Chapter Four

Airport Alternatives

The previous chapters have focused on the available facilities, the existing and potential future demand, as well as quantified the level of facilities that are needed both now and in the future. The purpose of this chapter is to formulate and examine rational airport development alternatives that can address the planning horizon demand levels. Because there are literally a multitude of possibilities and combinations thereof, intuitive judgement is necessary to focus in on those opportunities which have the greatest potential for success.

The major functional areas of an airport must be considered in the formulation of alternatives. At Charles B. Wheeler Downtown Airport (MKC), these include the airfield and landside general aviation facilities. In addition, operational support facilities and surface access for all these functions must be considered. The interrelationships of these functional areas require that they be evaluated both separately and as a whole to ensure the most functionally efficient, cost-effective, and environmentally compatible plan is derived. With this information, as well as the input and direction from government agencies, airport users, and other local stakeholders, a basic airport concept can evolve into a realistic development plan.

Prior to presenting the development alternatives, it is helpful to first review some of the important developments since the last master plan, which was completed in 1982. Recounting past planning considerations and implementation can help to identify current issues for this alternatives evaluation.

Previous planning efforts have also considered the "no action" alternative,
as well as relocating the airport or transferring services to another existing airport. These alternatives and why they are still not prudent or feasible will be summarized in the sections that follow. This will be followed by a summary of the current issues that need to be addressed and the alternatives analysis.

**REVIEW OF 1982 LAND USE AND DEVELOPMENT PLAN**

In 1969, the City Council of the City of Kansas City, Missouri, adopted a policy for the "continued development of Kansas City Municipal Airport (later renamed as MKC) as a major executive/business airport to serve growing non-airline air trade demand." This was reconfirmed in 1980 when the City commissioned a Land Use and Development Plan for the airport.

After the relocation of commercial service to Kansas City International Airport in 1972, the airport experienced a dramatic growth in annual operations from 118,000 to 200,000 in 1979. Projections called for 310,000 operations by 2000. The key issue was the lack of available space to accommodate additional general aviation demand. The old terminal building was being leased for non-aviation uses, and expenses were exceeding revenues. The study indicated that expenses would still exceed revenues even if the old terminal were fully leased, and a major refurbishing would be necessary if it were to be maintained.

The Land Use Plan predicted that operational traffic would become congested by the early 1990s and that this would be relieved as smaller aircraft gravitated to other airports in the metropolitan area. The study also determined that Runway 3-21 was not needed as it offered little capacity or crosswind coverage, but there was no reason to consider closing it in the short term.

The highlights of the recommendations of the 1982 Land Use Plan included:

- Continue to operate the airport as a first-class general aviation facility and develop it to its full potential to serve higher-performance general aviation aircraft.

- Remove the old terminal building and lease the 35 acres for aviation purposes. The plan did note that parts of the building could be retained if used for aviation.

- Abandon Runway 3-21 as soon as significant investment is required. Abandonment will make available an additional 70 acres of land for leasing or support facilities.

- When land becomes available, it should be leased for corporate and commercial general aviation.

- Passenger service can continue but would be limited to commuter service as long as emergency and security requirements do not significantly affect the costs of operation.
- Development should follow an adopted set of development standards.

The plan also called for the development of a microwave landing system (MLS) for the south approach to the primary runway. Taxiway improvements were designed for more efficient circulation and to open up development space. These included parallel taxiways on both sides of Runway 1-19.

Actual operational traffic in the year 2000 turned out to be less than half of what was forecast in the Land Use Plan. Based aircraft totaled 275 in 1980 and were forecast to reach 360 by 2000. This is higher than the actual 300 based aircraft that year, although the projection for 40 based jets met the actual total for 2000 exactly.

The runway and taxiway infrastructure is essentially the same as it was in 1980, with the only differences being the displacement of the Runway 3 threshold and a few minor taxiways removed. The largest change has been the removal of all but the core of the terminal building. Following the general guidance of the Land Use Plan, three large hangars have been constructed in the space left available. Two other large hangars have also been constructed on the west side, and the museum has moved to a hanger on the west side.

**ISSUE CONSIDERATIONS**

The primary goal for Kansas City MKC has not changed from the Land Use Plan. It is to operate the airport as a first-class general aviation facility, and to develop it to its full potential to serve higher-performance general aviation aircraft. Based upon operational characteristics today and those anticipated in the future, the airport should be planned for more based aircraft in the long range (440 versus the previous 360), but fewer annual operations (250,000 versus 310,000).

**Exhibit 4A** outlines the key considerations for this alternatives analysis. The key issue at the airport is related to the primary goal outlined above. Since the last 1982 Land Use Plan, the FAA has upgraded its airport design standards for airports serving the higher-performance general aviation aircraft. In particular, the FAA has become stringent in ensuring that airports do everything practical to meet the design standards for runway safety areas (RSA). As discussed in the previous chapter, neither of the existing runways meets the design standards for the extended runway safety area. The previously approved airport layout plan (ALP) calls for a displacement of the runway thresholds to meet design standards. This has been met with opposition from the fixed base operator (FBO) and corporate users because it significantly reduces the length of runway available for their use.
The airport could reach and exceed its annual service volume (ASV) in the later stages of the planning period. Providing a substantial increase in capacity will be difficult on the constrained site. Consideration should still be given to alternatives that could increase airfield efficiencies such as taxiway improvements and improved instrumentation.

Evaluation of the taxiway system should consider not only operational efficiencies, but also ways to minimize the potential for runway incursions. Parallel taxiways and strategically placed taxiway exits (including high speed exits) can help to improve efficiency. Intersections of multiple taxiways at the same point on a runway are examples of layouts that increase the chance for runway incursions to occur.

On the landside, consideration must be given to providing for adequate hangar space for a wide variety of general aviation needs. This includes corporate aviation, FBO, and other hangars as well. The facility requirements indicated that hangar parking positions could need to be increased by over 50 percent over the planning horizon.

Another consideration will be support facilities. In particular, the existing fuel farm is located very close to the north approach to the primary runway. A new location for this fuel farm is required.

A final consideration is maximizing the ability of the airport to be self-sustaining. Alternatives should be considered that are not only cost-effective, but that can increase revenue potential for the airport. A strong revenue capability will help to ensure that the airport does not become a financial burden on the City and the taxpayers.

**NON-DEVELOPMENT ALTERNATIVES**

Non-development alternatives include the no action or "do nothing" alternative, transferring service to an existing airport, or developing an airport at a new location. Previous planning efforts extending back to the decision to relocate commercial air service from MKC to Kansas City International Airport have considered these alternatives. The general conclusion has been to take advantage of MKC's proximity to the central business district of Kansas City and continue to develop and operate MKC as a first-class airport that can cater to the high-performance general aviation aircraft.

**NO ACTION ALTERNATIVE**

The "do-nothing" alternative essentially considers keeping the airport in its present condition and not providing for any type of improvement to the existing facilities. The primary result of this alternative would be the inability of the airport to satisfy the projected aviation demands of the airport service area and it would not meet safety standards.
AIRFIELD CONSIDERATIONS

- Extended Runway Safety Area (RSA)
- Taxiway Efficiency
- Minimize Runway Incursion Potential
- Improved Instrument Approaches

LANDSIDE CONSIDERATIONS

- Hangar/FBO area suitable for long range growth
- Relocate fuel farm
- Updated land use plan
The Kansas City metropolitan area continues to experience socioeconomic growth. The general aviation industry has experienced an extended period of adjustment over the last 20 years, but it is now seen as a growth industry once more. While overall, general aviation growth will be slow, the demand for higher performance aircraft is experiencing the strongest rate of growth. With heightened interest in security due to the recent terrorist attacks in the United States, corporate general aviation could expect demand for private executive aircraft to grow even more. Although some restrictions (e.g., Class B airspace) may work to counterbalance this, these reasons, combined with MKC’s role as a strategically located reliever airport, indicate a need to be capable to respond to anticipated demands for improved facilities.

One of the key considerations of this Master Plan is improving the extended runway safety areas. A no action approach would ignore this safety concern and is unacceptable to the FAA.

**SERVICE FROM ANOTHER AIRPORT**

The alternative of shifting all aviation services to another existing airport was found even less desirable due to the impact that a transfer would have on both the existing MKC users and other airports in the region. With 300 based aircraft and 125,000 to 150,000 annual operations, the relocation of services would affect the capacity of other airports.

In the past 20 years, two reliever airports in the metropolitan area have been closed. The system has been able to absorb the loss of the Fairfax Airport in Kansas City, Kansas, and the Richards-Gebaur Airport in south Kansas City. Neither of these airports had the level of activity that MKC supports, but their loss makes the remaining airports in the metropolitan reliever system even more critical to maintain.

MKC’s strategic location next to downtown Kansas City makes it a key airport in support of local commerce. The other reliever airports are located on the circumference of the metropolitan area. While they are convenient for the outlying areas, MKC is at the heart of the city. The advantages to the community of this location are extensive, as is evidenced by the number of major employers that have aircraft based at MKC.

An economic benefit study has been developed in conjunction with this Master Plan. The results of this study will be included in an appendix to the Master Plan. To get an indication of the effect of the higher performance aircraft on the local economy, some survey information was broken down for aircraft that require 6,000 feet or more runway length. Although making up just 23 percent of the survey respondents, the higher performance aircraft accounted for two out of three business trips (69 percent), 80 percent of the business miles originating from MKC, and 88.5 percent of the business passenger miles. The responding firms with aircraft needing the greater
runway length have over 75,000 employees in the area, with annual sales of $22.6 billion, compared to 4,233 employees and $500 million sales by other respondents.

Visiting aircraft requiring the longer runway length average 1.5 more passengers per trip (5.2 versus 3.7) and spend an average of 19 percent more per visit, even though the travel party stays less time (1.4 days versus 1.8 days).

There are only two other airports in the region that can accommodate all of the aircraft now using MKC. Kansas City International Airport is the airport that MKC relieves. New Century Airport on the southwest side of the metropolitan area is convenient to Johnson County, but is a 20- to 28-mile drive from midtown and downtown Kansas City. Alternatives to be discussed later will consider the impacts of relocating the higher end traffic from MKC to the other airports, but a full transfer of services cannot be considered as prudent or feasible.

Another option would be constructing a new airport. From social, political, and environmental standpoints, the commitment of a new large land area must also be considered. There has been significant opposition in the past to attempts to develop new airports in the metropolitan area. Furthermore, the development of a new airport similar to MKC would likely take a minimum of ten years to become a reality. The potential exists for significant environmental impacts associated with disturbing a large land area when developing a new airport site. To develop a new site with the capabilities of MKC could easily cost over $200 million and would not provide the strategic location that the MKC does today. The only areas with adequate space to relocate the airport are either within the Missouri River floodplain, affect the airspace of Kansas City International Airport, or located on the urban fringe of the metropolitan area.

Overall, transferring service to an existing airport in the region or to an entirely new facility are unreasonable alternatives that should not be pursued further at this time. MKC is a valuable asset to the economic dynamics of the downtown area. It should be developed to the extent practical to maintain and promote commerce in the area.

AIRFIELD ALTERNATIVES

The facility requirements analysis in the previous chapter indicated that neither runway meets the FAA safety design standards as outlined in FAA AC 150/5300-13, Airport Design. While the existing pavement length and width for the primary runway are adequate, the most critical issue is runway safety area. In particular, the runway safety area extending beyond the operable end of the runway. The following subsections examine each runway and the potential alternatives for meeting the current and long-range demand at MKC.
RUNWAY 1-19 SAFETY AREA DETERMINATION

FAA Order 5300.1F, Modification of Agency Airport Design, Construction, and Equipment Standards, indicates in Paragraph 6.d. the following:

"... Runway safety areas at both certificated and non-certificated airports that do not meet dimensional standards are subject to FAA Order 5200.8, Runway Safety Area Program. Modifications of Standards are not issued for nonstandard runway safety areas."

FAA Order 5200.8 establishes the procedures that the FAA will follow in implementing the Runway Safety Area Program. Paragraph 5 of this Order states:

"The objective of the Runway Safety Area Program is that all RSAs at federally obligated airports ... shall conform to the standards contained in AC 150/5300-13, Airport Design, to the extent practicable."

The Order goes on to indicate 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.

(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 standards, and it is not practicable to improve the RSA."

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)."

The previous chapters have identified the current safety area problem. Out of the list above, several basic options can be considered at MKC. The first, and most straightforward alternative, is to fully meet the design standards by providing for the clearing and proper fill and grading of the safety area and object free area off the runway ends. This is certainly the most desirable as long as physical, environmental, and economic considerations can be accommodated.

The next option is to relocate, shift, or realign the runway. At MKC, this could be Runway 3-21, a new orientation, or a runway at another airport. The options of another airport have been discussed earlier in this chapter, and the cost of diverting to another airport will be examined further below.

A third option would be to shift the threshold of the runway to effectively relocate the RSA and the object free area (OFA) within the available graded and cleared area. This is accomplished by either relocating or displacing the threshold. Unless combined with an addition of pavement and/or safety area, relocated and displaced thresholds generally reduce the effective length of the runway. The portion of pavement behind a relocated threshold is not available for takeoff or landing. The portion of pavement behind a displaced threshold is not available for landing, however, it may be available for takeoff roll. This option must be weighed not only against the costs of physically implementing the relocation or displacement, but also the effects on the operational capabilities of the airfield, and the constraints it places on the users of the airport.

Declared distances are used by the FAA to define the effective runway length for landing and takeoff when either a displaced or relocated threshold is involved. Declared distances are defined as the amount of runway declared available for certain takeoff and landing operations. The four types of declared distances, as defined in FAA Advisory Circular 150/530-13, Airport Design, are as follows:

**Takeoff Run Available (TORA)** - The runway length declared available and suitable for the ground run of an airplane taking off.

**Takeoff Distance Available (TODA)** - The TORA plus the length of any remaining runway and/or clearway beyond the far end of the TORA.

**Accelerate-Stop Distance Available (ASDA)** - The runway plus stopway length declared available for the acceleration and deceleration of an aircraft aborting a takeoff.

**Landing Distance Available (LDA)** - The runway length declared available and suitable for landing.
From discussions with chief pilots for several of the local companies with based business jets at MKC, it became evident that the most critical of the declared distances at MKC are ASDA and LDA. Evaluations of the effectiveness of each alternative will focus on these two declared distances. If a reduction in effective runway length is involved, costs to the users must be considered in the analysis. How these are to be determined is discussed in the next section.

A last option would be to determine how much safety area can be provided without significantly affecting the operations of the users of the airport. This is obviously less desirable to the FAA, and would be an acceptable determination only if the previous options are proven infeasible and it is proven that the alternative will not unnecessarily endanger lives or property. Paragraph 4 of the Appendix states:

"... Any portion of land that will increase the RSA, even if it is but an incremental increase, and will not result in meeting the standard fully, is preferable and will serve as a starting point for the consideration of additional alternatives... Incremental gains must be obtained whenever possible. The gain may be relatively little, but any gain is valuable."

Paragraph 4.f. of the Appendix further states:

"At any time, when it is not practicable to obtain a safety area that meets the current standards, consideration should be given to enhancing the safety of the area beyond the runway end with the installation of EMAS. The AC 150/5220-22, Change 1, Engineered Materials Arresting Systems (EMAS) for Aircraft Overruns, pertaining to the installation and use of EMAS, provides details on design to be considered in determining feasibility of this alternative."

Recognizing the difficulties associated with achieving a standard safety area at all airports, the FAA undertook research programs on the use of various materials for arresting systems. Engineered Materials Arresting Systems (EMAS) are comprised of high energy absorbing materials of selected strength which will reliably and predictably crush under the weight of an aircraft. According to the AC, EMAS is not to be considered a substitute for, nor equivalent to, any length or width of safety area, and does not affect declared distance calculations. It is also not intended to meet the FAA definition of a stopway.

For evaluation of the various options and alternatives, a baseline condition must be considered. This is the plan that will be implemented if a more optimum solution is not found. In many alternatives evaluations, the baseline condition is the No Action or "Do Nothing" alternative. When the primary need to be addressed is safety design standards, doing nothing cannot be considered as a viable baseline condition because the safety concern would remain.
A baseline condition for MKC has been previously established that is known to satisfy safety concerns. This is depicted on the currently approved airport layout plan (ALP). Concern has been expressed by airport tenants and users that implementing the existing ALP will affect their operations from the airport. Therefore, any alternative to be considered must provide for capability beyond the approved ALP, and must serve to improve safety beyond existing conditions.

Each alternative will be evaluated in relation to development costs, operational considerations, and potential environmental impacts. Development costs include the cost of design, construction, property acquisition, and environmental mitigation that will be necessary to implement the alternative. Environmental impacts to be considered are potential noise impacts and potential impacts to the Missouri River corridor that circumvents three sides of the airport. These could include effects on the floodway/floodplain, wetlands, biotic communities, river navigation, and area stormwater drainage.

A major consideration is the operational effect on users. While safety is the first and foremost consideration, an alternative that reduces the effective runway length could have an impact on users.

Runway Length Analysis

The potential cost impacts associated with a reduction of the operational runway length at Kansas City MKC were estimated utilizing surveys, industry standards, aircraft manufacturers’ information, fuel sales, lease information, and other sources. The goal of this analysis was to provide an estimate of the direct impact to airport users, in terms of increased operating costs from aircraft diversions.

For this analysis, the impact involves aircraft operator and passenger costs related to aircraft diversions that could become necessary due to inadequate landing lengths during wet runway conditions. The runway was considered to be wet 15 percent of the year. National Oceanic and Atmospheric Administration (NOAA) data for Kansas City indicates that there is at least 0.01 inch or more precipitation approximately 30 percent of the days of the year. It was then estimated that the pavement will remain wet, icy, or snow-covered for approximately half of that time.

Other weather data provided by the FAA indicated that precipitation is actually falling approximately eight percent of the time in Kansas City. Pavements will remain contaminated for a period of time upon the cessation of the precipitation event, so it can be assumed that the runway would be contaminated with some form of precipitation more than eight percent of the time. Doubling this time would result in a figure similar to that obtained with the other method.

Table 4A outlines the analysis of transient aircraft diversions. As presented, potential diversions were
categorized at thresholds of aircraft requiring a wet runway landing length of greater than 5,400 feet, 5,700 feet, 6,000 feet, 6,400 feet, and 6,700 feet. Diversion costs were based upon transient aircraft diverting to either New Century Airport near Gardner, Kansas, or to Kansas City International Airport (KCI). These are the only two airports in the metropolitan area with runways as long or longer than that available at MKC. The costs included one hour of block time operating costs for the model of aircraft, 30 additional miles of ground transportation round trip, and one hour of additional time for executive passengers. The number of passengers varied with the size of the aircraft. It should be noted that no costs are included for potential revenues lost to the fixed base operators or the Aviation Department in fuel sales and flowage fees due to the diversions.

<table>
<thead>
<tr>
<th>Aircraft</th>
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<td></td>
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Greater than 5,400 feet, less than 5,701 feet.

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Greater than 5,700 feet, less than 6,001 feet.

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<td></td>
<td>Wet Landings</td>
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Greater than 6,000 feet, less than 6,401 feet.

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<tr>
<td></td>
<td></td>
<td>Wet Landings</td>
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Greater than 6,700 feet.

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<tr>
<td></td>
<td></td>
<td>Wet Landings</td>
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4-11
A reduction to 5,400 feet of landing length (LDA) would cost current business aircraft users nearly $5.0 million annually. Increasing the landing length to 5,700 feet would provide some relief, saving $932,000 in annual diversion costs. A landing length of 6,000 feet would save over $3.5 million in annual diversion costs. A landing length of 6,400 feet would save another $305,000 in annual diversion costs. Approximately $210,000 in diversion costs could be saved maintaining the 7,000-foot landing length.

New Century Airport and KCI are also the only airports in the metropolitan area that could potentially accommodate the relocation of the based aircraft affected if the landing length at MKC were reduced to a point where the aircraft operator would choose to move. Although these airports meet the requirements of the “system of airports” developed and maintained by the FAA, they would result in additional costs to the individual and/or business owners if their aircraft were to be relocated to another airport. It should also be noted that Kansas City International Airport does not have hangar facilities to house based aircraft.

No assumption has been made for the cost to the operator and passengers for operating from a more distant airport on a daily basis. With many of the affected corporations located in the downtown or midtown areas of Kansas City, there would be more ground travel involved to go to either KCI or New Century Airport. On the average, this would be an additional 19 miles or 25 minutes of ground travel.

Similarly, no assumption is made for losses in other FBO sources of revenue such as aircraft maintenance and fuel sales. According to the economic benefit survey, maintenance costs average over $900,000 annually per aircraft. Table 4B estimates the based aircraft in each category.

**Baseline Condition**

The current approved Airport Layout Plan for MKC combines portions of the options outlined above. Exhibit 4B depicts the currently approved plan for Runway 1-19.

The plan calls for a 120-foot extension on the south end of the runway and a threshold displacement on each end. The displacement on the south end would be 744 feet from the end of the runway extension. The displacement on the north end would be 1,000 feet from the runway end. Table 4C summarizes the evaluation considerations of the baseline alternative for comparison to the other alternatives.

The Baseline Alternative represents the maximum effective runway length that can be obtained on the existing alignment within the existing airport operations area (AOA). According to the ALP, the ASDA would be 6,121 feet on Runway 1 and 6,377 feet on Runway 19. The LDA would be 5,377 feet for both runways. The baseline includes modifications to standards because the full safety area width of 500 feet is not available over the first 370 feet of runway from the Runway 19 end. On the south end, there is 376 feet of full width runway safety area available behind the existing end of Runway 1.
<table>
<thead>
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<th>Type</th>
<th>Landing Wet (ft.)</th>
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</thead>
<tbody>
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**@ 5,400 feet**

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<td>C-III</td>
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<td>Lear 31A</td>
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<td>Astra</td>
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<td>Lear 31A</td>
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**Greater than 5,400 feet, less than 5,701 feet**

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<td>Utilicorp United</td>
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<td>VF Corporation</td>
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<td>Citation III</td>
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<tr>
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<td>D-I</td>
<td>Lear 35</td>
<td>6,000</td>
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**Greater than 5,700 feet, less than 6,001 feet.**

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<tr>
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<tr>
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<td>5,500</td>
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<tr>
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<td>C-III</td>
<td>Global Express</td>
<td>5,500</td>
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<td>B-I</td>
<td>MU-300</td>
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<td>H&amp;H Aviation</td>
<td>B-I</td>
<td>Sabreliner 65</td>
<td>6,300</td>
</tr>
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</table>

**Greater than 6,400 feet, less than 6,701 feet.**

<table>
<thead>
<tr>
<th>Company</th>
<th>ARC</th>
<th>Type</th>
<th>Landing Wet (ft.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airnet Express</td>
<td>C-I</td>
<td>Lear 25</td>
<td>7,000</td>
</tr>
<tr>
<td>Cereal Food Processors</td>
<td>C-II</td>
<td>Jet Star</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Greater than 6,700 feet.**
The 1,000-foot displacement of the north threshold would provide sufficient room to be able to install a full MALSR on the approach. The proximity of the Missouri River channel prohibits installing the full MALSR with the existing threshold. The threshold needs to be displaced at least 700 feet to be able to accept a full MALSR.

With the runway and RSA remaining within the existing envelope, the Baseline Alternative has no appreciable environmental factors. The displacement of the runway thresholds would place aircraft slightly higher on approach. A reduction in operations as a result of the diversions and the relocation of several business jet aircraft that would use the field would further reduce the noise generated from the airport.

Construction costs associated with the Baseline Alternative are estimated at $9.7 million. This includes the construction of 120 feet of pavement on the south end, the relocation of the glide slope to Runway 1, and reconfiguration of the runway lighting systems. It also includes the rehabilitation of the existing runway pavement. This rehabilitation cost will be applied to each alternative that maintains the existing runway pavement.

Costs with the Baseline Alternative are reasonable and no construction would be necessary beyond the existing AOA. This alternative has been met with opposition from the corporate aircraft operators at the airport because it limits their operational capabilities. Of greatest concern is the landing distance available. With 5,377 feet available for landing, a number of aircraft could be forced to divert whenever the runway is contaminated with rain, snow, or ice. This is anticipated to affect an average of over 1,650 business jet landings annually. As many as 27 based business jets could be forced to relocate due to the diversion potentials.

According to the analyses outlined on Table 4A, the baseline landing length will cost business aircraft users $4.97 million in diversion costs annually.

**Alternative 1 - Provide Full Safety Area**

The first option in the runway safety area determination is to look at means by which the runway safety area could be extended to the north and south, off the ends of existing Runway 1-19. Exhibit 4C depicts the area that the full safety area and object free area would need to encompass off each end of the runway. This would involve extending the RSA and OFA over and across the Missouri River flood levee at both ends. At the north end, the runway is at or near the same elevation as the levee, however, the levee at the south end is 13.5 feet above the elevation of the south runway threshold.

The change in elevation between the runway and the levee on the south end makes extending the runway safety area over the levee and into the floodplain virtually infeasible. The slopes required between the existing grades would exceed the design
standards for both the allowable grade in the safety area and the allowable grade on the runway. The grade in an extended RSA should be downward from the runway end elevation at zero to a negative three percent for the first 200 feet. After that, grades of up to five percent are permitted with a maximum grade change of two percent per 100 feet, as long as the safety area does not penetrate the approach surface.

These grade requirements cannot be met on the south end without raising the elevation of the runway or lowering the levee. Raising the runway elevation would have a significant effect on grades and drainage throughout the airport, resulting in significant construction costs. Lowering the levee would require an extensive flood gate system (at least 800 feet wide) that would need to be closed for flood threats on the Missouri River. To obtain the required extended runway safety area, the levee would need to be modified on the river side and include filling into the floodway, or setting the RSA on piers.

In addition, the access road would need to be relocated either around or below the safety area. Access to the west side of the airport is currently available from both the north and south sides of the airport. If access from one direction is relocated into the floodplain, it will be critical that the access from the other direction be maintained within the levee.

At the north end, development of the full length of extended safety area would reach into the navigable channel of the Missouri River. Preliminary discussions with the U.S. Army Corps of Engineers (COE) indicated that construction in the river channel would not be permitted. The COE did indicate, however, that construction in the floodway could be considered if it were proven that construction could be accomplished without noticeably affecting the river's elevations during flood events.

This alternative would maintain the effective length of the runway at 7,001 feet for both LDA and ASDA. As a result, no current operations would be affected so there would be no operational cost to the users, or a savings of $4.97 million in annual diversion cost, compared to the Baseline.

To avoid increases to the flood elevations in the Missouri River, this alternative would require the runway safety areas to be constructed on piers off each end of the runway. The primary concern with the construction of the piers is the cost. To provide for the full safety areas in this manner would cost an estimated $158.8 million.

Therefore, providing a full runway safety area beyond each end is not financially or practically feasible and should not be considered further.

**Alternative 2 - Runway Realignment**

MKC has physical constraints on all sides. This includes the Missouri River and its levee system on three sides. The
other side is constrained by a major arterial highway leading into the central business district across the Missouri River. Immediately on the other side of the highway is a large railroad yard. Different runway alignments were considered to attempt to remain within these constraints.

The first consideration was the crosswind Runway 3-21. This runway currently has less length than Runway 1-19 and would be reduced even further if the Baseline Alternative were implemented. In fact, it is even more constrained beyond its ends than Runway 1-19. It is highly evident that Runway 3-21 cannot feasibly be developed in a manner that would replace Runway 1-19.

The airfield was examined for an alignment that would provide a larger envelope for the development of a runway that could meet the design criteria of 7,001 feet, or at least provide more ASDA and LDA than the Baseline Alternative.

Exhibit 4D depicts a runway in a 2-20 orientation that attempts to take advantage of the longest linear area within the constraints. As shown on the exhibit, the runway is 7,000 feet in length, but the new orientation still would not provide for the full RSA beyond the ends. To provide for the full 1,000-foot extended RSA, the south threshold would be displaced 626 feet and the north threshold would be displaced 417 feet. Even then, the full object free area would not be provided.

The ASDA and LDA are provided for comparison to other alternatives on Table 4C. An ASDA of 6,583 feet is available from the south, but the LDA is 5,957 feet in both directions. A longer ASDA could be achieved by extending the pavement further in either direction. An ASDA of 6,700 feet could likely be obtained before jet blast becomes the overriding factor. LDA, however, is more critical. Even with a new orientation, the LDA would be less than 6,000 feet. It is estimated there would be an average of 153 annual business jet operations affected each year. While this could save $4.46 million annually over the Baseline Alternative, construction costs are estimated to be on the order of $68.7 million. In addition, six based aircraft could potentially relocate.

Besides the high cost, there would be a significant short term operational impact associated with the construction of a new runway. Runway 1-19 would need to be closed during the entire construction period. Runway 3-21 would remain available for much of the construction period, but its limitations would require many of the business jet operators to temporarily relocate to other airports. At some point, Runway 3-21 would need to be closed to finish construction. An even shorter portion of the new runway would be all that would be available during that time.

The approach to the realigned runway would be directly over the heart of the railroad yard across the highway from the airport. The lighting from the rail
| TABLE 4C | Runway 1-19 Safety Area Alternatives | Comparative Summary | Kansas City Downtown Airport |
|------------------------------------------------|------------------------------------------------|------------------------------------------------|
| **Baseline Alternative** | **Alt. 1 - Full Safety Area** | **Alt. 2 - Runway Realignment** | **Alt. 3 - Maximize RSA** | **Alt. 4 - Runway Extensions** | **Alt. 5 - Limited RSA** |
| **PHYSICAL FACTORS** | Exhibit 4B | Exhibit 4C | Exhibit 4D | Exhibit 4F | Exhibit 4G | Exhibit 4J |
| Effective Runway Length | | | | | | |
| Take-off (ASDA) | 6,131' | 6,377' | 7,001' | 6,377' | 6,377' | 6,201' |
| Landing (LDA) | 5,777' | 5,377' | 7,001' | 5,957' | 5,957' | 6,201' |
| Property Acquisition | 0.0 Acres | 0.0 Acres | 20.9 Acres | 0.0 Acres | 0.0 Acres | 0.0 Acres |
| Facility Relocation | VASI-4A, glide slope (19), MALSR (19), REIL (19), edge lighting | VASI-4A, glide slope (19), MALSR (19), REIL (19), edge lighting | VASI-4B, glide slope (19), MALSR (19), REIL (1), access road (north) | VASI-4B, glide slope (19), MALSR (19), REIL (1), access road (north) | VASI-4B, MALSR (19), REIL (1), access road (north), edge lighting |
| Observation Removal | None | None | None | None | None | None |
| Infrastructure Development | Add 120 ft length to south end, realign taxiways to south end | Construct piers in river and floodway, raise south end of runway | New runway/taxiway system including full length parallel taxiways | Extend north RSA over levee into floodway | Extend north RSA over levee into floodway add 120' to west south, add 300' to west north |
| **OPERATIONAL FACTORS** | | | | | | |
| Aircraft Operations | Meets RSA design standards, curtail full MALSR, 1,652 average annual diversions, probabilistic loss of 27-based jets | Meets RSA design standards; no change in operational uses | Meets RSA design standards; 153 annual operations diverted | Meets RSA design standards; 153 annual operations diverted | Requires RSA determination, 72 annual operations diverted |
| Facility Maintenance | Maintain additional 120' of runway, maintenance of piers and deck, clean debris between piers | Short term improvements due to full pavement replacement | Maintain RSA in floodway | Maintain RSA in floodway | Maintain RSA in floodway |
| **ENVIRONMENTAL FACTORS** | | | | | | |
| Wetlands | None | Affects floodplain wetlands (north end) | None | Affects floodplain wetlands (north end) | Affects floodplain wetlands (north end) | Affects floodplain wetlands (north end) |
| Floodplain Effects | None | Effects on navigable river | None | Requires compensatory removal of fill downstream | Requires compensatory removal of fill downstream | Requires compensatory removal of fill downstream |
| Noise | Slightly reduced | None | Slightly reduced | Slightly reduced | Slightly reduced | Slightly reduced |
| Other | Minimal | Minimal | Minimal | Minimal | Minimal | Minimal |
| DEVELOPMENT COSTS | $9.7 million | $158.8 million | $76.3 million | $15.0 million | $17.6 million | $17.1 million |
| OPERATING BENEFITS | $0 (baseline) | $4.97 million | $4.46 million | $4.46 million | $4.46 million | $4.76 million |
yard could create problems for the instrument approach from the north. Conversely, the realignment could provide better opportunities for an approach from the south, although a full MALSR could not be provided without extending into the channel. Hangars and apron located on the northeast side of the airport would need to be relocated.

The new alignment is even closer to that of the crosswind Runway 3-21, therefore, the additional wind coverage provided by the crosswind runway would be even less significant. The new alignment could place overflights over areas not currently flown. This would include a residential area to the northeast of the airport.

While a new alignment could provide an improvement in LDA over the baseline, it would also be very expensive to construct and could disrupt airport operations for an extended period of time for construction. The $76.3 million in construction costs over the baseline cannot be justified for the $4.46 million in annual benefits from flight diversion savings.

Alternative 3 - Maximize Runway Safety Area

The evaluation of Alternative 1 established that the full runway safety area cannot be obtained in a practical manner. Similarly, the evaluation of Alternative 2 established that a runway realignment is not practical either. The next step is to consider what amount of safety area can be provided in combination with threshold displacements to meet the design standard.

The south end of the runway does have some extended safety area room within the AOA. There is approximately 430 feet of safety area length along the runway centerline before reaching the localizer. The controlling point is the security fencing where it intersects the east edge of the safety area, 386 feet from the Runway 19 threshold. This available safety area was considered in the Baseline Alternative.

Another option considered was to extend the safety area to the top of the levee. To meet grades, this would require raising the area beyond the end of the runway and tunneling the access road beneath the safety area. Since this would only net an additional 110 feet of safety area, a cost estimate was not prepared.

At the north end, the restricting factors are the location of the river and the effect of fill in the floodway. As shown on Exhibit 4E, there is room to construct 600 feet of full width safety area before reaching the riverbank. The grading would require 60,000 cubic yards of compacted fill.

To determine the potential effect on the Missouri River flood elevations, a one-dimensional hydraulic analysis was performed on the safety area grading design depicted on this exhibit. The analysis utilized a hydraulic model of the Missouri River developed for the Corps of Engineers. The analysis indicated that the design would create
no appreciable rise in flood elevations. The maximum rise in surface elevation was 0.02 feet.

It was further determined that excavation of 90,000 cubic yards downstream along the base of the levee could mitigate any potential rise. While additional coordination and approvals would be necessary, this safety area extension does appear to be feasible.

Exhibit 4F depicts Alternative 3 as an alternative that maximizes the available runway safety area at a reasonable cost. While the safety area can be extended for 600 feet, the access road must be relocated around the safety area as well. To remain on the bank, the access road would traverse the northwest corner of the safety area. If this is not permissible, the safety area would need to be reduced to 500 feet.

Assuming this is acceptable, and assuming that credit can be given for at least 400 feet of safety area on the south end as well, there would be 1,000 feet of total safety area available beyond the runway ends. To achieve full compliance with the design standards, the Runway 1 threshold would need to be displaced 600 feet and the Runway 19 threshold would need to be displaced 400 feet. For takeoffs, this would provide an ASDA of 6,601 feet on Runway 1 and 6,401 feet on Runway 19. For landings, the LDA would be 6,001 feet in both directions.

The amount of runway available for landing is essentially the same as for the runway realignment, so there would still be 153 annual diversions and the probability that six based aircraft would leave the airport. This would still save users $4.46 million annually over the Baseline Alternative.

Construction costs are estimated at $15.0 million. This is significantly less than the cost to reorient the runway while providing a similar LDA. Table 4C compares Alternative 3 to the other alternatives.

Alternative 4 - Maximize RSA with Runway Extension

The next alternative examines what could be gained if additional runway length were to be constructed into the extended runway safety area. The Baseline Alternative includes a 120-foot extension into the south RSA. This is the maximum extension that can be accommodated and still avoid potential jet blast effects on the localizer. Extensions of various lengths were examined for the north end.

Since there is not a feasible safety area extension beyond that offered by Alternative 3, it is not possible for any type of runway extension to increase the LDA beyond 6,001 feet. As a result, the transient and based aircraft affected will be the same as with Alternative 3. An extension on the south end increases the ASDA for takeoffs to the north, and an extension on the north end increases the ASDA for takeoffs to the south. The 120-foot extension on the south end would increase the ASDA on Runway 1 to 6,721 feet. A 300-foot extension would be needed on the north end to
provide a comparable ASDA of 6,701 feet for Runway 19. Exhibit 4G depicts this alternative.

Essentially, any length over 5,900 feet ASDA would permit business aircraft to take off from MKC with average loading (60 percent useful load). Any additional runway length provides additional non-stop trip range for aircraft. Costs for adding 120 feet of length to the south end and 300 feet on the north end are estimated at an additional $2.36 million. Thus, the total construction costs for Alternative 3 are estimated at $17.6 million. This alternative is compared to the others in Table 4C.

**Alternative 5 - Limited Safety Area**

Table 4C compares the alternatives that can meet the runway safety area design standards. Alternative 1 (full safety area) and Alternative 2 (reorient the runway) are cost-prohibitive, and have environmental and logistical problems as well. The Baseline Alternative as well as Alternative 3 (maximize safety area) and Alternative 4 (extend runways) have far more reasonable costs.

Alternatives 3 and 4 provide more ASDA and LDA than the Baseline Alternative. Either alternative would save at least $4.46 million annually in costs to users. Alternative 4 would cost more than Alternative 3 but would provide more ASDA to allow for longer nonstop trip lengths from MKC.

While being a significant improvement over the baseline, the LDA for both of these alternatives is 6,001 feet. This limitation could still force up to six existing based business jets to move to a more distant airport or face diversions when returning home in wet weather. In addition, a number of transient flights would still be forced to divert.

Providing an LDA of at least 6,400 feet would accommodate all frequent users in wet conditions except the B-727 and the Lear 25. While the operational cost to users would be $210,000 per year, both are older aircraft models that are no longer in production.

It should be recalled that the Baseline Alternative (the previously approved ALP) does not provide for the full RSA width at the north end of the runway. The full 500-foot width is available for only 600 feet of the 1,000-foot displacement.

Appendix 8 of FAA AC 150/5300-13 discusses the rationale behind the established design standard for the runway safety area. Exhibit 4H was taken from this Appendix and represents the percentage of aircraft overshooting or undershooting a runway that would end up within a given distance of the runway end. It is obvious from the table that the 1,000-foot standard is based upon safely accommodating 90 percent of aircraft that overshoot or undershoot the runway. A graded safety area 800 feet beyond the runway end would still accommodate approximately 84 percent.
of overshoot or undershoot incidents, just six percent less than the design standard. A 600-foot extended safety area would accommodate 75 percent of such incidents. The effectiveness falls more rapidly as the available safety area is reduced below 600 feet.

If 800 feet of extended RSA were provided behind the runway thresholds, the LDA would be 6,401 feet.

Generally, moving thresholds in 200-foot intervals is the most cost-effective. Runway edge lighting and the approach light system are set on 200-foot intervals. Other intervals could require that light fixtures be reset along the entire length of the runway, and would require all new base support systems for the approach lights. A safety area determination providing Runway 1-19 with 800-foot safety areas on both ends, would have an estimated $14.6 million in construction costs, and would have an annual operating benefit of $4.76 million.

Displacing the north threshold 200 feet does create a problem with regard to the ILS approach to Runway 19. FAA AC 150/5300-13, Change 6, established an additional object free area restriction at the threshold of a runway with minimums less than three-quarter mile. The precision object free area (POFA) is centered on the runway centerline extended, beginning at the runway threshold, 200 feet long and 800 feet wide. This standard will apply to all new instrument approach procedures with less than three-quarter-mile visibility. While the minimums on Runway 19 are currently at one-mile visibility, if they are ever to be lowered, the POFA will apply.

Under this definition, the 200-foot displaced threshold would place the exit taxiway at the end of Runway 19 in the POFA. This can be remedied by adding length to the north end of the runway and relocating the entrance taxiway at the new departure threshold to remove it from the POFA.

Alternative 5 displaced thresholds were reviewed with the fixed base operator at MKC, as well as several of the chief pilots for the major corporations with aircraft based at the airport. There was a consensus that the landing distance available provided with this alternative would be adequate, however, there was still concern with the accelerate-stop distance available on takeoff. It was noted that even the full 7,001 feet of length can be limiting on not only international, but some domestic flights to each coast.

Unlike landings, the pilot taking off has some other options. The first option is to delay the flight for more favorable conditions. This is generally unacceptable for a corporation that has invested in a business jet for the purpose of saving time. The other option involves reducing the takeoff weight. This would require either reducing the payload (passengers or cargo), reducing the fuel load, or a combination.

Of course, each option has a cost to the user. Reducing payload could affect the value and/or effectiveness of the trip to the business. Reducing fuel load would
reduce the range of the aircraft enough to require a fuel stop. Additional fuel stops increase the time involved in the trip. The additional takeoff and landing cycles also increase the amount of fuel consumed, as well as the wear and tear on the aircraft.

The ASDA for Alternative 5 without additional length would be 6,801 feet on Runway 1 (takeoffs to the north) and 6,601 feet on Runway 19 (takeoffs to the south). It was suggested by the FBO and chief pilots that the pavement extensions of Alternative 4 be included in Alternative 5. A 300-foot extension to the north and a 100-foot extension to the south would increase the ASDA to 6,901 feet in both directions. This was found acceptable by several representatives of high performance aircraft users based at the airport. These extensions are depicted as part of Alternative 5 on Exhibit 4J.

Information provided by the users indicated the effect of the 300-foot difference in ASDA. On the Hawker 800 aircraft (three of which are based at MKC) the difference on the design day (91 degrees F) is a payload of three passengers or 30 minutes of flight range. The difference on the Hawker 700 (four of which are based on the airport) would be one passenger or 10 minutes of flight range. For the Jet Star II based at the airport, the additional 300 feet of takeoff length would be the difference for five passengers or 30 minutes of flight time.

Most of the aircraft affected would be business jets with long range flight capabilities. This long range capability is important to the corporations that own or charter the aircraft. Other aircraft that would benefit from the additional 300 feet of ASDA include:

- Gulfstream IV (one based)
- Gulfstream V
- Global Express (two based)
- Lear 60
- Challenger 600 (one based)
- Sabreliner 65 (one based)
- Sabreliner 75

At least 13 based business jets would benefit from maintaining an ASDA of at least 6,901 feet. The 300-foot pavement extension to the north is most critical as the prevailing winds are generally out of the south during warmer weather.

Adding the 100 feet to the south end would provide equal declared distances in both directions. While the need for departures to the north may be less, so is the cost of the extension.

As with Alternative 4, the extension adds approximately 2.5 million to the cost of the project. This would result in a total cost of $17.1 million for Alternative 5.

Engineered Materials Arresting Systems (EMAS)

In compliance with FAA Order 5200.8, the Runway Safety Area Determination for MKC must consider EMAS because the standard safety area length cannot practicably be accommodated. As indicated earlier, EMAS is not meant to be considered a substitute for, or equivalent to, any length of runway.
safety area, and does not affect declared distance calculations.

The EMAS system is designed to stop an overrunning aircraft by exerting predictable deceleration forces on its landing gear as the EMAS material crushes. It must be designed to minimize the potential for structural damage to aircraft, since such damage could result in injuries to passengers and/or affect the predictability of deceleration forces.

As demonstrated on Exhibit 4K, an EMAS is located beyond the end of the runway, centered on the extended runway centerline. It typically is designed to begin at some distance beyond the runway end to avoid damage due to jet blast and short landings. The minimum width of the EMAS shall be the width of the runway, plus any sloped area as necessary. The system should be designed to decelerate jet aircraft expected to use the runway at exit speeds of 70 knots or less without imposing loads that exceed the aircraft’s structural design limits.

For planning purposes, an EMAS to serve Kansas City MKC and its critical aircraft would need to begin a minimum of 100 feet beyond the runway end, and extend to 400 feet beyond the runway end. Where more safety area is available, it is recommended that the system be placed to the back end of the available safety area. There is adequate space to install EMAS off either or both runway ends.

Ideally, an EMAS installation off the north end of the runway would be located on the back side of the extended RSA. Due to the downward slope of the RSA into the floodplain, however, the EMAS would need to be placed as close to the runway as possible, or else the RSA would need to be raised in elevation. This would require more fill within the floodway and possibly have a greater effect on the flood elevation than the previously proposed design.

Moving the EMAS closer to the runway would reduce the capability to add runway length for takeoff. It would also reduce the effectiveness of the remaining safety area behind the EMAS. On the south end of the runway, there is sufficient space to accommodate EMAS, but any plans for a runway extension for takeoff roll, as proposed by Alternatives 4 and 5, would need to be eliminated.

The cost for the installation of EMAS on both ends adds approximately $23.7 million total to the project. This cost breakdown would be slightly higher on the north end if the EMAS were installed at the back of the extended RSA. EMAS is generally limited to the width of the runway because of its cost, therefore, its effectiveness is limited to aircraft running directly off the end of the runway. There is also a cost to replace any part of the system damaged during an overrun incident.

In effect, EMAS is limited to providing an additional safety enhancement directly off the end of the runway. In the case of MKC, that enhancement is even more limited due to the fact that most operations are by general aviation aircraft with a design standard of 600 feet or less of extended RSA. In addition, most aircraft operating at the
ENGINEERED MATERIAL ARRESTING SYSTEM

The EMAS is typically the full width of the runway and the arrestor bed is set-back from the end of the runway.

On short runway safety areas EMAS typically extends the length of the space available.

On long runway safety areas the arrestor bed set-back is increased and the system is sized for 70-knot performance.

The front of the EMAS includes a lead-in ramp to transition the aircraft into the material.

Beyond the runway width the sides of the EMAS are stepped to provide emergency vehicle access and passenger egress.

TYPICAL PLAN VIEW

Runway Safety Area Length

Set-back

Runway width

Side steps

TYPICAL ELEVATION VIEW

Debris Deflector over concrete beam

Arristor bed

Lead in ramp

Base surface

Side steps

TYPICAL SECTION

Stepped sides provide ARFF access and passenger egress

Arristor bed

Base surface

Source: Engineered Arresting Systems Corp. (ESDO)
airport have limited seating compared to that of commercial jet aircraft. Less expensive aircraft and significantly fewer persons on board general aviation aircraft reduce the value of adding EMAS into the available safety area.

Conclusions

Based upon the alternatives analysis above, conducted in accordance with FAA Order 5200.8, Runway Safety Area Program, the suggested safety area determination in accordance with Paragraph 8.b. is:

"(3) The existing RSA can be improved to enhance safety, but the RSA will still not meet current standards."

The RSA can be extended to the north for a distance of 600 feet. Combined with 400 feet of safety area beyond the south end of the runway, and a 400-foot displacement to the Runway 1 (south) threshold, safety area of 800 feet can be provided for each end. This is a significant improvement over the current condition, and provides operating benefits well beyond those of the Baseline Alternative and any other alternative of reasonable development cost.

An extension of 300 feet to the north would remove the entrance taxiway from the future POFA, as well as increase the ASDA to 6,901 feet on Runway 19. Adding 100 feet to the south end would increase the ASDA on Runway 1 to the same length.

EMAS may be considered to complement the proposed safety area, however, its cost may be high for use in this specific situation on a general aviation airport. In addition, the proposed pavement extensions would have to be reduced in length.

As a result, Alternative 5 is recommended for implementation. This alternative best enhances safety, while maintaining the most reasonable operating capabilities at a feasible cost.

RUNWAY 3-21 SAFETY AREA DETERMINATION

As outlined previously, Runway 3-21 also does not conform to FAA design standards for RSA or OFA for the currently designated critical aircraft, ARC C-III. Runway 3-21 is currently 5,052 feet long by 150 feet wide. The Runway 3 landing threshold has been displaced 490 feet to the north due to the proximity of the levee and Lou Holland Drive. The Runway 21 landing threshold has been displaced 693 feet due to the railroad east of Broadway. The displacements allow for 4,560 feet of landing length on Runway 3 and 4,359 feet on Runway 21. Currently, the take-off departure length in either direction is not affected by the displacements.

Runway 3-21 serves as a crosswind runway, but Runway 3 also has the airport’s best landing minimums. Runway 3 is served by an instrument landing system (ILS) approach which can be also utilized to “circle” to land on Runway 1. In effect, Runway 3-21 currently provides the best approach from the south in poor weather conditions.
FAA AC 150/5300-13, Appendix A, states the desirable wind coverage for an airport is 95 percent. Analysis conducted in the previous chapter indicated that Runway 1-19 provides more than 95 percent coverage for crosswind thresholds 13 knots and higher. Runway 1-19 provides 93.88 percent coverage for small aircraft crosswind threshold of 10.5 knots. Thus, according to FAA criteria, Runway 3-21 should be designed at a minimum to accommodate aircraft in ARC A-I and B-I. The combination of both runways, however, increases the crosswind coverage by less than two percent to 95.83 percent.

Runway 3-21 currently serves as more than just a crosswind alternative for small aircraft. The ILS approach to Runway 3 allows medium-sized aircraft to land from the south in less than visual conditions. The runway also provides an alternative landing area for periods when Runway 1-19 is closed due to emergency, weather (e.g., snow removal), or maintenance. Therefore, the analysis considered planning Runway 3-21 to meet the minimum of ARC B-II aircraft. Consideration should also be given to meeting ARC C and D standards if possible.

The analysis to follow will consider the requirements put forth in the baseline condition (currently approved ALP at ARC C-III), ARC B-II, and closure of the runway. The analysis will follow the same FAA safety area program guidelines presented in the Runway 1-19 determination in the previous section.

Runway Length Analysis

Runway 3-21 provides the airport with slightly less than two percent additional crosswind coverage than singular Runway 1-19 for 10.5 knots. This figure is reduced to just over one percent for 13 knot crosswind. If up to two percent of the operations could be affected without Runway 3-21, approximately 2,500 operations would be affected. In the future, crosswind Runway 3-21 would be required for approximately 3,000 annual operations in the short term, 3,300 operations in the intermediate term, and 3,800 operations over the long range due to winds.

Runway 3-21 provides a back-up during periods when Runway 1-19 is closed. Its availability and layout allow the airport to accommodate a significant portion of the traffic during standard operating conditions (e.g., dry pavements and moderate temperatures). As previously mentioned, Runway 3 is served by an ILS approach. This approach is currently published for all aircraft. Even if the runway cannot be used for landing due to its length, larger aircraft may approach the runway and circle over to Runway 1 once the aircraft “clears” the weather (e.g., breaks the cloud ceiling or visually locates the runway end).

The straight-in Runway 3 ILS approach allows properly equipped aircraft and pilots to land with cloud ceilings of 400 feet above ground level (AGL) and 5,000-feet visibility for all approach categories. The circling approach
minimums increase to 700 feet AGL cloud ceilings with visibilities of one mile for approach category A and B aircraft, one and three-quarters-mile visibility for approach category C aircraft, and two miles for approach category D aircraft.

It should be noted that a straight-in global positioning system (GPS) approach to Runway 1 has been developed by the FAA. This approach, however, is based on the previously approved ALP, with the displaced threshold depicted in the Runway 1-19 Baseline Alternative. If approved, the GPS Runway 1 approach would provide minimums of 600 feet AGL cloud ceilings and one-mile visibility for approach category A and B aircraft, 1.75 miles for approach category C aircraft, and two miles for approach category D aircraft. Thus, the GPS Runway 1 would provide slightly better minima than the current circling approach.

In order to ensure that the runway meets the minimum length for aircraft in ARC B-I, at least 4,400 feet is required (per Table 3C, 100 percent of small airplanes with 10 or more passenger seats). To accommodate up to ARC C-II, the runway would need to provide 5,500 feet in length (75 percent of large airplanes at 60 percent useful load). To meet ARC D-II, a minimum length of 5,900 feet would be required. These lengths are somewhat generalized and are not put forth as all-inclusive. Requirements specific to individual aircraft within these categories vary depending on operational conditions.

The primary reason for planning Runway 3-21 for ARC C/D-III (as in the baseline condition) is that an ARC A/B-II design could result in the loss of published ILS approach minimums for approach categories C and D. The approach would be approved for small aircraft only, and would leave the airport without reasonable approach minimums from the south for large aircraft. It should be noted, however, that the FAA could implement the GPS Runway 1 approach under conditions presented on the currently approved ALP.

Baseline Condition

The currently approved ALP (baseline condition) for Runway 3-21 is depicted on Exhibit 4L. The baseline condition was approved with the critical aircraft for design being ARC C-III, and maintaining the full RSA with displaced thresholds. As discussed previously, the required RSA for approach category C is 1,000 feet beyond each runway end.

The plan includes further displacement of both runway ends. Runway 3 would be displaced 714 feet from the pavement end (224 feet more than current). Runway 21 would be displaced 1,000 feet (307 feet more than current). As planned, the runway would provide an ASDA of 4,052 feet for Runway 3 and 4,338 feet for Runway 21. The LDA in both directions would be 3,338 feet.

While these lengths may be sufficient for small aircraft, they are not adequate for most business jet aircraft. The advantages to maintaining a published
approach to Runway 3 for category C and D aircraft may prove of little value considering the landing length limitations.

In short, the baseline condition would significantly limit use by the aircraft for which it is designed. The RSA standard for approach category C would be achieved, but the landing length would be reduced so that the design aircraft could no longer operate on the runway.

Alternative 1
Design Runway for ARC B-II

The next option for design of Runway 3-21 is to meet ARC B-II standards. As discussed, Runway 1-19 meets all but 10.5 knot crosswind component requirements. Thus, the runway needs only to be provided to meet the needs of ARC A-I and B-I aircraft. Due to a need for a secondary landing area, designing for “small aircraft exclusively” would not be in the best interest of the airport or its users. For this reason, this alternative will consider ARC B-II standards as depicted on Exhibit 4M.

In order to meet design criteria for ARC A-II and B-II aircraft for a runway with navigational approach aids providing not lower than 0.75 miles visibility, the cleared and graded RSA would need to be 150 feet wide (centered on the runway) and extend 300 feet beyond each runway end.

Considering ARC B-II aircraft, the RSA at the north end of Runway 3-21 is obstructed by the location of Richards Road. The physical pavement end of the runway lies just west of Richards Road. In order to maintain the full RSA at the north end, approximately 400 feet of runway pavement would be considered as extended RSA. The south end of the runway has the full length and width of RSA for ARC B-II aircraft available beyond the runway end.

Obstructions off both ends are limitations to landing on Runway 3-21. Obstructions to the north include the rail yard, U.S. Highway 69, and Richards Road. The south approach to the runway is obstructed by the Missouri River levee and Lou Holland Drive.

The FAA requires that aircraft on approach to a runway be at least 15 feet above a local road, 17 feet over a freeway, and 23 feet over a railroad. The FAA’s Advisory Circular 5300-13, Change 6, Appendix 2, Threshold Siting Requirements, Paragraph 5d, indicates, however, that this approach only requires clearance for a 20 to 1 approach slope. In order to maintain proper clearances over these obstructions, Runway 21 should be displaced 800 feet south of the physical pavement end. This displacement of the landing threshold is actually 107 feet more than the existing runway displacement.

Due to the not lower than three-quarter-mile approach on Runway 3, obstruction clearance standards stipulate adequate clearances for a 34 to 1 approach slope. Considering the 34 to 1 approach slope, Runway 3 would need to be displaced 420 feet north, which is 70 feet less than the current displacement. Applying threshold siting criteria would require only a 200-

4-26
foot displacement of the landing threshold. The 200-foot displacement will be used for declared distance calculations for this alternative.

In order to determine the ultimate runway length available, consideration must be given to the most restricting obstruction to FAA standard. Once these obstructions have been identified, declared distances can be calculated. Terminal instrument procedures (TERPS) criteria would be used to determine departure clearance criteria.

For Runway 3, the LDA would be reduced by 200 feet for southerly approach obstructions and 400 feet for northerly RSA obstructions. Thus, the LDA for Runway 3 would be 4,452 feet. The ASDA for Runway 3 would be limited only by the 400-foot RSA obstruction on the north end. Thus, the ASDA for Runway 3 would be 4,652 feet. For Runway 21, the LDA would be 4,252 (800-foot displacement), while the ASDA would be 5,052 feet.

Obviously this alternative provides more ASDA and LDA length in both directions on Runway 3-21. The primary drawback would be limitation of the published ILS Runway 3 approach to only approach category A and B aircraft. Even so, the runway could accommodate a greater portion of the business aircraft fleet during standard operational conditions, especially those not operating under F.A.R. Part 135 flight rules. Furthermore, this alternative provides longer lengths for approach category B business jets, such as the Beechjet, who could utilize Runway 3-21 during normal operating conditions.

Alternative 2
Close Runway 3-21

The final alternative for Runway 3-21 would be to close the runway. As mentioned earlier, the runway provides marginal length to meet the needs of the corporate fleet and provides limited support for crosswind conditions (provides less than two percent improvement for combined coverage at 10.5 knots and slightly more than one percent for 13 knots).

The primary benefit in closing Runway 3-21 would be the resultant availability of developable property. The airport has limited space available without significant redevelopment of landside facilities. Closing Runway 3-21 could open up areas in the northeastern and southwestern portions of the airport for additional aviation facility development.

Another benefit for closure would be the cost savings generated by reduced runway maintenance. Runway 3-21 will require substantial investments in pavement rehabilitation to remain operational throughout the planning period. Closure could free up these monies for other needed projects. The 1982 Airport Land Use Study indicated that “Runway 3-21 can be retained until it becomes a financial burden to the City, or until sufficient demand develops to build aviation-serving facilities on the land that would be made available by its abandonment.” The study’s recommended land use concept included the ultimate closure of Runway 3-21.
The primary drawback to closure would be the loss of an alternative runway when Runway 1-19 is closed or when crosswinds are excessive for small aircraft. It should be noted that the closure of Runway 3-21 would not be feasible for some time. This master plan study was undertaken specifically to provide an RSA determination for Runway 1-19 so it could be rehabilitated. Runway 3-21 will be needed to keep the airport operational during rehabilitation. If the runway is ultimately closed, however, there will be a time when Runway 1-19 will again be closed for rehabilitation. At that time, other alternative means of accommodating the airport’s traffic will be needed. This will be discussed in the following section.

Another drawback to closure is the loss of a published approach from the south. As mentioned earlier, the ILS on the Runway 3 approach not only serves Runway 3, but also allows aircraft to circle to Runway 1. The loss of this approach for category C and D may not be a concern if an approach to Runway 1 can be established. Thus, the benefits for the ILS Runway 3 circling approach, given the possibility of a GPS approach to Runway 1, may not overcome the operational cost savings and land use development potentials provided by closure of Runway 3-21.

**Runway 3-21 Conclusions**

Runway 3-21 currently provides the airport with key benefits. The runway provides the airport’s only published approach from the south, an alternative landing area for small and medium-sized business aircraft when the primary runway is closed, and a landing area for small aircraft during excessive crosswind conditions.

It is evident that the baseline option would significantly reduce the operational capabilities of the runway. The reduction of landing length due to RSA criteria for ARC C-III aircraft would limit those aircraft for which it is designed, in such a manner that it would exclude them from using it most of the time.

Alternative 1, designing the runway to ARC B-II standards, would provide greater ASDA and LDA than the baseline condition. It could also be utilized by a significant portion of the corporate fleet during standard weather conditions. Finally, it would provide the airport with a much needed alternative operational runway when the primary runway is not available. A drawback would be the limitation of the ILS approach to approach category A and B, potentially leaving the airport without a published approach from the south for approach category C and D. It should be noted, that an approach to Runway 1 has been developed, however, the minimums provided would be higher than the Runway 3 straight-in approach minimums.

The remaining alternative would be closing the runway. This option was selected in the 1982 Airport Land Use Study. Closing the runway would provide additional landslide development potential in the southwestern and northeastern portions of the airport. As noted earlier, Runway 3-21 does serve the role of
providing the alternative landing area for small aircraft with excessive crosswinds. This role would be lost with this alternative. Also, the airport would need to rely on Runway 1 for a southerly approach and would be left without an alternative when Runway 1-19 is closed. This may be supported, however, with a parallel taxiway designed for use as a temporary runway.

The baseline alternative would result in such a severe reduction of effective runway length that it would no longer be financially or operationally feasible. As a result, the baseline condition will not be considered for implementation.

The two remaining alternatives of maintaining ARC B-II standards and closing the runway need to be further evaluated. Each alternative provides the airport with significantly distinct conditions for landside facility development. Landside alternative analysis will further refine the potential for each Runway 3-21 alternative so a final recommendation can be made.

TAXIWAY CONSIDERATIONS

The existing taxiway system at the airport is illustrated in Exhibit 4N. Both sides of the runway system are served by quasi and/or partial parallel taxiways and several entrance/exit and connector taxiways. There are holding apron locations at every runway end. The holding aprons provide an area off the taxiway for aircraft to prepare for departure and prevent delays to other aircraft ready for takeoff.

Taxiways should always be designed and constructed to improve and enhance operational safety and capacity. Although the current system remains functional, its layout poses several operational restraints. The layout of Taxiway G is less than ideal. Taxiway G, serving as the eastside parallel taxiway, runs along the western portion of the aircraft parking aprons, until Runway 21. At this point, Taxiway G becomes a 75-foot wide taxiway, crosses Runway 3-21 and then travels northwest to the Runway 19 threshold.

The taxiway system can best be improved by replacing Taxiways G and F with new, full-length taxiways (nearly full-length for Taxiway F) parallel Runway 1-19. FAA criterion requires construction of the taxiways 400 feet each side of runway centerline, as depicted on Exhibit 4N.

This alternative could provide more than just operational efficiency. It could be developed in such a manner that one of the parallel taxiways could be used as a temporary runway when Runway 1-19 is closed and if Runway 3-21 were no longer available. To be used as a runway, the taxiway would need to be at least 75 feet wide.

As depicted on Exhibit 4N, construction of a new, full-length parallel Taxiway G would require the relocation of the ILS glideslope antenna. If this taxiway is to be developed as an alternative runway, it would likely occur in the intermediate or long term of this plan. By that time, it is anticipated that the ILS equipment
will have been replaced by a GPS approach providing similar minimums.

In order to effectively operate as a temporary runway, the parallel taxiway should be 5,000 feet long by 75 feet wide. The temporary runway should also conform to at least ARC B-II standards for a visual or not-lower-than-one-mile approach. As depicted on Exhibit 4N, it appears that a westside temporary runway/parallel taxiway option would work best. The west side taxiway would be less restricted, as the southeastern portion of the airport supports a large apron and FBO operation that would be closer to the taxiway. Utilizing the east side taxiway may restrict the use of apron and FBO spaces.

Considerations should also be given to the improvement of the entire taxiway system. The current taxiway layout is somewhat inefficient and could lead to runway incursions for pilots not familiar with the layout. The FAA has instituted a runway incursion safety program which is aimed at minimizing the potential for runway incursions, including the development of more efficient airfield layouts. The primary risk of runway incursions currently is the crosswind runway and associated taxiways. If the runway were closed, the risk of incursions would be reduced.

The existing taxiway system would be greatly improved by the development of the east and west side parallel taxiways. This could serve as the starting point for additional taxiway improvements. Other improvements should include eliminating or consolidating some of the current taxiways not needed once the parallels have been developed.

Taxiway improvement alternatives must consider two ultimate scenarios: allowing Runway 3-21 to remain operational and closing Runway 3-21. The alternative of taxiway improvements with Runway 3-21 is presented on Exhibit 4P, while the taxiway improvements of Runway 3-21 are presented on Exhibit 4Q.

As depicted on Exhibit 4P, several taxiway improvements could be made with the existing airfield system. First, the construction of full-length parallel taxiways on the east and west side of Runway 1-19 would enhance efficiency. It would also aid in better shaping the entrance/exit taxiways.

The primary focus in this alternative would be to minimize the potential for runway incursions. To achieve this goal, several taxiways will need to be modified or removed altogether. As depicted, this alternative considers the removal of Taxiway C, Taxiway E (east and west side), most of Taxiway D, and Taxiway B. This alternative modifies Taxiways F and H. Of primary concern is Taxiway D, at the runway intersection. This configuration poses the greatest threat of runway incursions, especially by transient or student pilots.

This alternative also considers the redevelopment of Taxiways H and F. Taxiway H would be designed for a quasi-high-speed exit which nears a 90-degree angle as it abuts the ramp (Taxiway G). This modification would hinder aircraft operators from misusing
the taxiway and rolling onto the runway. The exhibit depicts the development of additional taxiways, one at near each end of the runway, and one on either side of the runway just north of midfield.

The second taxiway development alternative considers the closing of Runway 3-21. As presented on Exhibit 4Q, this alternative would greatly reduce potential for runway incursions. Similar to the previous taxiway alternative, several taxiways are shown as removed or modified. The remaining system would provide ample capacity and overall efficiency.

The key to either alternative would be the staging of improvements. It should be noted that a clear understanding of Runway 3-21’s future should be known before moving forward with either alternative. Some of the improvements proposed in the two taxiway alternatives might be counterproductive if a decision is changed in the future. Once the decision on the ultimate fate of Runway 3-21 is made, the ultimate layout of the taxiway system can be made.

**LANDSIDE ALTERNATIVES**

The orderly development of the airport terminal area can be the most critical, and probably the most difficult development to control on the airport. A terminal area development approach simply taking the short term path of least resistance can have a significant effect on the long term viability of an airport. Allowing development without regard to a functional, long term plan could result in a haphazard array of buildings and small ramp areas, which will eventually preclude the most efficient use of the valuable space along the flight line.

The existing landside facilities have been developed as needed and as space allowed. The majority of the facilities at the airport are large, conventional hangars. The airport’s only smaller shade and T-hangar facilities are on the northwestern portion of the airport. The airport has a mix of new and aged facilities and is currently space-limited in providing additional facilities.

Review of the 1982 Land Use Study indicated a number of changes at the airport over the past 20 years. Several conventional hangars have been constructed on both sides of the airport, to house corporate flight departments and a new flight museum. The old airport traffic control tower (ATCT) on the east side of the airport has been removed. A new airport maintenance facility has been developed north of Runway 21.

These developments have left the airport with very little developable space. Furthermore, the fuel farm should be relocated to enhance operational efficiencies and safety. The following sections will outline landside development alternatives. The focus of the landside alternative will consider two options: allowing Runway 3-21 to remain operational and closing Runway 3-21. The previous master plan’s recommended concept included the ultimate closure of Runway 3-21.
LANDSIDE ALTERNATIVE 1

The first landside alternative considers the development opportunities if both runways remain operational. Exhibit 4R depicts a potential landside development plan under this scenario.

As depicted on the exhibit, the only areas left to develop on the east side of the airport are just north of the terminal (in the location of the previous ATCT) and just south of the new airport maintenance facility.

On the west side of the airport, the plan depicts the development of additional conventional hangars in the southwestern portion of the airport. As depicted, this would require the decommissioning of the terminal VOR (T-VOR). The plan includes the construction of a new westside flight line, with large conventional hangars fronting a new aircraft parking apron. The apron could also serve as a portion of a westside parallel taxiway to Runway 3-21. In order to construct the hangars, automobile access would need to be developed similar to that illustrated. The new access route would traverse existing apron and would provide access to a new parking lot. The eastern hangars would face the runway system, while the western hangars would face west.

The plan also depicts areas which could be used for hangar development or for fuel farm relocation. Just south of the airport’s maintenance facility is an area which could be developed for hangar use or relocation of the fuel farm. Allowing the fuel farm to be relocated to this location would provide good access for fuel trucks. The second option would be at the southwestern corner of the airport. This site would be better suited from a logistical and aesthetic perspective. If not developed for a fuel farm, this location could support the construction of up to 20 T-hangars.

LANDSIDE ALTERNATIVE 2

The second alternative considers the development potential of landside facilities if Runway 3-21 were closed. This alternative is presented on Exhibit 4S.

As depicted on the exhibit, closure of Runway 3-21 would allow for the development of a linear flight line along the west side of Runway 1-19. This plan would develop corporate and aviation-related business hangars along the flight line, and storage hangars behind and facing west on the existing apron. The plan would also provide adequate space to develop more than 80 T-hangars.

Closure of Runway 3-21 would also allow for the extension of the current flight line on the east side of the airport. As depicted, closing the runway could allow for the construction of six new 150-feet by 150-feet hangars north of the Runway 21 threshold.

The plan also depicts two fuel farm relocation options. The first is in the northeastern portion of the airport, south of the new maintenance facility as with the previous alternative. The second would be located at the southwestern corner of the airport, adjacent the T-hangars. As with the previous alternative, the northeastern
fuel farm option would likely present less access problems, while the southwestern option would be a better location for logistics and aesthetics.

LANDSIDE SUMMARY

Future landside opportunities are dependent upon the decision regarding Runway 3-21. If the runway remains operational, the airport is left with more limited landside development potential. Airport businesses have expressed the need for additional development space. If the runway is closed, the airport could develop a new westside flight line and could meet large and small aircraft hangar needs with abundant conventional, corporate, and T-hangars. The airport's hangars are full and additional space will be required to meet future demand.

The decision to close Runway 3-21 should consider not only the airside needs of the airport, but also the landside needs. The previous master plan indicated that Runway 3-21 should ultimately be closed to meet landside needs. Although, in the short term the runway should remain open, the long range goals of the Kansas City Aviation Department and airport users may still ultimately necessitate the closure of the runway.

For this Master Plan, however, it is recommended that Runway 3-21 remain open as an ARC B-II runway. Thus, it is recommended that landside development follow the proposed layout presented on Exhibit 4R.