Airport Master Plan

KANSAS CITY DOWNTOWN AIRPORT – WHEELER FIELD

Chapter 4

Airport Development Alternatives

Airport Master Plan

KANSAS CITY DOWNTOWN AIRPORT–WHEELER FIELD

Chapter 4
AIRPORT DEVELOPMENT ALTERNATIVES

In the previous chapter, the aviation facilities required to satisfy airside and landside demand through the long-term planning period of the master plan were identified. In addition, several Federal Aviation Administration (FAA) standards were discussed that apply to airfield design. The next step in the planning process is to evaluate reasonable ways these facilities can be provided while also meeting design standards. The purpose of this chapter is to formulate and examine rational development alternatives that address the short-, intermediate-, and long-term planning horizon levels. Because there are a multitude of possibilities and combinations, it is necessary to focus on those opportunities that have the greatest potential for success. Each alternative provides a different approach to meeting existing and future facility needs; these layouts are presented for purposes of evaluation and discussion.

Some airports become constrained due to limited availability of space, while others may be constrained due to adjacent land use development or geographical features. Careful consideration should be given to the layout of future facilities and impacts to potential airfield improvements at Kansas City Downtown Airport – Wheeler Field (MKC). Proper planning at this time can ensure the long-term viability of the airport for aviation and economic growth.

The primary goal of this planning process is to develop a feasible plan to meet the needs of the projected market demand over the next 20 years. The plan of action should be developed in a manner that is consistent with the future goals and objectives of the City of Kansas City, Missouri, the Kansas City Aviation Department (KCAD), and airport stakeholders, including users of the airport and the local community and region, all of whom have a vested interest in the development and operation of MKC.

The goal is to develop an underlying rationale that supports the final preferred future development plan, which will be presented in Chapter Five. Through this process, an evaluation of the highest and best uses of airport property will be made, while also weighing local development goals, efficiency, physical and environmental factors, capacity, and appropriate safety design standards.

The alternatives presented in this chapter have been formulated as potential ways to meet the overall program objectives for the airport, and to do so in a balanced manner. Through coordination with KCAD, MKC management, the Planning Advisory Committee (PAC), and the public, an alternative (or combination of alternatives) will be refined and modified as necessary into a preferred future development plan. Therefore, the planning considerations and future alternatives presented in this chapter can be considered as the starting points in the evolution of a preferred future development plan for the future of MKC.

It should be noted that all the development alternatives presented in this chapter are conceptual in nature and are subject to further engineering refinement as the projects move to the implementation phase. All the alternatives represent a possible future condition. In fact, the preferred future development plan, to be presented in the next chapter, is one option that may be further refined in the future.

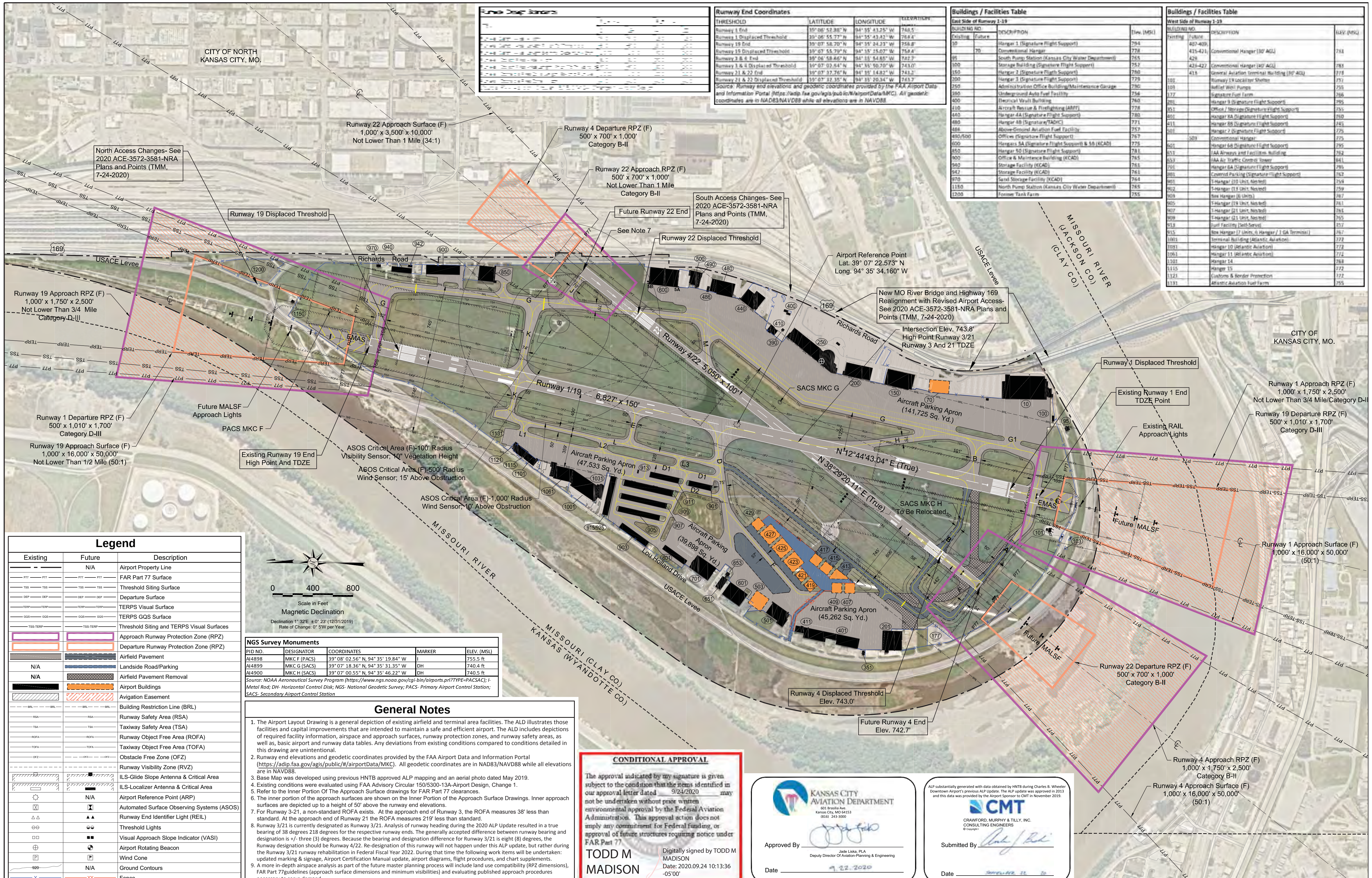
PLANNING OBJECTIVES

A set of basic planning objectives has been established to guide the alternatives development process. It is the goal of this master planning effort to produce a development plan for the airport that addresses forecast aviation demand and meets FAA design standards to the greatest degree possible. KCAD provides the overall guidance for the operation and development of the airport. It is of primary concern that MKC is marketed, developed, and operated for the betterment of the community and its users. The following basic planning principles and objectives will be utilized as general guidelines during this planning effort:

- To develop a safe, attractive, and efficient aviation facility in accordance with applicable federal, state, and local regulations;
- To preserve and protect public and private investments in existing airport facilities;
- To provide a means for the airport to grow as dictated by demand;
- To put into place a plan to ensure the long-term viability of the airport as well as to promote compatible land uses surrounding the airport;
- To develop a facility that is readily responsive to the changing needs of all aviation users;
- To be reflective and supportive of the long-term planning efforts currently applicable to the region;
- To develop a facility with a focus on self-sufficiency in both operational and developmental cost recovery; and,
- To ensure that future development is environmentally compatible.

REVIEW OF PREVIOUS AIRPORT PLANS

The previous master plan for MKC was completed in 2004. More recently, the Airport Layout Plan (ALP) was updated in 2020 to facilitate several high priority projects. The 2020 ALP is shown on **Exhibit 4A**. The drawing graphically depicts both airside and landside recommendations based upon previous airport planning efforts that include:



Runway End Coordinates			
THRESHOLD	LATITUDE	LONGITUDE	ELEVATION
Runway 1 End	39° 06' 52.38" N	94° 35' 43.25" W	748.5'
Runway 1 Displaced Threshold	39° 06' 55.77" N	94° 35' 43.42" W	764.4'
Runway 19 End	39° 07' 58.70" N	94° 35' 24.23" W	756.8'
Runway 19 Displaced Threshold	39° 07' 55.79" N	94° 35' 25.07" W	754.4'
Runway 3 & 4 End	39° 06' 58.66" N	94° 35' 54.65" W	742.7'
Runway 3 & 4 Displaced Threshold	39° 07' 02.54" N	94° 35' 50.70" W	743.0'
Runway 21 & 22 End	39° 07' 37.76" N	94° 35' 14.82" W	743.2'
Runway 21 & 22 Displaced Threshold	39° 07' 32.35" N	94° 35' 20.34" W	743.7'

Source: Runway end elevations and geodetic coordinates provided by the FAA Airport Data and Information Portal (https://adip.faa.gov/agis/public/#/airportData/MKC). All geodetic coordinates are in NAD83/NAVD88 while all elevations are in NAVD88.

Buildings / Facilities Table

East Side of Runway 1-19

BUILDING NO. Existing	BUILDING NO. Future	DESCRIPTION	Elev. (MSL)
10		Hangar 1 (Signature Flight Support)	794
	70	Conventional Hangar	778
95		South Pump Station (Kansas City Water Department)	765
100		Storage Building (Signature Flight Support)	752
150		Hangar 2 (Signature Flighth Support)	780
200		Hangar 3 (Signature Flight Support)	779
250		Administration Office Building/Maintenance Garage	790
390		Underground Auto Fuel Facility	756
400		Electrical Vault Building	760
410		Aircraft Rescue & Firefighting (ARFF)	778
440		Hangar 4A (Signature Flight Support)	780
480		Hangar 4B (Signature/TADIC)	771
486		Above-Ground Aviation Fuel Facility	757
490/500		Offices (Signature Flight Support)	767
600		Hangars 5A (Signature Flight Support) & 5B (KCAD)	775
850		Hangar 50 (Signature Flight Support)	781
900		Office & Maintence Building (KCAD)	765
940		Storage Facility (KCAD)	761
942		Storage Facility (KCAD)	761
970		Sand Storage Facility (KCAD)	764
1150		North Pump Station (Kansas City Water Department)	765
1200		Former Tank Farm	755

Buildings / Facilities Table

West Side of Runway 1-19

BUILDING NO. Existing	BUILDING NO. Future	DESCRIPTION	ELEV. (MSL)
	407-409, 415-421, 429	Conventional Hangar (30' AGL)	773
	423-427	Conventional Hangar (40' AGL)	783
	413	General Aviation Terminal Building (30' AGL)	773
101		Runway 19 Localizer Shelter	757
103		Relief Well Pumps	755
177		Signature Fuel Farm	766
201		Hangar 9 (Signature Flight Support)	795
351		Office / Storage (Signature Flight Support)	755
401		Hangar 8A (Signature Flight Support)	760
411		Hangar 8B (Signature Flight Support)	745
501		Hangar 7 (Signature Flight Support)	775
	503	Conventional Hangar	775
601		Hangar 6B (Signature Flight Support)	795
651		FAA Airways and Facilities Building	762
653		FAA Air Traffic Control Tower	841
701		Hangar 6A (Signature Flight Support)	795
801		Covered Parking (Signature Flight Support)	762
901		T-Hangar (10 Unit, Nested)	759
902		T-Hangar (13 Unit, Nested)	759
903		Box Hangar (6 Units)	767
905		T-Hangar (19 Unit, Nested)	761
907		T-Hangar (21 Unit, Nested)	761
909		T-Hangar (21 Unit, Nested)	765
913		Fuel Facility (Self-Serve)	757
915		Box Hangar (7 Units: 6 Hangar / 1 GA Terminal)	767
1001		Terminal Building (Atlantic Aviation)	772
1031		Hangar 10 (Atlantic Aviation)	772
1061		Hangar 11 (Atlantic Aviation)	772
1101		Hangar 14	763
1115		Hanger 15	772
1121		Customs & Border Protection	772
1131		Atlantic Aviation Fuel Farm	755

Legend

Existing	Future	Description
	N/A	Airport Property Line
P77	P77	FAR Part 77 Surface
TSS	TSS	Threshold Siting Surface
DEP	DEP	Departure Surface
TERP	TERP	TERPS Visual Surface
GQS	GQS	TERPS GQS Surface
TSS-TERP	TSS-TERP	Threshold Siting and TERPS Visual Surfaces
		Approach Runway Protection Zone (RPZ)
		Departure Runway Protection Zone (RPZ)
		Airfield Pavement
N/A		Landside Road/Parking
N/A		Airfield Pavement Removal
		Airport Buildings
		Avigation Easement
BRL	BRL	Building Restriction Line (BRL)
RSA	RSA	Runway Safety Area (RSA)
TSA	TSA	Taxiway Safety Area (TSA)
ROFA	ROFA	Runway Object Free Area (ROFA)
TOFA	TOFA	Taxiway Object Free Area (TOFA)
OFZ	OFZ	Obstacle Free Zone (OFZ)
		Runway Visibility Zone (RVZ)
		ILS-Glide Slope Antenna & Critical Area
		ILS-Localizer Antenna & Critical Area
	N/A	Airport Reference Point (ARP)
		Automated Surface Observing Systems (ASOS)
		Runway End Identifier Light (REIL)
		Threshold Lights
		Visual Approach Slope Indicator (VASI)
		Airport Rotating Beacon
		Wind Cone
920	N/A	Ground Contours
X	XX	Fence

NGS Survey Monuments				
PID NO.	DESIGNATOR	COORDINATES	MARKER	ELEV. (MSL)
AI4898	MKC F (PACS)	39° 08' 02.56" N, 94° 35' 19.84" W	I	755.5 ft
AI4899	MKC G (SACS)	39° 07' 18.36" N, 94° 35' 31.35" W	DH	740.4 ft
AI4900	MKC H (SACS)	39° 07' 00.55" N, 94° 35' 46.22" W	DH	740.5 ft

Source: NOAA Aeronautical Survey Program (https://www.ngs.noaa.gov/cgi-bin/airports.prl?TYPE=PACSAC); I- Metal Rod; DH- Horizontal Control Disk; NGS- National Geodetic Survey; PACS- Primary Airport Control Station; SACS- Secondary Airport Control Station

General Notes

1. The Airport Layout Drawing is a general depiction of existing airfield and terminal area facilities. The ALD illustrates those facilities and capital improvements that are intended to maintain a safe and efficient airport. The ALD includes depictions of required facility information, airspace and approach surfaces, runway protection zones, and runway safety areas, as well as, basic airport and runway data tables. Any deviations from existing conditions compared to conditions detailed in this drawing are unintentional.
2. Runway end elevations and geodetic coordinates provided by the FAA Airport Data and Information Portal (https://adip.faa.gov/agis/public/#/airportData/MKC). All geodetic coordinates are in NAD83/NAVD88 while all elevations are in NAVD88.
3. Base Map was developed using previous HNTB approved ALP mapping and an aerial photo dated May 2019.
4. Existing conditions were evaluated using FAA Advisory Circular 150/5300-13A-Airport Design, Change 1.
5. Refer to the Inner Portion Of The Approach Surface drawings for FAR Part 77 clearances.
6. The inner portion of the approach surfaces are shown on the Inner Portion of the Approach Surface Drawings. Inner approach surfaces are depicted up to a height of 50' above the runway end elevations.
7. For Runway 3-21, a non-standard ROFA exists. At the approach end of Runway 3, the ROFA measures 38' less than standard. At the approach end of Runway 21 the ROFA measures 219' less than standard.
8. Runway 3/21 is currently designated as Runway 3/21. Analysis of runway heading during the 2020 ALP Update resulted in a true bearing of 38 degrees 218 degrees for the respective runway ends. The generally accepted difference between runway bearing and designation is +/- three (3) degrees. Because the bearing and designation difference for Runway 3/21 is eight (8) degrees, the Runway designation should be Runway 4/22. Re-designation of this runway will not happen under this ALP update, but rather during the Runway 3/21 runway rehabilitation in Federal Fiscal Year 2022. During that time the following work items will be undertaken: updated marking & signage, Airport Certification Manual update, airport diagrams, flight procedures, and chart supplements.
9. A more in-depth airspace analysis as part of the future master planning process will include land use compatibility (RPZ dimensions), FAR Part 77guidelines (approach surface dimensions and minimum visibilities) and evaluating published approach procedures necessary to serve demand.

CONDITIONAL APPROVAL

The approval indicated by my signature is given subject to the condition that the items identified in our approval letter dated 9/24/2020 may not be undertaken without prior written environmental approval by the Federal Aviation Administration. This approval action does not imply any commitment for Federal funding, or approval of future structures requiring notice under FAR Part 77.

TODD M MADISON

Digitally signed by TODD M MADISON
Date: 2020.09.24 10:13:36 -05'00'

KANSAS CITY AVIATION DEPARTMENT
601 Brasilia Ave.
Kansas City, MO 64153
(816) 243-3000

Approved By
Jade Liska, PLA
Deputy Director Of Aviation-Planning & Engineering
Date 9.22.2020

ALP substantially generated with data obtained by HNTB during Charles B. Wheeler Downtown Airport's previous ALP Update. The ALP update was approved in 2013 and this data was provided by the Airport Sponsor to CMT in November 2019.

CMT
CRAWFORD, MURPHY & TILLY, INC.
CONSULTING ENGINEERS

Submitted By
Date September 22 20

0 1 2
THIS BAR IS EQUAL TO 2" AT FULL SCALE (24x36).

CMT

REVISIONS			
NO.	BY	DATE	DESCRIPTION

DESIGN BY	AJB
DRAWN BY	CMT
CHECKED BY	DRG
APPROVED BY	

KANSAS CITY AVIATION DEPARTMENT
CITY OF KANSAS CITY, MISSOURI

CHARLES B. WHEELER DOWNTOWN AIRPORT (MKC)

Future Airport Layout Drawing

SCALE AS NOTED | JOB NO. 190447-02 | DATE 11/06/2019 | SHEET 03 OF 26 SHEETS

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- Construction of new taxiway pavement and closure/removal of existing pavement on the southwest side of the airport to eliminate Hot Spot #3 and improve overall efficiency,
- Southwest hangar development area with aircraft access via existing Taxiway F and recently completed Taxiway L extension,
- New hangar construction on the east side.

The analysis presented in this chapter will revisit the recommendations presented on the ALP, as well as in the previous master plan. Since completion of the last master plan, the FAA has made significant modifications to airfield design standards, as outlined in the previous chapter. As such, some of the previous plan's elements may be carried over to this master plan, while others may be changed or removed from further consideration.

NO ACTION/NON-DEVELOPMENT ALTERNATIVES

The KCAD is charged with managing the airport for the economic betterment of the community and region. MKC is a vibrant facility with a substantial economic impact to the region. **An analysis of the economic benefit of the airport, completed in 2023, found that MKC generated $625 million in total economic output and nearly 2,800 jobs**. With any alternatives evaluation, a no-action option should be considered. Under a no-action plan, the airport would remain in its existing condition, including areas of non-compliance. No new development would be planned, and no significant investment would be made into existing infrastructure such as the runways, taxiways, and aprons. This would be inconsistent with the long-term goals of the FAA and the KCAD, which is to maintain a safe and effective facility that is compatible with the surrounding environment. MKC is an important economic engine for the region and choosing not to adequately maintain the facility would ultimately lead to a negative economic impact.

Relocation of services to another airport, or development of a new airport site, is another potential no-action alternative to consider in a master plan. The development of a new facility such as MKC is a very complex and expensive option. A new site will require greater land area, duplication of investment in facilities, installation of supporting infrastructure that is already available at the existing site, and greater potential for negative impacts to natural, biological, and cultural resources. This master plan will not consider relocation of services or development of a new airport as viable alternatives.

The purpose of this master plan is to examine aviation needs at MKC over the course of the next 20 years. Therefore, this master plan will examine the needs of the existing airport and present a program of potential capital improvement projects to cover the scope of the plan. The airport is a lucrative business, transportation utility, and economic asset for the region. It can accommodate existing and future demand and should be developed accordingly to support the interests of residents and businesses which rely upon it. Ultimately, the final decision regarding development rests with the City of Kansas City, KCAD, MoDOT, and the FAA on an individual project basis. The analysis to follow considers airside and landside development alternatives that consider an array of facility demands, including safety, capacity, access, and efficiency.

DEVELOPMENT ALTERNATIVES

The development alternatives are categorized into two functional areas: airside and landside. The airside relates to runways, taxiways, navigational aids, lighting and marking aids, etc., which require the greatest commitment of land area to meet the physical layout of an airport, as well as the required airfield safety standards. The design of the airfield also defines minimum set-back distances from the runway and object clearance standards. These criteria are defined first to ensure the fundamental needs of MKC are met. The landside element includes terminal services, hangars, aircraft parking aprons, as well as utilization of remaining property to provide revenue support for the airport and to benefit the economic development and well-being of the region.

Each functional area interrelates and affects the development potential of the others. Therefore, all areas are examined individually, and then as a whole, to ensure the final plan is functional, efficient, and cost-effective. The total impact of all these factors must be evaluated to determine if the investment in MKC will meet the needs of the surrounding area, both during and beyond the planning period of this study.

AIRSIDE ALTERNATIVES

The airside relates to the runway and taxiway system. The airside alternatives analysis will examine specific elements individually, then combine various viable solutions into several consolidated airside alternatives. The alternatives process often includes presenting options that are clearly not feasible to document exactly why those options should not be further considered. Ultimately, a decision will be made following consultation with the various airport stakeholders as to the most appropriate plan.

AIRSIDE CONSIDERATIONS

Exhibit 3G previously presented a summary of the primary airside planning considerations for the alternatives analysis. Landside planning considerations are outlined later in this chapter. These considerations are the result of the findings of the aviation demand forecasts and facility requirements evaluations, as well as input from airport stakeholders. In addition to these considerations, both runways should continue to meet applicable Runway Design Code (RDC) standards.[1] Runway 1-19 is planned to meet RDC D-III-4000[2] standards at a minimum, while Runway 4-22 is planned to meet RDC B-II-4000 design standards.

Consideration #1 – Runway Dimensions

The primary runway at MKC, Runway 1-19, is currently 6,827 feet long and 150 feet wide. The existing width exceeds RDC D-III-4000 standard, which calls for a 100-foot width. However, for runways that support aircraft weighing more than 150,000 pounds, the runway width standard increases to 150 feet.

[1] Applicable RDC standards are detailed in Chapter 3: Facility Requirements.
[2] The potential for meeting RDC D-III-2400 standards on Runway 1-19 will be discussed in a later section.

As outlined in previous chapters, Runway 1-19 is often used by aircraft that exceed 150,000 pounds. These are most typically Boeing 737 and 757 models, as well as other large transport type aircraft used by charter operators for sports teams. In 2022, these larger and heavier aircraft accounted for 324 operations. The applicable runway width standard is typically determined by the critical aircraft which accounts for 500 or more annual operations. In the future, the critical aircraft may be the family of aircraft weighing more than 150,000 pounds.

Chapter Three previously outlined an ideal runway length of approximately 8,700 feet for Runway 1-19, based on FAA runway length calculations and analysis of aircraft flight planning manuals. While a runway extension would likely be justified based on current and projected usage by aircraft requiring a longer runway, an extension to Runway 1-19 is infeasible due to existing constraints on each runway end. The Missouri River and its associated levee bound the runway at each end, and the EMAS beds located off each end further limit any extension potential. In fact, the EMAS beds already maximize the length of Runway 1-19. Therefore, this alternatives analysis will not specifically consider extending Runway 1-19.

Runway 1-19 does not meet current safety design standards for runway safety area (RSA), runway object free area (ROFA), and runway obstacle free zone (ROFZ). The alternatives analysis will consider methods to fully meet these design standards, some of which may include shortening the runway or altering the existing declared distances.

Crosswind Runway 4-22 is 5,050 feet long and 100 feet wide and provides instrument approach visibility minimums not lower than ¾-mile. The runway width standard under these conditions is 75 feet. However, Runway 4-22 provides additional capability as a capacity runway. In cases where the airfield capacity is near 60 percent of the annual service volume (ASV), like MKC, a wider runway can be justified. Runway 4-22 also accommodates activity by B-III, C/D-III aircraft, all of which justify a 100-foot-wide runway. Therefore, Runway 4-22 is planned to be maintained at its current width of 100 feet. Runway 4-22's status as a crosswind runway and a capacity runway is formally documented in the FAAs internal SOAR database.

The future length of Runway 4-22 is not yet determined. It should be as long as possible because of the need for the runway to accommodate larger aircraft that might normally use Runway 1, if it had an instrument approach. However, the ROFA and OFZ on the Runway 22 end, extend off airport property. To bring these imaginary surfaces onto the airport would require shortening the runway.

The alternatives analysis will examine possible options to meet these runway design standards, which could include shortening the runway or altering the existing declared distances.

Consideration #2 – Non-standard Conditions in Safety Areas

Runway 1-19

For Runway 1-19, the standard RSA and ROFA length beyond the end of a runway meeting D-III-4000 or 2400 design standards is 1,000 feet. The RSA has a width of 500 feet and the ROFA has a width of 800 feet. The ROFZ dimensions are 400 feet wide and extend 200 feet beyond the pavement end.

Achieving a standard RSA, ROFA, and ROFZ is not possible due to the presence of public roads and the Missouri River levee. Obstructions are also present within safety areas. Because a modification to standard is not allowable for an RSA,[3] the airport installed EMAS beds at each end of Runway 1-19. EMAS is an acceptable alternative to RSA/ROFA length and effectively allows the airport to achieve a standard RSA/ROFA in terms of length. The EMAS is not, however, a substitute for RSA/ROFA width, which results in obstructions to these safety areas on each runway end, as depicted in **Exhibit 4B**. Additionally, the terrain slopes up within the Runway 19 RSA and ROFA due to the levee, which is a non-standard condition—design standards call for a flat or negative grade. Previous planning studies determined that it is not feasible to relocate or alter the levee due to design and operational requirements (to be discussed further in a later section). Lou Holland Drive also passes through the ROFA at each runway end. While this non-standard condition is not deemed as hazardous (due to previous planning associated with the EMAS installation), the alternatives will nonetheless illustrate various options for mitigating the non-standard RSA/ROFA/ROFZ conditions associated with Runway 1-19.

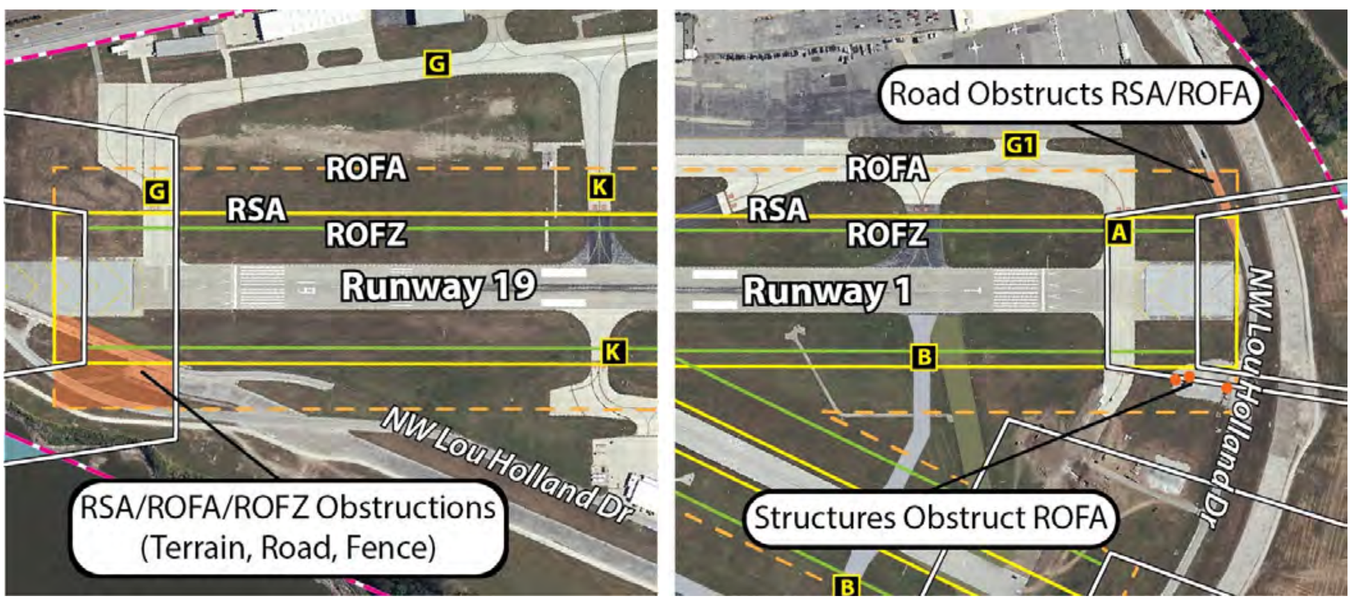


Exhibit 4B – Non-standard Safety Areas (Runway 1-19)

[3] The FAA will not consider modification to standard for either the RSA or the ROFZ. This will be discussed in greater detail in the "Runway Safety Area Determination" section.

The runway protection zones (RPZ) associated with each runway end also contain potentially incompatible land uses in the form of public roads (i.e., Lou Holland Drive, Richards Road, and U.S. Highway 169) and a rail yard, as shown on **Exhibit 4C**. While removal of incompatible land uses within RPZs is preferred by the FAA, there are significant limiting factors to removing or relocating public roadways and rail lines. Lou Holland Drive provides the only route for accessing the airport's west side, and constructing a new roadway outside of the RPZs is not feasible due to the Missouri River. A reroute of Richards Road or U.S. Highway 169 faces a similar obstacle as they are bounded by the adjacent rail yard. Thus, the only remaining option to clear the RPZs would be to further displace the runway thresholds and to reduce operational length. Considering these substantial constraints and the negative consequence of an additional runway length reduction, no further consideration will be given to mitigating RPZ incompatibilities.

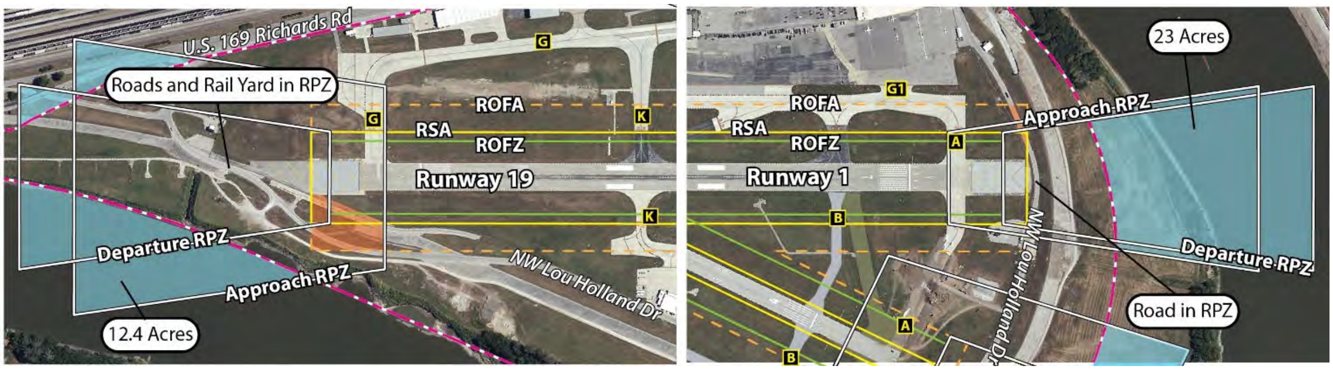


Exhibit 4C – Potential Incompatible Land Uses in RPZs (Runway 1-19)

Runway 4-22

RDC B-II-4000 design standards call for the RSA to measure 300 feet beyond the runway end at a width of 150 feet and for the ROFA to measure 300 feet beyond the runway end at a width of 500 feet. The ROFZ standard is 200 feet beyond the runway end and 400 feet wide. As shown on **Exhibit 4D**, Runway 4-22 currently contains obstructions in the ROFA and ROFZ, as well as potentially incompatible land uses in the RPZs. The RSA is free from obstructions on the Runway 22 end due to the declared distances currently in effect. On the Runway 22 end, the ROFA and ROFZ extend beyond airport property and over perimeter fencing, public roadways, and the rail yard. On the Runway 4 end, the ROFA extends slightly over Lou Holland Drive and encompasses the fence. The RPZs associated with each runway end extend beyond airport property and encompass potentially incompatible land uses. The alternatives will depict options to mitigate non-standard conditions within the Runway 4-22 ROFA and ROFZ, while the RPZs are planned to remain as-is.

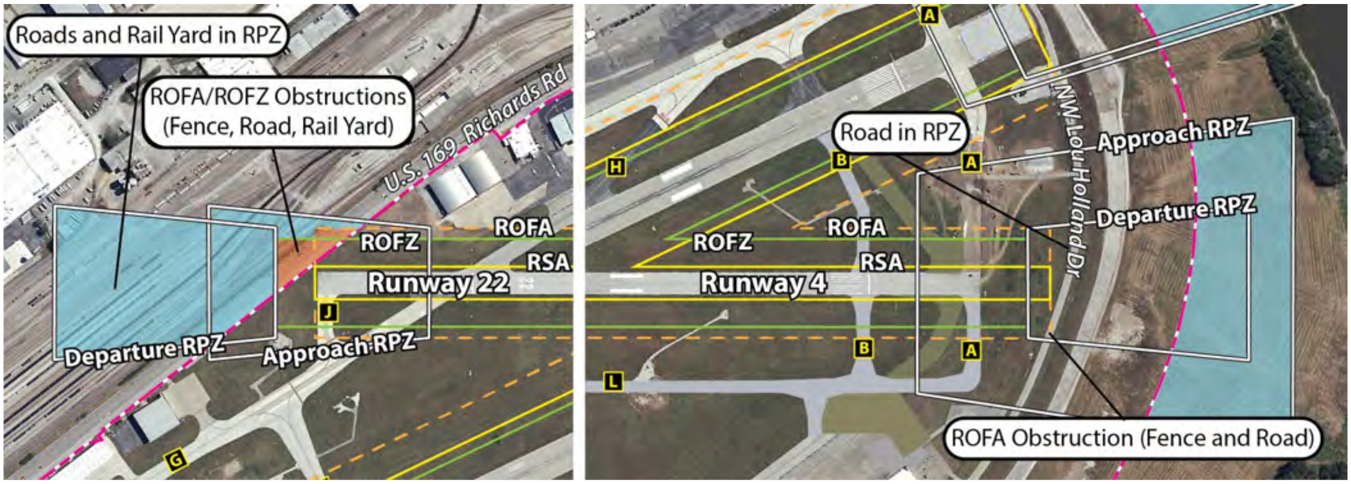


Exhibit 4D – Non-standard Safety Areas & Potentially Incompatible Land Uses in RPZs (Runway 4-22)

Table 4A summarizes the various safety area obstructions/incompatibilities associated with each runway.

Table 4A | MKC Non-Standard Safety Area Conditions

	Runway 1	Runway 19	Runway 4	Runway 22
RSA Obstruction	Lou Holland Drive	Perimeter Fencing, Terrain (Levee)	None	None*
ROFA Obstruction	Lou Holland Drive Perimeter Fencing Localizer Shelter Wastewater Treatment Facility	Perimeter Fencing Terrain (Levee) Lou Holland Drive**	Lou Holland Drive Perimeter Fencing	Richards Road U.S. 169 Railyard Perimeter Fencing
ROFZ Obstruction	None	Perimeter Fencing	None	Richards Road U.S. 169 Railyard Perimeter Fencing
RPZ Incompatibility	Lou Holland Drive	Lou Holland Drive Richards Road U.S. 169 Railyard	Lou Holland Drive	Richards Road U.S. 169 Railyard

*There are no RSA obstructions off the Runway 22 end due to published declared distances.
**Previous planning associated with EMAS installation determined this ROFA penetration to not be hazardous.
Source: Coffman Associates analysis

Consideration #3 – Runway Visual Aids

Both runways at MKC are equipped with visual approach aids, with Runway 19 equipped with a four-light precision approach path indicator (PAPI-4) and Runways 1, 4, and 22 served by visual approach slope indicator (VASI) systems. As VASIs are being phased out and replaced with PAPIs when they reach the end of their lifespan, the alternatives to follow will depict an upgrade of each VASI system to a PAPI system. Runway end identifier lights (REILs) should be made available to runway ends not served by a more sophisticated approach lighting system. It is recommended that Runway 4, which does not have REILs, install these visual aids and that the REILs on Runways 1 and 22 be maintained. Runway 19 is equipped with a medium intensity approach lighting system with sequenced flashers (MALSF) which should be maintained. The alternatives to follow will each depict the addition of REILs on Runway 4.

Consideration #4 – Instrument Approach Procedures

MKC is currently equipped with instrument approach procedures to Runways 19, 4, and 22, with the lowest visibility minimums of ¾-mile available to Runways 19 and 4. As detailed in Chapter Three, the master plan includes analysis on the feasibility of implementing an instrument approach to Runway 1. This analysis is ongoing and will be summarized in the next chapter, with the complete findings included as an appendix to the master plan. For planning purposes, the alternatives exhibits that follow will each depict an RPZ based on an instrument approach to Runway 1 with visibility minimums not lower than ¾-mile.

Consideration #5 – Taxiway System

FAA Hot Spots

The FAA has identified three hot spots at MKC,[4] as detailed in previous chapters. While the Taxiway L extension will alleviate Hot Spot #3 and reduce some of the risk associated with Hot Spot #2, additional options must be considered to fully resolve Hot Spots #1 and #2. Three alternatives will be presented that illustrate taxiway geometry modifications that eliminate these hot spots and improve airfield safety.

Angled Intersections

Taxiway geometry standards recommend that taxiways be positioned 90 degrees to intersecting taxiways and runways. FAA studies indicate that the risk of runway incursions increases on angled taxiways used for crossing runways. Acute-angled intersections are present at MKC on Taxiways D, G, H, and M. Right-angle taxiways provide the best visual perspective to a pilot approaching an intersection, and the taxiway alternatives will outline potential corrections to acute-angled taxiways.

Taxiway Width

Taxiway Design Group (TDG) 3, which has been determined as the appropriate future design standard for MKC, calls for 50-foot-wide taxiway pavement. Currently, taxiways at the airport range in width from 38 feet to 125 feet. The alternatives to follow will depict all proposed taxiway pavement at 50 feet wide, with existing taxiway pavement exceeding this standard proposed to be reduced in width at the time a reconstruction project is necessary. Existing taxiways that are less than 50 feet wide are proposed to be widened to meet the standard.

[4] Refer to Exhibit 1J for a graphical depiction and more information.

It should be noted that taxilanes intended exclusively for small aircraft do not need to be 50 feet wide. Taxilane widths of 25 or 35 feet may be more appropriate for these areas. The narrower taxilanes typically provide access for small aircraft hangars areas.

Direct Access

Taxiway M provides direct access from the apron to Runway 4-22, leading to an increased risk for a runway incursion. The FAA recommends that pilots be forced to make a turn prior to entering the runway environment, thereby improving situational awareness and decreasing the risk for an incursion. The taxiway alternatives to follow will depict options to mitigate this non-standard condition.

Consideration #6 – Holding Bays

The FAA recommends that holding bays be constructed at airports that experience 75,000 or more annual operations. In 2022, MKC totaled more than 114,000 operations, and this number is anticipated to increase steadily over the planning period. There are currently two holding bays located on the north side of the airport – one adjacent to Taxiway G and the other adjacent to Taxiway L. The taxiway alternatives will consider the addition of a holding bay on the south side of the airfield. New holding bay design standards incorporate clearly marked entrance/exits with independent parking areas that are either separated by islands or are clearly marked with centerlines to allow aircraft to safely bypass each other, with two design options. These will be depicted on the taxiway alternatives.

RUNWAY SAFETY AREA DETERMINATION

FAA Order 5300.1F, *Modification to Agency Airport Design, Construction, and Equipment Standards*, indicates the following in Paragraph 7.e:

> "A Modification of Standard (MOS) is not issued for RSA dimensions. Instead, the Regional Airports Division Manager will evaluate RSAs and issue an RSA determination in accordance with FAA Order 5200.8, *Runway Safety Area Program* and FAA Order 5200.9, *Financial Feasibility and Equivalency of Runway Safety Area Improvements and Engineered Material Arresting Systems*, for each affected runway at federally obligated airports and airports certificated under 14 CFR Part 139. Modification of Standards is not issued for nonstandard runway safety areas."

The FAA placed a greater emphasis on meeting RSA standards with the publication of FAA Order 5200.8, *Runway Safety Area Program* in 1999, following congressional direction. A law enacted in 2006 required the FAA to complete planning for improving nonstandard runway safety areas by 2010, and for RSA improvements to be completed by 2015.

FAA Order 5200.8, Paragraph 5, states: "The objective of the Runway Safety Area Program is that all RSAs at federally obligated airports and all RSAs at airports certified under 14 Code of Federal Regulations

(CFR) Part 139 shall conform to the standards contained in AC 150/5300-13, *Airport Design*, to the extent practicable." MKC is a federally obligated airport and is a Part 139 airport.

The Order goes on to state in Paragraph 8.b:

> "The Regional Airports Division Manager shall review all data collected for each RSA in Paragraph 7, along with the supporting documentation prepared by the region/ADO for that RSA, and make one of the following determinations:
>
> 1) The existing RSA meets the current standards contained in AC 150/5300-13, *Airport Design*.
> 2) The existing RSA does not meet the current standards, but it is practicable to improve the RSA so that it will meet current standards.
> 3) The existing RSA can be improved to enhance safety, but the RSA will still not meet current standards.
> 4) The existing RSA does not meet current RSA standards, and it is not practicable to improve the RSA."

In 2011, an RSA determination for each runway at MKC was issued by FAA that concluded: "The existing RSA meets the current standards contained in AC 150/5300-13." The determination for Runway 1-19 was based on the implementation of EMAS and declared distances which provide an equivalency to meeting RSA dimensional standards. The determination for Runway 3-21 (now Runway 4-22) was based on the implementation of a displaced landing threshold on both ends of the runway.

In the years since this determination was made, FAA AC 150/5300, *Airport Design* has been updated in regard to the benefits of EMAS in relation to RSA dimensions. The current version, 150/5300-13B, now states, "the presence of EMAS does not diminish the standard width." While the RSA will still end at the back end of the EMAS, the full RSA width is required to have a determination that the RSA meets standard. Therefore, a full review of the RSA dimensions for both runways will be undertaken in this master plan. This review and analysis will follow guidance provided in the following FAA guidance documents:

- FAA Order 5200.8, *Runway Safety Area Program*.
- FAA Order 5200.9, *Financial Feasibility and Equivalency of Runway Safety Area Improvements and Engineered Material Arresting Systems.*
- FAA Order 7050.1B, *Runway Safety Program.*
- FAA Order 5300.1F, *Modification to Agency Airport Design, Construction, and Equipment Standards.*
- FAA AC 150/5220-22B, *Engineered Materials Arresting Systems (EMAS) for Airport Overruns.*
- FAA AC 150/5300-13B, *Airport Design*.

The findings of this master plan will aid the Regional Airports Division Manager for the FAA's Central Region in deciding on the existing condition of the RSAs at MKC.

Appendix 2 of FAA Order 5200.8 provides the direction for an RSA determination. This includes the alternatives that must be evaluated. Paragraph 3 of Appendix 2 states:

> "The first alternative that must be considered in every case is constructing the traditional graded runway safety area surrounding the runway. Where it is not practicable to obtain the entire safety area in this manner, as much as possible should be obtained. Then the following alternatives shall be addressed in the supporting documentation... :
>
> A. Relocation, shifting, or realignment of the runway.
> B. Reduction in runway length where the existing runway length exceeds that which is required for the existing or projected design aircraft.
> C. A combination of runway relocation, shifting, grading, realignment, or reduction.
> D. Declared distances.
> E. Engineered Materials Arresting Systems (EMAS).

FAA AC 150/5220-22B, *Engineered Materials Arresting Systems (EMAS) for Airport Overruns,* 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 runway safety area standards if there is an adverse operational impact to the airport."

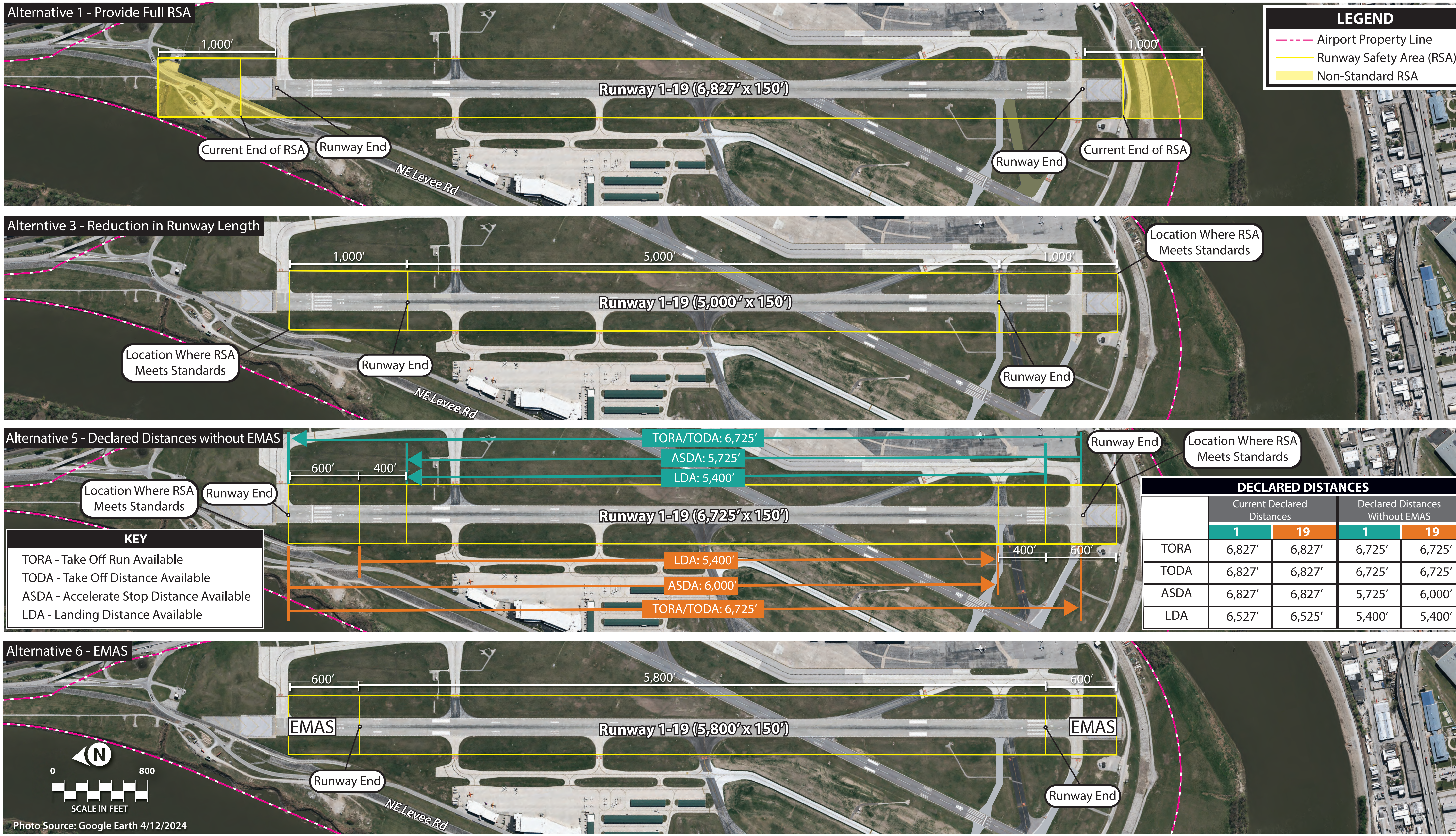
The following subsections will discuss the application of the above FAA-recommended alternatives for mitigating RSA deficiencies. This discussion will assume that each runway will remain in its current orientation, with the Airport Reference Code (ARC) noted on the current ALP and in Chapter Two – Forecasts of this master plan.

RUNWAY 1-19 RSA ALTERNATIVES

Runway 1-19 is the primary runway serving MKC. It has a current runway design code (RDC) of D-III-4000. In the future, this runway may have an RDC of D-III-2400 if lower instrument approach visibility minimums can be obtained. Under both conditions, the standard RSA dimension is 500 feet wide and extends 1,000 feet beyond the end of the runway. EMAS beds are currently installed on both ends of the runway. Therefore, the RSA length ends at the back end of the EMAS beds. As noted, the most recent Airport Design AC indicates that the presence of EMAS does not diminish the need to meet the RSA width standard. This is a change from when the EMAS beds were installed. The 500-foot width of the RSA is penetrated in several locations, as noted previously. The following subsections address the feasibility of applying each FAA-prescribed alternative solution to Runway 1-19.

Alternative 1 - Provide Full RSA

As stated in FAA Order 5200.8, *Runway Safety Area Program*, analysis of the possibility of providing a full RSA is the first step in an RSA determination. Alternative 1 depicted in the top frame of **Exhibit 4E** shows the RSA surrounding the runway without consideration of the presence of EMAS.



KEY

- TORA - Take Off Run Available
- TODA - Take Off Distance Available
- ASDA - Accelerate Stop Distance Available
- LDA - Landing Distance Available

DECLARED DISTANCES

	Current Declared Distances		Declared Distances Without EMAS	
	1	19	1	19
TORA	6,827′	6,827′	6,725′	6,725′
TODA	6,827′	6,827′	6,725′	6,725′
ASDA	6,827′	6,827′	5,725′	6,000′
LDA	6,527′	6,525′	5,400′	5,400′

EMAS: Engineered Materials Arresting System

Exhibit 4E
RSA ANALYSIS - RUNWAY 1-19

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Behind the Runway 1 end, the RSA would extend from the end of the runway south across Lou Holland Drive and through the levee, ending just short of the Missouri River. Behind the Runway 19 end, the RSA would extend out over Lou Holland Drive and through the levee, again ending just short of the Missouri River. Providing a standard RSA, based on the current runway ends, would require closing Lou Holland Road in two locations, and removing the levee in two locations. Obviously, breaching the levee would have catastrophic consequences as river water would flood the airport.

Moving the levee could potentially allow remediation of the non-standard safety areas off the ends of Runways 1, 19, and 4. Extensive analysis has already been conducted, however, in regard to this option. Prior to the installation of the EMAS beds in 2010, the U.S. Army Corps of Engineers was consulted to provide input to several options for obtaining adequate RSAs that would impact the levee. It was found that altering the levee by shifting the location or lowering the height was not feasible or supported by the Army Corps. A compromise was reached to allow Lou Holland Drive to be re-routed over the levee in the northwest corner (outside the RSA) and then allow it to continue on the river side of the levee for a short distance until crossing back over the levee north of the runway. Due to the extensive analysis already completed in regard to the levee, it is not recommended to pursue a path that would impact the levee. The result is that it is not feasible to provide the full RSA when considering the existing runway ends.

Alternative 2 - Relocation, Shifting, or Realignment of Runway

MKC is situated in a very constrained environment due to the location of the river, levee, and roads. There is no reasonable option to relocate, shift or realign the runway. As a result, this option is not considered feasible.

Alternative 3 - Reduction in Runway Length

This alternative would require shortening the runway on both runway ends to provide for the RSA width and length as shown on **Exhibit 4E**. The total available runway would be reduced to 5,000 feet. As stated in FAA Order 5200.8, this alternative is only practicable when the existing runway length "exceeds that which is required for the existing or projected design aircraft." For MKC, the entire existing length of Runway 1-19 is required to accommodate the current critical aircraft. In fact, the runway is currently shorter than the recommended runway length of approximately 8,700 feet as determined in Chapter Three – Facility Requirements.

As noted previously, Advisory Circular 150/5220-22A, *Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns*, published in September 2005, states the following: "The FAA does not require an airport sponsor to reduce the length of a runway or declare its length to be less than the actual pavement length to meet runway safety area standards if there is an operational impact to the airport." Because the runway is already shorter than recommended, shortening the runway further to meet RSA standards is not required and is not considered feasible.

Alternative 4 - Combination of Runway Relocation, Shifting, Grading, Realignment, or Reduction

Since relocation, shifting, realignment, or a reduction in runway length did not prove viable in and of themselves, a combination of these alternatives is impracticable and will not be given further consideration.

Alternative 5 - Declared Distances

The next alternative for meeting RSA standards is through the use of declared distances. Declared distances are the effective runway distances that the airport operator declares are available for takeoff run, takeoff distance, accelerate-stop distance, and landing distance requirements. According to FAA AC 150/5300-13B, *Airport Design*, use of declared distances is a reasonable alternative to mitigate existing runway shortcomings and better meet design standards. Use of declared distances are considered by FAA to be an incremental step toward fully meeting runway design standards. The applicable declared distances are defined by the FAA as:

> *Takeoff Run Available (TORA)* - The runway length declared available and suitable for ground run of an aircraft taking off;
>
> *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 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; and
>
> *Landing Distance Available (LDA)* – The runway length declared available and suitable for landing an aircraft.

The ASDA and the LDA are the primary considerations in determining the runway length available for use by aircraft, as the RSA and ROFA must be considered in the calculations. The ASDA and LDA can be figured as the usable portions of the runway minus the area required to maintain adequate RSA and ROFA beyond the ends of the runway. For takeoff operations, or ASDA calculations, 1,000 feet of RSA and ROFA must be provided at the far end of the runway in which the departure is occurring. For landing operations, or LDA calculations, 600 feet of RSA and ROFA must be provided prior to the landing threshold and 1,000 feet must be provided beyond the far end of the runway. The TORA and TODA are usable pavement calculations which do not take into consideration the availability of the RSA and ROFA. The ASDA and LDA must take into consideration the provision of standard RSA and ROFA.

Declared Distances Without EMAS

Exhibit 4E shows how declared distances would work for Runway 1-19 without EMAS. The key to determining where to start the declared distances calculations is to first identify the physical location where the RSA would meet the width standard of 500 feet. On the Runway 1 end, that location is 55 feet north of the back end of the existing EMAS bed. On the Runway 19 end, that location is 401 feet south of the back of the existing EMAS bed. This location on both ends of the runway becomes the back end of the RSA.

To calculate the ASDA for Runway 1 departures, the measurement is taken from the runway end (the current pavement end) as the RSA behind an aircraft is not included for takeoff operations. The distance available is then measured from this point to an end point that is 1,000 feet from the back of the RSA on the opposite runway end. This results in an ASDA of 5,725 feet. This means that aircraft taking off would have 1,102 feet less takeoff length than is available today.

The LDA for Runway 1 is calculated slightly differently because, on landing, only 600 feet of RSA is required prior to the landing threshold. This means that 5,400 feet of landing length would be available because the landing threshold would have to be displaced by 600 feet from the back of the RSA. The new landing threshold would be relocated 25 feet north of the existing landing threshold. The far end of a landing operation would end at the same location as the ASDA. The landing distance available would be 1,127 feet shorter than what is currently available.

The ASDA calculation for Runway 19 would not begin at the existing runway pavement end; it would instead be at a point 101 feet further down the runway. This is the point where the full RSA width is available. The ASDA is then calculated beginning at this point and extending to a point that is 1,000 feet from the end of the RSA. A length of 6,000 feet would be available for the ASDA calculation, which is a reduction of 827 feet from what is currently available.

The LDA calculation for landing on Runway 19 requires 600 feet of RSA prior to the landing threshold. The landing threshold would thus be 400 feet south of the current landing threshold. The end of the LDA would coincide with the end of the ASDA. The total LDA available would be 5,400 feet, or a reduction of 1,125 feet.

Table 4B compares the existing declared distances with the declared distances without EMAS and with a full RSA provided. The negative impacts to available runway length for both takeoff and landing are significant. Because the current critical aircraft is already impacted by the runway length, further reducing the runway length with these declared distances is not considered feasible.

TABLE 4B | Declared Distances Without EMAS for RSA

Declared Distance Parameters	CURRENT DECLARED DISTANCES		DECLARED DISTANCES WITHOUT EMAS	
	Runway 1	Runway 19	Runway 1	Runway 19
TORA	6,827	6,827	6,725	6,725
TODA	6,827	6,827	6,725	6,725
ASDA	6,827	6,827	5,725	6,000
LDA	6,527	6,525	5,400	5,400

TORA: Takeoff Run Available
TODA: Takeoff Distance Available
ASDA: Accelerate-Stop Distance Available
LDA: Landing Distance Available

Source: FAA 5010 Airport Master Record; Coffman Associates analysis of FAA AC 150/5300-13B, Airport Design

Alternative 6 - Engineered Materials Arresting Systems (EMAS)

The final alternative to be considered when seeking to improve RSA width compliance is the use of EMAS. Guidance for comparing RSA alternatives with EMAS is provided in FAA Order 5200.9, *Financial Feasibility and Equivalency of Runway Safety Area Improvements and Engineered Material Arresting Systems*. As mentioned, the installation of EMAS on the extended runway centerline is accepted by the FAA as complying with RSA length standards but not width standards.

EMAS is designed of compressible concrete and is similar in function to the sandy, high-speed exits provided on highways in mountainous terrain designed to safely stop a runaway tractor trailer. EMAS is designed to stop an aircraft overrun by exerting predictable deceleration forces on the landing gear as the EMAS material crushes. It is designed to minimize the potential for structural damage to the aircraft, as such damage could result in injuries to passengers and/or affect the predictability of deceleration forces.

When EMAS is in place, it provides an acceptable level of safety to a standard 1,000-foot RSA beyond the runway end. EMAS is intended to safely slow an aircraft if it overruns the runway end; it is not intended to aid short landings and does not impact the RSA standard prior to landing. Therefore, on landing, 600 feet of RSA must be available prior to the threshold, and that RSA may contain the EMAS bed for operations in the opposite direction. Because of these factors, the LDA will begin 600 feet from the back of an EMAS bed.

To meet the RSA width standard, the back of the EMAS beds will be at that point where the standard RSA width is provided. This would require shortening Runway 1-19. With EMAS in place on both runway ends, and 600 feet prior to the landing threshold reserved for the RSA, the runway would be reduced to 5,800[5] feet for all declared distances.

Installing EMAS in such a manner that the RSA width is met at the back end of the EMAS, would require shortening the runway by 1,027 feet. This would clearly negatively impact the operational capability of the critical aircraft, which would benefit from additional runway length, not less. Depending on the final design of the EMAS bed, up to 200 feet of additional usable runway could be obtained with declared distances.

[5] The analysis does not include specific dimensions for the EMAS beds. As such, there is potential for the usable runway pavement to be longer than 5,800 feet. The exhibit is intended to simply illustrate the maximum reduction in length.

Runway 1-19 RSA Analysis Conclusion

FAA Order 5200.8, *Runway Safety Area Program,* outlines a procedure for analyzing RSA alternatives. That procedure includes a six-step process. Each of the six steps was considered in evaluating if it is feasible to provide an RSA for Runway 1-19 that meets both length and width standards. Currently, the RSA does not meet the width standard on both ends of the runway. The analysis showed that it is not possible to provide the full RSA width without significantly reducing the runway length.

FAA guidance indicates that airports will not be forced to reduce runway length to meet RSA standards if that reduction would negatively impact airport operations. Previous analysis indicated that the airport would benefit from a longer runway, not a shorter runway. The current critical aircraft family (D-III) includes aircraft such as the Boeing 737 and 757, the Gulfstream V, and other passenger aircraft. In 2022, these aircraft accounted for 802 operations. Therefore, any reduction in runway length would negatively impact airport operations. As described previously, the FAA Order outlines potential FAA determinations with regard to RSA standards. Those are:

1) The existing RSA meets current standards contained in AC 150/5300-13, *Airport Design*.
2) The existing RSA does not meet standards, but it is practicable to improve the RSA so that it will meet current standards.
3) The existing RSA can be improved to enhance safety, but the RSA will still not meet current standards.
4) The existing RSA does not meet current standards, and it is not practicable to improve the RSA.

Because none of the alternatives would improve the RSA without negatively impacting airport operations of the critical aircraft, it is recommended that FAA consider determination number 4: The existing RSA does not meet current standards, and it is not practicable to improve the RSA.

It should be noted that FAA Order 5200.8, *Runway Safety Area Program* is exclusive to the RSA. It does not address any other safety surfaces including the ROFA, OFZ, and RPZ.

RUNWAY 4-22 RSA ALTERNATIVES

Runway 4-22 is identified on the current ALP and in the forecast element of this master plan with an RDC of B-II-4000 both now and into the future. The runway is 5,050 feet long and 100 feet wide. The standard RSA dimensions are 150 feet wide extending 300 feet beyond the runway end. Currently, declared distances are applied to this runway to meet the RSA dimensional requirements.

The RSA determination procedure outlined in FAA Order 5200.8, *Runway Safety Area Program,* will be used to analyze the Runway 4-22 RSA and identify any adjustments that can or need to be made. Following this analysis, an RSA determination recommendation will be presented.

Under optimal conditions, the full length of a runway would be available for pilot runway length calculations. Use of declared distances is considered by FAA to be an incremental step toward fully meeting runway design standards, and it is typical to revisit any previous assumptions regarding declared distances.

As noted previously, FAA will not require an airport sponsor to reduce runway length to achieve runway safety area if that reduction will have a negative impact on airport operations. In Chapter Three – Facility Requirements, it was recommended that the current length of Runway 4-22 be maintained because this runway currently provides the most sophisticated instrument approach at the airport with an ILS approach to Runway 4. This capability allows many aircraft, including a portion of the aircraft type that make up the critical aircraft family, to operate at the airport in poor visibility conditions.

Alternative 1 - Provide Full Safety Area

Without the existing declared distances, the RSA for Runway 4-22 would extend beyond the Runway 22 end and be penetrated by the perimeter fence, Richards Road, U.S. Highway 169, and the rail yard. Beyond the Runway 4 end, the full RSA is clear of obstructions. Because of these factors, a standard RSA based on the current runway pavement footprint is not feasible, as it is not feasible to remove or relocate the penetrations on the Runway 22 end.

Alternative 2 - Relocation, Shifting, or Realignment of Runway

The MKC property footprint is extremely constrained due to the location of the river, levee, roads, and the railyard. There is no space to relocate, shift, or realign Runway 4-22. This alternative is not feasible.

Alternative 3 - Reduction in Runway Length

The current length of Runway 4-22 should be preserved to the greatest degree possible because of the ILS approach to Runway 4. This approach allows many aircraft within the critical aircraft family to land from the south in poor visibility conditions. Ideally, an ILS would be available to Runway 1, which is the longer runway and better suited to the critical aircraft family. If such an approach to Runway 1, with comparable visibility minimums (¾-mile) could be made available, then some adjustment to the length of Runway 4-22 may be feasible.

As discussed in Chapter Three – Facility Requirements, the predominant wind patterns at the airport indicate a need for a crosswind runway to meet the needs of smaller B-I aircraft. The B-I classification includes many turboprops and small business jets in the general aviation fleet. To accommodate this group of aircraft, a minimum runway length of 4,300 feet would be recommended. The RSA dimensions for B-I are 120 feet in width extending 240 feet beyond the end of the runway.

Runway 4-22 also serves as a capacity runway meaning it should be designed to a higher standard because it provides capacity relief to the airport. Currently, this runway is designed to B-II standards to provide additional capacity relief. Therefore, the length and width should be preserved to the greatest degree possible.

Alternative 4 - Combination of Runway Relocation, Shifting, Grading, Realignment, or Reduction

When maintaining a runway length of 5,050 feet, it is not feasible to apply some combination of relocating, shifting, realigning, or reducing the runway to meet RSA design standards because of the proximity of the river, levee, public roads, and the railyard. Since Runway 4-22 is not only a justified B-I crosswind runway but also a justified B-II secondary runway for capacity purposes, the current length and width should be maintained to the greatest degree feasible.

Alternative 5 - Declared Distances

Declared distances are currently applied to meet RSA design standards for Runway 4-22, as outlined in **Table 4C**. The TORA and TODA are the full length of the runway pavement, as the RSA dimensions do not apply to these parameters. For Runway 4, the ASDA begins at the runway pavement end and extends to a point 4,770 feet down the runway. This location (280 feet from the end of pavement) is effectively the end of the runway for those taking off from Runway 4. At this location, the RSA continues unimpeded for 300 feet (includes 20 feet beyond the pavement end), thus meeting the RSA standard. The LDA for Runway 4 begins at the displaced landing threshold, which is 500 feet from the Runway 4 pavement end. This displaced landing threshold is necessary to provide approach clearance when landing. The LDA then extends to the same location as the end of the ASDA. The available LDA is 4,270 feet.

TABLE 4C | Current Declared Distances (Runway 4-22)

Declared Distance Parameters	CURRENT DECLARED DISTANCES	
	Runway 4	Runway 22
TORA: Take-Off Run Available	5,050'	5,050'
TODA: Take-Off Distance Available	5,050'	5,050'
ASDA: Accelerate-Stop Distance Available	4,770'	5,050'
LDA: Landing Distance Available	4,270'	4,351'

Source: FAA 5010 Airport Master Record

The ASDA for Runway 22 is the full length of the runway, as the RSA beyond the runway departure end is clear of penetrations. The landing threshold for Runway 22 is displaced 700 feet from the runway end. This displacement is necessary for approach clearance. The LDA begins at the landing threshold and extends to the end of the pavement for a total available LDA of 4,351 feet.

The use of declared distances for Runway 4-22 is a feasible means to maintain maximum runway length while meeting RSA design standards.

Alternative 6 - Engineered Materials Arresting Systems (EMAS)

There is no need to consider an EMAS bed on the Runway 4 end because the standard RSA is provided. If an EMAS bed were considered on the Runway 22 end, it would occupy the last 280 feet of the runway (including paved lead-in area), as the runway is currently declared 280 feet short of the pavement end because there is only 20 feet of unobstructed RSA beyond the pavement end. Even with an EMAS bed on the Runway 22 end, there would be no practicable operating benefit, as the currently employed declared distances already provide for a standard RSA. The cost to install an EMAS bed would far outweigh any operational benefit and, therefore, EMAS is not considered a viable alternative for Runway 4-22.

Runway 4-22 RSA Analysis Conclusion

Like the RSA analysis completed for Runway 1-19, the six-step alternatives analysis procedure outlined in FAA Order 5200.8, *Runway Safety Area Program,* was utilized. Each of the six steps was considered in evaluating if it is feasible to provide an RSA for Runway 4-22 that meets the length and width RSA standard. Currently, the RSA meets standard through declared distances. The analysis showed that continued use of declared distances is the most practical method for maintaining maximum runway length while meeting RSA design standards.

The FAA Order outlines potential FAA determinations with regard to RSA standards. Those are:

1) The existing RSA meets current standards contained in AC 150/5300-13, Airport Design.
2) The existing RSA does not meet standards, but it is practicable to improve the RSA so that it will meet current standards.
3) The existing RSA can be improved to enhance safety, but the RSA will still not meet current standards.
4) The existing RSA does not meet current standards, and it is not practicable to improve the RSA.

If the standard RSA were applied to the Runway 4-22 paved area and the RSA extended 300 feet beyond the end of the Runway 22 pavement, then the RSA would not meet standard because it would extend through the fence, over Richards Road and U.S. 169. However, with the current implementation of declared distances, the ASDA and LDA for Runway 4 are declared to end 300 feet short of these potential RSA penetrations. Therefore, it is recommended that FAA consider determination number 1: The existing RSA meets current standards contained in AC 150/5300-13, *Airport Design*. It should be noted that this RSA analysis which follows guidance in FAA Order 5200.8, *Runway Safety Area Program,* is exclusive to the RSA. It does not address any other safety surfaces including the ROFA, OFZ, and RPZ.

RUNWAY 4-22 ROFA AND OFZ ALTERNATIVES

While the previous sections focused on options for meeting RSA standards for each runway, alternatives for bringing the ROFA and OFZ must also be evaluated. For Runway 1-19, the previous section included a determination that the RSA is of a non-standard condition, but that it is not practicable to improve the RSA. Any improvement to the RSA would result in a reduction in runway utility, which would have negative impacts on operations conducted by the critical aircraft family (i.e., reduction in runway length). As such, it is also not practicable to pursue alternatives that would alter Runway 1-19 to bring the ROFA or OFZ to standard as this would also impact the RSA. The alternatives to follow focus only on Runway 4-22 and options to bring the ROFA and OFZ associated with this runway to standard.

As previously mentioned, the FAA will not issue a modification to standard for an OFZ. While a modification to standard is possible for a ROFA (if the current condition still provides an equivalent level of safety), the alternative depicted on **Exhibit 4F** illustrates the modifications necessary to bring Runway 4-22 into compliance with ROFA and OFZ design standards.

On the Runway 4 end, a small portion of the ROFA currently extends over the perimeter fencing and Lou Holland Drive. To achieve a standard ROFA, Option #1 of the alternative includes a plan to shorten the runway by 37 feet. A reduction of this length would shift the ROFA inwards, clearing it of the fence and road. This would also necessitate the relocation of the VASI equipment serving this runway end, as well as removal/reconstruction of taxiway pavement.

On the Runway 22 end, the ROFA and ROFZ extend past the airport's boundary and over public roads (U.S. Highway 169 and Richard Road) and a rail yard. The RSA is unobstructed due to the declared distances currently in effect. To bring the ROFA and ROFZ onto airport property and free of obstructions, 503 feet of runway pavement is proposed to be removed. Due to the existing layout of Runway 22 and Taxiway G, no changes to the taxiway system in this area are depicted, with the exception of the proposed closure of Taxiway J. If this alternative were to be pursued, it is assumed that the modifications made to correct Hot Spot #1 would also serve to provide access to the Runway 22 threshold.

As noted previously, the FAA has determined that Runway 4-22 is not only an eligible crosswind runway (B-I) but also an eligible secondary runway (B-II) for capacity purposes. To fulfill these two roles, the maximum runways length should be preserved. To preserve the current 5,050-foot length, the existing penetrations to the OFZ and ROFA would need to be acceptable to the FAA.

Option #2, shown in an inset on the graphic, depicts another alternative for meeting ROFA standards on the Runway 4 end. This option includes rerouting Lou Holland Drive and relocating the perimeter fencing around the ROFA. This option may involve a slight modification to the levee, which as previously noted, is extremely challenging because the levee requires a set back at the toe of the levee that prevents any modification or construction to ensure the integrity of the levee is maintained. The set back is two feet from the west edge of Lou Holland Road.

TAXIWAY ALTERNATIVES

Evaluation of options to correct non-standard taxiway geometry is another area of consideration. As detailed previously, there are areas of concern within the existing taxiway system, including Hot Spots #1 and 2, angled intersections, and direct access. **Exhibit 4G** illustrates three options for mitigation of these nonstandard conditions. Each of these alternatives also depicts an option to reduce the width of taxiways exceeding the 50-foot width standard for taxiway design group (TDG) 3, an upgrade of the VASI systems associated with Runways 1, 4, and 22 to PAPI-4s, as well as a standard holding bay serving the ends of Runways 1 and 4. New holding bay design standards incorporate clearly marked entrance/exits with independent parking areas that are either separated by islands or are clearly marked with centerlines to allow aircraft to safely bypass each other. Each of the alternatives shown considers the construction of a standard holding bay on the south end of the airfield.

Alternative 1 | Alternative 1 illustrates options to correct each of the non-standard issues outlined above. Beginning with Hot Spot #1, located at the intersection of Runway 22 and Taxiway G, an option is shown that involves removing the portion of Taxiway G pavement that crosses the Runway 22 threshold, and construction of new taxiway pavement that would intersect the runway at a right angle approximately 380 feet south of the threshold. The new pavement is proposed to extend west from the north end of the apron, cross the runway, then turn to the northeast to connect with Taxiway J. The new partial parallel taxiway to Runway 4-22 at the north end is planned to be separated from the runway by 240 feet, in accordance with B-II design standards, with holding positions set 200 feet from the runway centerline.

Hot Spot #2 is proposed to be alleviated by the closure of a portion of Taxiway D connecting to the runway. A replacement connector taxiway is then proposed approximately 100 feet south of the existing Taxiway D pavement and 550 feet from the intersection of the runways. In years past, an option similar to this was studied. The primary concern was that a replacement Taxiway D connector closer to the intersection of the two runways might lead to pilot confusion and potential runway incursions. At the time the replacement Taxiway D connector was farther south than the one depicted here.
Taxiways H and M are currently also angled connections. In this alternative, existing Taxiway H pavement is proposed to be removed and a new right-angle connector constructed between Runway 1-19 and Taxiway G. Taxiway M is proposed to be removed, with the new taxiway connecting the north apron to Runway 22 serving as an exit for pilots landing on Runway 4.

This alternative also proposes two no-taxi islands, which are areas of either natural turf or artificial turf/paint that function to force pilots to make a turn prior to entering the runway environment, thereby improving pilot situational awareness and reducing the risk of a runway incursion. These are proposed near the entrances of the connector near the Runway 22 threshold (near the existing Taxiway M entrance) and the Taxiway H entrance.

A standard holding bay is also proposed on the south side of the airport, between the Runway 1 and 4 thresholds. This design incorporates islands between the taxilanes, which can be either turf or painted to clearly indicate the separation between aircraft parking positions.

Alternative 2 | The second option for mitigating taxiway issues at MKC considers different layouts for correcting Hot Spots #1 and #2. Under this alternative, shown on the second page of **Exhibit 4G**, Hot Spot #1 is again proposed to be corrected by the elimination of Taxiway G pavement and construction of right-angle taxiway pavement on either side of Runway 4-22. Rather than constructing a partial parallel taxiway to Runway 4-22, however, a partial parallel taxiway is proposed for Runway 1-19. The proposed taxiway would extend from the apron, cross Runway 4-22, then turn north to connect with Taxiway K. The taxiway would be separated from Runway 1-19 at a distance of 400 feet, in accordance with D-III design standards, with holding positions to Runway 4-22 set 200 feet from the runway centerline.

The intersection of Runway 1-19 and Taxiway D, which is where Hot Spot #2 is located, is proposed to be slightly modified to reduce the risk in this area. As depicted on the exhibit, Taxiway D is proposed to be narrowed to 50 feet, eliminating excess pavement that may contribute to confusion in this area. Removing pavement on either side of this taxiway also serves to form a right-angle connection between the taxiway and runway, which is preferred by the FAA. Finally, to further reduce the risk for accidental entrance onto Runway 1-19, elevated runway guard lights are proposed to be installed. Elevated runway

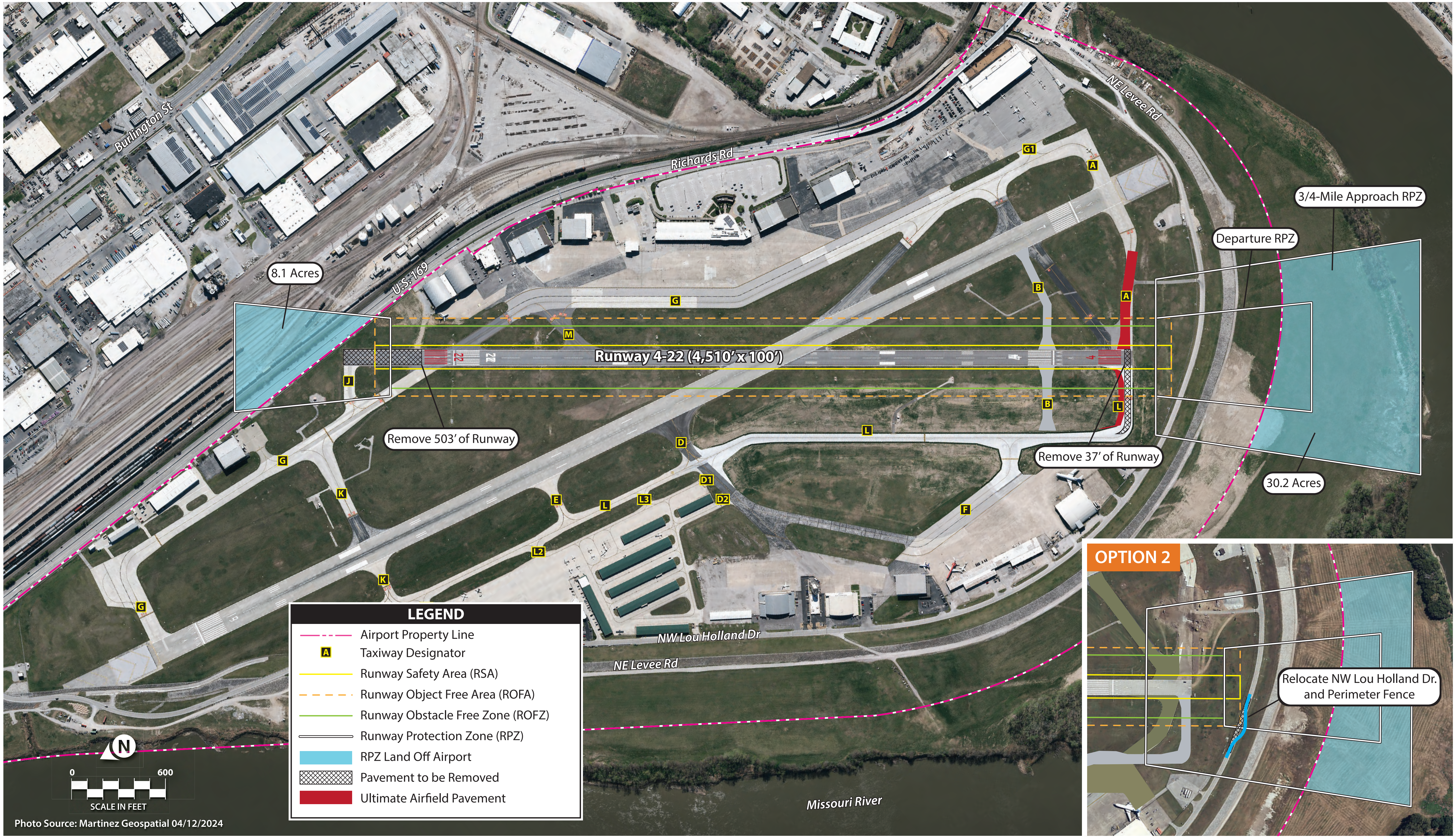


Exhibit 4F
RUNWAY 4-22 ROFA AND OFZ ALTERNATIVE

ALTERNATIVE 1

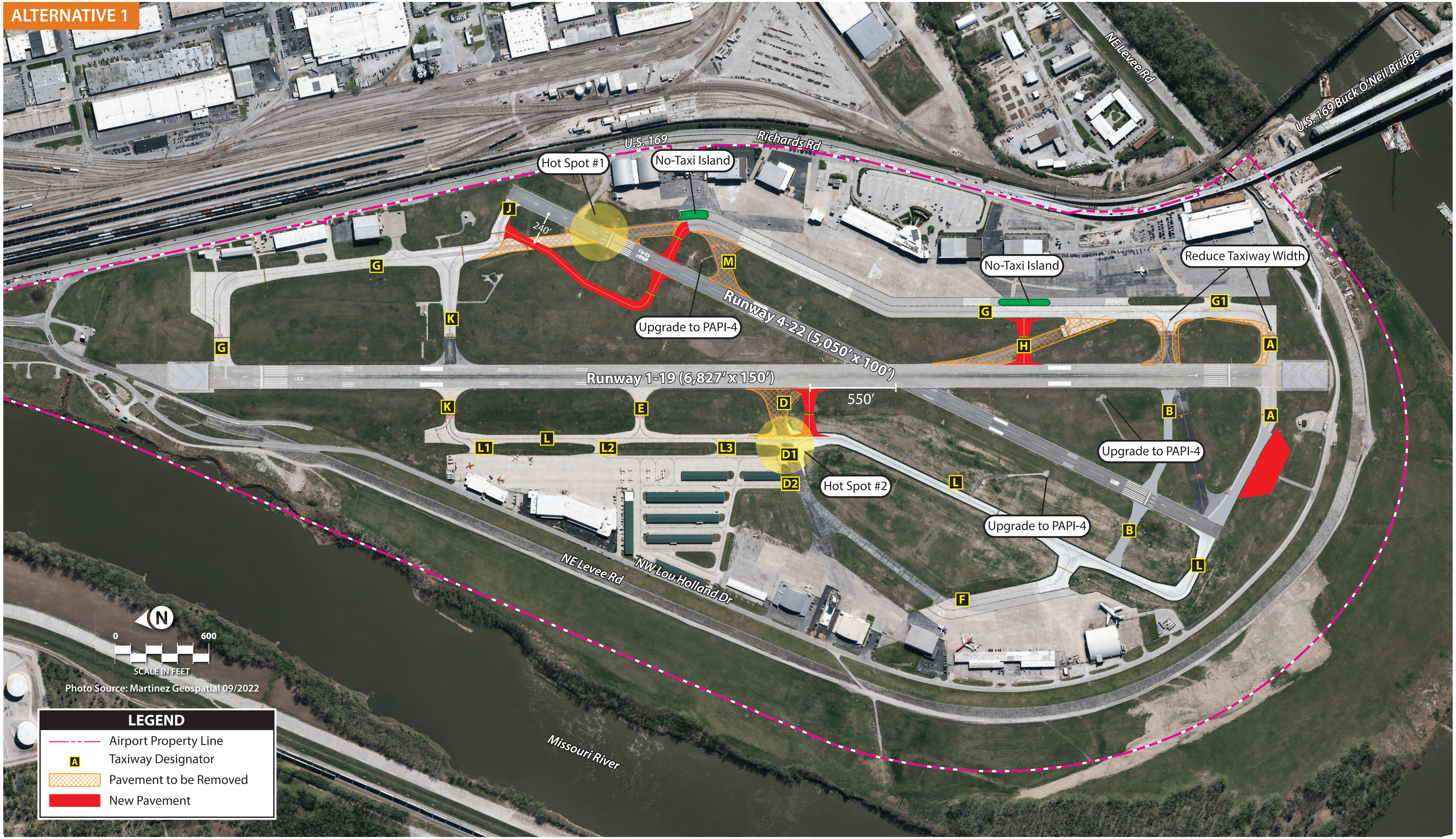
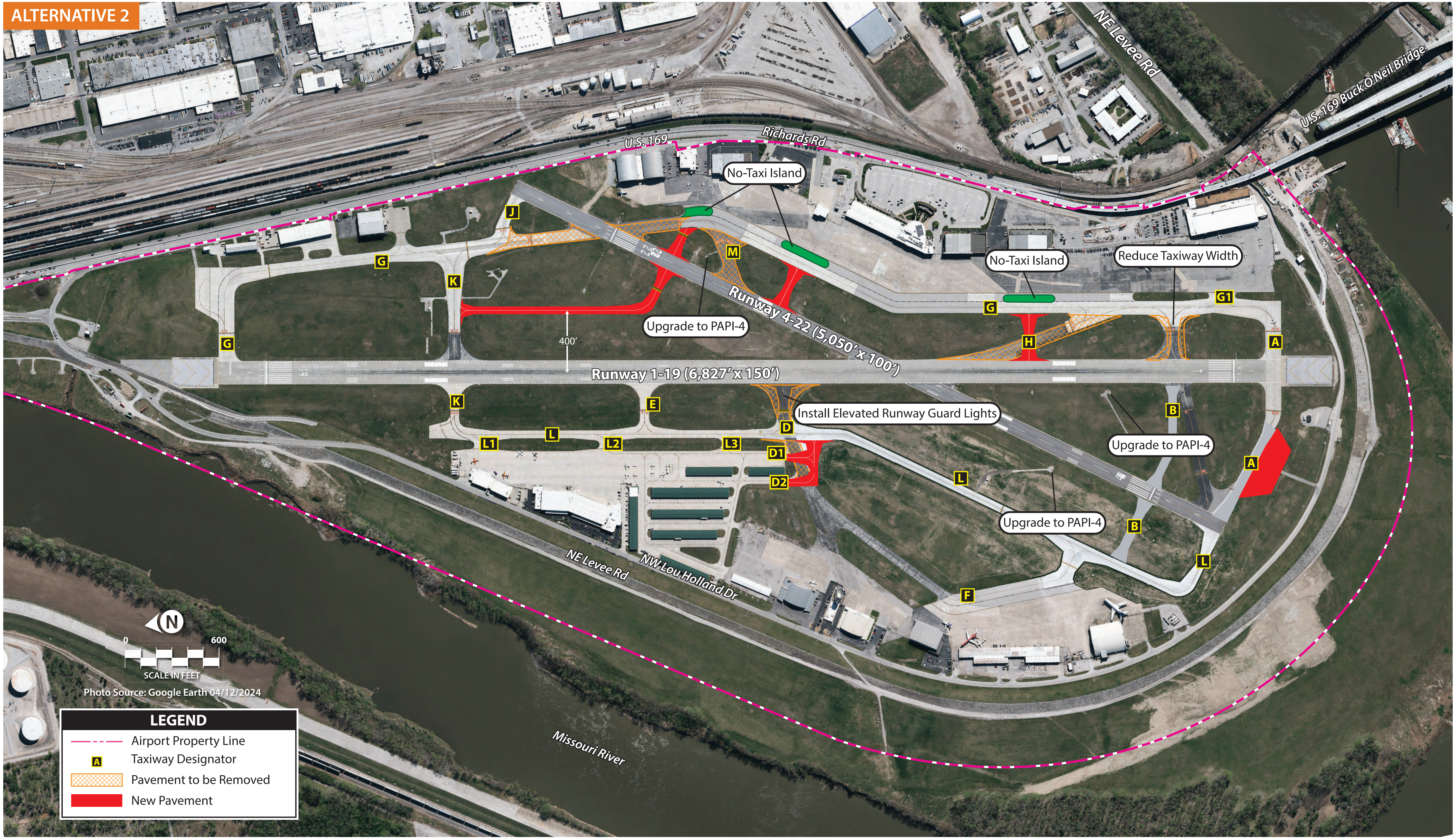
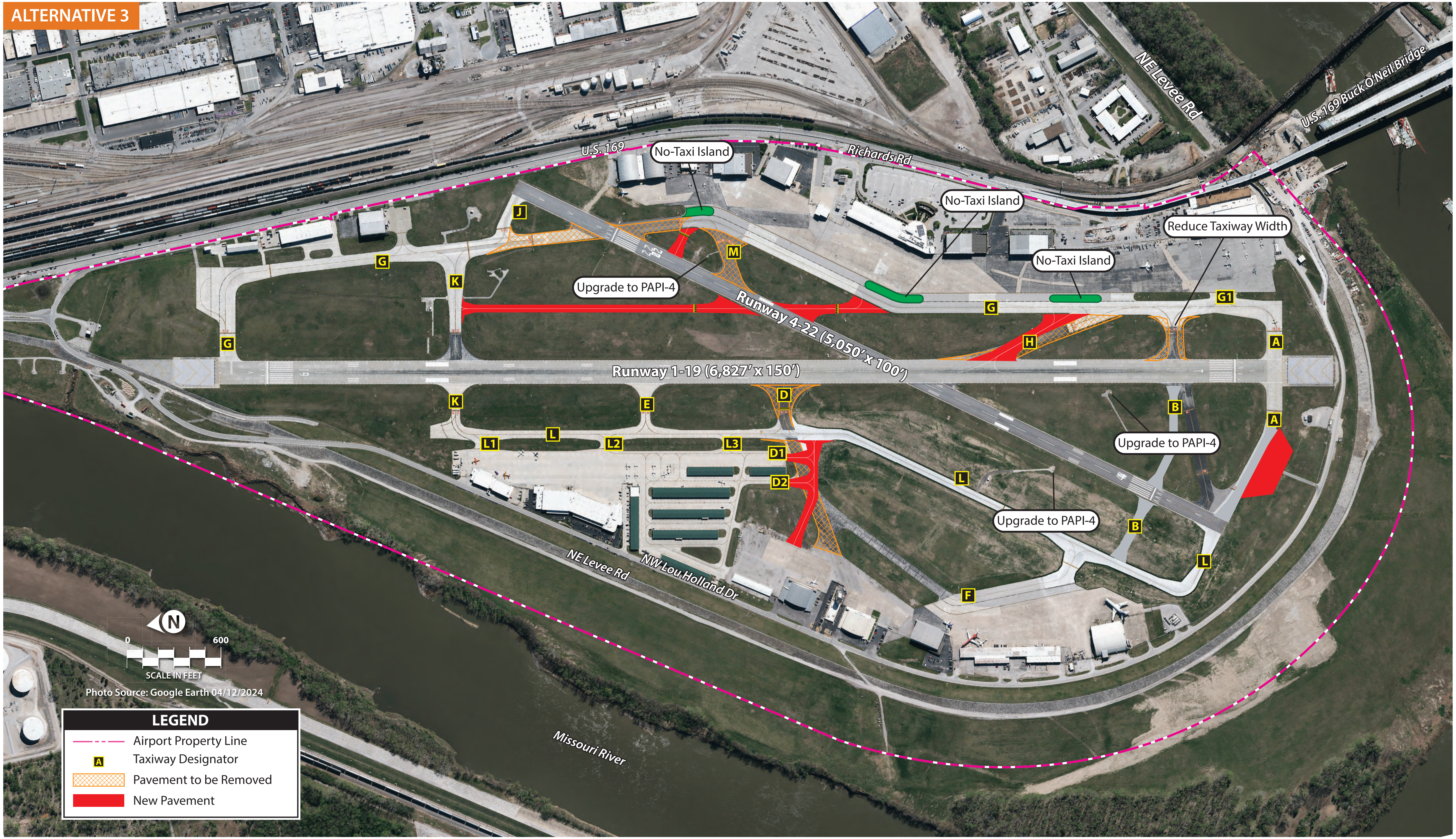


Exhibit 4G
TAXIWAY ALTERNATIVES

ALTERNATIVE 2



ALTERNATIVE 3



guard lights are installed at taxiway/runway intersections to enhance the visibility of taxiway/runway intersections. They consist of either a pair of elevated flashing yellow lights installed on either side of the taxiway, or a row of in-pavement yellow lights installed across the entire taxiway, at the runway holding position marking. Taxiway D west of Taxiway L is also modified by shifting it slightly south to eliminate direct access to the runway and to make it a 90-degree intersection with Taxiway L.

Like the previous taxiway alternative, similar modifications are proposed for Taxiways H and M. Existing Taxiway H pavement is proposed to be removed and a new right-angle connector constructed between Runway 1-19 and Taxiway G. Taxiway M is proposed to be removed and a new taxiway connector between Taxiway G and Runway 4-22 constructed south of existing Taxiway M. This connector would serve as an exit for pilots arriving on Runway 4.

No-taxi islands are also planned for three areas on the east side apron to reduce the risk of inadvertent runway access from landside areas. These are depicted near the entrances of the three proposed taxiway connectors—two in the area of existing Taxiway M and one located at the reconfigured Taxiway H.

A standard holding bay is also proposed on the south side of the airport, between the Runway 1 and 4 thresholds. This design incorporates islands between the taxilanes, which can be either turf or painted to clearly indicate the separation between aircraft parking positions.

Alternative 3 | Alternative 3, depicted on the third page of **Exhibit 4G**, examines a different layout for the taxiway system at MKC, with a focus on providing a longer parallel taxiway to Runway 1-19. The FAA recommends that airports with published instrument approaches provide a full-length parallel taxiway where feasible. As such, this alternative illustrates an option to extend Taxiway G from the south to connect with Taxiway K.

Hot Spots #1 and #2 are proposed to be mitigated similar to what was shown on Alternative 2 previously. Portions of Taxiway G near the Runway 22 end are shown as removed to correct Hot Spot #1, and Taxiway D is narrowed to provide a 50-foot-wide surface and right-angle connection to Runway 1-19 to correct Hot Spot #2. Furthermore, the western portion of Taxiway D that extends from Taxiway L to the west apron is proposed to be closed and configured to provide an offset connection to Taxiway L.
Taxiway M is proposed to be removed, with a new exit taxiway proposed to extend from the northeast apron to connect with Runway 4-22. No taxi-islands are included at the entrance to this proposed exit as well as the parallel taxiway.

In this alternative, Taxiway H is proposed to remain operational. As a high-speed exit taxiway, it enhances runway capacity by reducing runway occupancy times. This taxiway is also highly utilized according to the control tower manager, and the manager indicated they would prefer to keep it operational as a high-speed exit. When it is time for Taxiway H to be reconstructed due to normal use, it is shown in a slightly different configuration. Currently the angle between the runway centerline and the Taxiway H centerline is 20 degrees. According to FAA AC 150/5300-13B, *Airport Design*, the standard angle is 30 degrees for a high-speed exit. Therefore, this alternative shows Taxiway H to be reconstructed at the standard 30-degree angle.

Another consideration is the capability for a reverse turn onto the parallel taxiway. The recommended runway to taxiway separation to allow for a reverse turn is 350 feet for a critical aircraft in TDG 3. The future TDG for the airport is TDG 3, and the current runway to taxiway separation is 412.5 feet, therefore a high-speed exit with a reverse turn onto the parallel taxiway is feasible.

HOLD BAY OBSTRUCTION ANALYSIS

Each of the taxiway alternatives shown on **Exhibit 4G** also shows a potential hold bay to be located on Taxiway A between Runway 1 and 4. Hold bays enhance airfield capacity by allowing aircraft to perform pre-departure run-ups and engine checks and to allow other aircraft ready for departure to bypass.

From a design perspective, hold bays must allow holding aircraft to remain clear of the RSA, ROFZ, and the taxiway OFA. The location of the hold bay must also meet the design criteria of any of the runway imaginary surfaces. Under ideal conditions, hold bays should be designed to accommodate the critical aircraft (D-III-3).

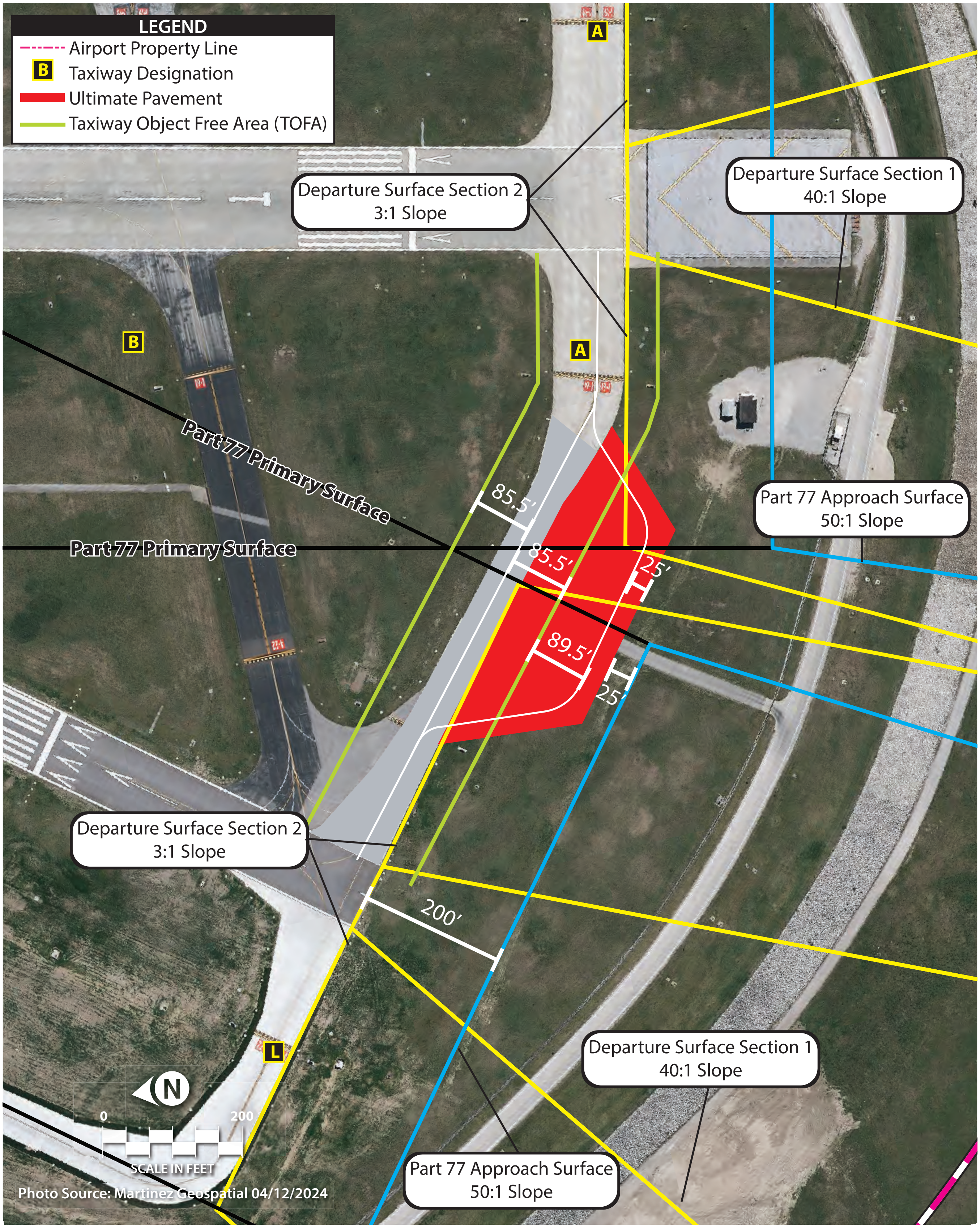
Three relevant imaginary surfaces considered in relation to the hold bay are the Part 77 Primary Surface and Approach Surface and the Departure Surface as defined in FAA AC 150/5300-13B, *Airport Design*. The Primary Surface is not considered a restrictive surface for aircraft to hold or taxi therefore it does not impact the capability of the hold bay. The Part 77 Approach Surface starts 200 feet from the runway end, therefore there is no Approach Surface penetration since the hold bay does not extend to the Approach Surface. The hold bay falls below Section 2 of the Departure Surface which has a 3:1 slope ratio emanating outward from Section 1 of the Departure Surface. At its lowest point, the Departure Surface clearance is 65.5 feet, well below any aircraft tail height using MKC. The Approach Surface defined in AC 150/5300-13B, *Airport Design* (different that the Part 77 Approach Surface) was analyzed but it does not cross the planned hold apron.

Exhibit 4H shows the hold bay location relative to the imaginary surfaces. Inclusion of a hold apron is feasible in this location adjacent Taxiway A. Currently, tower personnel will hold aircraft on Taxiway A when needed. The ability to move those aircraft to a hold bay would increase efficiency and capacity.

INSTRUMENT APPROACH TO RUNWAY 1

A detailed analysis was undertaken to determine if an instrument approach procedure (IAP) to Runway 1 is feasible. Currently, there is not an instrument approach to Runway 1 and pilots can only land to the runway in visual conditions. Visual condition is when the cloud ceiling height is 1,000 feet or higher and the visibility minimum is greater than three miles. If the meteorological conditions are below either of these parameters, then pilots cannot land on Runway 1.

The analysis showed that it is feasible to establish an IAP to Runway 1 for all classes of aircraft including the critical aircraft (D-III). The cloud ceiling height would be 448 feet and the visibility minimums would be 1⅜-miles.



Note: Planned hold apron provides a minimum of 65' height clearance from all imaginary surfaces.

Exhibit 4H
HOLD BAY ANALYSIS

Additional analysis was undertaken to determine if an IAP to Runway 1 could be established with lower minimums. **Table 4D** shows the results of this analysis. There are two controlling obstacles on the final approach course to Runway 1 that would have to be removed to allow for lower minimums. The first is an existing building (Weld Wheel building) and the second is the street light poles on the highway ramp from Interstate 70 to Interstate 35 (See **Figure 4-1**). A private developer has proposed to demolish the Weld building and replace it with condominiums that will rise to 78 feet above ground level. Under this scenario, the IAP minimums would be 337 feet cloud ceiling height and 1-mile visibility. If in addition to replacing the Weld building, the light poles are lowered, then the visibility minimums could be as low as 250 feet cloud ceiling height and ¾-mile visibility minimums. Each of these options will require the final approach course to be offset by one degree from the extended runway centerline. This analysis also assumes that the FAA RAM Tool (Runway Airspace Maintenance Tool) will be utilized to deconflict several outdated buildings, stacks, and tree obstacles in the River Bottoms.

TABLE 4D | Runway 1 Instrument Approach Options

Option	Obstacle Status	Retain Current Displaced Landing Threshold of 300' (1.0˚Offset FAC)	Displace Landing Threshold to 550' (1.5˚ Offset FAC)	Displace Landing Threshold 650' (1.5˚Offset FAC)
		Cloud Height/Visibility Minimum		
A	No changes to Obstacles	448' / 1⅜-mile	368' / 1-mile	250' / ¾-mile
B	Weld Building replaced by 78'AGL Condos	337' / 1-mile	250' / ¾-mile	250' / ¾-mile
C	Eliminate/Reduce Height for On-Ramp Light Poles	448' / 1⅜-mile	455' / 1⅜-mile	250' / ¾-mile
D	Replace Weld Building and Reduce Light Poles	250' / ¾-mile	250' / ¾-mile	250' / ¾-mile

FAC: Final Approach Course
Source: LEAN Technology analysis

Figure 4-1: Potential Instrument Approach Obstructions

The table also shows additional analysis under various conditions and the resulting IAP minimums. Minimums below 250 feet and ¾-mile are not possible due to offset final approach course and the lack of an approach lighting system. **Appendix C** presents this detailed analysis.

Disclaimer: This analysis of the feasibility of an IAP to Runway 1 was undertaken by experts in the field that have a very good track record. However, only FAA Flight Procedures can develop IAPs for use at airports. The airport sponsor will need to engage FAA Flight Procedures to determine if in fact an IAP is feasible.

LANDSIDE ALTERNATIVES

Generally, landside issues are related to those facilities necessary or designed for the safe and efficient parking and storage of aircraft, movement of pilots and passengers to and from aircraft, airport support facilities, and overall revenue support functions. To maximize airport efficiency, it is important to locate facilities together that are intended to serve similar functions. The best approach to landside facility planning is to consider the development to be like that of a community where land use planning is the guide. For airports, the land use guide in the terminal area should generally be dictated by aviation activity levels. Consideration will also be given to non-aviation uses that can provide additional revenue for the airport and support economic development for the region.

LANDSIDE CONSIDERATIONS

Landside planning considerations, summarized below, will focus on a philosophy of separating activity levels. Landside facility development at MKC is focused on the east and west sides, including currently adopted hangar developments, future hangar facilities, and areas designated for future fixed-base operator (FBO) or specialty aviation service operator (SASO) facilities. The implementation of advanced air mobility (AAM) is also considered, as well as the potential for relocating the ATCT.

Development of landside facilities is challenging at MKC, as the airport is essentially landlocked, with no option to expand its boundary due to the presence of the Missouri River and surrounding infrastructure (i.e., U.S. 169 Highway and other public roads, rail yard, and other existing developments). Additionally, there is limited space to develop new aviation facilities, as much of the airport's property is already developed. However, the Taxiway L project on the southwest side of the airport opens a significant portion of property that could be developed for landside facilities. The alternatives to follow will illustrate options for development in this area, as well as some development on the airport's east side. Each area to be considered is summarized below.

Consideration #1 – Future Hangar Development

Hangar occupancy at MKC stands at more than 90 percent, with 107 people on a waiting list for hangar space as of November 2023. With clear demand for additional hangar capacity at the airport, the landside alternatives will consider areas for the development of various hangar styles, including small aircraft facilities, executive box, and conventional hangars. These areas are further defined below.

- **Small aircraft facilities** typically consist of T-hangars/T-shades and linear box hangars. These facilities often have lower levels of activity and, as such, can be located away from the primary apron areas in more remote locations of the airport. Limited utility services are needed for these areas. The airport currently has approximately 139,900 square feet (sf) of T-hangar/linear box hangar storage space, with an additional 7,000 sf projected to be needed by the end of the 20-year planning period.

- **Executive box hangars** consist primarily of clear span hangars with no interior supporting structure. Executive hangars are typically less than 10,000 sf and can accommodate small aviation businesses, one larger aircraft, or multiple smaller aircraft. These hangars typically require all utilities and segregated roadway access. MKC has approximately 17,900 sf of executive box hangar space, with an additional 28,600 sf estimated to be needed by the end of the planning period.

- **Conventional hangars** are clear span hangars with no interior supporting structure, similar to executive box hangars, but are larger, typically ranging in size from 10,000 sf to 20,000 sf. MKC has approximately 369,600 sf of conventional hangar space, with an additional 39,000 sf estimated to be needed by the end of the planning period.

Prior to development of new hangar facilities, analysis must also be undertaken to ensure that all movement areas are visible from the existing ATCT. This is especially true when considering development on the west side of the airfield, where the existing tower is located. The biggest area for potential development is in the southwest quadrant of the airport, as the extension of Taxiway L has spurred interest in new hangar development. Any development in this area or other locations cannot obstruct the tower's view of runways and taxiways, and planning for new structures must be carefully evaluated to ensure clear lines of sight.

Consideration #2 – Expanded/New Support Facilities

Additional fuel storage capacity for Jet A fuel is needed over the course of the planning period due to increased activity by turbine aircraft. Several options for locating an additional fuel farm are depicted on the alternative exhibits to follow. These should assume tanks for Jet A fuel but may also include 100LL tanks along with storage for unleaded aviation fuel (100LL). The FAA has approved the use of 100UL in piston-powered aircraft, although unknowns regarding infrastructure and distribution remain. Nevertheless, the alternatives will include placeholders for these facilities.

Consideration is also given to the addition of an aircraft wash rack. These are commonly found at busy GA airports like MKC. Currently, there is no such facility at the airport; the alternatives will highlight potential locations for the inclusion of an aircraft wash rack.

Consideration #3 – Advanced Air Mobility (AAM) and Urban Air Mobility (UAM)

As described in Chapter Three, another segment of commercial air travel that will need to be factored for this master plan is the potential for the emerging industry of AAM and UAM. These utilize manned and unmanned aircraft that are capable of vertical takeoff and landing to conduct air taxi operations moving people around urban areas and providing connections to other transportation modes, including airports. While the FAA is still in the process of developing infrastructure standards, interim guidance has been released (Engineering Brief 105, *Vertiport Design*). Based on this guidance, the alternatives to follow will illustrate areas on the airport to serve as placeholders for future AAM/UAM facilities.

Consideration #4 – Airport Traffic Control Tower

The airport traffic control tower (ATCT) at MKC is aging. Consideration should be given to replacing and relocating it to a new site with improved visibility of west side hangar areas. For planning purposes, preliminary analysis was conducted based on the existing airport condition. Four potential locations will be presented that currently meet FAA ATCT siting criteria. Prior to construction of a new ATCT, additional study will need to be conducted by the FAA.

LANDSIDE ALTERNATIVES

The following sections describe a series of landside alternatives as they relate to considerations detailed above. Several alternatives have been prepared to illustrate potential development plans aimed at meeting the diverse needs of general aviation at MKC through the long-term planning period and, in some cases, beyond. It should be noted that the alternatives to be presented are not the only reasonable options for development. In some cases, a portion of one alternative could be intermixed with another. Also, some development concepts could be replaced with others. The overall intent of this exercise is to outline basic development concepts to spur collaboration for a final recommended plan. The final recommended plan only serves as a guide for the airport, which will aid the Kansas City Aviation Department in the strategic planning of airport property. Many times, airport operators change their plan to meet the needs of specific users. The goal in analyzing landside development alternatives is to focus future development so that airport property can be maximized, and aviation activity can be protected.

Hangar development is assumed to be funded by private developers through ground lease agreements with the sponsor.

Southwest Landside Alternatives

A viewshed analysis has been conducted for each of the southwest landside alternatives to follow. This analysis is based on the current ATCT location to determine if the alternatives as presented would interfere with tower controller line of sight. Each analysis is based on a cab eye level of 72 feet, with assumed hangar heights ranging from 20 feet (T-hangar) to 65 feet (200-foot by 200-foot conventional hangar). Areas shaded in red are locations that would not be visible from the cab to the ground. The viewshed analysis for each of the southwest landside alternatives is shown on the second page of each exhibit.

Alternative 1 | As described previously, the extension of Taxiway L (completed in 2024) brings significant opportunity for hangar development on the southwest side of the airport. The first option, shown on **Exhibit 4J**, includes a mix of conventional hangars adjacent to extended Taxiway L, as well as an expansion of the existing T-hangar complex. Beginning on the south end, a new vehicle access road is proposed to extend from Lou Holland Drive near Hangar 8B,[6] providing access to four 10,000 sf conventional hangars. Dedicated vehicle parking is proposed for each of these hangars. The access roads and vehicle parking lots will have security fencing and gates around them and as a result, the existing west side Taxiway F and aprons will be bisected and not allow for any aircraft taxi operations from north to south around the backside of the proposed hangars. Taxiway F would become a non-movement area from a controller perspective. Aircraft taxiing movements from north to south (or vice versa) would use Taxiway L, which will be controlled by tower personnel.

Farther north, a larger complex of conventional hangars is depicted. These would also be accessible via a new road extending from the parking lot near Hangar 6B. As depicted on the exhibit, new apron pavement is planned to support four new 10,000 sf hangars, with existing Taxiway F planned to be converted to apron. Beyond these four hangars, the road would extend to a larger complex of conventional hangars ranging in size from 100’ by 100’ (10,000 sf) to 150’ by 110’ (16,500 sf), with dedicated vehicle parking for each along with a larger, centrally located parking lot. The east-facing hangars would have access to Taxiway L with two taxilanes, one at each end of the proposed apron. The taxilane fronting the east-facing hangars is planned to serve ADG III aircraft, with a 158-foot wide taxilane object free area (TLOFA). The T-hangar complex on the GA apron is also planned for expansion, with four new T-hangars ranging in size from 55’ by 230’ (12,650 sf) to 55’ by 375’ (20,625 sf). The existing shade hangar in this area is proposed to be removed, and a new vehicle parking lot added for tenants in this area.

Alternative 1 also depicts expansion of support facilities on the west side, including the addition of a new fuel farm and an aircraft wash rack. The fuel farm as depicted would require the removal of Hangar 8B. The aircraft wash rack is intended to serve smaller aircraft on the field and is proposed to be located immediately north of one of the proposed T-hangars. Lastly, an area has been reserved to support future AAM activity at the airport. A vertiport is shown on the north side of the proposed central apron area.

The viewshed analysis for this hangar configuration is shown on the second page of **Exhibit 4J**, with areas shaded in red not visible from the existing tower cab. As can be seen, the proposed apron fronting the hangars adjacent to extended Taxiway L would not be visible from the cab, with portions of stub taxiways also obstructed. The centerline of Taxiway L would, however, be visible from the existing cab. Other areas on the airfield with obstructed views are outside the movement area.

Alternative 2 | Alternative 2, shown on the first page of **Exhibit 4K**, depicts a different conceptual layout for the southwest hangar area. Under this option, a mix of hangars ranging from 75’ by 75’ (5,625 sf) executive box hangars to 150’ by 150’ (22,500 sf) conventional hangars are proposed. The largest of these hangars are depicted on the current site of Hangars 8A and 8B, which would be demolished, and new conventional hangars constructed under this option. In the central portion of the developable space, a new road extending from the parking lot adjacent Hangar 6B is proposed to provide access to executive box and conventional hangars. Rather than a large singular apron, an expansion to existing

[6] Refer to Exhibit 1R in Chapter One for a map of existing hangar facilities.

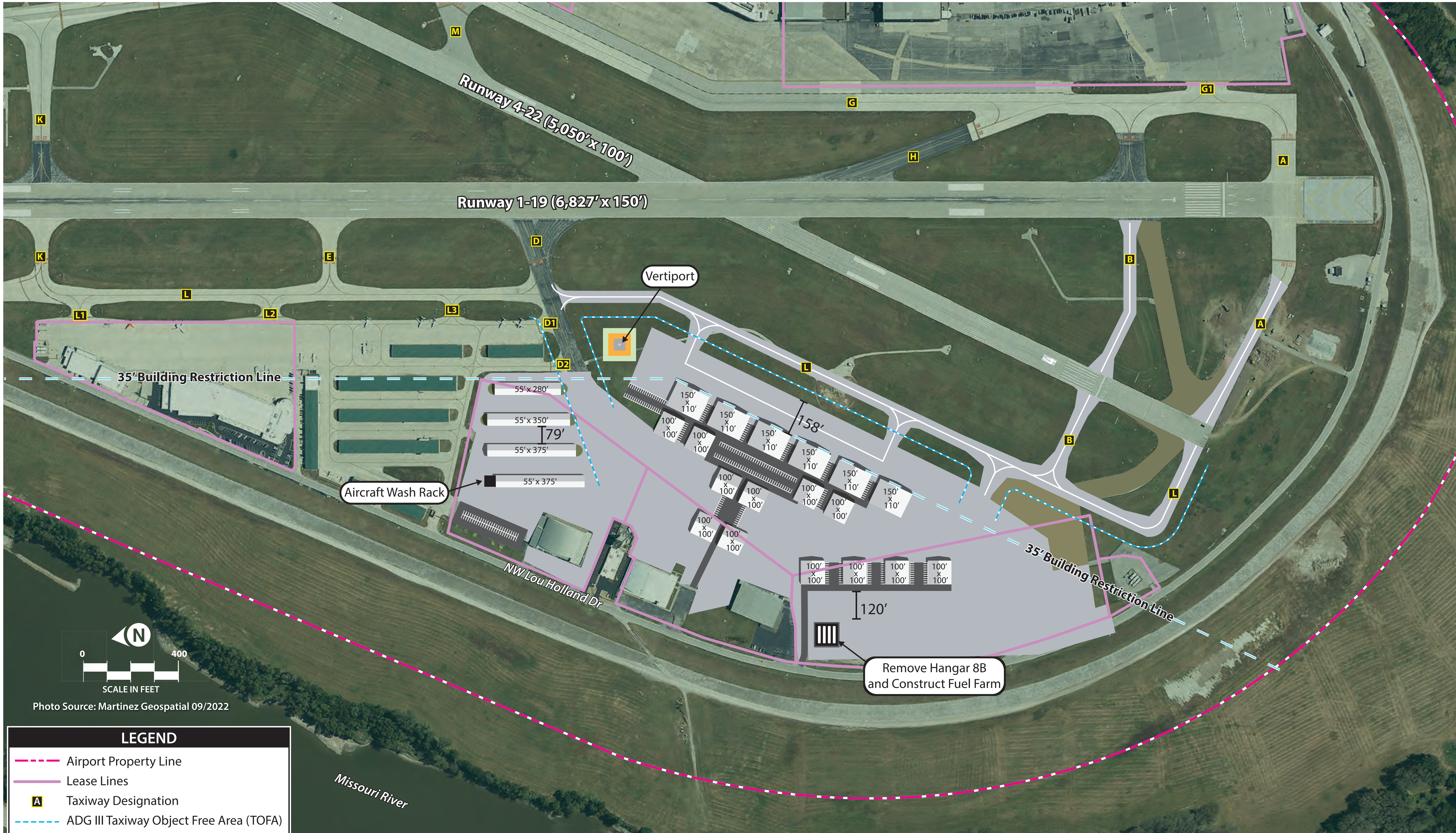


Exhibit 4J
SOUTHWEST LANDSIDE ALTERNATIVE 1

Exhibit 4J
SOUTHWEST LANDSIDE ALTERNATIVE 1

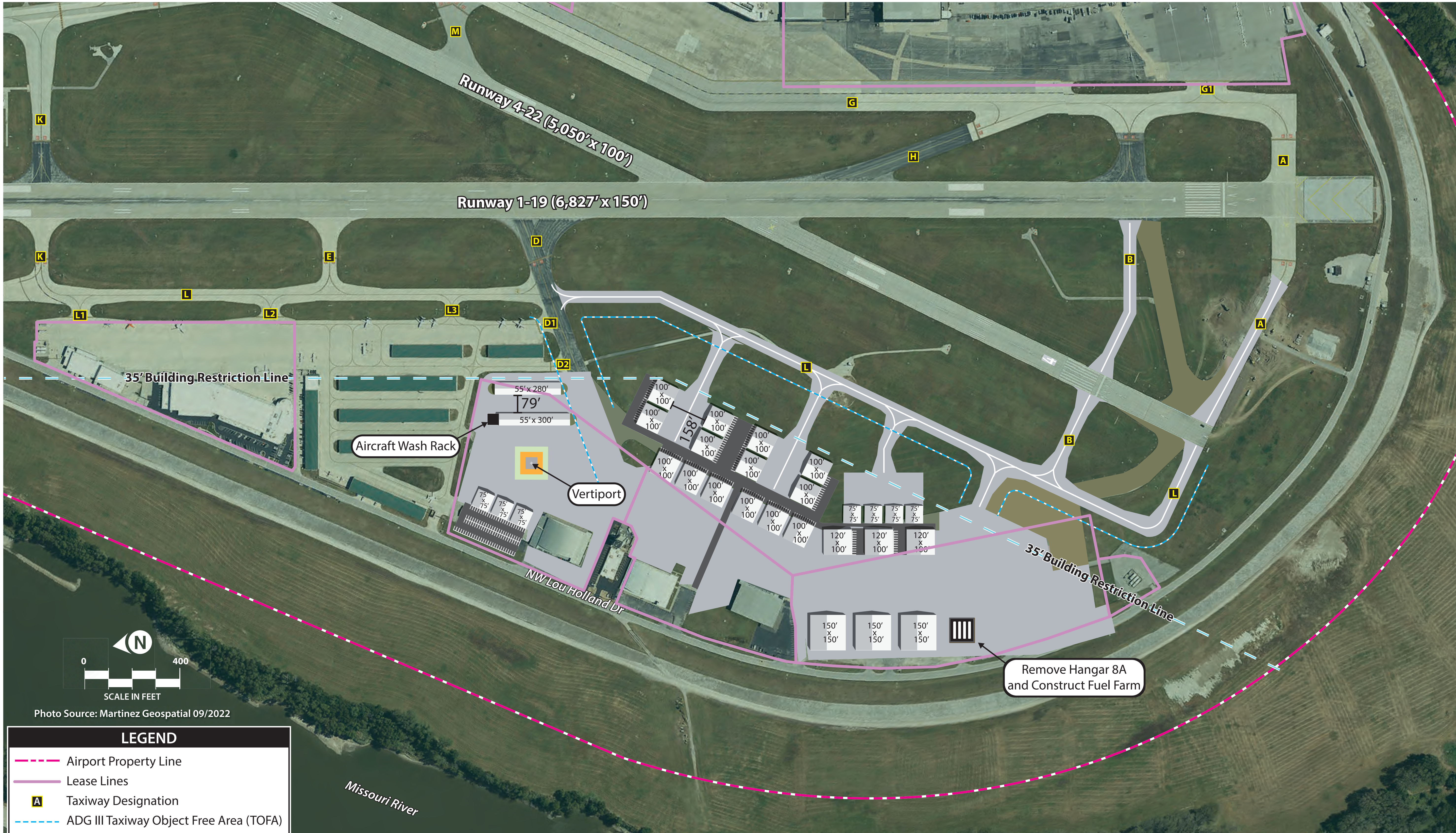


Exhibit 4K
SOUTHWEST LANDSIDE ALTERNATIVE 2

Exhibit 4K
SOUTHWEST LANDSIDE ALTERNATIVE 2

apron pavement is planned to support west-facing conventional hangars, while three smaller aprons with access to Taxiway L are planned to support additional hangars. Dedicated vehicle parking is planned for each of these facilities.

Like the first alternative, the access roads and vehicle parking lots will have security fencing and gates around them and as a result, the existing west side Taxiway F and aprons will be bisected and not allow for any aircraft taxi operations from north to south around the backside of the proposed hangars. Taxiway F would become a non-movement area from a controller perspective. Aircraft taxiing movements from north to south (or vice versa) would use Taxiway L, which will be controlled by tower personnel.

To the north, additional executive box hangars are proposed in the area of the existing shade hangar, with a new vehicle parking lot for tenants and other airport users. Two T-hangars are proposed south of the existing T-hangar, with an adjacent aircraft wash rack planned. A potential vertiport to support AAM operations is also proposed in this area.

The second page of **Exhibit 4K** depicts the viewshed analysis for this landside alternative. Under this option, which includes smaller, 35-foot-tall hangars adjacent to Taxiway L, there is better visibility from the tower as compared to the previous alternative. Taxiway L is completely visible from the existing tower cab, along with much of the proposed apron area.

Alternative 3 | The final alternative depicting hangar development on the southwest side of the airport focuses on expanded conventional hangar facilities. This option is shown on the first page of **Exhibit 4L**. The alternative proposes the removal of Hangars 8A and 8B, with new 100' by 100' (10,000 sf) hangars constructed on the site. A fuel farm is also proposed in this area, with access from Lou Holland Drive, as is a reserve area for AAM operations.

The largest hangar development area is again in the central portion near extended Taxiway L, with a new access road planned in the Hangar 8B area. The access road would bisect current Taxiway F and the apron like the previous alternatives. Hangars are proposed that would range in size from 100' by 100' (10,000 sf) to 200' by 200' (40,000 sf), with the largest of these facing Taxiway L. These are envisioned as hangars that could potentially support an FBO or a large-scale SASO. Two taxilanes are proposed to extend from the apron to access Taxiway L.

Farther north, another road is proposed to extend from Lou Holland Drive near the existing shade hangar. This road would serve as access to two proposed conventional hangars south of the T-hangar complex, with a new vehicle parking lot for tenants in this area. A portion of the shade hangar is proposed to be removed and an aircraft wash rack installed. A second option for a new fuel farm is proposed near Hangar 7, with a loop road constructed to allow easy access for fuel trucks.

The viewshed analysis for Alternative 3, shown on the second page of **Exhibit 4L**, presents the most limited view from the current tower. This alternative includes development of hangars that could be up to 65 feet tall. At that height, these structures would obstruct tower personnel from viewing a significant portion of extended Taxiway L.

Alternative 4 | This is the first of two alternatives that generally preserve the existing lease lines in the southwest quadrant. This alternative considers several large conventional hangars that might be typical of an FBO complex. The hangars are large enough to house the largest business jets and potentially larger commercial type aircraft used for charter purposes.

An access road is extended from Lou Holland Drive adjacent to Hangar 8B. This location is along the current lease line which limits separating facilities. The access road extends to the 21-acre parcel that is currently unleased. The parking lot extends along the west edge of the lease line and then hangars are shown. This layout attempts to locate the hangars as far back to the west as possible to maximize control tower sightlines.

As with all of the hangar layout alternatives, the access road will necessarily bisect current Taxiway F. This effectively creates three distinct apron/hangar areas. One area is north of the access road, one to the south, and the third is the planned development adjacent Taxiway L. Currently, Taxiway F is a tower-controlled movement area. Once the access road to the 21-acre parcel is constructed, consideration may be given to removing former Taxiway F from the controlled movement areas. Taxiway L effectively replaces the need for Taxiway F.

This alternative shows additional hangar development on parcels that are currently leased. Additional T-hangars are shown in proximity to the existing T-hangars. The existing share hangar is shows to be replaced with two medium sized box hangars. The south area is shown to be completely redeveloped with a series of conventional hangars. **Exhibit 4M** shows this alternative.

Page two of the exhibit shows the viewshed analysis from the current control tower. Taxiway L is visible, however there are small portions of the TOFA that would be blocked. The height of the proposed hangars could be lowered to make the entire TOFA visible.

Alternative 5 | This is a variation of Alternative 4 in that the centrally located hangars are more linearly oriented. There are a variety of hangar sizes, however all are larger hangars typical for FBO services, bulk storage, or maintenance activities. The access road is again extending adjacent Hangar 8B, along the existing parcel line.

As with all of the hangar layout alternatives, the access road will necessarily bisect current Taxiway F. This effectively creates three distinct apron/hangar areas. One area is north of the access road, one to the south, and the third is the planned development adjacent Taxiway L. Currently, Taxiway F is a tower-controlled movement area. Once the access road to the 21-acre parcel is constructed, consideration may be given to removing former Taxiway F from the controlled movement areas. Taxiway L effectively replaces the need for Taxiway F.

A development scenario is also shown for those areas that are currently under lease. On the south side of the new access road is redevelopment with four large conventional hangars. On the north side of the access road the shade hangar is replaced with a conventional hangar and one other box hangar is shown to fill in an undeveloped area next to the AirShare hangar. The area next to the existing T-hangars is shown with a tie-down apron. **Exhibit 4N** shows this alternative.

The second page of the exhibit shows the viewshed analysis from the tower cab eye elevation. The entirety of Taxiway L and the TOFA are visible.

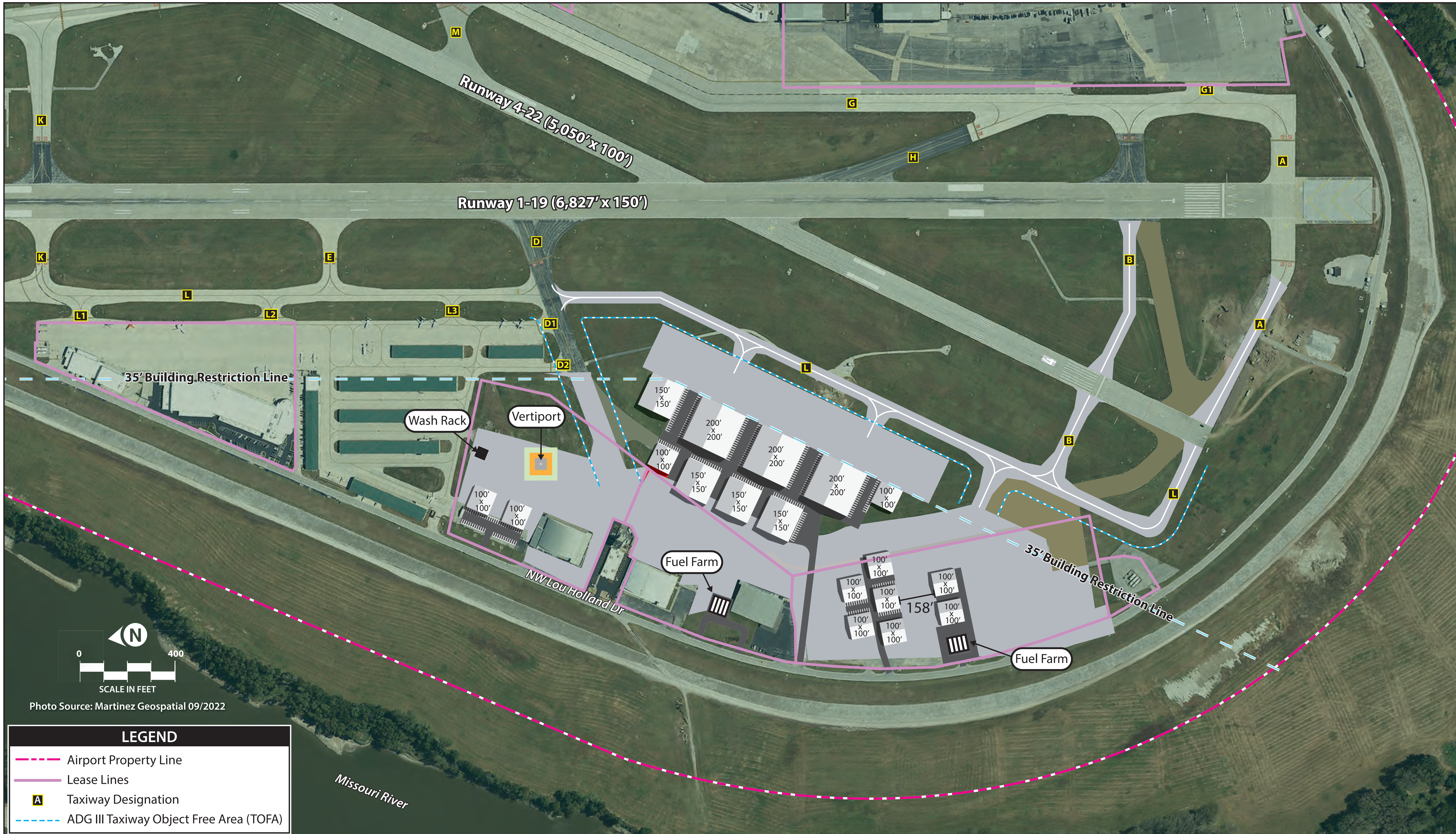


Exhibit 4L
SOUTHWEST LANDSIDE ALTERNATIVE 3

Exhibit 4L
SOUTHWEST LANDSIDE ALTERNATIVE 3

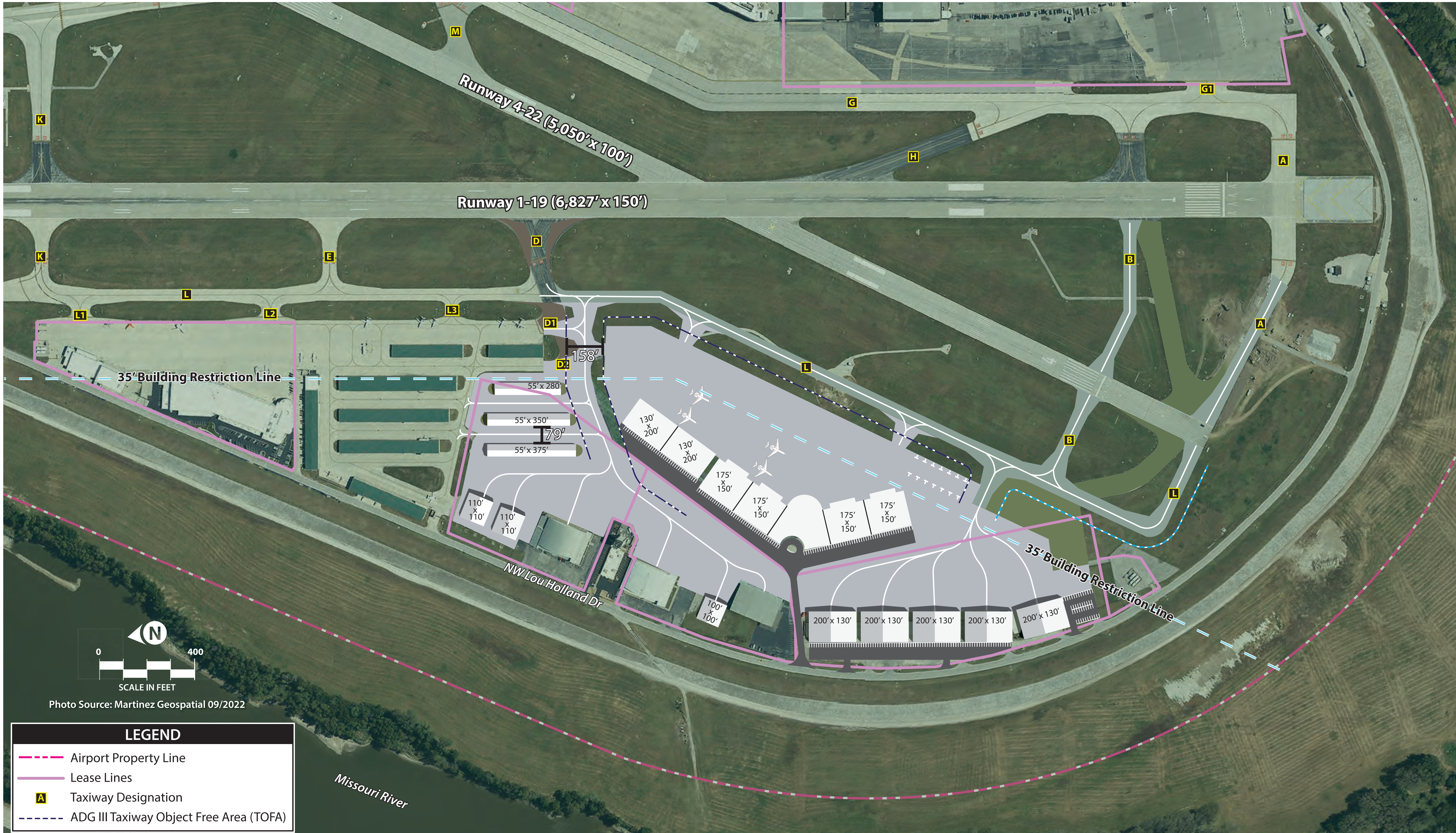


Exhibit 4M
SOUTHWEST LANDSIDE ALTERNATIVE 4

Exhibit 4M
SOUTHWEST LANDSIDE ALTERNATIVE 4

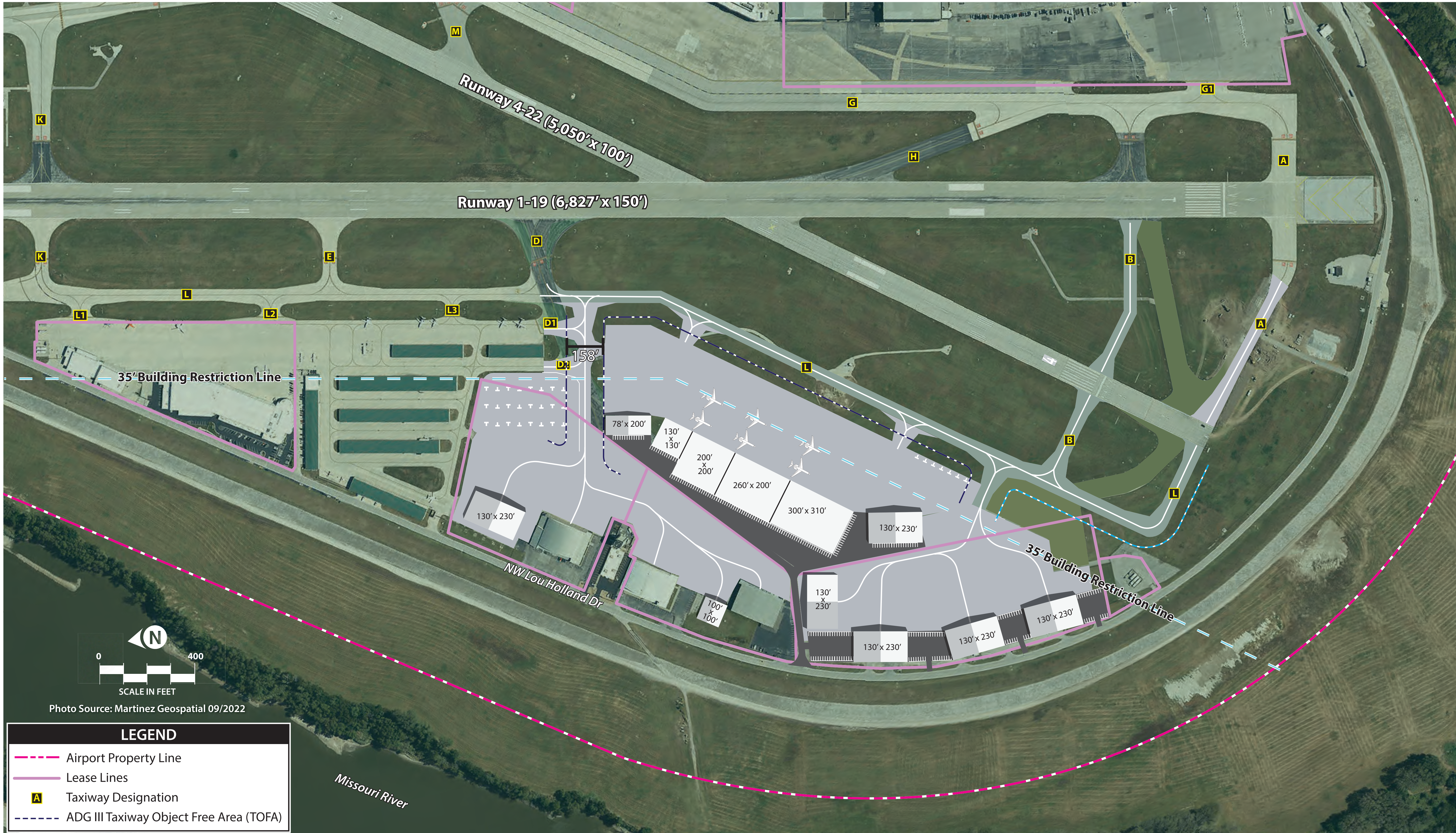


Exhibit 4N
SOUTHWEST LANDSIDE ALTERNATIVE 5

Exhibit 4N
SOUTHWEST LANDSIDE ALTERNATIVE 5

Summary of New Hangar Space by Alternative

Each of the alternatives provides for additional hangar space. **Table 4E** summarizes that new space made available by planned hangar type. As can be seen, all of the alternatives except number three provide at least 100 new hangar spaces. Number three does not show any T-hangars or additional tie-down apron, although there is space to add that. This level of new hangar space exceeds what is forecast to be needed in the based aircraft forecasts. This level of new hangar space would help alleviate the hangar wait list which currently stands at 107.

TABLE 4E | Hangar Space by Alternative

Alternative	T-Hangar Space[1]	Estimated Units	Conventional and Box Hangar Space[1]	Estimated Units	Total New Space	Total Units
Alternative 1	68,310	49	197,100	66	265,410	114
Alternative 2	28,710	21	254,588	85	283,298	105
Alternative 3	0	0	267,750	89	267,750	89
Alternative 4	49,748	36	289,080	96	338,828	132
Alternative 5	Tie-down Apron	24	393,210	131	393,210	155

[1]Total hangar space less 10% reserved for non-aircraft storage purposes such as offices, lounge, flight planning, etc.

Vertiport Detail

Each of the westside landside alternatives includes a vertiport, the design of which is based on guidance of FAA Engineering Brief #105, *Vertiport Design*. This engineering brief is written for vertical takeoff and landing (VTOL) aircraft powered by electric motors. The vertiport design considerations are very similar to the guidance provided in FAA AC 150/5390-2D, *Heliport Design*. The size of the landing area and the associated safety areas are a function of the controlling dimensions of the aircraft, typically the smallest enclosing circle that can surround the aircraft. This is similar to heliport design where the circumference of the helicopter rotor defines the landing area.

Vertiports and heliports have approach and departure surfaces associated with the landing area. The preferred approach/departure surface is based on the predominant wind direction. Where a reciprocal approach/departure surface is not possible in the opposite direction, a minimum 135-degree angle should be used. **Figure 4-2** shows the dimensions of the approach/departure surfaces for vertiports.

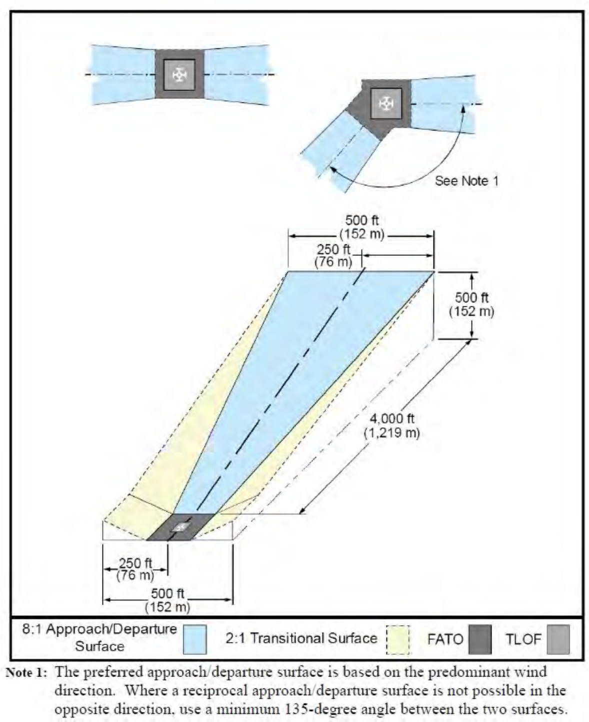


Figure 4-2: Vertiport Design Considerations

The approach and departure surface are one and the same and they rise at a ratio of 8:1. The approach/departure surface can rise above other structures. All of the vertiport options shown on the alternatives have clear approach/departure surfaces.

East Landside Alternatives

Alternative 1 | The east side of the airfield offers limited capability to develop additional hangar facilities. The area is mostly built out, with only a few vacant tracts of land that could potentially be developed for aviation facilities. Alternative 1, depicted on the top half of **Exhibit 4P**, highlights possible locations for hangar construction. As shown, a 150' by 150' (22,500 sf) conventional hangar is proposed on the north side of the airfield, across from Hangar 50 and accessible from Taxiway G. Another conventional hangar, sized 125' by 125' (15,625 sf), is proposed near the ARFF building, while two additional hangars of the same dimensions are proposed on the existing parking lot between Hangars 1 and 2. This lot is also proposed as a potential site to accommodate AAM activity, as shown by the reserved vertiport area on the exhibit.

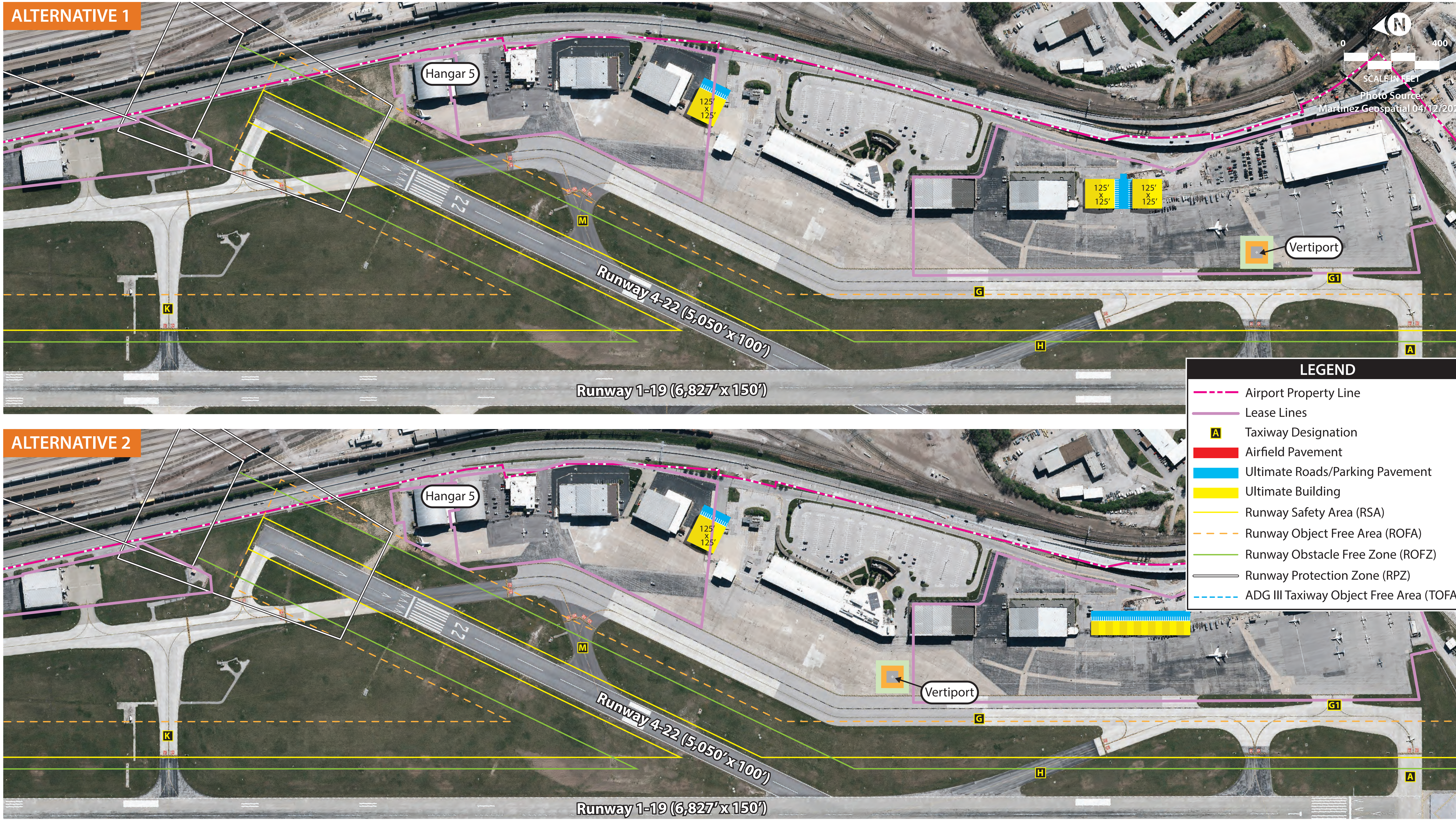
Alternative 2 | On the bottom half of **Exhibit 4P**, a secondary option for the parking lot between Hangars 1 and 2 is shown. Rather than conventional hangars and a vertiport on the parking lot, a linear box hangar is depicted that could accommodate smaller based aircraft.

Tower Site Alternatives

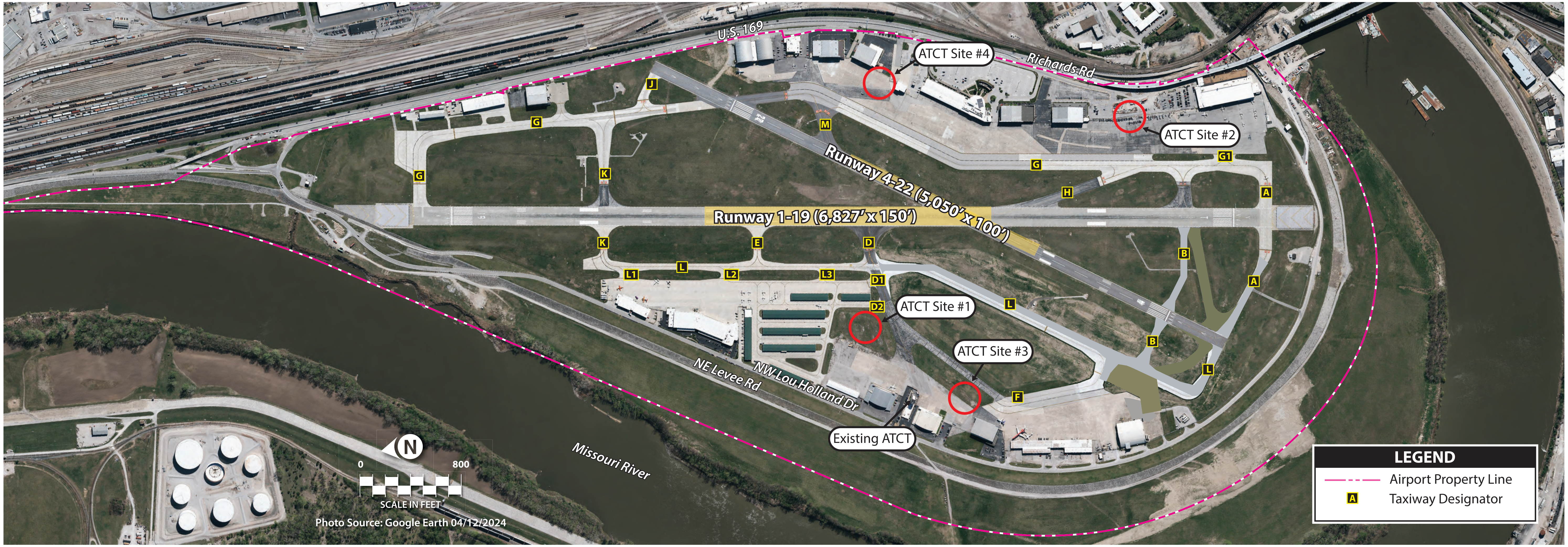
As detailed in the previous chapter, the ATCT at MKC is an aging facility that does not meet current design standards, including the Americans with Disabilities Act (ADA). The top of the tower is 84 feet above the ground, while the cab eye elevation is approximately 72 feet. Tower personnel are able to see all primary movement areas (runways and taxiways), but portions of the west hangar areas are not entirely visible from the tower. As such, four potential sites for relocating the tower are presented on **Exhibit 4Q**. These sites meet FAA ATCT siting criteria,[7] and each assumes a footprint of ¼-acre with variable tower and cab heights. The preferred orientation for a tower is north-facing to lessen the effects of direct and indirect sun glare; however, given the limited developable space on the airport, a north-facing tower is not feasible. If a north-facing tower is not an option, an east-facing tower is the next best option, followed by west and then south-facing.

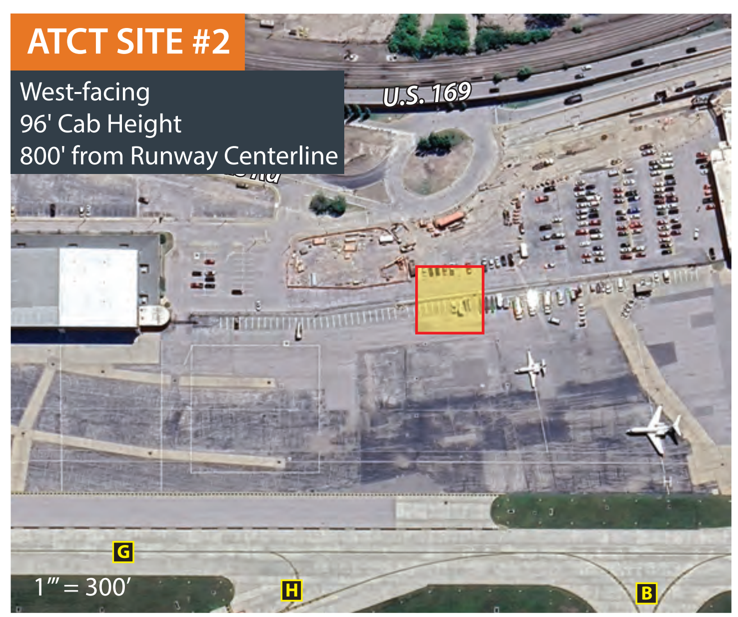
It should be clearly stated that these sites are preliminary in nature and are subject to change based on the ultimate tower design, runway disposition, and ultimate landside developments. Prior to construction of a new tower, coordination with the FAA and additional study will be required. **Table 4F** summarizes key details regarding the four potential sites for relocating the tower at MKC.

[7] This analysis utilized components of the operational requirements stated in FAA AC 6480.4b; specifically, sections of 6480.4b Appendix D (Visibility Performance Analyses). The FAA Air Traffic Control Visibility Analysis Tool was utilized to determine minimum cab heights based on potential tower sites.



Note: Hangar 5 is in the Part 77 Primary Surface. Replacement hangars in this location are prohibited.





Note: Cab heights presented are the minimum height necessary to achieve clear line-of-sight to each runway end, based on existing airport infrastructure.

Exhibit 4Q
ATCT SITE ALTERNATIVES

Table 4F | Preliminary ATCT Relocation Sites

	ATCT Site #1	ATCT Site #2	ATCT Site #3	ATCT Site #4
Direction	East-facing	West-facing	East-facing	West-facing
Cab Height	52’	96’	77’	68’
Distance from Nearest Runway Centerline	850’	800’	1,400’	650’

Sources: FAA AC 6480.4b; FAA Air Traffic Control Visibility Analysis Tool; Coffman Associates analysis

LANDSIDE SUMMARY

The landside alternatives presented strive to accommodate an array of aviation activities that either currently occur or could be expected to occur at MKC in the future. There is demand for new facilities at MKC, and with a diverse fleet mix of aircraft that includes everything from small piston aircraft to larger business jets, airport management will need to determine how to develop its property in an organized and thoughtful way. The extension of Taxiway L presents a unique opportunity to further develop the southwest portion of the airport. Airport management and the KCAD must carefully weigh the options when pursuing development in this area, however, as visibility of all movement areas will take precedence over landside growth. If development of large-scale facilities is desired, then consideration must be given to relocating the ATCT.

Each of the development options considers a long-term vision that would, in some cases, extend beyond the 20-year scope of this master plan. Nonetheless, it is beneficial to provide a long-term vision for the airport for future generations.

SUMMARY

This chapter is intended to present an analysis of various options that may be considered for specific airport elements. The need for alternatives is typically spurred by projections of aviation demand growth and/or by the need to resolve non-standard airport elements. FAA design standards are frequently updated with the intent of improving the safety and efficiency of aircraft movements on and around airports, which can lead to certain pavement geometries now being classified as non-standard when they previously met standards.

Several development alternatives related to both the airside and the landside have been presented. On the airside, the major considerations involve resolving non-standard safety area conditions on the airfield and improving airfield geometry to meet proper taxiway design standards. For the landside, alternatives were presented to consider additional aviation development on the east and west sides of the airport. As the airport already accommodates the full array of GA aircraft, and with the potential for increased operations and based aircraft, it will be important to clearly delineate development areas for facilities to accommodate airport users. This becomes even more critical with the potential introduction of AAM/UAM operations into the mix, and segregating operators by type of aircraft will contribute to operational safety and present a more organized and efficient airport.

The next step in the master plan development process is to arrive at a recommended development concept. Participation of the PAC and the public will be important considerations, and additional consultation with the FAA may also be required. Once a consolidated development plan is identified, a 20-year capital improvement program, with a list of prioritized projects tied to aviation demand and/or necessity, will be presented. Finally, a financial analysis will be presented to identify potential funding sources and to show airport management what local funds will be necessary to implement the plan.