAA AC 150/5220-22B, *Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns*, which states, “The FAA does not require an airport operator to reduce the length of a runway or declare its length to be less than the actual pavement length to meet RSA standards if there is an adverse operational impact to the airport.”

EMAS is not a substitute for RSA dimensional standards prior to landing. Runway 1-19 requires 600 feet of RSA prior to landing. To achieve this distance, both ends of the runway have displaced landing thresholds. On the Runway 1 end, the landing threshold is displaced 299 feet. On the Runway 19 end, the landing threshold is displaced 302 feet. The provision of 600 feet of RSA prior to landing through displaced landing thresholds should be maintained.

### *Runway 4-22 RSA*

The standard RSA for crosswind Runway 4-22 is 150 feet wide as centered on the runway and it extends 300 feet beyond the runway ends. Behind the Runway 4 end, the RSA fully meets the RSA design standard. Behind the Runway 22 end, a standard RSA is not feasible as it would extend through the perimeter fence, across Richards Road, and across U.S. 169 Highway. As a result, declared distances have been applied to the runway. Those departing using Runway 4 have 4,770 feet available, which means the runway end is 280 feet shorter than the runway pavement length. By declaring the runway shorter than the actual pavement length, that distance is applied to the RSA length beyond the runway end. Therefore, with declared distances, both ends of Runway 4-22 meet current RSA standards, which should be maintained.

## **Runway Object Free Area (ROFA)**

The ROFA is “a two-dimensional ground area, surrounding runways, taxiways, and taxilanes, which is clear of objects except for objects whose location is fixed by function (i.e., airfield lighting, signs, etc.).” The ROFA does not have to be graded and level like the RSA; instead, the primary requirement for the ROFA is that no object in the ROFA penetrates the lateral elevation of the RSA. The runway ROFA is centered on the runway, extending out in accordance with the critical aircraft design category utilizing the runway.

According to FAA AC 150/5300-13B, *Airport Design*, the principal purpose of the ROFA is to ensure:

1. Development buffer in proximity to a runway, and
2. Wing clearance for a runway excursion event to the outer limit of the RSA.

*Runway 1-19 ROFA*

The ROFA for Runway 1-19 is 800 feet wide, centered on the runway, and extends the same distance as the RSA. Under normal circumstances, the ROFA would extend 1,000 feet beyond each runway end. However, as noted in the RSA discussion, EMAS is in place beyond the runway ends, therefore, the ROFA ends where the RSA ends. Behind the Runway 1 end, the ROFA ends 322 feet from the end of the pavement. Behind the Runway 19 end, the ROFA ends 298 feet from the end of the runway pavement.

Like the RSA, the presence of EMAS does not impact the width of the ROFA. Behind the Runway 1 end, the width of the ROFA is penetrated by two small structures associated with the localizer and a wastewater treatment facility on the west side of the extended runway centerline. All three of these structures would ideally be removed from the ROFA. The public roadway and the perimeter fence also slightly penetrate the ROFA behind the Runway 1 end.

On the Runway 19 end, the ROFA has the same river levee penetration as the RSA as well as the perimeter fence. In fact, Lou Holland Drive used to be atop the levee; however, the road was shifted to the west during the EMAS installation project in 2011. Because of the extensive study involved in the EMAS project, the ROFA penetration in this location is not considered to be a hazard. Therefore, no specific alternatives will be developed to remedy this relatively minor ROFA penetration. If the alternatives developed in the next section of this master plan do show changes to the runway, then an effort will be made to provide an ROFA that fully meets standard.

*Runway 4-22 ROFA*

The ROFA design standard for Runway 4-22 is 500 wide and extends 300 feet beyond the runway ends. On the Runway 4 end, a small corner of the ROFA extends through the perimeter fence and onto Lou Holland Drive. On the Runway 22 end, the ROFA ends at the same location as the RSA (due to declared distances), however, the width of the ROFA in this location extends through the perimeter fence, across Richards Road, and across U.S. 169 Highway and onto the adjacent rail yard. The depth of the ROFA penetration beyond the perimeter fence is 250 feet. If feasible, the ROFA on both ends of Runway 4-22 should meet standard. The feasibility of meeting the ROFA standard will be examined in the alternatives chapter. **Figure 3-2** shows the details of this area.

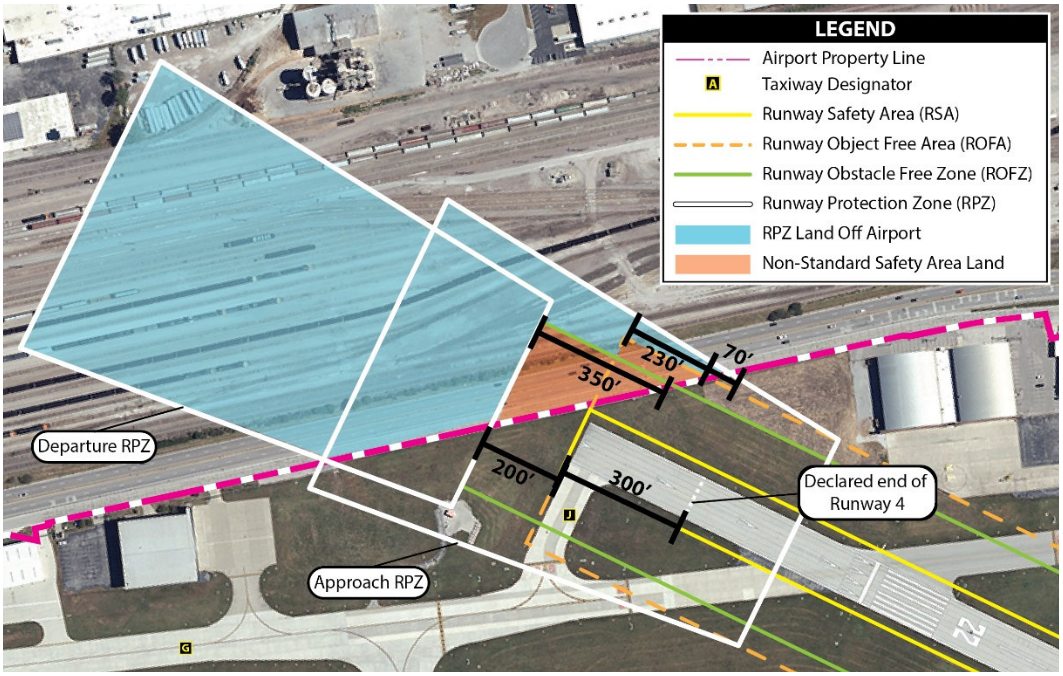


*Figure 3-2: Non-Standard ROFA/ROFZ for Runway 22 End*

## Runway Obstacle Free Zone (ROFZ)

The OFZ is an imaginary surface that precludes object penetration, including taxiing and parked aircraft. The only allowance for OFZ obstructions is for navigational aids mounted on frangible bases, which are fixed in their location by function(such as airfield signs). The ROFZ is established to ensure the safety of aircraft operations. If the ROFZ is obstructed, the airport's approaches could be removed, or approach minimums could be increased. The base elevation of the ROFZ is that of the highest runway elevation at that particular location.

The ROFZ for both runways is 400 feet wide, extending 200 feet beyond the physical runway ends. The presence of declared distances or displaced landing thresholds does not impact the ROFZ. Like the RSA, the FAA will not consider a modification of standards to address non-standard ROFZs.

### *Runway 1-19 ROFZ*

Behind the Runway 1 end, the ROFZ fully meets standard, which should be maintained. Behind the Runway 19 end, the northwest corner of the ROFZ is penetrated by the river levee and the perimeter fence (like the RSA and ROFA). As noted previously, the levee cannot be lowered and the ROFZ penetration is very minor. Therefore, no specific alternatives to lower the levee will be considered, however if other alternatives developed in the next chapter propose altering the runway, an effort will be made to bring the ROFZ to standard.

*Runway 4-22 ROFZ*

Behind the Runway 4 pavement end, the ROFZ fully meets the design standard, which should be maintained. Behind the Runway 22 end, the ROFZ does not meet the design standard. The east side of the ROFZ (a length of approximately 340 feet) extends through the perimeter fence, across Richards Road, across U.S. 169 Highway, and into the railroad yard on the east side of U.S. 169 Highway. If feasible, the ROFZ should meet the design standard. The alternatives chapter of this master plan will explore options for meeting the ROFZ standard. **Figure 3-2** shows the details of this area.

### Precision Obstacle Free Zone (POFZ)

The POFZ is a volume of airspace above an area beginning at the landing thresholds of runways supporting vertically guided instrument approaches with cloud ceiling minimums of less than 250 feet or visibility minimums of less than ¾ mile. The POFZ extends 200 feet prior to the landing threshold and is 800 feet wide. The POFZ is only in effect when an aircraft is on final approach within two miles of the runway threshold.

The ILS approaches to Runway 19 and Runway 4 provide vertically guided approaches; however, neither provides minimums below 250 feet or below ¾ mile. Therefore, there is currently no POFZ at the airport. If the cloud ceiling or visibility minimums are lowered for the ILS approaches in the future, then the POFZ would be in effect when an aircraft is on final approach.

### Part 77 Primary Surface

The FAA has identified several imaginary surfaces surrounding airports that are used for obstruction evaluation. Each of these surfaces are described in detail in the appendix that includes the airport layout plan. One of these surfaces, the Primary Surface, has been considered at length during previous planning efforts for MKC.

The Primary Surface is longitudinally centered on a runway. The Primary Surface extends 200 feet beyond both ends of the that runway. The elevation of any point on the Primary Surface is the same as the elevation of the nearest point on the runway centerline. Primary surface widths vary with the classification of the runway; however, the width is uniform throughout and is based on the most precise approach existing or planned for either end of that runway.

The Primary Surface for Runway 4-22 is 1,000 feet wide because the runway is a non-utility runway having a non-precision instrument approach with visibility minimums of ¾-miles or lower. The Primary Surface extends over Hangar 5 at MKC as shown on **Figure 3-3**. It was determined during the previous planning efforts that when Hangar 5 is slated for demolition, no replacement hangars should be constructed in its place that would also penetrate the Primary Surface. There are other penetrations to the Primary Surface, however, the airport has control over Hangar 5, therefore, the airport can remediate this Primary Surface penetration by not allowing a replacement structure.

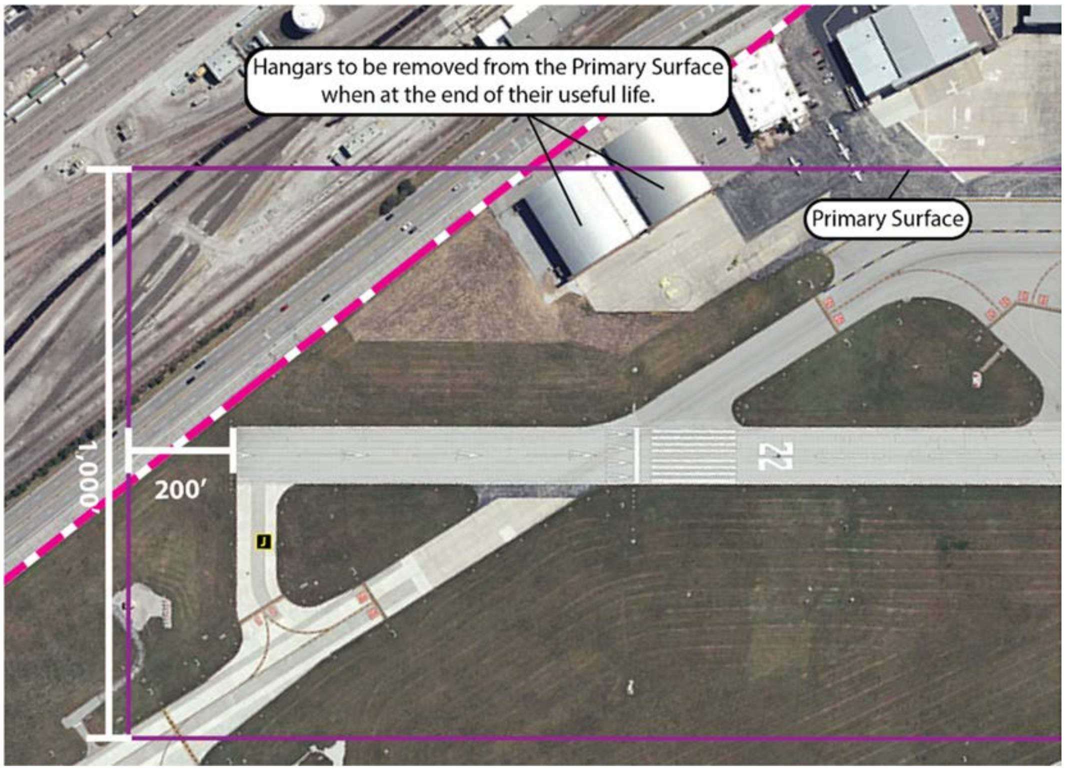


*Figure 3-3: Primary Surface Penetrations*

**Runway Protection Zone (RPZ)**

The RPZ is a trapezoidal area centered on the runway, typically beginning 200 feet beyond the runway end. When an RPZ begins at a location other than 200 feet beyond the end of a runway, two RPZs are required (i.e., a departure RPZ and an approach RPZ). The RPZ has been established by the FAA to provide an area clear of obstructions and incompatible land uses to enhance the protection of people and property on the ground.

On September 16, 2022, the FAA published AC 150/5190-4B, *Airport Land Use Compatibility Planning*. This AC represented a significant effort to address RPZ land use compatibility. Airport-compatible land uses are those that can coexist with a nearby airport without constraining the safe and efficient operations of the airport. Assuring compatible land uses within the RPZ is best achieved through:

1. Airport ownership of the RPZ property;
2. Possessing sufficient interest in the RPZ property through easements, deed restrictions, etc.;
3. Possessing sufficient land use control authority to regulate land use in the jurisdiction containing the RPZ;
4. Possessing and exercising the power of eminent domain over the RPZ property; or
5. Possessing and exercising permitting authority over proponents of development within the RPZ.

### *Expectations of Airport Sponsors*

The FAA requires all federally obligated airport sponsors to comply with FAA Grant Assurances. These include, but are not limited to, Assurance 21, *Compatible Land Use*. Sponsors should take appropriate measures to protect against, remove, or mitigate land uses that introduce incompatible development within RPZs. For projects proposed by the sponsor (such as runway extensions or new runways) that would result in moving the RPZ into an area that has incompatible land uses, the FAA expects the sponsor to have or secure sufficient control of the RPZ, ideally through fee simple ownership, including any off-airport property within the RPZ.

### *Existing Incompatible Land Uses*

The FAA expects airport sponsors to seek all possible opportunities to eliminate, reduce, or mitigate existing incompatible land uses. Examples may include land acquisition, land exchanges, right-of-first-refusal to purchase, agreements with property owners on land uses, easements, or other such measures. The FAA also expects sponsors to actively consider and evaluate available options any time there is an ALP update or master plan update, and to be vigilant for any other opportunities that may arise from time to time—especially opportunities to purchase land—to eliminate or minimize existing incompatibilities. The FAA expects airport sponsors to document their efforts to demonstrate that they are complying with relevant FAA Grant Assurances. **Table 3H** summarizes FAA expectations regarding existing incompatible land uses within an RPZ.

**TABLE 3H | Expectations of Airport Sponsors - Existing Incompatible Land Uses**

| Type of Land Use Control | Expectations of Airport Sponsors |
|---|---|
| If the airport sponsor owns the land | Because the sponsor has total land use control, the FAA considers it a reasonable expectation that the sponsor will establish and enforce the necessary zoning controls or lease terms to enable it to address existing incompatible land uses when the opportunity arises. |
| Property is off-airport, but the sponsor has land use authority or the local jurisdiction and land use regulatory authority is owned by the same governing body | Because the sponsor has at least some influence over land use control, the FAA considers it a reasonable expectation that the sponsor will seek to establish the necessary zoning controls to enable it to address existing incompatible land uses when the opportunity arises. |
| If the sponsor has no land use control (i.e., RPZ land falls in another jurisdiction) | Even though the sponsor has no land use control, the FAA still considers it a reasonable expectation that the sponsor will actively seek opportunities to establish the necessary zoning controls to enable it to address existing incompatible land uses when the opportunity arises. The FAA will consider financial assistance to public-sector airport sponsors for land acquisition even if the airport sponsor has no land use control, but only if the sponsor demonstrates that the airport sponsor is taking all appropriate steps available to enhance control and mitigate existing risks. |

*Source: FAA AC 150/5190-4B, Airport Land Use Compatibility Planning*

*Proposed Incompatible Land Uses*

The FAA expects the airport sponsor to take active steps to prevent or mitigate proposed incompatible land uses. The FAA expects the airport sponsor to actively seek opportunities to prevent or mitigate risks associated with proposed incompatible land uses within the RPZ. The FAA expects the airport sponsor to secure control of land within the RPZ if a sponsor-initiated project results in incompatible land use within the newly defined RPZ. This is expected, regardless of the funding source(s) involved. Sponsors should actively monitor conditions and publicly object to proposed incompatible land uses and should make it a high priority (financially or otherwise) to acquire land or otherwise establish land use controls that prevent incompatible uses. The FAA expects airport sponsors to document their efforts so that they can demonstrate that the airport is complying with its grant assurances. **Table 3J** summarizes FAA expectations regarding proposals for introducing new incompatible land uses within an RPZ.

Potential new incompatible land uses within an RPZ might be caused by one or more circumstances. Some of these circumstances may result from airport sponsor-proposed projects, including (but not limited to):

- An airfield project (e.g., runway extension, runway shift);
- A change in the critical design aircraft that increases the RPZ dimensions;
- A new or revised instrument approach procedure that increases the size of the RPZ; or
- A local development proposal in the RPZ (either new or reconfigured), which can include roadway construction, relocation, or improvements.

**TABLE 3J | Expectations of Airport Sponsors - New Incompatible Land Uses**

| Type of Land Use Control | Expectations of Airport Sponsors |
|---|---|
| If the airport sponsor owns the land | Because the sponsor has total land use control, the FAA expects that the sponsor will establish all necessary protections to prevent new incompatible land uses. |
| Property is off-airport, but the sponsor has land use authority or the local jurisdiction and land use regulatory authority is owned by the same governing body | The FAA expects the sponsor to take all appropriate steps available to establish and exercise zoning controls necessary to prevent any new incompatible land uses.<br>The FAA recognizes that the standard of "appropriate action, to the extent reasonable" does not mean, in this case, that the sponsor can always prevail. Rather, the FAA expects the sponsor to demonstrate and document a reasonable effort. |
| If the sponsor has no land use control (i.e., RPZ land falls within another jurisdiction) | Even though the sponsor has no land use control, the FAA still expects the sponsor to actively pursue and consider all possible steps to secure land necessary to prevent any new incompatible land uses. The FAA recognizes that the standard of "appropriate action, to the extent reasonable" may not succeed. Even so, the FAA expects the sponsor to demonstrate and document a reasonable effort. The FAA expects the airport sponsor to adopt a strong public stance to oppose incompatible land uses and to communicate the purpose of the RPZ and associated risks to the proponent, and to actively consider measures such as land acquisition, land exchanges, right-of-first-refusal to purchase, agreements with property owners regarding land uses, or other such measures. |

*Source: FAA AC 150/5190-4B, Airport Land Use Compatibility Planning*

The FAA has higher expectations for the airport sponsor to mitigate potential incompatible land uses within the RPZs when the introduction of the incompatible land use is the result of an airport sponsor-initiated project (regardless of funding source). The sponsor should submit an alternatives evaluation to the FAA unless the land use is permissible. These are the permissible land uses requiring no further evaluation:

- Farming that meets airport design clearance standards in FAA AC 150/5300-13 and guidance as outlined in AC 150/5200-33;
- Irrigation channels meeting the standards of AC 150/5200-33 and FAA/USDA manual, *Wildlife Hazard Management at Airports*;
- Airport service roads, as long as they are not public roads and are directly controlled by the airport operator;
- Underground facilities, as long as they meet other design criteria (such as RSA standards), as applicable;
- NAVAIDs and aviation facilities, such as equipment for airport facilities considered fixed-by-function in regard to the RPZ; or
- Above-ground fuel tanks associated with backup generators for unstaffed NAVAIDs.

At MKC, there are some existing incompatible land uses within the RPZs. The approach RPZ to Runway 19 has public roads passing through it, as well as the adjacent rail yard. The Runway 1 departure RPZ (on the Runway 19 end) also has roads passing through it. The approach RPZ to Runway 22 has roads and the railyard within it, as does the departure RPZ for Runway 4 (on the Runway 22 end). The RPZs associated with Runway 1 and Runway 4 have Lou Holland Drive passing through them. The alternatives chapter of this master plan will detail any opportunities to reduce or eliminate incompatible land uses within the RPZ.

### Runway/Taxiway Separation

The design standards for the separation between runways and parallel taxiways are determined by the RDC. The RDC for Runway 1-19 is D-III-4000, which has a minimum separation standard of 400 feet from the centerline of the runway to the centerline of a parallel taxiway. The parallel portion of Taxiway G is 413 feet from the runway. This exceeds the standard and is acceptable to maintain as such. There may be an opportunity to shift the taxiway 13 feet west to obtain additional apron space. This potential option will be explored in the alternatives chapter.

The existing separation between Runway 1-19 and parallel Taxiway L is 400 feet, which meets standard. The new section of Taxiway L that is under construction (2023) is also planned at a separation distance of 400 feet. Taxiway L should be maintained at the separation distance of 400 feet.

The RDC of Runway 4-22 is B-II-4000, which has a runway to taxiway separation standard of 240 feet. A portion of Taxiway G is 358 feet from the runway. The existing condition exceeds the design standard; however, this taxiway and the runway are utilized by large business jets, and it may be better to maintain the current separation distance. The alternatives chapter will not consider shifting this portion of Taxiway G closer to Runway 4-22.

### Hold Line Separation

The distance that aircraft hold lines should be marked on taxiways is a function of the RDC. The hold lines for Runway 1-19 should be positioned 258 feet from the runway centerline. The standard distance of 250 feet is adjusted upward one foot for every 100 feet of elevation of the airport. At 756 feet above mean sea level (MSL), an additional eight feet are added to the standard. The hold lines on Taxiways E and K are 250 feet from the runway centerline. These hold lines should be re-marked at 258 feet as part of the next re-marking project.

The hold position markings associated with Runway 4-22 should be a minimum of 200 feet from the runway centerline. All hold positions are currently 250 feet from the runway centerline. Because large business jets can and do operate on Runway 4-22, it is recommended that the hold position markings be maintained at a distance of 250 feet.

## FAA HOT SPOTS

As noted in Chapter 1 – Inventory, there are currently three FAA-designated hot spots on the airfield (reference Exhibit 1J). During a master plan study, it is required that a full analysis of options to mitigate hot spots be undertaken. That analysis will be documented in the next chapter. The three current hot spots are:

1. Intersection of Runway 4-22 and Taxiway G: Taxiway G is at an unusual angle at the intersection with the runway. This has caused pilot confusion in the past.
2. Intersection of Taxiways L, D, and F: Aircraft taxiing south on Taxiway L need to be aware that to access the Runway 1 threshold, they need to utilize Taxiway F and not inadvertently turn left on Taxiway D and accidentally enter the runway environment. Likewise, pilots taxiing northbound on Taxiway F need to be sure to turn onto Taxiway L and not inadvertently enter the runway environment.
3. Intersection of Taxiways A, B, and the Runway 4 threshold: This is a confusing intersection with angled taxiways. The Taxiway L project scheduled for the summer of 2023 will rectify this unusual taxiway geometry, and this hot spot should then be removed from the FAA list. Note: This master plan document is being developed under the assumption that the project to fix this hot spot has already occurred.

## RUNWAY INCURSION MITIGATION (RIM)

Unusual or non-standard airfield geometry is a primary contributing factor for runway incursions. The Runway Incursion Mitigation (RIM) program identifies airport risk factors that might contribute to a runway incursion and develops strategies to help airport sponsors mitigate those risks. The RIM program is a data-driven, risk-based, proactive program that develops solutions at runway/taxiway intersections to help prevent runway incursions.

A runway incursion is any occurrence at an airport involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and takeoff of aircraft. Risk factors that contribute to runway incursions may include unclear taxiway markings, airport signage, and more complex issues, such as the runway or taxiway layout. Through RIM, the FAA focuses on reducing runway incursions by addressing risks at specific locations on an airport that have a history of runway incursions. To be included on the RIM list, there must be three or more runway incursions in a calendar year or an average of one or more runway incursions per year since 2007. A RIM location may also be classified as a hot spot, but a hot spot is not necessarily included in the FAA's RIM database.

There is one designated RIM location at MKC, at the intersection of Taxiway G and Runway 4-22 (south of the runway). This location is also designated as a hot spot and was added to the RIM database in 2022. There have been 14 runway incursions in this location, four of which occurred in the same calendar year. Runway incursions are classified based on the level of risk involved and the potential for a collision. The runway incursion classification system is as follows:

- Accident: An incursion that results in a collision. (These are classified as Category A.)
- Category A: A serious incident in which a collision was narrowly avoided.
- Category B: An incident in which separation decreased and there was a significant potential for collision, which may have resulted in a time-critical corrective/evasive response to avoid a collision.
- Category C: An incident characterized by ample time and/or distance to avoid a collision.
- Category D: An incident that meets the definition of RI, such as incorrect presence of a single vehicle/person/aircraft on the protected area of a surface designated for the landing and takeoff of aircraft, but with no immediate safety consequences.
- Category E: An incident in which insufficient or conflicting evidence of the event precludes assigning another category.

All of the 14 runway incursions in recent years have been classified as either Category C or D, which means the deviations did not represent an imminent risk of an accident. One of the clear objectives of this master plan is to examine this intersection in detail, develop viable alternatives to mitigate the risk of additional runway incursions, collaboratively identify a preferred solution that will be shown on the airport layout plan, and then program a project in the short term to improve the intersection.

## PRIMARY RUNWAY LENGTH REQUIREMENTS

Aircraft operate on a wide variety of available runway lengths. Many factors govern the suitability of those runway lengths for aircraft, such as elevation, temperature, wind velocity, aircraft operating weight, wing flap settings, runway condition (wet or dry), runway gradient, vicinity airspace obstructions, and any special operating procedures. Runway 1-19 is 6,827 feet long and serves as the primary runway.

FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, provides a five-step process for determining runway length needs:

1. Identify the list of critical design airplanes or airplane group.
2. Identify the airplanes or airplane group that will require the longest runway length at maximum certificated takeoff weight (MTOW).
3. Determine which of the three methods described in the AC will be used for establishing the runway length.
4. Select the recommended runway length from the appropriate methodology.
5. Apply any necessary adjustments to the obtained runway length.

There are three methodologies for determining runway length requirements, which are based on the MTOW of the critical aircraft or the airplane group for each runway. The airplane group consists of multiple aircraft with similar design characteristics. The three weight classifications are those airplanes with a MTOW of 12,500 pounds or less, those weighing over 12,500 pounds but less than 60,000 pounds, and those weighing 60,000 pounds or more. **Table 3K** shows these classifications and the appropriate methodology to use in runway length determination.

**TABLE 3K | Airplane Weight Classification for Runway Length Requirements**

| Airplane Weight Category (MTOW) | | Design Approach | Methodology |
|---|---|---|---|
| **12,500 pounds or less** | Approach speeds of less than 30 knots | Family grouping of small airplanes | Chapter 2: para. 203 |
| | Approach speeds of at least 30 knots but less than 50 knots | Family grouping of small airplanes | Chapter 2: para. 204 |
| | Approach speeds of 50 knots or more with fewer than 10 passenger seats | Family grouping of small airplanes | Chapter 2: para. 205, Figure 2-1 |
| | Approach speeds of 50 knots or more with 10 or more passenger seats | Family grouping of small airplanes | Chapter 2: para. 205, Figure 2-1 |
| **Over 12,500 pounds but less than 60,000 pounds** | | Family grouping of large airplanes | Chapter 3: Figures 3-1 or 3-2 and Tables 3-1 or 3-2 |
| **60,000 pounds or more, or Regional Jets** | | Individual large airplanes | Chapter 4: *Airplane performance manuals* |

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

At MKC, there are more than 500 annual operations by aircraft weighing more than 60,000 pounds. **Table 3L** summarizes most of those aircraft and the total number of operations for 2022. The appropriate methodology for determining the optimal runway length at MKC is to reference individual aircraft planning manuals. The table also shows the recommended runway length for each of the selected aircraft. All of them would require a runway length of at least 7,500 feet.

**TABLE 3L | Operations by Aircraft over 60,000 Pounds MTOW**

| Aircraft | MTOW | 2022 Operations[1] | Estimated Takeoff Runway Length at MTOW[2] |
|---|---|---|---|
| Gulfstream IV/G400 | 73,200 | 696 | 7,710' |
| Gulfstream V/500 | 91,000 | 470 | 8,100' |
| Gulfstream 600 | 94,600 | 110 | 7,500' |
| Boeing 737-700 | 154,500 | 38 | 10,100' |
| Boeing 737-800 | 174,100 | 138 | 8,100' |
| Boeing 737-900 | 187,679 | 56 | 10,000' |
| Boeing 757-200 | 255,000 | 34 | 7,700' |
| Airbus A320 | 172,000 | 16 | 7,500' |
| **TOTAL** | | **1,558** | |

MTOW: Maximum Takeoff Weight
[1] Traffic Flow Management System Count (FAA)
[2] Flight planning manuals for each aircraft type

**Supplemental Analysis Undertaken for Typical Business Jets Operating with Local Conditions**

An additional analysis was undertaken to estimate the required runway lengths for common business jets under a variety of conditions. This analysis is the output from UltraNav software, which utilizes the flight planning manuals for the selected aircraft.

The required takeoff and landing lengths for maximum load and range—adjusted for temperature and elevation—for many of the turbine aircraft utilizing the airport are presented in **Table 3M**, for both dry and wet pavement conditions. The takeoff distance requirements reflect maximum gross weight for the aircraft; however, the percentage of useful load has also been calculated for the existing 6,827-foot runway length. When the runway length requirement exceeds the available runway length at the given design temperature, aircraft operators may be required to reduce payload. Runway length requirements that exceed the current length of Runway 1-19 are noted in red type.

Business jets may operate under different regulations depending on the type of flight being conducted, as noted in **Table 3M**. These regulations may impact the calculated runway available for landing. CFR Part 91k refers to operations conducted via fractional ownership, and Part 135 refers to commuter/on-demand (charter) operations. Fractional operators must be capable of landing within 80 percent of the landing distance available (LDA) and commuter/on-demand operators must be capable of landing within 60 percent of LDA. Operations conducted under CFR Part 25 are GA operations conducted by private owners, which are unfactored.

**TABLE 3M | Runway Length Requirements for Business Jets**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Airfield Parameters** | Elevation: 756.8' MSL | | | | | | | | | |
| | Temp: 90.2°F | | | | | | | | | |
| | 0.12% Runway 1-19 (8.3' difference) | | | | | | | | | |
| **Runway Parameters** | **Takeoff Length Required at MTOW** | | **% Useful Load for Takeoff on 6,827' Runway** | | **Landing Length Requirements** | | | | | |
| | | | | | **C.F.R. Part 25 (Unfactored)** | | **C.F.R. Part 135 (60% factored)** | | **C.F.R. Part 91k (80% factored)** | |
| **Runway Condition** | **Dry** | **Wet** | **Dry** | **Wet** | **Dry** | **Wet** | **Dry** | **Wet** | **Dry** | **Wet** |
| Lear 60 | 7,256 | 7,696 | 93% | 85% | 3,642 | 4,880 | 6,070 | 8,133 | 4,553 | 6,100 |
| Gulfstream V | 7,333 | 8,096 | 95% | 86% | 2,832 | 3,257 | 4,720 | 5,428 | 3,540 | 4,071 |
| Citation X | 6,400 | 7,200 | 100% | 93% | 3,824 | 5,442 | 6,373 | 9,070 | 4,780 | 6,803 |
| Falcon 50EX | 6,242 | 6,672 | 100% | 100% | 2,972 | 3,418 | 4,953 | 5,697 | 3,715 | 4,273 |
| Gulfstream IV | 6,485 | 7,382 | 100% | 91% | 3,673 | 7,040 | 6,122 | 11,733 | 4,591 | 8,800 |
| Challenger 300 | 6,122 | 6,466 | 100% | 100% | 2,644 | 5,068 | 4,407 | 8,447 | 3,305 | 6,335 |
| Lear 45XR | 5,571 | 5,603 | 100% | 100% | 2,860 | 3,619 | 4,767 | 6,032 | 3,575 | 4,524 |
| Citation (525) CJ1 | 5,108 | 5,860 | 100% | 100% | 2,918 | 3,947 | 4,863 | 6,578 | 3,648 | 4,934 |
| Beechjet 400A | 5,237 | 6,382 | 100% | 100% | 3,746 | 5,545 | 6,243 | 9,242 | 4,683 | 6,931 |
| Citation Bravo | 4,701 | 5,123 | 100% | 100% | 3,599 | 5,648 | 5,998 | 9,413 | 4,499 | 7,060 |
| Citation 560 XLS | 4,430 | 4,549 | 100% | 100% | 3,451 | 5,431 | 5,752 | 9,052 | 4,314 | 6,789 |
| Citation Encore | 4,397 | 4,900 | 100% | 100% | 3,050 | 4,594 | 5,083 | 7,657 | 3,813 | 5,743 |
| Citation (525A) CJ2 | 4,227 | 4,499 | 100% | 100% | 3,214 | 4,668 | 5,357 | 7,780 | 4,018 | 5,835 |
| Citation Sovereign | 4,108 | 4,635 | 100% | 100% | 2,883 | 3,658 | 4,805 | 6,097 | 3,604 | 4,573 |
| Citation CJ3 | 3,797 | 4,240 | 100% | 100% | 3,034 | 4,139 | 5,057 | 6,898 | 3,793 | 5,174 |
| Citation I/SP | 3,798 | 4,367 | 100% | 100% | 2,411 | 2,772 | 4,018 | 4,620 | 3,014 | 3,465 |

KEY: MSL - Mean Sea Level; MTOW - Maximum Takeoff Weight; CFR - Code of Federal Regulations
CFR Part 25: Standard unfactored landing lengths.
CFR Part 135: 60% factored landing length as required by commuter/on-demand operators.
CFR Part 91k: 80% factored as required by fractional operators.
BL: Brake Limited
O/L: Weight limited due to climb performance
N/A: No data available
Figures in red exceed the available runway length.

*Source: Aircraft operating manuals from UltraNav software*

## FAA Runway Length for Jets Weighing Less Than 60,000 Pounds

Utilizing FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, the following is the five-step process for determining the recommended runway length for aircraft with a maximum takeoff weight (MTOW) between 12,500 pounds and 60,000 pounds.

*Step 1: Identify the critical airplane or airplane group.*

This runway length analysis assumes that the critical aircraft is a large business jet weighing less than 60,000 pounds MTOW. There are more than 500 annual operations by these types of aircraft at MKC. The appropriate runway length methodology, in this case, is to examine the general runway length tables from Chapter 3 of AC 150/5325-4B for aircraft weighing between 12,500 pounds and 60,000 pounds.

*Step 2: Identify the airplanes or airplane group that will require the longest runway length at maximum certificated takeoff weight (MTOW).*

Business jets typically require the longest runway lengths; therefore, the runway length curves in Chapter 3 of AC 150/5325-4B will be examined for future conditions.

*Step 3: Determine which of the three methods described in the AC will be used for establishing the runway length.*

In consideration of the growing number of business jets, it is necessary to select the specific methodology to use for the business jets. Chapter 3 of the AC groups business jets weighing over 12,500 pounds but less than 60,000 pounds into the following two categories:

- 75 percent of the fleet; and
- 100 percent of the fleet.

The AC states that the airplanes in the "75 percent of the fleet" category generally need 5,000 feet or less of runway at mean sea level and standard day temperature (59° F), while those in the "100 percent of the fleet" category need more than 5,000 feet of runway under the same conditions.

The AC indicates that the airport designer must determine which category to use for runway length determination. MKC experiences significant levels of business jet activity from the full range of the business jet fleet. **Table 3N** shows example aircraft for each runway length category. For this analysis, those business jets in the 75-100 percent category will be analyzed.

There are two runway length curves presented in the AC under the 75-100 percent category:

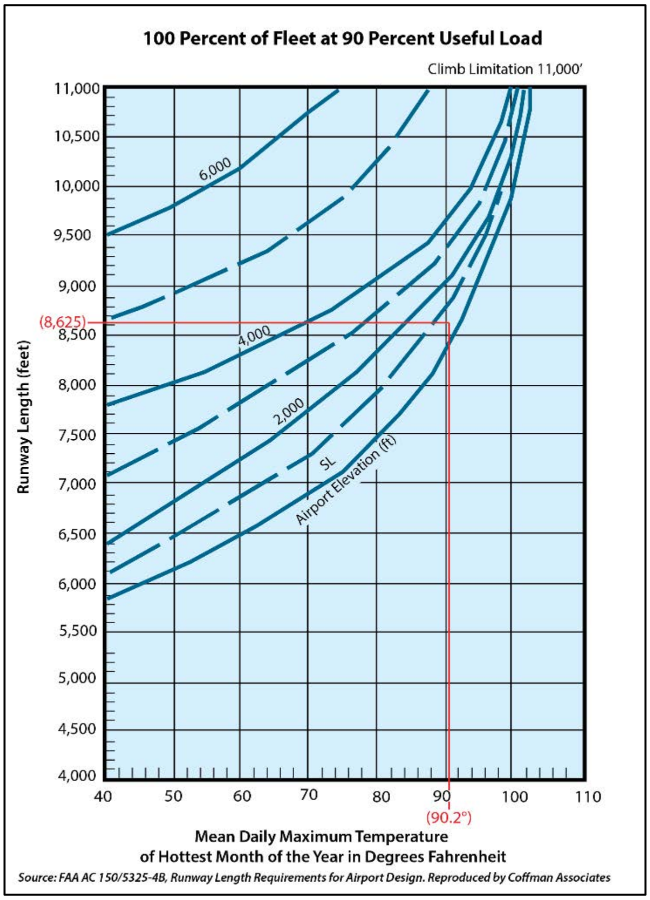
- 60 percent useful load; and
- 90 percent useful load.

**TABLE 3N | Aircraft Categories for Runway Length Determination**

| 0-75 percent of the national fleet | MTOW | 75-100 percent of the national fleet | MTOW |
|---|---|---|---|
| Lear 35 | 20,350 | Lear 55 | 21,500 |
| Lear 45 | 20,500 | Lear 60 | 23,500 |
| Cessna 550 | 14,100 | Hawker 800XP | 28,000 |
| Cessna 560XL | 20,000 | Hawker 1000 | 31,000 |
| Cessna 650 (VII) | 22,000 | Cessna 650 (III/IV) | 22,000 |
| IAI Westwind | 23,500 | Cessna 750 (X) | 35,700 |
| Beechjet 400 | 15,800 | Challenger 604 | 47,600 |
| Falcon 50 | 18,500 | IAI Astra | 23,500 |
| MTOW: Maximum Takeoff Weight | | | |

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

The useful load is the difference between the maximum allowable structural weight and the operating empty weight (OEW). The useful load consists of passengers, cargo, and usable fuel. The determination of which useful load category to use will have a significant impact on the recommended runway length; however, it is inherently difficult to determine because of the variable needs of each aircraft operator. For shorter flights, pilots may take on less fuel; however, pilots may choose to ferry fuel so that they do not have to refuel frequently. Because of the variability in aircraft weights and haul lengths, the 60 percent useful load category is typically considered the default, unless there are specific known operations that would suggest using the 90 percent useful load category. For MKC, there are known long-haul operations that would suggest applying the 90 percent useful load classification. Data was acquired from GCR, Inc. that document city pairs by air taxi aircraft. An examination of the cities shows more than 800 operations between MKC and airports that are more than 1,000 miles away. This examination is air taxi only and does not include private flights. Because of the frequency of long-haul flights to and from MKC, the 90 percent useful load category is the most appropriate to apply when estimating runway length requirements for business jets weighing between 12,500 and 60,000 pounds.



*Source: FAA AC 150/5325-4B, Runway Length Requirements for Airport Design. Reproduced by Coffman Associates*

*Figure 3-4: Raw Runway Length for Business Jets*

*Step 4: Select the recommended runway length from the appropriate methodology.*

The next step is to examine the performance charts for the "100 percent of the fleet" classification for 90 percent useful load category. (See **Figure 3-4.**) This chart requires the following inputs:

- The mean maximum daily temperature of the hottest month: July at 90.2°(F)
- The airport elevation: 756.8 feet above mean sea level (MSL)

By cross-referencing the temperature and elevation on the charts, the raw recommended runway length is 8,625 feet.

*Step 5: Apply any necessary adjustments to the obtained runway length.*

The recommended runway length determined in Step #4 is based on no wind, a dry runway surface, and zero effective runway gradient. Therefore, the following criteria are applied:

- Wet runway surface
- 0.12% effective runway gradient (8.3 feet of elevation difference for Runway 1-19)

To account for a wet/contaminated surface, the runway length obtained from the load performance chart used in Step #4 is increased by 15 percent or up to 7,000 feet for the 90 percent category, whichever is less.

The runway length obtained from Step #4 is also increased at the rate of 10 feet for each foot of elevation difference between the high and low points of the runway centerline. At MKC, this equates to an additional 90 feet of runway length, resulting in an adjusted runway length of 8,715 feet.

**Table 3P** summarizes the data inputs and the final recommended runway lengths for MKC. To accommodate 100 percent of the fleet at 90 percent useful load, a runway length of 8,700 feet is recommended.

**TABLE 3P | Runway Length Requirements**

| | |
|---|---|
| Airport Elevation | 756.8' feet above mean sea level |
| Average High Monthly Temp. | 90.2 degrees F (July) |
| Runway Gradient | 0.12% Runway 1-19 (8') |

| Fleet Mix Category | Raw Runway Length from FAA AC | Runway Length with Gradient Adjustment | Wet Surface Landing Length for Jets (+15%)* | Final Runway Length |
|---|---|---|---|---|
| 75% of fleet at 60% useful load | 4,775' | 4,855' | 5,500' | 5,500' |
| 100% of fleet at 60% useful load | 5,637' | 5,717' | 5,500' | 5,700' |
| 75% of fleet at 90% useful load | 6,749' | 6,829' | 7,000' | 7,000' |
| 100% of fleet at 90% useful load | 8,625' | 8,715' | 7,000' | 8,700' |

*Max 5,500' for 60% useful load and max 7,000' for 90% useful load in wet conditions

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

As can be seen in the table, most small- and medium-sized business jets can take off under maximum loading conditions. Only the largest business jets (less than 60,000 pounds) may have to reduce payload to takeoff from MKC under the conditions presented.

## Primary Runway Length Summary

According to FAA 150/5325-4B, *Runway Length Requirements for Airport Design*, individual aircraft flight planning manuals should be used to determine the optimal runway length. These manuals were consulted for several of the large business jets and common transport category aircraft (e.g., Boeing 737, Airbus A-320, etc.) that operate at the airport. To accommodate these aircraft, a runway length between 7,500 feet and 10,100 feet is recommended.

UltraNav software—which calculates runway length needs for certain business jets, based on the flight planning manuals—was also consulted. According to UltraNav, nearly all of the selected business jets can operate unrestricted within the current runway length. Under certain conditions, some airplanes will be weight restricted, especially on a wet/contaminated runway.

Finally, the FAA-provided runway length methodology for business jets weighing between 12,500 pounds and 60,000 pounds was also applied. This resulted in a recommended runway length of 8,700 feet. For MKC, this would be the optimal length to plan for; however, there are known limitations to extending the primary runway (i.e., the levee and the Missouri River). It is also more challenging at MKC because of the existing EMAS on both ends of Runway 1-19. The presence of EMAS effectively sets the limit for future runway length. The feasibility of extending the runway will be examined briefly in the alternatives chapter.

**Runway 4-22 Runway Length Recommendation**

Runway 4-22 is 5,050 feet long and serves as a crosswind and secondary capacity runway. The same five-step process outlined in FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, applies to this runway. As discussed in Chapter Two – Forecasts, the critical aircraft for Runway 4-22 is B-II-2B, which includes all small aircraft, most turboprops, and approximately 50 percent of business jets. In this chapter, it was noted that, based on wind coverage, Runway 4-22 should accommodate B-I type aircraft, at a minimum, for crosswind coverage purposes. If wind coverage was the only justification for this runway, then the recommended runway length would be 4,300 feet. However, Runway 4-22 is also classified by FAA as an eligible secondary capacity runway that should be designed to B-II standards. Therefore, to continue to fulfill its role as a capacity runway, the maximum runway length feasible should be preserved.

In addition, Runway 4-22 provides a critical ILS approach to Runway 4, which is needed when visibility is poor and winds would indicate a landing from the south. However, it was also noted that Runway 4-22 does not fully meet the runway design standards for ROFZ and ROFA. In the alternatives chapter of this master plan, an extensive analysis of Runway 4-22 will be undertaken. The result of that analysis will be a recommended runway length somewhere between 4,300 feet and the existing 5,050 feet. Extending this runway is not feasible due to the levee on the Runway 4 end and the already non-standard conditions on the Runway 22 end. Therefore, extending the runway will not be considered in the alternatives chapter.

## RUNWAY WIDTH

Runway 1-19 is 150 feet wide. The RDC D-III-4000 standard is 100 feet wide, and 150 feet wide for a D-III critical aircraft weighing more than 150,000 pounds. The TFMSC data presented in Chapter Two – Forecasts showed that there were 324 operations by aircraft weighing more than 150,000 pounds. Most of these operations were by chartered passenger aircraft, like the Boeing 737-800 and the Boeing 757-200. Since more enplanements are forecast for the airport, it is likely that there will be more operations by these large aircraft; therefore, it is recommended that the current width of 150 feet be maintained through the planning period.

Runway 4-22 is 100 feet wide. The design standard for this B-II-4000 runway with ¾-mile visibility minimums is 75 feet. If the instrument approach visibility minimum is below ¾ mile, then the standard is 100 feet. As noted, this runway serves a critical function as the only ILS approach serving approaches from the south. Many of those operations may be by large business jets that would otherwise use Runway 1 (for the additional landing length) which has the effect of enhancing overall airfield capacity. For these reasons, it is recommended that the runway be maintained at 100 feet in width.

## RUNWAY BLAST PADS

Blast pads are paved or prepared areas beyond the runway threshold that are intended to reduce erosion from prop wash and jet blast. Blast pads are not a required element of the runway system. There are no blast pads on either end of Runway 4-22. The EMAS on both ends of Runway 1-19 effectively serve as blast pads.

FAA does recommend blast pads under any of the following conditions:

- Runways with ADG-III as the critical aircraft (i.e., MKC),
- Runways experiencing erosion of soil adjacent to the runway,
- Runways with soil not suitable for turf establishment,
- For locations experiencing wrong surface landings to improve pilot visual cues to the runway ends.

The blast pads at MKC (EMAS) for Runway 1-19 are recommended to be maintained because the critical aircraft is D-III. Blast pads are not necessary for Runway 4-22.

### RUNWAY PAVEMENT STRENGTH

An important feature of airfield pavement is its ability to withstand repeated use by aircraft of significant weight. The current published strength rating for Runway 1-19 is 86,000 pounds for single-wheel landing type gear (SWL), 171,000 pounds for dual-wheel (DWL), and 342,000 pounds for dual tandem wheel landing gear struts (DTWL). This pavement rating is high enough to accommodate all GA aircraft and most commercial transport aircraft. The pavement strength of Runway 1-19 should be maintained through the planning period.

Runway 4-22 has a pavement strength rating of 48,000 pounds SWL, 73,000 pounds DWL, and 136,000 pounds DTWL. This strength rating is high enough to accommodate all aircraft that will use the runway and it should be maintained.

It should be noted that the pavement strength rating is not the maximum weight limit for aircraft. Aircraft weighing more than the certified strength can operate on the runway on an infrequent basis. However, frequent operations by heavier aircraft can shorten the lifespan of airport pavements.

### RUNWAY LINE-OF-SIGHT AND GRADIENT

The FAA has instituted various line-of-sight requirements to facilitate coordination among aircraft, and between aircraft and vehicles that are operating on active runways. This allows departing and arriving aircraft to verify the location and actions of other aircraft and vehicles on the ground that could create a conflict.

Line-of-sight standards for an individual runway are based on the availability of a parallel taxiway. When a full-length parallel taxiway is available—thus facilitating faster runway exit times—then any point five feet above the runway centerline must be mutually visible with any other point five feet above the runway centerline that is located at less than half the length of the runway. If a full-length parallel taxiway is not available, then any two points five feet above the runway must be mutually visible for the whole length of the runway. Both runways meet the second line-of-sight standard for runways without full parallel taxiways.

The surface gradient of a runway affects aircraft performance and pilot perception. The surface gradient is the maximum allowable slope for a runway. For runways designated for approach categories A and B, like Runway 4-22, the maximum longitudinal grade is 2.0 percent. The maximum longitudinal grade for runways in approach categories C, D, and E, like Runway 1-19, is 1.5 percent; however, longitudinal grades exceeding 0.8 percent are not acceptable within the lesser of the following criteria:

- In the first and last quarter of the runway length, or
- The first and last 2,500 feet of the runway length.

The Runway 19 end is eight feet higher than the Runway 1 end, which is a gradient of 0.12 percent. The Runway 22 end is 0.5 feet higher than the Runway 4 end, for a gradient of 0.01 percent. Both runways meet gradient standards.

## TAXIWAY DESIGN STANDARDS

The design standards associated with taxiways are determined by the taxiway design group (TDG) and the airplane design group (ADG) of the critical design aircraft that would potentially use that taxiway. **Table 3Q** presents the taxiway design standards to be applied at MKC. The airport currently meets these standards; however, in some cases, the width of taxiways and taxilanes exceeds the design standard.

**TABLE 3Q | Taxiway Design Standards**

| STANDARDS BASED ON WINGSPAN (ADG) | ADG III (Runway 1-19) | ADG II (Runway 4-22) |
|---|---|---|
| **Taxiway/Taxilane Protection** | | |
| Taxiway Safety Area (TSA) width | 118' | 79' |
| Taxiway Object Free Area (TOFA) width | 171' | 124' |
| Taxilane Object Free Area (TLOFA) width | 158' | 110' |
| **Taxiway/Taxilane Separation** | | |
| Taxiway Centerline to: | | |
| Parallel Taxiway/Taxilane | 144.5' | 101.5' |
| Fixed or Movable Object | 85.5' | 62' |
| Taxilane Centerline to: | | |
| Parallel Taxilane | 138' | 94.5' |
| Fixed or Movable Object | 79' | 55' |
| **Wingtip Clearance** | | |
| Taxiway Wingtip Clearance | 26.5' | 22.5' |
| Taxilane Wingtip Clearance | 20' | 15.5' |
| **STANDARDS BASED ON TDG** | **TDG 2B (Current)** | **TDG 3 (Future)** |
| Taxiway Width Standard | 35' | 50' |
| Taxiway Edge Safety Margin | 7.5' | 10' |
| Taxiway Shoulder Width | 15' | 20' |
| ADG: Airplane Design Group<br>TDG: Taxiway Design Group | | |

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

Taxiways typically provide direct access to the runway via either a parallel taxiway or connecting taxiways. Taxiways typically allow for faster ground movements than taxilanes. Taxiway ground movement speeds are generally between 15 and 35 miles per hour, while taxilane movement speeds are below 15 miles per hour. Taxilanes typically extend from taxiways to hangar areas, and they facilitate slower movement speeds than taxiways. As result, certain separation standards are different for taxiways and taxilanes. While taxiways should be planned to meet the critical aircraft standards, taxilanes can be designed to accommodate aircraft that will use them. For example, a taxilane leading to a row of small T-hangars only needs to meet the separation requirement for small aircraft and not for the larger critical aircraft.

### Taxiway Width Standards

All taxiways and taxilanes should be constructed at the standard uniform width that applies to them. All taxiways/taxilanes that will serve the critical aircraft should be at least 50 feet wide, which is the standard associated with TDG 3 for the critical aircraft. Taxiways D2 and D3 only need to meet the width standard for TDG 2B. **Table 3R** summarizes the taxiway width standards as compared to the current geometry. Several of the taxiways exceed the width standard; this can mean that a wide expanse of pavement is present, which can be a cause for pilot confusion. These taxiway widths are shown in bold. The alternatives chapter will include analysis of the taxiway geometry.

Typically, the FAA will support maintaining the existing width of taxiways until the pavement needs to be reconstructed, even if they exceed the design standard. When the taxiways are reconstructed, they should be designed to meet the current taxiway width standard.

**TABLE 3R | Taxiway Width Standards**

| Taxiway Designation | Current & Future TDG/Standard Width | Current Width |
|---|---|---|
| Taxiway A (Threshold of Rwy 1) | 3/50' | **100'** |
| Taxiway A (Threshold of Rwy 4) | 3/50' | 50' |
| Taxiway B (Bypass at Twy G) | 3/50' | **101'** |
| Taxiway B (West of Rwy 1) | 3/50' | 50' |
| Taxiway D | 3/50' | **75'** |
| Taxiway D1 | 2B/35' | **65'** |
| Taxiway D2 | 2B/35' | 38' |
| Taxiway E | 3/50' | **60'** |
| Taxiway F (From Twy D to Apron Curve) | 3/50' | **57'** |
| Taxiway F (From Apron Curve to Twy L) | 3/50' | **75'** |
| Taxiway G (Threshold Rwy 19) | 3/50' | **75'** |
| Taxiway G1 | 3/50' | **165'** |
| Taxiway H | 3/50' | **75'** |
| Taxiway J | 3/50' | **70'** |
| Taxiway L | 3/50' | 50' |
| Taxiway K (West of Rwy 1-19) | 3/50' | **55'** |
| Taxiway K (East of Rwy 1-19) | 3/50' | **74'** |
| Taxiway L1 | 3/50' | **80'** |
| Taxiway L2 | 3/50' | **80'** |
| Taxiway L3 | 3/50' | 45' |
| Taxiway M | 2B/35' | 75' |

## Other Taxiway Design Considerations

FAA AC 150/5300-13B, *Airport Design*, provides guidance on taxiway design with a goal of enhancing safety by providing a taxiway geometry that reduces the potential for runway incursions. As noted previously, a runway incursion is defined as, "any occurrence at an airport involving the incorrect presence of an aircraft, vehicle, or person on the protected area of a surface designated for the landing and takeoff of aircraft."

The following is a list of the taxiway design guidelines and the basic rationale behind each recommendation:

1. **Taxi Method**: Taxiways are designed for "cockpit over centerline" taxiing, with pavement being sufficiently wide to allow a certain amount of wander. On turns, enough pavement should be provided to maintain the edge safety margin from the landing gear. When constructing new taxiways, upgrading existing intersections should be undertaken to eliminate judgmental over-steering, which is when the pilot must intentionally steer the cockpit outside the marked centerline to assure the aircraft remains on the taxiway pavement.
2. **Steering Angle**: Taxiways should be designed such that the nose gear steering angle is no more than 50 degrees, which is the generally accepted value to prevent excessive tire scrubbing.
3. **Three-Node Concept**: To maintain pilot situational awareness, taxiway intersections should provide a pilot with a maximum of three choices of travel direction. Ideally, these are right- and left-angle turns and a continuation straight ahead.
4. **Intersection Angles**: Design turns to be 90 degrees wherever possible. For acute-angle intersections, standard angles of 30, 45, 60, 120, 135, and 150 degrees are preferred.
5. **Runway Incursions**: Design taxiways to reduce the probability of runway incursions.
    - *Increase Pilot Situational Awareness*: A pilot who knows where he/she is on the airport is less likely to enter a runway improperly. Complexity leads to confusion. Keep taxiway systems simple using the "three nodes" concept.
    - *Avoid Wide Expanses of Pavement*: Wide pavements require placement of signs far from a pilot's eye. This is especially critical at runway entrance points. Where a wide expanse of pavement is necessary, avoid direct access to a runway.
    - *Limit Runway Crossings*: The taxiway layout can reduce the opportunity for human error. The benefits are twofold – through a simple reduction in the number of occurrences, and through a reduction in air traffic controller workload.
    - *Avoid "High Energy" Intersections*: These are intersections in the middle third of runways. By limiting runway crossings to the first and last thirds of the runway, the portion of the runway where a pilot can least easily maneuver to avoid a collision is kept clear.
    - *Increase Visibility*: Right-angle intersections, both between taxiways and runways, provide the best visibility. Acute-angle runway exits provide for greater efficiency in runway usage but should not be used as runway entrances or crossing points. A right-angle turn at the end of a parallel taxiway is a clear indicator to a pilot approaching a runway.
    - *Avoid "Dual Purpose" Pavements*: Runways used as taxiways and taxiways used as runways can lead to confusion. A runway should always be clearly identified as a runway, and only a runway.

  - *Indirect Access*: Do not design taxiways to lead directly from an apron to a runway. Such configurations can lead to confusion when a pilot typically expects to encounter a parallel taxiway.
  - *Hot Spots*: Confusing intersections near runways are more likely to contribute to runway incursions. These intersections must be redesigned when the associated runway is subject to reconstruction or rehabilitation. Other hot spots should be corrected as soon as practicable.

6. **Runway/Taxiway Intersections**:
   - *Right Angle*: Right-angle intersections are the standard for all runway/taxiway intersections, except where there is a need for a high-speed exit. Right-angle taxiways provide the best visual perspective to a pilot approaching an intersection with the runway to observe aircraft in both the left and right directions. They also provide optimal orientation of the runway holding position signs so that they are visible to pilots.
   - *Acute Angle*: Acute angles should not be larger than 45 degrees from the runway centerline. A 30-degree taxiway layout should be reserved for high-speed exits. The use of multiple intersecting taxiways with acute angles creates pilot confusion and improper positioning of taxiway signage.
   - *Large Expanses of Pavement*: Taxiways must never coincide with the intersection of two runways. Taxiway configurations with multiple taxiway and runway intersections in a single area create large expanses of pavement, making it difficult to provide proper signage, marking, and lighting.

7. **Taxiway/Runway/Apron Incursion Prevention**: Apron locations that allow direct access into a runway should be avoided. Increase pilot situational awareness by designing taxiways in a manner that forces pilots to consciously make turns. Taxiways originating from aprons and forming a straight line across runways at mid-span should be avoided.
   - *Wide Throat Taxiways*: Wide throat taxiway entrances should be avoided. Such large expanses of pavement may cause pilot confusion and make lighting and marking more difficult.
   - *Direct Access from Apron to a Runway*: Avoid taxiway connectors that cross over a parallel taxiway and directly onto a runway. Consider a staggered taxiway layout that forces pilots to make a conscious decision to turn.
   - *Apron to Parallel Taxiway End*: Avoid direct connection from an apron to a parallel taxiway at the end of a runway.

FAA AC 150/5300-13B, *Airport Design*, states that, “existing taxiway geometry should be improved whenever feasible, with emphasis on designated hot spots. To the extent practicable, the removal of existing pavement may be necessary to correct confusing layouts.” The following lists taxiway geometry issues (other than excessive width) that need to be addressed in the alternatives analysis, and these are also depicted on **Exhibit 3F**:

- Taxiway D enters Runway 1-19 at an angle. This is also an FAA-designated hot spot.
- Taxiway G at the intersection with Runway 4-22 has led to pilot confusion. This is also an FAA-designated hot spot.
- Taxiway H is an angled taxiway, which may lead to aircraft exiting the runway at high speed.
- Taxiway M is connected to Runway 4-22 at an angle and provides direct access from the northeast Signature apron to Runway 4-22.

# Exhibit 3F
# TAXIWAY GEOMETRY

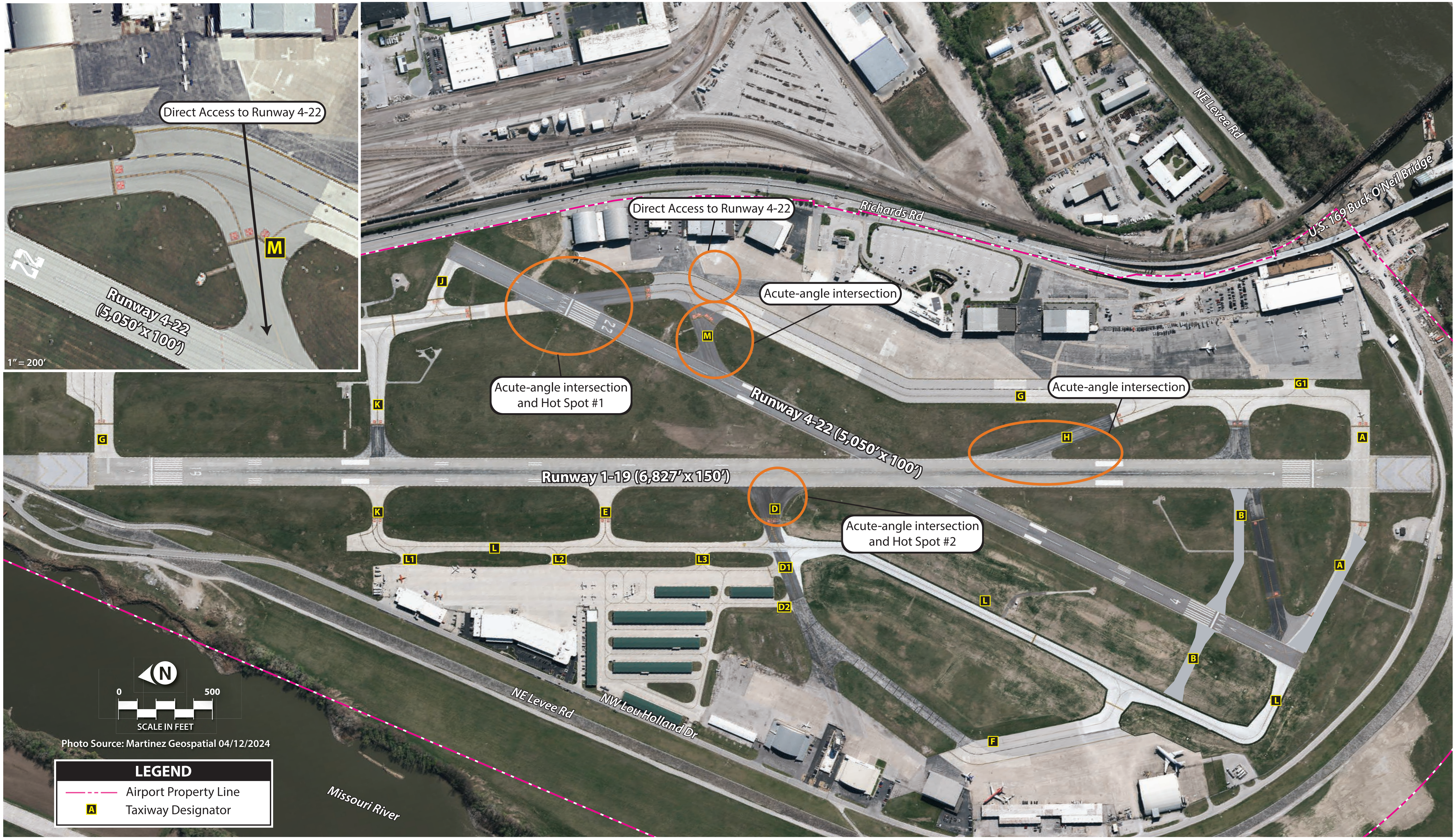


Photo Source: Martinez Geospatial 04/12/2024

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The alternatives chapter will examine possible taxiway geometry changes that would improve pilot situational awareness and reduce potential pilot confusion. Any changes will consider the practicality of each alternative in terms of cost and benefit.

### Taxilane Design Considerations

Taxilanes are distinguished from taxiways in that they do not provide access directly to or from the runway system. Taxilanes typically provide access to hangar areas and thus accommodate a slower movement speed. As a result, taxilanes can be constructed to varying design standards depending on the type of aircraft utilizing the taxilane. For example, a taxilane leading to a T-hangar area only needs to be designed to accommodate those aircraft typically accessing a T-hangar (e.g., A/B-I aircraft).

The minimum taxilane object free area (TLOFA) is 79 feet, which is based on aircraft with a wingspan of 49 feet or less. All of the taxilanes leading to T-hangars have a TLOFA of 79 feet, thus meeting standard. If additional T-hangars are to be constructed, they should also be at least 79 apart.

## HOLD APRONS

Hold aprons are an important feature at busy airports like MKC. Pilots can pull off the main taxiways onto a hold apron to perform final pre-flight checks and engine run-ups. These activities can take several minutes, so other aircraft that are ready for takeoff are then able to proceed to the runway threshold for departure without delay.

Hold aprons have specific design and separation standards that are intended to allow other aircraft to bypass aircraft using the hold apron. Specifically, the location on the hold apron where aircraft park should meet the taxiway-to-taxiway separation standard. That separation standard is based on the airplane design group of the critical aircraft. The current and future airplane design group is ADG III, which includes all wingspans up to 118 feet wide. The separation standard from the taxiway centerline to the holding position on the hold apron is 144 feet.

There are two designated hold aprons on the airfield. One is located at the north end of Taxiway G and the other is located at the north end of Taxiway L. Both meet the standard for separation and should be maintained.

There are no designated hold aprons at the south end of the airfield. In the alternatives chapter, opportunities to locate one or more hold aprons at the south end will be explored.

### Compass Calibration Pad

A compass calibration pad is a paved area, often located on a portion of a hold apron or an aircraft parking apron, where pilots can position the aircraft to calibrate the aircraft's magnetic compass. This allows the pilot to determine the deviation error in the magnetic compass. Pilots should periodically calibrate the aircraft compass under normal conditions, and if aircraft maintenance has been performed the compass should always be calibrated.

There is not a compass calibration pad at MKC currently. Considerations will be given to locating a compass calibration pad at the airport. There are design standards for a compass calibration pad, but the primary consideration is for it to be located away from any other potential magnetic interference, including from metal (e.g., rebar) that may be in the pavement.

## INSTRUMENT NAVIGATIONAL AIDS

Instrumentation for runways is important when weather conditions are less than visual (lower than three-mile visibility and lower than 1,000-foot cloud ceilings). The lowest visibility minimums typically available to GA airports are ½-mile visibility, at which an approach lighting system is required along with other ground-based equipment, including a localizer and glideslope antenna (referred to as an instrument landing system [ILS]). However, the FAA is not making new ILS installations as they move toward GPS-based instrument approaches. Without an approach lighting system, the lowest feasible visibility minimums are ¾-mile.

Runway 1 is currently a visual runway with no instrument approach procedures. As part of this master plan study, an analysis will be undertaken to determine if this runway can support an instrument approach. The results of this analysis will be presented later in this study. Additional survey work will be performed to facilitate this analysis. If an instrument approach is feasible, then the analysis will estimate what the cloud ceiling and visibility minimums could be. The hope is that an instrument approach with ¾-mile visibility minimums may be feasible to Runway 1.

Runway 19 has an ILS with ¾-mile visibility minimums. This is a very good instrument approach that extends the capability of the airport to times of poor weather conditions. This approach should be maintained.

Runway 4 is also served by an ILS approach with ¾-mile visibility minimums. This instrument approach is extremely important as it allows aircraft to approach and land from the south in poor weather conditions. This approach should be maintained.

Runway 22 has a GPS approach with 1-mile visibility minimums. This approach is adequate and should be maintained.

## APPROACH LIGHTING AIDS

To provide pilots with visual guidance information during landings, electronic visual approach aids are commonly provided at airports. Runway 1 is outfitted with a four-box visual approach slope indicator (VASI). The glidepath of the VASI is set to 3.70 degrees for obstacle clearance, which is higher than the standard 3.0-degree glide path. VASIs are an older technology and are commonly replaced with the newer precision approach path indicator (PAPI). When the VASI serving Runway 1 exceeds its typical useful life, it should be replaced with a four-light PAPI system.

Runway 19 is equipped with a four-light PAPI that is set to the standard 3.0-degree glide path. This is an appropriate system for this runway and should be maintained. Runway 4 has a four-box VASI set to the standard 3.0-degree glide path. Runway 22 also has a four-box VASI, which is set to a 3.30-degree glide path. When these VASI systems need to be replaced, consideration should be given to upgrading to the four-light PAPI system.

Both ends of Runway 1-19 have an approach lighting system. The approach to Runway 1 has runway alignment indicator lights (RAIL) leading to the landing threshold. These linear sequenced flashing lights provide pilots alignment information. This system should be maintained. The approach to Runway 19 has a more sophisticated medium intensity approach lighting system with sequenced flashers (MALSF). This system provides a 1,400-foot lighted grid leading to the landing threshold. The MALSF is augmented with a RAIL system of sequenced flashing lights. This system should be maintained.

Runway end identification lights (REILs) are flashing strobe lights located at the outside edge of the landing threshold. REILs provide pilots with a quick indication of the location of the threshold. REILs are typically provided for lighted runways that serve business jet operations. REILS are currently available for approaches to Runway 1 and 22. Runway 19 does not need REILs because of the MALSF approach lighting system. Considerations should be given to installing REILs on the Runway 4 end, especially since this runway has an ILS instrument approach.

## AIRFIELD LIGHTING, MARKING, AND SIGNAGE SYSTEMS

Airfield lighting, marking, and signage provide information to pilots to assist in ground movements, as well as in locating the airport at night.

The airport has a rotating beacon that projects a green light on one side and a white light on the other. Pilots can see the rotating beacon at night from a distance of up to 20 miles. The existing beacon is located on top of the old terminal building on the east side of the airfield. This location is accessible and should be maintained.

Both runways have high intensity runway edge lighting (HIRL). The HIRL lights for Runway 1-19 are incandescent, and the lights for Runway 4-22 are LED. At the time of the next major project for Runway 1-19, the incandescent edge lights should be upgraded to more reliable LED lights.

All taxiways are equipped with LED medium intensity taxiway lighting (MITL). These edge lighting systems are appropriate and should be maintained.

Runway markings are designed according to the type of straight-in instrument approaches available to each runway end. Runways 19 and 4 have precision instrument markings that include the threshold bar, threshold markings, centerline, edge markings, aiming point, touch down zone markings, and the runway designation. These marking are appropriate for the type of instrument approach to these runway ends and should be maintained. Runways 1 and 22 have non-precision markings (same as precision except for the touchdown zone markings). These markings are appropriate for these runway ends, and they should be maintained. Runway markings will fade over time and should be re-marked if they deteriorate.

The airfield is outfitted with a runway/taxiway signage system. The signage system includes runway and taxiway designations, hold positions, routing/directional, runway end and exits, and runway distance remaining signs. These systems should be maintained.

## WEATHER AND COMMUNICATION AIDS

The airport has four lighted windsocks. The primary windsock is located on the west side of the runway near the midpoint of the airfield and south of Taxiway D. There is a windsock near the Runway 22 end and there are windsocks at both the north and south ends of the airport, as well. Each of these visual weather aids meets design standards and should be maintained.

Pilots can access on-airport weather and other pertinent information via the Automated Terminal Information Service (ATIS). ATIS broadcasts are updated hourly and be accessed via frequency 120.75 MHz or through the UNICOM frequency of 122.95 MHz. This system is maintained by control tower personnel and should continue to be maintained.

The airport is equipped with an automated surface observing system (ASOS) that collects and broadcasts weather data. Pilots can access the broadcasts via VHF ground-to-air radio, through the ATIS frequency, or via a local telephone number. Having an on-field weather observation system is critical for a busy airport like MKC. This equipment should be maintained.

## AIRPORT TRAFFIC CONTROL TOWER

The control tower was constructed in the mid-1980s. While it has been remodeled several times, it is an aging structure that does not meet current design standards, including the Americans with Disabilities Act (ADA). The top of the tower is 84 feet above the ground. The cab eye elevation is approximately 72 feet. Tower personnel are able to see all primary movement areas (runways and taxiways). Portions of the west hangar areas are not entirely visible from the tower. Consideration will be given to constructing a replacement control tower. Based on an interview with the current tower manager, a location on the west side of the airfield is preferred, and perhaps a little closer to the runway so that all hangar areas are visible. In the alternatives analysis, options for locating a replacement tower will be considered.

## AIRSIDE SUMMARY

The Kansas City Downtown Airport – Wheeler Field has a nice complement of airside systems, including a 6,827-foot-long primary runway and a 5,050-foot-long crosswind runway. Analysis in this chapter showed that the optimal runway length is approximately 8,700 feet; however, the primary runway has EMAS installed beyond each runway end. The EMAS was installed to maximize runway length and provide an equivalent level of safety for the RSA, which is normally 1,000 feet beyond the runway ends. Because of the presence of the EMAS, the primary runway length provides the maximum length possible. The presence of EMAS is required because of the Missouri River beyond both ends of Runway 1-19. The

EMAS was the result of previous planning and environmental studies as the preferred alternative because modifications to the Missouri River levees were not permitted, and the no-rise requirement for the river, which means that no fill could be placed outside of the levees within the Missouri River floodway.

The ROFZ and ROFA safety areas surrounding Runway 4-22 do not meet current design standards; however, the RSA for Runway 4-22 does meet standard. This runway is undergoing a major rehabilitation in the summer of 2023, and the current runway length is to be maintained.

The recent pavement condition report indicates that most apron areas, except those north of Taxiway D, are showing significant signs of deterioration. Rehabilitation projects should be considered for any runway/taxiway pavement with a PCI of 75 or less.

The geometry of several taxiways does not meet current FAA standards, as previously outlined. The alternatives chapter will consider geometry solutions to the non-standard taxiway elements.

A summary of the airside facility needs is shown on **Exhibit 3G**.

## LANDSIDE REQUIREMENTS

Landside facilities provide the essential interface between the airside facilities and ground access to and from the airport. The capacities of existing facilities have been examined against the projected requirements to gauge anticipated timing of needs. Included in the following analysis are aircraft hangars and storage, aircraft parking apron, GA terminal services, automobile parking, and support elements, such as fuel storage, perimeter fencing, and a potential control tower.

### AIRCRAFT STORAGE REQUIREMENTS

The demand for hangar space is based upon the forecast number and mix of aircraft expected to be based at the airport in the future. Most based aircraft are stored in either individual hangars or shared conventional hangars. It is estimated that 90 percent of based aircraft are stored in hangars. This percentage is carried forward to future years.

Currently, there are approximately 527,400 square feet (sf) of hangar space at the airport. Through the long-term planning period, the forecast indicates the addition of up to 30 more based aircraft. The mix of based aircraft is anticipated to continue to include a higher percentage of larger business jets. For planning purposes, future hangar space needs are a function of providing 1,400 sf for T-hangars, 2,200 sf for individual or connected box hangars, and 3,000 sf for conventional hangars. The future mix of aircraft is then distributed to these hangar types. Over the next 20 years, the hangar space model (**Table 3S**) shows a need for an additional 74,600 sf of hangar space.

**TABLE 3S | Hangar Needs**

| | Currently Available | Short Term | Inter. Term | Long Term |
|---|---|---|---|---|
| Based Aircraft | 196 | 206 | 213 | 226 |
| Aircraft to be Hangared (90%) | 177 | 185 | 192 | 203 |
| Single and Multi-Engine Piston | 74 | 74 | 75 | 75 |
| Turboprops, Jets, and Helicopters | 102 | 111 | 117 | 128 |
| **Hangar Area Requirements** | | | | |
| T-Hangar Area | 139,900 | 141,300 | 143,100 | 146,900 |
| Box Hangar Area | 17,900 | 27,800 | 35,500 | 46,500 |
| Conventional Hangar Area | 369,600 | 383,100 | 390,600 | 408,600 |
| **Total Storage Area (sf)** | **527,400** | **552,200** | **569,200** | **602,000** |
| **Total Hangar Area Needed (sf)** | **-** | **24,800** | **41,800** | **74,600** |

Future T-hangar area is estimated at 1,400 sf per aircraft parking space
Future box hangars are estimated at 2,200 sf per aircraft parking space
Future conventional hangar area is estimated at 3,000 sf per aircraft parking space

*Source: Coffman Associates analysis*

The hangar need model is based on current and future based aircraft and an estimate of the space needed for each aircraft. Hangars are also used by airport businesses, which make investments based on their business plans and/or the economic conditions to run an aviation business. Airports like MKC may attract aviation businesses that cater to aircraft owners around the country, so the based aircraft model for determining hangar needs is only one consideration. Following the construction of Taxiway L, approximately 20 acres of developable land will become available for development. The business model of the developer could show a demand for far more hangars than the based aircraft model.

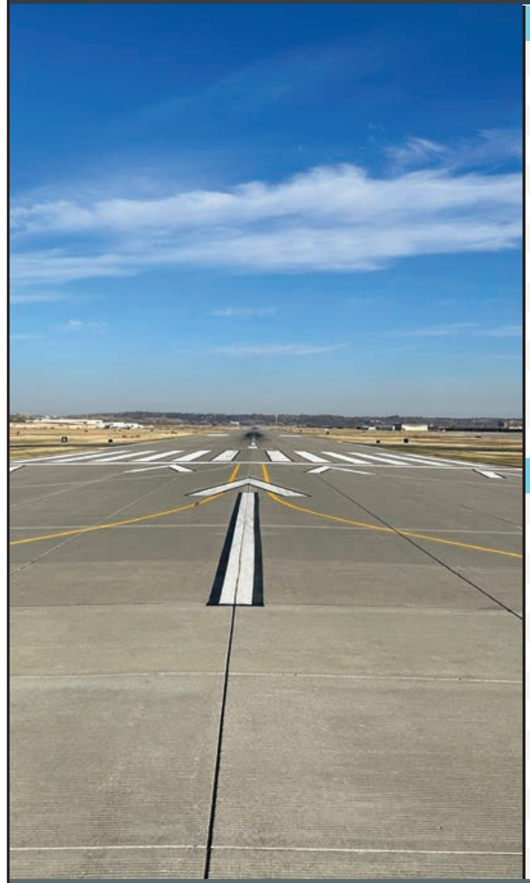
### Redevelopment Opportunities

Having been dedicated in 1927, MKC is nearly 100 years old, and many of the hangars and other support facilities are aging. Some of them have deferred maintenance that is decades overdue. As a result, it may be more cost-efficient to raze these older structures and replace them with new and modern facilities. The landside alternatives—to be presented in the next chapter—will consider redevelopment of some hangars if it provides for the most efficient development plan.

## AIRCRAFT PARKING APRON REQUIREMENTS

Aircraft parking aprons should provide for the locally based aircraft that are not stored in hangars, transient aircraft, and those apron areas used for maintenance functions, such as temporary ramp space when moving aircraft around. The aprons at MKC are multi-use, meaning local and itinerant aircraft will both use the aprons—typically at the direction of the fixed base operator (FBO) line services—to maximize apron utilization. There are approximately 234,400 square yards (sy) of apron space available for aircraft parking. Exhibit 1S documented the general apron areas at the airport.

## RUNWAYS



| AVAILABLE | POTENTIAL IMPROVEMENT/CHANGE |
|---|---|
| **RUNWAY 1-19** | |
| RDC: D-III-4000 | D-III-4000 or D-III-2400 |
| Visibility Minimum: ¾-mile | Examine ½-mile visibility minimums |
| Runway Length/Width: 6,827' x 150' | Consider Extension to 8,700'/Maintain 150' width for Aircraft Exceeding 150,000 lbs MTOW |
| Pavement Strength: 86(S)/171(D)/342(DD) | Maintain |
| - PCN: 67/R/B/W/T | Maintain |
| RSA: 500' Wide x 1,000' Beyond Runway Ends[1] | Maintain |
| ROFA: 800' Wide x 1,000' Beyond Runway Ends[1] | Penetrated by Road and Equipment on Runway 1 End - Clear if Possible |
| EMAS[1] Present Beyond zEnds of Runway | Maintain |
| OFZ: 400' wide x 200' Beyond Runway Ends | Meets Standard - Maintain |
| RPZ Ownership: Partial Ownership | Acquire if Feasible. |
| RPZ Incompatibilities: Roads | Provide Compatible RPZ Land Uses if Feasible |
| Nonprecision Markings Runway 1 | Meets Standard - Maintain |
| Precision Markings Runway 19 | Meets Standard - Maintain |
| High Intensity Runway Lighting (HIRL) | Meets Standard - Maintain |
| **RUNWAY 4-22** | |
| RDC: B-II-4000 | Maintain |
| Visibility Minimum: ¾-mile | Maintain |
| Runway Length/Width: 5,050' x 100' | Maintain |
| Pavement Strength: 48(S)/73(D)/136(DD) | Maintain |
| - PCN: 74/F/C/W/T | Maintain |
| RSA: 150' Wide x 300' Beyond Runway Ends | Meets Standard with Declared Distances - Maintain |
| ROFA: 500' Wide x 300' Beyond Runway Ends | Penetrated by Fence and Road - Bring to Standard if Feasible |
| ROFZ: 400' Wide x 200' Beyond Runway Ends | Penetrated by Fence and Road - Bring to Standard if Feasible |
| RPZ ownership: Partial Ownership | Acquire if Feasible. |
| RPZ Incompatibilities: Roads/Rail Yard | Provide compatible RPZ Land Uses if Feasible |
| Nonprecision Markings Runway 22 | Meets Standard - Maintain |
| Precision Markings Runway 4 | Meets Standard - Maintain |
| Medium Intensity Runway Lighting (HIRL) | Meets Standard - Maintain |

## TAXIWAYS

| AVAILABLE | POTENTIAL IMPROVEMENT/CHANGE |
|---|---|
| Taxiway G Hot Spot/RIM | Explore Geometry Redesign |
| Taxiway D Hot Spot | Explore Geometry Redesign |
| Taxiway Width | Provide Uniform 50' Wide Taxiways |
| Centerline Markings | Maintain |

## INSTRUMENT NAVIGATION AND WEATHER AIDS

| AVAILABLE | POTENTIAL IMPROVEMENT/CHANGE |
|---|---|
| Weather Reporting System: ASOS | Maintain |
| Beacon | Replace Aging Beacon as Necessary |
| 3 Windsocks | Maintain |
| Airport Traffic Control Tower | Consider Replacement/Relocation |
| Visual Approach to Runway 1 | Evaluate instrument approach procedure with lowest feasible visibility minimums |
| ¾-Mile ILS Approach to Runway 19 | Maintain |
| ¾-Mile ILS Approach to Runway 4 | Maintain |
| 1-Mile GPS Approach to Runway 22 | Maintain |

## VISUAL AIDS

| AVAILABLE | POTENTIAL IMPROVEMENT/CHANGE |
|---|---|
| PAPI-4L (Rwy 19) | Maintain |
| VASI 4L (Rwy 1) | Upgrade to PAPI-4L |
| VASI 4L (Rwy 4-22) | Upgrade to PAPI-4L |
| REILs: Runway 1 and 22 | Maintain |

[1] EMAS provides safety equivilance for RSA and ROFA

KEY

**AWOS** - Automated Weather Observing System
**EMAS** - Engineered Materials Arresting System
**MIRL/HIRL** - Medium/High Intensity Runway Lighting
MTOW - Maximum Takeoff Weight
**MITL** - Medium Intensity Taxiway Lighting
**OFZ** - Obstacle Free Zone
**PAPI** - Precision Approach Path Indicator
**RDC** - Runway Design Code
**REIL** - Runway End Identification Lights
**ROFA** - Runway Object Free Area
**RPZ** - Runway Protection Zone
**RSA** - Runway Safety Area
**TDG** - Taxiway Design Group

**Exhibit 3G**
**AIRSIDE FACILITY REQUIREMENTS**

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**Table 3T** presents the forecast apron area needs based on standard industry models. Local tie-down positions are estimated as 10 percent of based aircraft plus 10 more positions to address any intermittent spike in utilization. The area needed for local positions is estimated at 450 sy per aircraft (typically single engine aircraft).

**TABLE 3T | Aircraft Apron Requirements**

| | | FORECAST | | |
|---|---|---|---|---|
| | **Currently Available** | **Short Term** | **Intermediate Term** | **Long Term** |
| Local Apron Positions | | 31 | 31 | 33 |
| Local Apron Area (sy) | | 13,800 | 14,100 | 14,700 |
| Transient Apron Positions | | 105 | 109 | 117 |
| Piston Transient Positions | | 79 | 77 | 76 |
| Turbine Transient Positions | | 26 | 33 | 41 |
| Transient Apron Area (sy) | | 88,200 | 95,800 | 106,700 |
| **Total Apron Area (sy)** | **234,400** | **102,000** | **109,900** | **121,400** |

*Source: Coffman Associates analysis*

Transient apron needs are a function of busy day itinerant operations and the assumption that up to 30 percent of those aircraft would need apron parking space at any one time. Transient space is estimated for both small aircraft (650 sy) and larger turboprops and business jets (1,400 sy). The model then assumes that over time, a higher percentage of the aircraft using transient apron space will be large aircraft.

The apron model results in a long-term need for a total of 121,400 sy of apron space to meet the needs of both local tie-down and transient users. While the airport already meets the calculated apron area need, there are times throughout the year when apron needs spike. These are usually centered around large events, such as NFL football games or concerts. In addition, hangar developers may desire to construct apron areas to support their needs.

### AAM/UAM/eVTOL FACILITIES

Advanced Air Mobility, Urban Air Mobility, and Electric Vertical Takeoff and Landing vehicles are terms describing the emergence of a highly anticipated aviation market. This market will use highly automated to fully automated aircraft that will operate and transport passengers and cargo at low altitudes within urban and suburban areas. Within the next two years, several new aircraft are expected to be certified by the FAA for commercial use. These aircraft are typically battery powered and have vertical takeoff capability and fly like a fixed wing aircraft once airborne. These are smaller aircraft with passenger seating up to six people.

While there are nearly 100 companies attempting to enter this emerging market, those closest to commercial viability are looking to establish commuter service in more densely populated markets. The business model is to ferry passengers between destinations. For example, the Kansas City region could see a service from MKC to the stadium complex or to south Overland Park.

The FAA is currently in the process of developing infrastructure standards for airports to support AAM/UAM activity. In April 2023, the FAA published *Concept of Operations v.2.0 for Urban Air Mobility*. This document, which is a working analysis of the emergence of AAM/UAM, will continue to be updated and includes information about the likely infrastructure needs, including vertiports and vertistops. As this segment of transportation begins, operators are likely to use existing helicopter infrastructure. In March 2022, the FAA issued draft interim guidance via Engineering Brief 105, *Vertiport Design*, for the design and operation of facilities to support AAM/UAM activity. This Engineering Brief will be utilized to guide subsequent planning in this master plan for facilities to support AAM/UAM at MKC.

## DRONES/UNMANNED AIRCRAFT SYSTEMS (UAS)

The proliferation of interest in and the use of UAS, or drones, has led to significant policy and regulatory adaptations to integrate these platforms into the airport environment. Operating UAS, launch and recovery, from airport property is complex. As of this writing (March 2024), the FAA continues to research best practices for UAS integration and has issued numerous publications to inform airports sponsors of various safety considerations.

FAA organizes small UAS operators into three categories:

1. Government, Public Safety, and Law Enforcement: Government functions for authorized public aircraft operations often occur with a certificate of authorization (COA).
2. Certificated Remote Pilots (Business, Commercial, Non-profits): Most of these operations must comply with Part 107 rules while operations for package delivery are regulated by Part 135 and operations for dispensing of chemicals or agricultural products are regulated by Part 137.
3. Recreational/Model Aircraft or for Higher Education: Operations strictly for enjoyment, fun, or education and research are permissible under USC 44809, however, recreational UAS operations are considered a non-aeronautical activity for purposes of airport access under the Airport Improvement Program Grant Assurances.

Additionally, airspace access should not be construed as access to the airport. Physical access to the airport is an approval granted by the airport sponsor and governing authority. As the owner/operator of the airport property, airport sponsors have the authority to approve or disapprove a UAS operation requesting access to operate at an airport.

Airports have discretion to permit drone/UAS activity on their airport. Operators may be outside entities or the airport itself (e.g., fence inspections). Typically, dedicated facilities are not required for drone operations; however, there could be a need in the future. Specific drone/UAS facilities are not planned to be incorporated into this master plan, but the airport sponsor should monitor any inquiries and follow the FAA published best practices to ensure safety.

## AUTONOMOUS VEHICLES

Autonomous ground vehicle systems (AGVS) is the term for a technology that is advancing in the airport realm. In the future, it is conceivable to see unmanned mowers, snow removal equipment, aircraft tugs, baggage carts, employee and passenger busses and sweepers in operation at airports in the future. Currently, use of AVGS technology is not permitted on the airside by the FAA at part 139 certificated airports and federally obligated airports. While specific recommendations for the use of AGVS technology is not part of this master plan, the airport sponsor should monitor the potential benefits of such technology and monitor FAA advancement of these possibilities.

## ELECTRIC CHARGING STATIONS

There is a growing demand for charging stations to support electric vehicles (EV) and aircraft and airports need to be considering these needs. On the EV side, there are three levels of EV charging:

- Level 1: A 120-volt outlet which takes days to fully charge. These have the least impact on existing electrical systems and are best for longer-term parking.
- Level 2: A 220-volt outlet which fully charges a vehicle within eight hours. These are the most common chargers in use today.
- Level 3: These are direct current fast chargers which can fully charge an EV in about 30 minutes. These chargers have a significant impact on existing electrical sources. Good airport locations for these charging stations may be cell phone lots, taxi and rideshare lots, and short-term parking. The installation cost is higher than other charging station types so airports must weigh the cost-benefit.

Additional study beyond this master plan should be undertaken to determine if the installation of any or all of the charging capability is beneficial. The potential impact on the electrical grid and the potential need to increase capacity at the airport should also be considered. Providing EV charging stations is one step airports can take when embracing sustainability initiatives.

Aircraft that operate on batteries alone are beginning to come online. Initially, the AAM/UAM market will have the need for recharging capability. Ultimately, general aviation and commercial aircraft will have the need. There are many unknowns when planning for aircraft charging. Planning for this capability will require an understanding of the charging equipment, the location of the charging equipment, and the size of aircraft to be charged. For a general aviation airport, an ideal location would be in proximity to a terminal building or FBO, so that pilots and passengers have a place to rest comfortably. There could be a need for expanded aircraft apron space near charging stations.

## GENERAL AVIATION TERMINAL BUILDING

General aviation (GA) terminal buildings generally provide several functions, such as flight planning, a pilot's lounge, airport management offices, and storage. Many airports will also have leasable space in the terminal building for such features as a restaurant or concessions area, FBO line services, and other amenities. It is also common for FBOs to provide many of these services, as is the case at MKC.

The Charles E. McGee General Aviation Terminal is located on the west side of the airfield. It was constructed in 2010 as part of the construction of several hangars. The GA terminal is approximately 3,100 sf and has restrooms, showers, vending, a flight planning station, a small kitchen, and a large conference room. The GA terminal is intended as a central gathering place and is not meant to replace services provided by the FBOs.

The methodology used in estimating GA terminal facility needs is based on the number of airport users expected to utilize these facilities during the design hour. GA space requirements are based upon providing 120 sf per design hour itinerant passenger. Design hour itinerant passengers are determined by multiplying design hour itinerant operations by the estimated number of passengers on the aircraft.

By the long-term planning period, approximately 11,400 sf of space should be available for terminal services. Today, the combination of the GA terminal building and FBO-provided terminal services is estimated at 15,000 sf. The calculations described above show that the combination of the existing terminal building and the space provided by the FBOs is adequate through the long-term planning period. The existing terminal building is in the ideal location, central to the runway system and fronted by a large transient apron. Since the terminal building also serves as the first introduction travelers may have to the region, it should be maintained and remodeled as necessary to reflect the values of the community.

### AUTOMOBILE PARKING

Airport planners should be cognizant of the need for vehicle parking space on GA airports. At the same time, parking needs are generally determined by the hangar owners' needs. Those operating a business may have a need for more parking, while private hangars may not have a need for any dedicated parking as they park in their hangars when utilizing their aircraft. For this reason, it is inherently challenging to estimate future hangar needs.

Parking needs can be divided between transient airport users and locally based users. Transient users include visitors and those employed at the airport, while locally based users primarily include those attending to their based aircraft. Ideally, both user types would have access to dedicated vehicle parking outside the fence; however, at GA airports, it is common for locally based aircraft owners to park in their hangars. Rather than attempt to determine a specific number of vehicle positions needed in the future, developers should include vehicle parking, where necessary, in their development plans.

There are approximately 1,800 marked vehicle parking spaces around the airport. Approximately 1,375 are accessible by the public, with the remaining being associated with private hangars. The existing number of vehicle parking spaces should be adequate through the long-term planning period; however, any new hangars should account for adequate parking in proximity to the facility.

## *SUPPORT FACILITIES*

Various facilities that do not logically fall within the airside or landside classification are examined in this support facilities section. These support facilities relate to the overall operations of the airport.

## FUEL STORAGE

Fuel sales are primarily managed by the fuel providers on the airport. They own and operate their own fuel storage and delivery vehicles. Therefore, it is a business decision if additional fuel storage capacity is needed. The Kansas City Aviation Department manages the Avgas self-serve fuel island and the 12,500-gallon storage tank that supplies the self-serve pump.

Additional fuel storage capacity should be planned if the fuel providers are unable to maintain an adequate supply and reserve. An ideal reserve is typically 14 days for GA airports. For busier reliever airports with significant levels of turbine engine activity, a seven-day Jet A fuel supply may be adequate.

Based on fuel sales records, a volume of nearly 5.7 million gallons of Jet A fuel was sold in 2022. This works out to approximately 172 gallons sold for every turbine engine operation. By applying a modest growth rate to the forecast years, the airport is projected to sell 9.45 million gallons of Jet A fuel within the 20-year planning horizon. By the short-term planning period (the next five years), the airport is projected to begin realizing a constraint on fuel storage capacity, if maintaining a seven-day reserve. By the long-term planning period, the airport would need an additional 51,800 gallons of Jet A capacity. Additional Avgas storage capacity may be needed by the long-term planning period. **Table 3U** documents the fuel storage capacity analysis.

**Table 3U | Fuel Storage Requirements**

| | | | Planning Horizon | | |
|---|---|---|---|---|---|
| | Current Capacity | Baseline Consumption[1] | Short Term | Intermediate Term | Long Term |
| **Jet A Gallons per Operation** | 129,500 gal | 172 gal/op | 180 gal/op | 190 gal/op | 210 gal/op |
| Annual Usage (gal) | | 5,678,872 | 6,886,800 | 7,784,300 | 9,452,100 |
| Daily Usage (gal) | | 15,559 | 18,868 | 21,327 | 25,896 |
| 7-Day Storage (gal) | | 108,910 | 132,076 | 149,288 | 181,273 |
| **Avgas Gallons per Operation** | 26,700 gal | 3 gal/op | 4 gal/op | 5 gal/op | 7 gal/op |
| Annual Usage (gal) | | 260,988 | 380,262 | 502,265 | 783,986 |
| Daily Usage (gal) | | 715 | 1,042 | 1,376 | 2,148 |
| 14-Day Storage (gal) | | 10,010 | 14,585 | 19,265 | 30,071 |

*Source: [1]Coffman Associates estimate based on airport records*

### Sustainable and Alternative Fuels

In recent years there has been significant movement in the development of alternative and sustainable aviation fuels (SAF's). SAF is developed from a more sustainable source than traditional fossil fuels and has the effect of reducing emissions when compared to fossil fuels. Alternative aviation fuels include unleaded avgas, batteries, and hydrogen power. Generally, these aviation fuel options will require dedicated storage capacity and delivery vehicles. Therefore, additional space may need to be reserved to support the installation of infrastructure to support alternatives and sustainable fuel options at the airport.

## PERIMETER FENCING

At GA airports, full perimeter fencing is not required like it is at commercial service airports. Perimeter fencing serves multiple purposes, including basic airfield security and wildlife deterrence. As development occurs around GA airports, the need for full perimeter fencing becomes more necessary, especially for airports in urban environments, like MKC.

MKC has full perimeter fencing. All the fencing is seven-foot-high chain-link topped with three-strand barbed wire. In the summer of 2022, the airport undertook a project to replace multiple sections of the perimeter fencing, so the fencing is currently in excellent condition.

## AIRCRAFT RESCUE AND FIREFIGHTING FACILITIES

Airports that are certificated under Title 14 Code of Federal Regulations, Part 139 with a commercial operating certificate are required to meet certain on-site firefighting capabilities. MKC holds a Class IV operating certificate, which is issued to airports that can serve unscheduled passenger operations (i.e., charters) of large air carrier aircraft. Class IV airports cannot serve scheduled large air carrier or small air carrier aircraft.

In 2013, a new aircraft rescue and firefighting (ARFF) building was constructed on the east side of the airfield. The equipment, agents, and staffing meet the required ARFF Index A standard. The airport can also meet ARFF Index C requirements when necessary. The facility is generally unstaffed. Any air carrier operator is required to receive prior permission from the airport manager to operate at the airport. For the 30-minute period surrounding the air carrier operation, ARFF-certified Kansas City Fire Department personnel will be on-site at the ARFF station.

The ARFF station is in an ideal location that allows for rapid response times, and it is staffed during air carrier operations. This facility should be maintained through the planning period.

## AIRPORT ACCESS

Primary access to the airport is from an exit on U.S. 169 Highway that leads to Richards Road and the east side airport facilities. Richards Road wraps around both the north and south sides of the airfield, providing access to west side facilities via Lou Holland Drive. The airport can also be accessed via a southbound exit from U.S. 169 Highway at the north end of the airport. This exit provides access to both sides of the airfield.

For years, the primary concern related to access to the airport has been morning and afternoon congestion on U.S. 169 Highway. Currently, a new bridge is being constructed across the Missouri River which will carry U.S. 169 Highway traffic, and which will alleviate congestion problems.

**Interior Access**

Most facilities at the airport have dedicated vehicle parking outside the perimeter fencing, with the exception of the T-hangar facilities on the west side. Those who lease T-hangars have gate passes and will typically park their vehicles in their hangars when flying. This is acceptable at GA airports. There is a tenant training program that identifies the movement/non-movement areas to educate those with gate access to avoid the aircraft movement areas.

## AIRPORT MAINTENANCE FACILITIES

In 2017, the airport constructed a new 9,000-sf administration office and attached 21,600-sf maintenance building on the east side of the airfield. The maintenance building houses various equipment, including snow removal equipment. Two other existing buildings (10,000 sf and 800 sf) just south of the administration offices are also used for equipment storage. The combination of these maintenance facility buildings will be adequate through the long-term planning period.

## WASH RACK

Busier GA airports will often desire to establish an aircraft wash rack in a single location for aircraft cleaning purposes. Wash racks and water recovery systems enhance pollution prevention through water reclamation, wash water filtration, and cleaning solution reclamation. Wash racks provide an environmentally friendly method to contain aircraft cleaning fluids.

There is not currently a dedicated wash rack facility at the airport. The alternatives analysis will consider potential locations for a wash rack.

## LANDSIDE SUMMARY

This section has documented the potential needs of the airport for landside facilities. The most prominent landside facility for GA airports is the aircraft storage hangars. Aircraft hangars range in size from small single-unit T-hangars to large corporate or FBO hangars. MKC currently provides a variety of hangar types. With the completion of the Taxiway L extension, an area of approximately 20 acres on the west side of the airfield will be available for development and redevelopment.

It is forecast that the airport will need at least 74,600 sf of new aircraft storage space within the next 20 years. The aircraft apron areas are shown to be adequate to accommodate both local and transient activity; however, at peak times—like for a major sporting event—the aprons may be congested.

MKC has a GA terminal building providing various pilot functions and a meeting place. The FBOs also provide excellent pilot/passenger amenities. These facilities are often the first impression of a city, so it is encouraged to maintain these facilities. Landscaping around the airport can also lead to a positive first impression of a city.

MKC is known as a convenient refueling stop and sells a high volume of fuel compared to its operational count. The analysis indicated that additional Jet A fuel storage tanks may be needed in the five-to-10-year timeframe to maintain a minimum seven-day supply. **Exhibit 3H** summarizes the landside facility needs for the 20-year forecast period.

In the next chapter of this master plan, various development alternatives and hangar layout concepts will be presented. The alternatives will include accommodations for the needs identified.

## *SUMMARY*

This chapter has outlined both airside and landside facility requirements for MKC for a 20-year planning period.

At its current length of 6,827 feet, Runway 1-19 meets the needs of current airport users, for the most part. The airport supports a wide range of aircraft types and sizes, including larger air carrier aircraft, such as Boeing 737 and 757, which are operated as charters (mostly for sporting team flights). Analysis in this chapter showed that some operators would benefit from a longer runway. As noted, MKC is likely constrained from adding additional runway length; however, that possibility will be covered in the alternatives chapter.

Consideration will be given to potential improvements to the instrument approach procedures. Currently, Runway 1 does not have an instrument approach due to certain obstructions on the approach to the runways. An enhanced survey of the approach to Runway 1 has been undertaken and an analysis will be completed to determine if an instrument approach to Runway 1 may be feasible.

The ROFA and ROFZ surrounding Runway 4-22 are non-standard on the Runway 4 end. Analysis will be undertaken in the alternatives chapter to address these areas.

There are three FAA-identified hot spots and one RIM location on the airfield. One of the hot spots is anticipated to be resolved with the completion of the Taxiway L extension and Taxiway B projects. The other two hot spots (Taxiway D and Taxiway G) will be the subject of in-depth analysis in the alternatives chapter.

On the landside, with the completion of the Taxiway L extension project in 2023, an area encompassing approximately 20 acres will become available for development. This is a rare opportunity for an urban airport that is nearly built out already. Special care and detail will be given to several potential development concepts for this area on the west side of the airport.

The following chapter will consider various airside and landside layouts to address forecast growth at the Kansas City Downtown Airport – Wheeler Field.

| | Available | Short-Term | Intermediate-Term | Long-Term |
|---|---|---|---|---|
| **Based Aircraft** | 196 | 206 | 213 | 226 |
| **Hangar Positions** | 177 | 185 | 192 | 203 |
| **Hangar Area (s.f.)** | 527,400 | 552,200 | 569,200 | 602,000 |
| Net New Hangar Area (s.f.) | NA | 24,800 | 41,800 | 74,600 |
| **Aircraft Parking Positions** | | | |  |
| Local Positions | NA | 31 | 31 | 33 |
| Transient Piston Positions | NA | 79 | 77 | 76 |
| Transient Business Jet Positions | NA | 26 | 33 | 41 |
| **Aircraft Parking Apron (s.y.)** | | | |  |
| Local Apron Area | NA | 13,800 | 14,100 | 14,700 |
| Transient Apron Area | NA | 88,200 | 95,800 | 106,700 |
| Total Apron | 234,400 | 102,000 | 109,900 | 121,400 |
| **Auto Parking** | | | |  |
| Total Vehicle Parking Spaces | NA | 210 | 223 | 247 |
| Total Vehicle Parking Area (s.f.) | NA | 54,000 | 58,000 | 64,000 |
| **GA Terminal Building** | | | |  |
| Area (s.f.) | 15,000[1] | 9,500 | 10,200 | 11,400 |
| **Fuel Storage** | | | |  |
| Jet A Capacity | 129,500 gal. | Maintain | Add 24,000 gal. | Add 24,000 gal. |
| AvGas Capacity | 26,700 gal. | Maintain | Maintain | Add 12,000 gal. |
| **Perimeter Fencing** | Complete Perimeter Fencing with 3 Strand Barbed-Wire | Maintain | Maintain | Maintain and Replace As Needed |
| **Aircraft Wash Rack** | NA | Add Wash Rack | Maintain | Maintain |
| **Advanced Air Mobility/ Urban Air Mobility Facilities** | NA | Consider Dedicated Facilities | Maintain | Maintain |

[1] Includes GA Terminal and FBO Provided Areas.

**Exhibit 3H**
**LANDSIDE AND SUPPORT REQUIREMENTS**

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