# CHAPTER FOUR
## *Demand Capacity Analysis and Facility Requirements*

This chapter contains the 20-year airfield demand/capacity analysis and facility requirements for RIC and assesses the adequacy of facilities based on future demand, as projected in *Chapter Three, Aviation Demand Forecasts* (the "Forecast"). The findings presented in this chapter provide the basis for the definition and evaluation of airfield and facility alternatives. The shortfall in facilities, as determined from the Forecast and the demand capacity analysis, dictates the timing and degree to which facility expansion and improvements are needed in the 20-year planning horizon.

Facility requirements were calculated for the Base Year (2006) and for the forecast years of 2011, 2016, 2021, and 2026. Facility requirements for the major land uses at RIC are presented in this chapter and are as follows:

- Airfield Facilities – Runway and taxiway system and the ability of the airfield system to serve projected demand levels in terms of runway capacity and design standards
- Passenger Terminal Facilities – Aircraft gates, terminal building, and apron frontage
- Support/Ancillary Facilities – Cargo facilities, aircraft/airport maintenance facilities, GA/FBO facilities, and other support facilities
- Ground Access Facilities – Access roadways, vehicle parking areas, and rental car facilities

## 4.1 AIRFIELD FACILITIES

### *4.1.1 Airfield Capacity*

Airfield capacity is typically defined as the number of hourly or annual aircraft operations the airfield can accommodate. Airfield capacity is a function of runway configuration, aircraft fleet mix, and other factors unique to an airport. When airport demand approaches capacity, high levels of delay may occur. An acceptable level of delay for long-term planning purposes is defined as an average of four to six minutes per aircraft[1].

#### 4.1.1.1 Methodology

Airfield capacity is determined by a number of factors, including meteorology, airfield layout, runway use, aircraft fleet mix, runway instrumentation, arrival and departure percentages, and exit taxiway locations. The calculation of airfield capacity and delay is essential in evaluating the ability of the airfield to effectively serve future activity levels. The basis for

[1] Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5070-6B

the capacity of the existing runway system was analyzed using FAA AC 150/5060-5, Airport Capacity and Delay.

4.1.1.2 Existing and Forecast Demand

The Forecast approved for this study indicates sustained growth at RIC over the 20-year planning horizon. **Table 4.1** summarizes the findings from the Forecast used to determine these facility requirements.

**Table 4.1 Base Year Forecast of Aviation Activity Summary**

| | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Annual Enplanements/1 | 1,647,700 | 2,093,900 | 2,402,700 | 2,709,400 | 3,031,000 |
| Annual Operations/2 | 120,500 | 139,100 | 157,100 | 173,600 | 191,400 |

1/ Average annual growth rate for enplanements is 3.1% (Base Case Scenario).
2/ Average annual growth rate for operations is 2.3% (Base Case Scenario).

The aircraft fleet mix is an important factor in determining an airfield's operational capacity. To determine the capacity, aircraft are separated into categories by their approach speed and size. As the range within the aircraft size and approach speed increases, operational capacity decreases. This is due to the separation requirements for sequential aircraft approaching or departing an airport. The greater the variation in size and approach speed between two aircraft arriving or departing, the greater the amount of separation required.

The existing and forecasted aircraft fleet mix was grouped into six passenger aircraft categories as shown in **Table 4.2**. The Base Year indicates that 79 percent of aircraft utilizing RIC were considered regional jets or turboprops, 21 percent were narrow-body aircraft, and wide-body aircraft did not utilize RIC. By 2026 it is forecasted that 59 percent of the aircraft utilizing RIC will be regional jets, 40 percent will be narrow-body aircraft, and 1 percent will be wide-body aircraft. The Forecast represents nearly a 20 percent shift from regional jets to narrow-body aircraft.

**Table 4.2 Fleet Mix by Category**

| Passenger Aircraft Category | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Turboprops | 2% | 0% | 0% | 0% | 0% |
| Small Regional Jets (</= 50 Seats) | 60% | 57% | 48% | 41% | 34% |
| Large Regional Jets (> 50 Seats, </= 100 Seats) | 17% | 20% | 22% | 24% | 25% |
| Small/Medium Narrow-bodies (> 100 Seats, </= 150 Seats) | 20% | 22% | 28% | 32% | 37% |
| Large Narrow-bodies (> 150 Seats, </= 200 Seats) | 1% | 1% | 2% | 2% | 3% |
| Small/Medium Wide-bodies (>/= 200 Seats) | 0% | 0% | 0.5% | 0.5% | 1% |
| **Total** | **100%** | **100%** | **100%** | **100%** | **100%** |

### 4.1.1.3 Weather Conditions

Wind and weather conditions play a significant role in dictating runway orientation, navigational aid (NAVAID) requirements, and operating configurations. The key weather characteristics affecting airfield facility requirements are wind (speed and direction), cloud cover, precipitation, and visibility. Historical weather data was analyzed to assess the nature, frequency, and duration of weather conditions that influence runway use and operating procedures at RIC.

As discussed in *Chapter Two, Inventory and Existing Conditions*, ceiling, and visibility minima are grouped into two categories: Visual Meteorological Conditions (VMC) and Instrument Meteorological Conditions (IMC). VMC exists when the cloud ceiling is greater than or equal to 1,000 feet and visibility is greater than or equal to three miles. IMC conditions prevail when the visibility or cloud ceiling falls below the VMC minima. The annual occurrence of VFR and IFR weather conditions for RIC is shown in **Table 4.3**.

**Table 4.3 Annual Occurrences of Weather Conditions**

| Category | Ceiling | Visibility | Annual Occurrence |
|---|---|---|---|
| VFR | > 1,000' | > 3 miles | 91% |
| IFR | < 1,000' | < 3 miles | 9% |

Source: NOAA National Climatic Data Center (NCDC), National Weather Service Hourly surface observations, 10-year averaged data (1998-2007, Station #72401)

### 4.1.1.4 Runway Configuration

RIC currently has three runways arranged in a triangular layout. This design was popular among military airports during World War II, as it produces good wind coverage with minimal land. However, the triangular design inhibits the number of operations the airfield may be capable of handling due to intersecting runways and the inability to provide simultaneous operations on two or more runways.

The airport's three runways are operated in different combinations (configurations) depending on wind and weather conditions. RIC's primary runway is Runway 16-34, which is 9,003 feet long by 150 feet wide. RIC's second runway is Runway 02-20, which is 6,607 feet long and 150 feet wide. The third runway, Runway 07-25, is 5,326 feet long and 100 feet wide. It is important to note that Runway 07-25, the crosswind runway, does not provide additional capacity primarily because the crosswind runway cannot be operated independently of the main runway (16-34).

#### 4.1.1.5 Runway Exits and Taxiways

Runway exits and taxiways affect how long aircraft remain on the runway and therefore are important components of capacity. When calculating the capacity of an airfield, it is assumed that there are sufficient full-length parallel taxiways for each runway, sufficient runway entrances and exits, and no taxiway/runway crossing problems. The capacity may be lower without these elements in place.

#### 4.1.1.6 Airfield Demand/Capacity Analysis

There are a number of different methodologies that can be used to assess runway capacity and the need for runway expansion. These may include detailed computer simulation, an analysis of hourly runway demand capacity, annual service volumes (ASV), or aircraft delay. Given the operational nature of RIC and its role in both the state's as well as the National Airport System, the airport's ASV is an appropriate measure for determining airfield capacity. These calculations are used to project future requirements of existing airfield facilities (runways, taxiways, and instrumentation).

ASV is used by the FAA as a gross measure of an airport's operating capacity and is defined as the maximum level of annual aircraft operations that can take place at an airport and does not consider levels of delay. As actual annual operations approach the ASV of the airport, aircraft delays begin to occur. As the number of operations get closer to the ASV, the length of average delay increases to the point that capacity enhancements (e.g., additional runway exits and/or additional runways) are warranted. As a general rule, when demand at an airport reaches 60 percent of its capacity, as defined by the ASV, delays may be noticeable during the day and new airfield facilities (i.e., runways) should be planned. When airport activity reaches 80 percent of operational capacity, new airfield facilities should be constructed.

According to the Base Year demand calculation for RIC, the airport was operating at 55% capacity. In 2011 the annual demand for RIC is projected to reach 62%. At this point, planning should commence for capacity enhancements. Once the annual demand at RIC reaches 80%, implementation for the new runway should begin. RIC is projected to reach this capacity towards the end of the planning horizon (2026).

A minimal change occurs in the planning horizon when the Class D aircraft increases, as depicted in **Tables 4.4 and 4.5**. For the ASV to be increased substantially, a large number of Class D aircraft must be introduced into the fleet mix. As noted in the Forecast, the only aircraft that may be introduced into the fleet mix during the planning horizon is the Boeing 767-300. The additional 1% of class D aircraft does not change the annual demand over the planning horizon in regards to the Annual Service Demand.

**Table 4.4 Annual Service Volume**

| Year | Aircraft Mix/1 | | | | Mix Index | Capacity (Ops/Hour) | |
|---|---|---|---|---|---|---|---|
| | %A | %B | %C | %D | %(C+3D) | VFR | IFR |
| Base Year | 79% | 79% | 21% | 0.0% | 21.0% | 91% | 9% |
| 2011 | 77% | 77% | 23% | 0.0% | 23.0% | 91% | 9% |
| 2016 | 70% | 70% | 29.5% | 0.5% | 31.0% | 91% | 9% |
| 2021 | 65% | 65% | 35.5% | 0.5% | 35.5% | 91% | 9% |
| 2026 | 0.0% | 59% | 40% | 1.0% | 43.0% | 91% | 9% |

1/ Columns for %A and %B are small aircraft and are a part of the same category.

Source: FAA Advisory Circular 150/5060-5, Airport Capacity and Delay

**Table 4.5 Annual Service Volume, continued from Table 4.4**

| Year | Annual Service Volume Calculation | | | | Average Delay per a/c (min.) | | Min. of Annual Delay (000) | |
|---|---|---|---|---|---|---|---|---|
| | Config. | ASV | Annual Demand | AD/ASV | Low | High | Low | High |
| Base Year | 15 | 220,000 | 120,600 | 55% | 0.4 | 0.6 | 50000 | 75000 |
| 2011 | 15 | 220,000 | 136,300 | 62% | 0.5 | 0.8 | 68150 | 109040 |
| 2016 | 15 | 220,000 | 154,600 | 70% | 0.7 | 1.0 | 108220 | 154600 |
| 2021 | 15 | 220,000 | 172,300 | 78% | 0.8 | 1.2 | 137840 | 206760 |
| 2026 | 15 | 220,000 | 191,200 | 87% | 1.1 | 1.7 | 210320 | 325040 |

1/ Columns for %A and %B are small aircraft and are a part of the same category.

Source: FAA Advisory Circular 150/5060-5, Airport Capacity and Delay

### *4.1.2 Runway Length Requirements*

The purpose of this runway length analysis is to evaluate the lengths of the current runways for adequacy, as well as to determine the lengths required for any future runways.

Guidance on determining runway length is provided by airport planning manuals from the aircraft manufacturers. For airports serving aircraft over 60,000 pounds, such as RIC, runway length is generally calculated specifically for the most demanding aircraft operating at the airport on a regular basis, defined as a minimum of 500 annual operations.

Runway length requirements were calculated using the Maximum Mean Daily Temperature conditions, consisting of temperatures in the mid to high 80's. At high temperatures, the density of the air decreases, causing a decrease in aircraft performance and increase in required runway length.

4.1.2.1 Existing Runway Lengths

RIC is equipped with a total of three runways, one of which is the primary runway, and the remaining two are support/crosswind runways.

- 16-34 is the primary runway at 9,003 feet long by 150 feet wide, used primarily for arrivals and departures.
- 02-20 is a secondary/supporting runway at 6,607 feet long by 150 feet wide.
- 07-25 is also a secondary/supporting runway at 5,326 feet long by 100 feet wide.

4.1.2.2 Take-off Runway Length Requirements

**Table 4.6** provides the take-off length requirements and range calculations. The take-off length requirements were computed under the Maximum Mean Daily Temperature conditions with the aircraft at maximum take-off weight. The range computations assumed maximum take-off weight as well as maximum passenger payload.

**Table 4.6 Runway Take-off Length and Range**

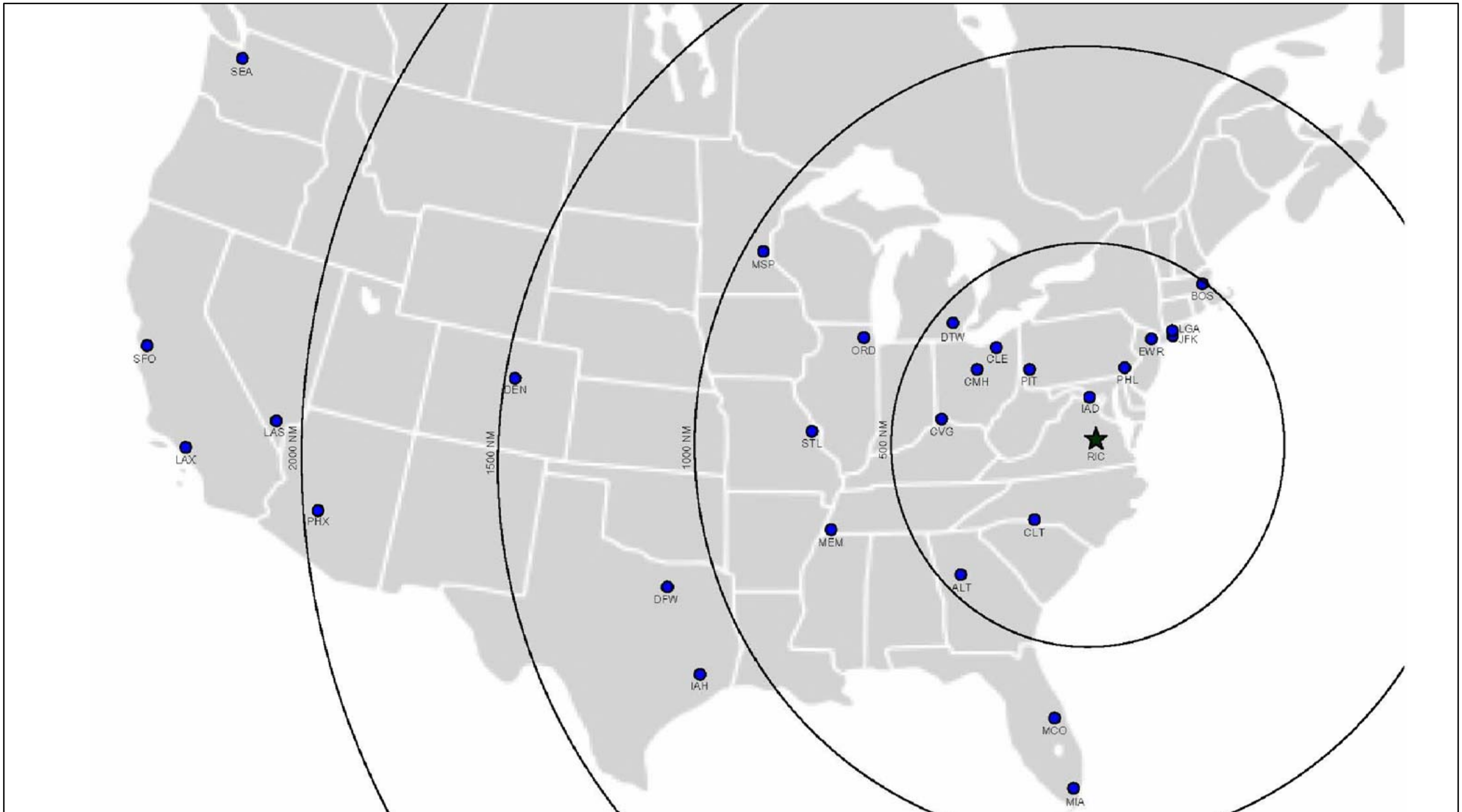
| Heavy Aircraft | Runway Length (Feet) | Range (Nautical Miles) | Large Aircraft | Runway Length (Feet) | Range (Nautical Miles) |
|---|---|---|---|---|---|
| B767-200 | 6,500 | 4,000 | ERJ 145 | 7,700 | 1,250 |
| B757-200 | 7,900 | 3,500 | A321-100 | 8,500 | 2,300 |
| | | | A319 | 9,200 | 2,800 |
| | | | B737-300/1 | 7,250 | 2,800 |
| | | | B737-300/2 | 10,500 | 2,800/3 |

1/ B737-300 with CFM56-3B-2 Engines
2/ B737-300 with CFM56-3B-1 Engines
3/ Range is not capable of being reached due to runway constraint.

Source: FAA and Aircraft Manufacturer's Planning Manuals; wet conditions

The two most demanding aircraft for departures are the Boeing 737-300, with the CFM56-3B-1 Engines at 10,500 feet, followed by the Airbus 319 at 9,200 feet. Therefore, the critical length for runways used for departing aircraft at their maximum take-off weight is 10,500 feet; however, due to the markets RIC serves, 9,000 feet for a departure runway is recommended. The existing primary departure runway at RIC (Runway 16/34) is 9,003 feet. The length of Runway 16/34 allows for all current and forecasted heavy and large aircraft at maximum take-off weight except for the Boeing 737-300 (CFM56-3B-1 Engines) and the Airbus 319.

The Boeing 737-300 with the CFM56-3B-1 Engines is the only aircraft not capable of reaching a destination within its maximum range while carrying the maximum passenger payload. This is due to the fact that the aircraft's weight would have to be reduced, sacrificing passengers or fuel, in order to depart on Runway 16/34. If the aircraft were to depart using a 9,000 foot runway length, it would have to sacrifice approximately 5,000 pounds of its maximum gross weight. This could result in a decrease in range of approximately 500 nautical miles of range. **Exhibit 4.1** shows the departure range for RIC utilizing the current airfield.




# Departure Range

NTS NTS NTS
GRAPHIC SCALE IN FEET

RICHMOND INTERNATIONAL AIRPORT Master Plan

Kutchins & Groh consulting associates for airports

EXHIBIT 4-1

#### 4.1.2.3 Landing Runway Length Requirements

**Table 4.7** provides the landing length requirements under the Maximum Mean Daily Temperature conditions, wet runway surface conditions with the aircraft at maximum landing weight. As shown in **Table 4.7**, the range of runway lengths needed for these aircraft is from 4,500 feet to 6,200 feet.

**Table 4.7 Runway Landing Length Requirements**

| Heavy Aircraft | Runway Length (Feet) | Large Aircraft | Runway Length (Feet) |
|---|---|---|---|
| B767 | 5,700 | ERJ 145 | 4,500 |
| B757-200 | 5,300 | A321-100 | 6,200 |
| | | A319 | 5,300 |
| | | B737-300 | 5,200 |

Source: FAA and Aircraft Manufacturer's Planning Manuals; wet conditions

The most demanding aircraft for landings is the Airbus 321 at 6,200 feet. Therefore, the critical length for runways used for landing aircraft at their maximum take-off weight is 6,200 feet. The length of Runway 16/34 allows for all current and forecasted heavy and large aircraft at maximum landing weight.

#### 4.1.2.4 Summary

Runway length requirements were identified for landing and departing aircraft. Required lengths for arriving aircraft on existing runways are adequate. The departure length for Runway 16/34 is recommended to be extended to 10,500 feet, which is currently shown on RIC approved Airport Layout Plan. Future runway(s) at RIC are recommended to be the following:

- 9,000 feet to service departure aircraft
- 8,000 feet to service arrival aircraft

### 4.1.3 Taxiway Requirements

Taxiways are defined as an aircraft movement path on the airfield which connects runways with ramps, hangars, terminals, and other facilities. This section evaluates the existing taxiway system at RIC.

The taxiways at RIC have been divided into primary and secondary taxiways. The primary taxiways at RIC are Taxiways A, C, E, H, L, M, and U. The remaining taxiways are considered to be secondary in nature and aid in aircraft movement on the airfield.

#### 4.1.3.1 Primary Taxiways

Runway 16-34 is flanked by two parallel taxiways — Taxiways L and M. Runway 02-20 is also accommodated by two parallel taxiways — Taxiways A and U. Each of the parallel taxiways is full length with respect to the runway it serves except for Taxiway L, which is approximately two-thirds of the length of Runway 16-34. The remaining primary taxiways (C, E, and H) allow aircraft movement between the runways and the terminal area.

All of the primary taxiways are capable of accommodating Aircraft Design Group IV aircraft; however, the Pavement Inventory Report identified several taxiway pavement areas that cannot accommodate the weight of ADG IV aircraft, thus requiring the need for these areas to be improved as recommended in Pavement Inventory Report found in **Appendix A**.

#### 4.1.3.2 Secondary Taxiways

The secondary taxiways primarily service the terminal area; however, runway entrance/exit taxiways have also been included within this group. The terminal area/west ramp is serviced by Taxiways B, F, G, J, K, R, S, T, and V. These taxiways aid in the flow of aircraft around the terminal and other facilities located on the western side of the airport.

Taxiways M1, M2, and M3 are entrance/exit taxiways to Runway 16-34. Only Taxiway M2 is at a sufficient angle to be considered a high-speed exit. This is of particular importance, as the number and location of runway exits impacts the amount of time that an aircraft takes to exit the runway, which impacts the capacity of the runway. Runways with an adequate number of properly spaced runway exits allow capacity to be optimized by minimizing the runway occupancy times of arriving aircraft.

#### 4.1.3.3 Summary

The taxiway analysis identifies the following taxiway needs:

- Realign Taxiways M and L to be full-length parallel taxiways
- Provide additional high speed runway exits
- Bring noncompliant taxiway pavement strengths up to standard

### 4.1.4 Instrumentation and Lighting

Instrumentation, lighting, and other navigational aids assist pilots in maneuvering their aircraft safely and efficiently under various weather conditions. This section evaluates the existing instrumentation and lighting systems at RIC.

#### 4.1.4.1 Instrumentation

A variety of NAVAIDS are currently in place in and around RIC, including: Non-Directional Radio Beacon (NDB) facilities, VHF Omni-directional Range (VOR), and en route NAVAID facilities. Aircraft (primarily general aviation) use an NDB to determine their bearing relative to the location of the beacon, which consists of low- to medium-frequency radio signals. A VOR uses very high-frequency signals to provide bearing information to the aircraft.

NAVAIDS used for arriving aircraft provide course guidance and, in some instances, vertical guidance to the runway threshold. This allows aircraft to land in IMC. As stated previously, RIC operates under IFR nine percent of the time, and aircraft also use the instrument approaches during VFR for additional guidance. The type of instrumentation available for a runway determines the minimum ceiling and visibility, or "lowest minimums," during which landings can occur while under IFR. At RIC, instrument approach systems are provided for all runways, as shown below in **Table 4.8**.

**Table 4.8 RIC Instrument Runways and Lowest Approach Minimums**

| Runway | Controlling Instrument Approach | Approach Minimums |
|---|---|---|
| Runway 2 | CAT I ILS | Ceil 300'; Visibility 3/4 mi |
| Runway 7 | RNAV | Ceil 400'; Visibility 1 mi |
| Runway 16 | CAT I ILS | Ceil 200'; Visibility 1/2 mi |
| Runway 20 | RNAV | Ceil 500'; Visibility 1 mi |
| Runway 25 | RNAV | Ceil 400'; Visibility 1½ mi |
| Runway 34 | CAT III ILS | RVR 07/06 |

Source: RIC Instrument Approach Procedures, www.naco.faa.gov, December 2007

Currently, Runway 34 is the primary runway for IMC operations. Runway 34 can accommodate aircraft landings during all weather conditions due to its CAT III ILS system. Runways 02 and 16 are the secondary runways during IMC operations due to their precision approaches. The remaining runways, Runway 07, 20, and 25, have non-precision approaches, which are more restrictive in terms of approach minimums.

Given that the airport's main runway is equipped with precision approaches in both directions, instrument capabilities are adequate. To preserve the airfield's capabilities under all conditions, any future runway(s) should be equipped with state-of-the-art instrumentation capability on both runway ends.

### 4.1.4.2 Approach Lighting Systems

The approach lighting system aids in the transition from the instrument approach to touch-down, the most critical point of landing. The approach light systems for all runways at RIC are shown in **Table 4.9**.

**Table 4.9 RIC Approach Lighting System**

| Runway | Lighting/2 |
|---|---|
| Runway 2 | MIRL, VASI, REIL |
| Runway 7 | HIRL |
| Runway 16/1 | HIRL, MALSR, VASI |
| Runway 20 | MIRL, VASI, REIL |
| Runway 25 | HIRL, VASI |
| Runway 34 | HIRL, ALSF-2 |

1/ Runway 16-34 is the only runway equipped with in-pavement centerline lights
2/ ALSF-2: Approach Lighting System with Sequencing Flashing Lights; HIRL: High Intensity Runway Edge Lights; MALSR: Medium Intensity Approach Lighting System; VASI: Visual Approach Slope Indicator Lights; REIL: Runway End Identifier Lights.

Source: FAA Airport Data (5010), www.faa.gov, December 2007

The current approach lighting systems are adequate for the airport's approach capabilities. Any improvements to the airfield will require all design standards to be met for the approach lighting system.

### 4.1.5 FAA Runway Design Standards

The FAA provides airport geometric design standards and recommendations to ensure the safety, efficiency, economy, and longevity of airports. Safety design standards were analyzed specifically for the design group aircraft that utilize the airport. The Airport Reference Code (ARC) for RIC is D-IV, which encompasses aircraft with an approach speed of greater than or equal to 141 knots but less than 166 knots and a wingspan greater than or equal to 118 feet but less than 171 feet.

Based on this design group, the key safety design standards examined for each runway were the Runway Safety Area (RSA), Object Free Area (OFA), Runway Protection Zones (RPZ), and Precision Obstacle Free Zones (POFZ).

#### 4.1.5.1 Runway Safety Area (RSA)

The Runway Safety Area (RSA) is defined as the surface surrounding the runway prepared or suitable for reducing the risk of damage to airplanes in the event of an undershoot, overshoot, or excursion from the runway. The dimensions of the RSA for each runway are determined by the type and size of the design aircraft, or the ARC. At RIC, the ARC is D-IV for each runway; therefore, the FAA requires an RSA of 1,000 feet beyond the runway end with a width of 500 feet, centered on the runway centerline.

The RSAs for the existing runways at RIC meet FAA requirements.

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

The Runway Object Free Area (OFA) is defined as the area on the ground centered over the runway centerline provided to enhance the safety of aircraft operations by having the area free of objects. The length of the OFA for RIC is 1,000 feet beyond the end of the runway with a width of 800 feet.

The OFAs for the existing runways at RIC meet FAA requirements.

#### 4.1.5.3 Runway Protection Zone (RPZ)

The Runway Protection Zone (RPZ) is defined as an area off the runway end to enhance the protection of people and property on the ground. The RPZ begins 200 feet from the end of the runway and is trapezoidal in shape. The RPZ should be kept clear of all incompatible objects, activities, and land uses. **Figure 4.1** depicts the shape of an RPZ and **Table 4.10** provides standard dimensions for RPZs.

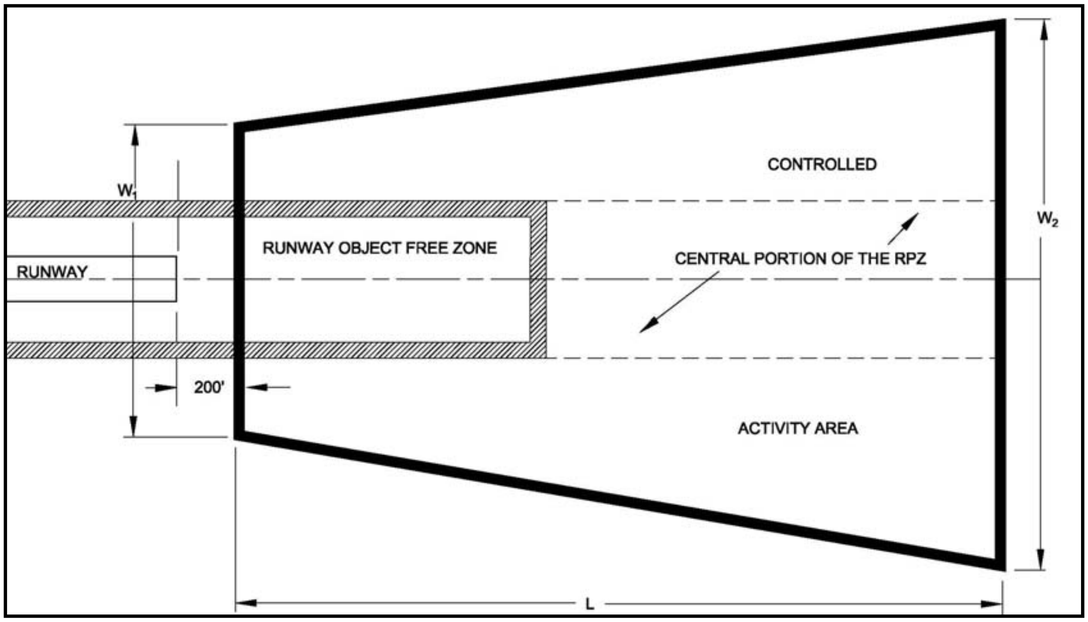



Figure 4.1 Runway Protection Zone

**Table 4.10 Runway Protection Zone Dimensions**

| Approach Visibility Minimums[1] | Facilities Expected To Serve | Dimensions | | | |
|---|---|---|---|---|---|
| | | Length (L) Feet | Inner Width ($W_1$) Feet | Outer Width ($W_2$) Feet | RPZ Acres |
| Visual and Not Lower Than 1-Mile | Small Aircraft Exclusively | 1,000 | 250 | 450 | 8,035 |
| | Aircraft Approach Categories A & B | 1,000 | 500 | 700 | 13,770 |
| | Aircraft Approach Categories C & D | 1,700 | 500 | 1,010 | 29,465 |
| Not Lower Than 3/4-Mile | All Aircraft | 1,700 | 1,000 | 1,510 | 48,978 |
| Lower Than 3/4-Mile | All Aircraft | 2,500 | 1,000 | 1,750 | 78,914 |

1/ The RPZ dimensional standards are the runway end with the specified approach visibility minimums. The departure RPZ dimensional standards are equal to or less than the approach RPZ dimensional standards. When a RPZ begins other than 200 feet beyond the runway end, separate approach and departure RPZs should be provided.

Source: FAA Advisory Circular 150/5300-13, Airport Design

The RPZs for the existing runways at RIC meet FAA requirements.

#### 4.1.5.4 Precision Obstacle Free Zone (POFZ)

The Precision Obstacle Free Zone (POFZ) is defined as the volume of airspace above an area beginning at the runway threshold and centered on the extended runway centerline, 200 feet long by 800 feet wide. The purpose of the POFZ is to provide additional safety measures by keeping obstacles free and clear from the runway environment during the following operational conditions:

- Vertically Guided Approach
- Reported ceiling below 250 feet and/or visibility less than three-fourths statute mile (or RVR below 4,000 feet)
- An aircraft on final approach within two miles of the runway threshold

The POFZs for the existing runways at RIC meet FAA requirements.

### 4.1.6 Summary of Airfield Requirements

Existing facilities meet current demands; however, the airfield requirements analysis identified the following long-term airfield development needs:

Runway Requirements:

- Provide length requirements: 9,000 feet for all departure runways; 8,000 feet for all arrival runways; 9,000 feet for any mixed-use runway
- As capacity demands dictate, initiate planning and/or implementation of an additional runway that meets all necessary configuration requirements

Taxiway Improvements:

- Provide full-length parallel taxiways for all new runways constructed in the future
- Provide additional high-speed runway exits
- Bring all taxiway pavement strengths up to airport reference code D-IV design standards

## 4.2 PASSENGER TERMINAL FACILITY REQUIREMENTS

Terminal space planning, as an element of Airport Master Planning, develops a baseline to support future activity levels. The intent of space planning is to establish building blocks for the functional elements of the systems that are representative of the size necessary to accommodate future activity levels. Before the facility requirements for future planning levels can be established, a baseline of the existing facilities' capacities must be determined. The capacity of each element of a terminal facility can vary depending on the acceptable level of service, level of congestion, and length of processing time.

*Chapter Three, Aviation Demand Forecasts,* indicates sustained growth at RIC over the 20-year planning horizon. Data from the Forecast is used to develop future gate requirements for the terminal. **Table 4.11** summarizes the findings from the Forecast that will be used in this analysis.

**Table 4.11 Base Year Forecast of Aviation Activity Summary**

| | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Annual Enplanements | 1,647,700 | 2,094,000 | 2,403,000 | 2,709,000 | 3,031,000 |
| Peak Month Enplanements/1 | 154,884 | 196,836 | 225,882 | 254,646 | 284,914 |
| Annual Operations/2 | 83,600 | 102,300 | 116,100 | 128,200 | 141,000 |
| Peak Month Average Day Peak Hour Operations/3 | 699 | 856 | 971 | 1,073 | 1,180 |

1/ Peak Month enplanements/operations are calculated as 9.4% of annual.
2/ Operations are calculated without freighters, military, and GA aircraft.
3/ Peak Month Average Day Peak Hour Operations are calculated as 8.9% of total.

### *4.2.1 Terminal Utilization*

To determine future terminal requirements, it is important to understand the historical and existing airport terminal utilization. The airlines operating out of RIC have point-to-point routing strategies. These airlines utilize RIC as a spoke in their hub and spoke system, meaning a higher percentage of origin and destination (O&D) passengers. While peaks of activity do occur daily, enplanement and operational activity tend to be fairly constant. Along with the above-mentioned airline operating configuration, the remaining domestic and international activity, as well as their associated planning needs, will be taken into account.

### *4.2.2 Aircraft Gate Utilization*

Aircraft are typically classified according to FAA Aircraft Design Groups (ADG) as shown in **Table 4.12.** To define the term "gate," approximations can be developed by applying Narrow-Body Equivalent Gate (NBEG) factors. This index converts the gate requirements of many aircraft, from small commuters to wide-body and jumbo aircraft, so they are equivalent to the apron capacity of a typical narrow-body aircraft gate. The number of gates required to meet future demand (as presented in this analysis) is based on the A320/B737-700 aircraft. The NBEG technique provides a common denominator for the number of gates and aircraft seats useful for sizing terminal components and evaluating capacities in airport master planning.

**Table 4.12 NBEG Factor Description**

| Aircraft Design Group | Design Aircraft | Maximum Wingspan (feet) | Typical Aircraft | NBEG Factor |
|---|---|---|---|---|
| I/II | Small/Medium Commuter | 79 | ERJ/CRJ/SF340 | 0.7 |
| | | | A319/A320/B737 | |
| III | Narrow-body/Large Commuter | 113 | MD-80/DC9 | 1.0 |
| IIIA[1] | B757 | 125 | B757 | 1.1 |
| IV | Wide-body | 171 | B767/MD-11/DC-10 | 1.4 |
| V | Jumbo | 214 | B747/A330/A340/B777 | 1.8 |

1/ The Aircraft Design Group IIIA has been added to account for the Boeing 757, which has a wider wingspan than Group III but is smaller than a typical Group IV aircraft.

Source: Advisory Circular 150 5300-13

**Table 4.13** shows existing aircraft gates grouped by relative aircraft size. The aircraft size groupings are determined by the maximum wingspan of aircraft permitted to park at each gate. As the number of gates required to support increased activity grows, the type of additional gates needed should mirror industry trends as described in the Forecast.

**Table 4.13 RIC Terminal Existing Gates (Base Year)**

| Aircraft Design Group | Design Aircraft | Gates | NBEG Factor | NBEG Calculation | % of Total NBEG |
|---|---|---|---|---|---|
| I/II | Small/Medium Commuter | 2 | 0.7 | 1.4 | 6% |
| III | Narrow-body/Large Commuter | 6 | 1.0 | 6 | 26% |
| IIIA | B757 | 14 | 1.1 | 15.4 | 68% |
| IV | Wide-body | 0 | 1.4 | 0 | 0% |
| V | Jumbo | 0 | 1.8 | 0 | 0% |
| | **Total** | **22** | | **19.4** | **100%** |

### *4.2.3 Methodology*

As mentioned previously, future gate requirements are developed by applying NBEG factors, which are based on the A320/B737-700 aircraft. This will provide the baseline for determining future gate requirements. A more detailed analysis will convert NBEG future gate requirements to specific gate sizing to accommodate ADG V aircraft or ADG I/II aircraft. The methodologies employed by this analysis to determine future gate requirements include:

- Annual Enplanements per NBEG
- Peak Month Enplanements per NBEG
- Annual Operations per NBEG

- Peak Month Average Day Operations per NBEG
- Design Day Forecast

Annual Enplanements per NBEG – This method calculates the ratio of annual enplaned passengers per gate. That ratio is then applied to the forecast annual enplaned passenger levels. This method uses the gate utilization previously determined and remains constant over the planning horizon.

Peak Month Enplanements per NBEG – This method calculates the ratio of peak month enplaned passengers per gate. The ratio is then applied to the forecast peak month enplaned passenger levels. This method assumes that the current usage of the gates in the peak month is acceptable and remains constant over the planning horizon.

Annual Operations per NBEG – This method calculates the ratio of annual operations per gate. That ratio is then applied to the forecast annual operation levels. This method uses the gate utilization previously determined and remains constant over the planning horizon.

Peak Month Average Day Operations per NBEG – The previous methodologies are based on average activity levels. While peaks of activity do occur daily, enplanement and operational activity tend to be fairly constant. This methodology takes this into account and assumes that the current utilization of gates will remain constant over the planning horizon.

Design Day Forecast – Another methodology for determining future gate requirements is to use a design day forecast to simulate activity for 2026. This forecast does not use NBEG gates as a basis for determining requirements, but uses existing air carrier activity, load factors, and aircraft type to determine the ultimate number of gates needed. This methodology also assumes that the current utilization of gates will remain constant over the planning horizon.

### *4.2.4 Future Gate Requirements*

4.2.4.1 Annual Enplanements per NBEG

**Table 4.14** depicts the results of the Annual Enplanements per NBEG method.

**Table 4.14 Annual Enplanements Per NBEG Method**

| Year | Annual Enplanements | Annual Enplanements Per Gate Ratio | Required NBEG |
|---|---|---|---|
| Base Year | 1,647,700 | 72,268 | 23 |
| 2011 | 2,094,000 | 72,268 | 29* |
| 2016 | 2,403,000 | 72,268 | 33* |
| 2021 | 2,709,000 | 72,268 | 37* |
| 2026 | 3,031,000 | 72,268 | 42* |

*Calculated Data

### 4.2.4.2 Peak Month Enplanements per NBEG

**Table 4.15** depicts the results of the Peak Month (PM) Enplanements per NBEG method.

**Table 4.15 Peak Month Enplanements Per NBEG**

| Year | Peak Month Enplanements | PM Annual Enpl. Per Gate Ratio | Required NBEG |
|---|---|---|---|
| Base Year | 154,884 | 6,793* | 23* |
| 2011 | 196,836 | 6,793* | 29* |
| 2016 | 225,882 | 6,793* | 33* |
| 2021 | 254,646 | 6.793* | 37* |
| 2026 | 284,914 | 6,793* | 42* |

*Calculated Data

### 4.2.4.3 Annual Operations per NBEG

Future gates can also be estimated from base year annual gate utilization and forecast annual operations. To understand how airfield operations relate to gate activity, the terminology "turns" per gate has been adopted to include an aircraft's arrival and departure, a complete cycle of activity. **Table 4.16** depicts the results of the Annual Operations per NBEG method.

**Table 4.16 Annual Operations Per NBEG Method**

| Year | Annual Operations | Annual Operations Per Gate | Turns Per Gate Per Day | Required NBEG |
|---|---|---|---|---|
| Base Year | 83,600 | 3,667* | 5.0* | 23* |
| 2011 | 102,300 | 3,667* | 5.0* | 28* |
| 2016 | 116,100 | 3,667* | 5.0* | 32* |
| 2021 | 128,200 | 3,667* | 5.0* | 35* |
| 2026 | 141,000 | 3,667* | 5.0* | 38* |

*Calculated Data

### 4.2.4.4 Peak Month Average Day Operations per NBEG

**Table 4.17** depicts the results of the Peak Month Average Day (PMAD) Operations per NBEG analysis.

**Table 4.17 PMAD Operations Per NBEG Method**

| Year | PMAD Operations | PMAD Operations Per Gate Ratio | Required NBEG |
|---|---|---|---|
| Base Year | 699 | 31* | 23* |
| 2011 | 856 | 31* | 28* |
| 2016 | 971 | 31* | 32* |
| 2021 | 1,073 | 31* | 35* |
| 2026 | 1,180 | 31* | 38* |

*Calculated Data

4.2.4.5 Design Day Forecast Method

Gates can also be estimated from looking at each airline operator's actual activity and its percent of market share. For this analysis, it was assumed that market shares and load factors would stay the same and the average turns-per-gate would stay the same. This methodology best defines how each airline is using the gates and provides a look at "What If" scenarios like a new carrier or major shift in market share. **Figures 4.2 and 4.3** depict the assumptions and results of the Design Day Forecast Gate method.

## Figure 4.2

2

| 2007 EXISTING DATA | Existing Active Aircraft Gates | 2007 (OAG & RIC) Daily Scheduled Departures | Scheduled Seats | Enplanements | PMAD* Turns per Aircraft Gate | PMAD Departures | 2007 PMAD Enplanements per Departure | PMAD Seats per Departure | PMAD* Load Factor | Market Share |
|---|---|---|---|---|---|---|---|---|---|---|
| **Domestic** | | | | | | | | | | |
| American Airlines | 2 | 10 | 740 | 612 | 5.0 | 10.0 | 61.2 | 74 | 82.7% | 11.3% |
| Jet Blue | 2 | 6 | 600 | 466 | 3.0 | 6.0 | 77.7 | 100 | 77.7% | 8.6% |
| Continental | 2 | 10 | 500 | 403 | 5.0 | 10.0 | 40.3 | 50 | 80.6% | 7.4% |
| Delta | 5 | 21 | 1,652 | 1,263 | 4.2 | 21.0 | 60.1 | 79 | 76.4% | 23.2% |
| AirTran Airways | 2 | 6 | 702 | 480 | 3.0 | 6.0 | 80.0 | 117 | 68.4% | 8.8% |
| Northwest Airlines | 2 | 5 | 350 | 219 | 2.5 | 5.0 | 43.7 | 70 | 62.5% | 4.0% |
| SkyBus | 1 | 1 | 120 | 32 | 1.0 | 1.0 | 32.0 | 120 | 26.7% | 0.6% |
| United Airlines | 2 | 11 | 706 | 566 | 5.5 | 11.0 | 51.4 | 64 | 80.1% | 10.4% |
| US Airways | 4 | 29 | 1,908 | 1,392 | 7.3 | 29.0 | 48.0 | 66 | 73.0% | 25.6% |
| **Total** | 22 | 99 | 7,278 | 5,433 | 4.1 | 99.0 | 55.8 | 74 | 74.6% | 100% |

* = Calculated Data
PMAD Turns per Aircraft Gate = impact on required Gates
PMAD Seats per Departure is directly connected to Aircarrier Fleet Mix = impact on required Aircraft Gates
PMAD Load Factor = impact on required Aircraft Gates.

## Figure 4.3

**2026 FORECAST DATA (BASE)**

**Assumptions:**
Seats per Departure remain the same
Load Factors based on Forecast Report
Aircarrier percent of activity remains same as December 2007
2026 Turns per Aircraft Gate reflect that of PMAD 2007

| | 2026 PMAD* Forecast Enplanements | 2026 PMAD* Load Factor | 2026 Scheduled* Seats | PMAD* Seats per Departure | 2026 Scheduled* Departures | 2006 PMAD Departures | 2026 PMAD* Departures | 2026 Added* Departures | 2007 Market Share | 2026 Market Share |
|---|---|---|---|---|---|---|---|---|---|---|
| **Domestic** | | | | | | | | | | |
| American Airlines | 1,130 | 82.7% | 1,365 | 74 | 18 | 10.0 | 20.5 | 10.5 | 11.3% | 11.3% |
| Jet Blue | 860 | 77.7% | 1,107 | 100 | 11 | 6.0 | 15.6 | 9.6 | 8.6% | 8.6% |
| Continental | 740 | 80.6% | 918 | 50 | 18 | 10.0 | 13.5 | 3.5 | 7.4% | 7.4% |
| Delta | 2,329 | 76.4% | 3,047 | 79 | 39 | 21.0 | 42.3 | 21.3 | 23.2% | 23.3% |
| AirTran Airways | 880 | 68.4% | 1,287 | 117 | 11 | 6.0 | 16.1 | 10.1 | 8.8% | 8.8% |
| Northwest Airlines | 400 | 62.5% | 640 | 70 | 9 | 5.0 | 7.3 | 2.3 | 4.0% | 4.0% |
| SkyBus | 60 | 26.7% | 225 | 120 | 2 | 1.0 | 1.1 | 0.1 | 0.6% | 0.6% |
| United Airlines | 1,040 | 80.1% | 1,297 | 64 | 20 | 11.0 | 19.0 | 8.0 | 10.4% | 10.4% |
| US Airways | 2,559 | 73.0% | 3,508 | 66 | 53 | 29.0 | 46.7 | 17.7 | 25.6% | 25.6% |
| **Sub-Total** | **9,996** | 74.6% | 13393 | 73.6 | 182 | 99.0 | 182.2 | 83.2 | 100% | 100% |
| Additional Service | | | | | | | | | | |
| **TBD** | 0 | 0.0% | 0 | 0 | 0 | | 0.0 | 0.0 | 0.0 | 0.0 |
| **Total** | 9,996 | 74.6% | 26,785 | 0 | 182 | 99 | 182.2 | 83.2 | 0.0 | 0.0 |

**FORECAST AIRCRAFT POSITIONS**

| | 2007 Turns Per Gate | 2026 Turns Per Gate | 2026 Gates* Required |
|---|---|---|---|
| **Domestic** | | | |
| American | 5.0 | 5.0 | 3.7 |
| Jet Blue | 3.0 | 4.0 | 2.8 |
| Continental | 5.0 | 5.0 | 3.7 |
| Delta | 4.2 | 4.0 | 9.6 |
| AirTran | 3.0 | 4.0 | 2.7 |
| Northwest | 2.5 | 4.0 | 2.3 |
| SkyBus | 1.0 | 1.0 | 1.9 |
| United | 5.5 | 4.0 | 5.1 |
| US Airways | 7.3 | 7.0 | 7.6 |
| | 4.1 | 4.2 | 39.3 |
| **TBD** | | 0.0 | 0.0 |
| **Total** | | 0.0 | **40.0** |

2026 Aircraft Gates Required = Forecasted Scheduled Departures/350/Forcasted Turns Per Aircraft Gate

4.2.4.6 Terminal Gate Requirements Summary

**Table 4.18** shows a summary of the gate requirements derived from the different methodologies.

**Table 4.18 Gate Requirements Summary**

| Method | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Annual Enplanements per NBEG | 23 | 29 | 33 | 37 | 42 |
| Peak Month Enplanements per NBEG | 23 | 29 | 33 | 37 | 42 |
| Annual Operations per NBEG | 23 | 28 | 32 | 35 | 38 |
| PMAD Operations per NBEG | 23 | 28 | 32 | 35 | 38 |
| Design Day Forecast | 22 | 27 | 31 | 35 | 40 |

It is important to note that even though the analysis indicates a requirement of up to 36 NBEG, airline operating characteristics and the addition of air carriers will necessitate looking at gate expansion and locations. The most likely accommodations for growth in activity will occur through increases in gate utilization, the activation of all programmed gates, and the potential expansion of both concourses to accommodate new gates.

NBEG gates can be converted into actual gates by removing the NBEG calculation and redistributing gates. The results are shown in **Table 4.19**.

**Table 4.19 RIC Terminal Gates**

**2011**

| Aircraft Design Group | Design Aircraft | NBEG Factor | % of Total NBEG | # NBEG Gates | # Actual Gates Required |
|---|---|---|---|---|---|
| I/II | Small/Medium Commuter | 0.7 | 6% | 2 | 2 |
| III | Narrow-body/Large Commuter | 1.0 | 26% | 8 | 8 |
| IIIA | B757 | 1.1 | 68% | 19 | 18 |
| IV | Wide-body | 1.4 | 0% | 0 | - |
| V | Jumbo | 1.8 | 0% | 0 | - |
| | **Total** | | | **29** | **28** |

**2016**

| Aircraft Design Group | Design Aircraft | NBEG Factor | % of Total NBEG | # NBEG Gates | # Actual Gates Required |
|---|---|---|---|---|---|
| I/II | Small/Medium Commuter | 0.7 | 6% | 2 | 3 |
| III | Narrow-body/Large Commuter | 1.0 | 26% | 9 | 9 |
| IIIA | B757 | 1.1 | 68% | 22 | 20 |
| IV | Wide-body | 1.4 | 0% | 0 | - |
| V | Jumbo | 1.8 | 0% | 0 | - |
| | **Total** | | | **33** | **32** |

**2021**

| Aircraft Design Group | Design Aircraft | NBEG Factor | % of Total NBEG | # NBEG Gates | # Actual Gates Required |
|---|---|---|---|---|---|
| I/II | Small/Medium Commuter | 0.7 | 6% | 2 | 3 |
| III | Narrow-body/Large Commuter | 1.0 | 26% | 10 | 10 |
| IIIA | B757 | 1.1 | 68% | 25 | 23 |
| IV | Wide-body | 1.4 | 0% | 0 | - |
| V | Jumbo | 1.8 | 0% | 0 | - |
| | **Total** | | | **37** | **36** |

**2026**

| Aircraft Design Group | Design Aircraft | NBEG Factor | % of Total NBEG | # NBEG Gates | # Actual Gates Required |
|---|---|---|---|---|---|
| I/II | Small/Medium Commuter | 0.7 | 6% | 3 | 4 |
| III | Narrow-body/Large Commuter | 1.0 | 26% | 11 | 11 |
| IIIA | B757 | 1.1 | 68% | 28 | 26 |
| IV | Wide-body | 1.4 | 0% | 0 | - |
| V | Jumbo | 1.8 | 0% | 0 | - |
| | **Total** | | | **42** | **41** |

### *4.2.5 Apron Frontage Requirements*

The gate requirements stated previously are convenient planning tools for developing future apron frontage and terminal area configurations. The apron frontage was calculated using the narrow-body equivalent methodology. Using the B-757 as the representative aircraft requiring a narrow-body equivalent gate (125 feet wingspan plus 25 feet wingtip clearance between aircraft, for a total width of 150 feet), **Table 4.20** shows the future terminal configurations for each of the planning years. The gate frontage required for the airport may vary due to changes in schedules, future fleet mixes, the geometric configuration of the terminal, and other factors.

**Table 4.20 Apron Frontage Base Upon Annual Enplanements Per NBEG Method**

| Year | Annual Enplanements | Annual Enplanements Per Gate | Required NBEG | Apron Frontage |
|---|---|---|---|---|
| Base Year | 1,647,700 | 72.268 | 23 | 3,300[/1] |
| 2011 | 2,094,000 | 72,268 | 29* | 4,350* |
| 2016 | 2,403,000 | 72,268 | 33* | 4,950* |
| 2021 | 2,709,000 | 72,268 | 37* | 5,550* |
| 2026 | 3,031,000 | 72,268 | 42* | 6,300* |

1/ Existing Apron Frontage at RIC based upon 22 gates and the B-757 as the representative aircraft utilizing a narrow-body equivalent gate (125 feet wingspan plus 25 feet wingtip clearance between aircraft for a total width of 150 feet).

*Calculated Data

### *4.2.6 Passenger Terminal Building Area*

For this Master Plan, a projection of gross building area will be sufficient to plan the amount of future or expanded terminal facilities. Development of a detailed terminal area space program is more appropriate during subsequent planning and design phases of a terminal expansion project. The broad-level methodology used to calculate overall terminal building size utilizes the following:

- FAA Advisory Circular Planning criteria in conjunction with activity forecasts developed in *Chapter Three, Aviation Demand Forecasts.*

- An estimate of terminal area per gate, while considering ongoing planning and design efforts and industry standards.

This methodology takes into account all of the functions in the terminal (airline space, security, hold rooms, concessions, etc.).

#### 4.2.6.1 Terminal Facility Requirements

The Terminal Area encompasses approximately 510,000 square feet of building area to support 22 gates. This equates to a factor of 23,000 square feet per gate, which is slightly more than the industry average of 20,000 square feet of terminal area per gate. **Table 4.21** depicts the calculation of total passenger terminal space needed for each planning horizon, assuming a 20,000 square feet per gate planning factor.

**Table 4.21 Terminal Square Foot Per Gate Requirements**

| Year | Gates | Terminal Square Foot |
|---|---|---|
| Base Year | 22 | 510,000 |
| 2011 | 28 | 560,000* |
| 2016 | 32 | 640,000* |
| 2021 | 36 | 720,000* |
| 2026 | 41 | 820,000* |

*Calculated Data

**Table 4.22** depicts the future utilization characteristics for RIC. Future requirements are determined by using the existing utilization metrics and applying them against future estimates of gate demands and enplanement projections. Comparing the planned area to the FAA criteria of between 0.08 to 0.12 square feet per enplaning passenger suggests the existing terminal is constructed to a factor of 0.31 square feet per enplaning passenger. Due to this factor, RIC's terminal is sized larger than what the FAA's criteria state, meaning that if and when improvements are made to the terminal building, focus will be on efficiency rather than accommodating demand.

**Table 4.22 Future Terminal Utilization Characteristics**

| Year | Gates | Annual Enplanements | Terminal Building Area (S.F.) | Terminal Area Per Enplanement (S.F.) |
|---|---|---|---|---|
| Base Year | 22 | 1,647,700 | 510,000 | 0.31* |
| 2011 | 28 | 2,094,000 | 648,140* | 0.31* |
| 2016 | 32 | 2,403,000 | 743,782* | 0.31* |
| 2021 | 36 | 2,709,000 | 838,496* | 0.31* |
| 2026 | 41 | 3,031,000 | 938,162* | 0.31* |

*Calculated Data

As with the analysis of future gate needs, the methods of determining terminal requirements were explored to provide a range of future needs. **Table 4.23** summarizes each methodology used to determine the future space requirements in the terminal building.

**Table 4.23 Terminal Requirements Summary (Total Terminal Square Footage Required)**

| Method | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Square Foot per Gate Method | 510,000 | 560,000 | 640,000 | 720,000 | 820,000 |
| Future Terminal Utilization | 510,000 | 648,140 | 743,782 | 838,496 | 938,162 |

Understanding the limitations of the methodologies presented allows for a more detailed analysis of the number of gates required for 2026. Each methodology is grounded in the principal that Base Year airline operating characteristics are sufficient to handle the activity presented. Industry trends show that airlines are utilizing their gates more efficiently to handle increased activity. This trend in airline operating characteristics may affect terminal facility requirements for 2026.

### *4.2.7 Terminal Processing Facility Requirements*

For this Master Plan, a projection of gross building area is sufficient to plan a total amount of future or expanded terminal facilities. However, passenger processing components for the terminal require further analysis to understand how much of the gross building area should be allocated to these components. As mentioned previously, development of a detailed terminal area space program is more appropriate during subsequent planning and design phases of a terminal expansion project. The broad-level methodology used to calculate passenger processing facility requirements utilizes FAA Advisory Circular 150-5360-13, *Planning and Design Guidelines for Airport Terminal Facilities,* criteria in conjunction with activity forecasts developed in the Forecast, while considering ongoing planning and design efforts and industry standards.

#### 4.2.7.1 Terminal Ticketing Positions

Airline ticketing areas include airline administrative spaces, airline ticket counters, and public queuing areas. There are three resources used to process passengers in the terminal departures level: full service in-line kiosks, standalone kiosks, and traditional ticket counters. Presently, RIC has nine operational ticket counters (six computer terminals each) and three vacant ticket counters in the terminal building. In addition to these counter positions, there are a total of 16 e-ticket kiosks to service passengers with carry-on baggage. For planning purposes it is assumed that all check-in options are equal and that all passengers are equal in type. Additionally, it is assumed that the average range of passenger processing times falls within the industry standard range of 0.5 minutes (kiosk) to 5.9 minutes (international) per passenger.

With the full utilization of the existing counter and kiosk infrastructure, the terminal area provides a total of 88 passenger check-in units (counters or kiosks), and, at an average processing rate of 2.6 - minutes per passenger, the terminal could process 2,031 peak hour passengers. **Table 4.24** indicates the peak hour departure passengers for the planning years.

**Table 4.24 Terminal Ticketing Requirements**

| Method | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Ticket Counter and Kiosks | | | | | |
| Passenger Processing Rate | 2,031 | 2,031 | 2,031 | 2,031 | 2,031 |
| Peak Hour Departure Passengers | 988 | 1,132 | 1,299 | 1,465 | 1,639 |

Planning for additional ticketing positions will not be necessary within the planning horizon.

#### 4.2.7.2 Terminal Security Screening Check Point Stations

RIC is currently equipped with six Security Screening Check Point (SSCP) lanes, which can each process 200 passengers per hour. Due to the amount of activity on Concourse A, the third lane is infrequently used. With all of the SSCP lanes operable in the peak hour, 1,200 passengers can be processed for Concourse B. Other ways that increased activity can be accommodated are through increased rate of SSCP processing and longer wait times. **Table 4.25** depicts the demand and capacity of the SSCP lanes.

**Table 4.25 Security Check Point Station Requirements**

| Method | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Security Check Point Lanes Processing Rates[/1] | 1,200 | 1,200 | 1,200 | 1,200 | 1,200 |
| Peak Hour Passenger Departures | 988 | 1,132 | 1,299 | 1,465 | 1,639 |
| Number of Lanes | 6 | 6 | 7 | 8 | 9 |

1/ Number of Passengers processed through security if all six lanes are open (at 200 passengers per lane).

### 4.2.7.3 In-Line Baggage Processing

RIC is operating an in-line baggage processing system that is equipped with four L3 Explosive Detection System (EDS) machines. Each EDS machine can process 400 bags per hour, with a total of 1,600 bags per hour when all machines are operating at full capacity. Assuming that there are 1.5 bags per passenger, the total number of bags processed during the peak hour during the base year is 1,482 bags.

**Table 4.26** indicates that beginning in planning year 2011, one additional EDS machine is needed to accommodate the forecasted peak hour departures. At the end of the planning horizon (2026), three additional EDS machines are projected to be needed to meet future growth.

**Table 4.26 In-Line Baggage Processing Requirements**

| Method | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| In-Line Baggage Processing Rates[/1] | 1600 | 1600 | 1600 | 1600 | 1600 |
| Peak Hour Departures | 988 | 1,132 | 1,299 | 1,465 | 1,639 |
| In-Line Baggage System Demand | 1,482 | 1,698* | 1,949* | 2,198* | 2,459* |
| EDS Machines | 4 | 5* | 5* | 6* | 7* |

1/ Number of bags processed through security if all four machines are in use (at 400 bags per hour).

*Calculated Data

### 4.2.7.4 Baggage Claim

Standard Baggage claim units can process 13 bags per minute. RIC has six baggage claim units, which can process approximately 4,680 bags in an hour. In 2026, there are 1,552 arrival passengers projected in the peak hour. For planning purposes it is assumed that there are 1.5 bags per passenger, which would equal about 2,338 bags during the peak hour in 2026. **Table 4.27** indicates that the existing baggage carousels will be adequate to accommodate demand throughout the planning horizon.

**Table 4.27 Baggage Handling Requirements**

| Method | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Baggage Handling Capacity | 4,680 | 4,680 | 4,680 | 4,680 | 4,680 |
| Peak Hour Arriving Passengers | 936 | 1,072 | 1,230 | 1,387 | 1,552 |
| Baggage Handling Demand[/1] (# of Bags in Peak Hour) | 1,404* | 1,608* | 1,845* | 2,081* | 2,338* |

1/ Peak hour arriving passengers were multiplied by 1.5 bags per passenger to calculate the baggage handling demand for the planning years.

*Calculated Data

### *4.2.8 Airport Concessions*

The existing concession program at RIC consists of 16,600 square feet of space in the Terminal Building. Food and beverage concessions account for 61% of total concession space (10,054 square feet), and retail concessions account for 39% of total concession space (6,546 square feet). There are no duty free concessions at RIC. The relationship between the total concession square footage and annual enplanements for 2006 yields a planning factor of 10.07, which compares favorably among airports of similar number of enplaned passengers as RIC. Based upon this planning factor, the amount of future concession space in the future planning years is shown in **Table 4.28.**

**Table 4.28 Airport Concession Requirements**

| Method | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Enplanements | 1,647,700 | 2,093,900 | 2,402,700 | 2,709,400 | 3,031,000 |
| Airport Concession S.F.[/1] | 16,600 | 21,086 | 24,196 | 27,284 | 30,523 |

1/ Assumes that the relationship of enplanements and concession space remains the same throughout the planning horizon.

Source: Kutchins & Groh, SH&E/CAM Concession Program Review and Assessment, 2007

## 4.3 SUPPORT/ANCILLARY FACILITY REQUIREMENTS

Support facilities are vital to the overall operability and maintenance of RIC. It is important to identify needs for these facilities to maintain flexibility with other airfield improvements as the airport expands in the future.

Support facilities that warrant consideration include the following:

- Airport Traffic Control Tower
- Air Cargo Facilities
- Airline Aircraft Maintenance
- Flight Kitchen
- Airport Maintenance
- General Aviation/Fixed Based Operator
- Aircraft Rescue and Firefighting (ARFF) Facilities
- Deicing/Diversion Apron
- Other Facilities
- Utilities

### *4.3.1 Airport Traffic Control Tower*

The RIC Airport Traffic Control Tower (ATCT) is located in the northwest corner of the airfield. The ATCT was commissioned in 2005 and should be sufficient through the planning horizon. Airport traffic control towers generally have a 20-year expected lifespan; therefore, the end of the tower's useful life is expected to be 2025. However, as it is the FAA's responsibility to determine whether and when a replacement tower is needed, and that agency will need to coordinate its decisions with the Commission's long-term development plan for the airfield.

The current ATCT facilities and location are adequate through the foreseeable future. However, there are a few instances in which the current ATCT may not be adequate. These instances include line-of-sight issues or an operational need. As the ATCT is only two years old, the increase in operations over the planning horizon are not expected to result in the facility being outgrown. However, the location of any future runway(s) may warrant the relocation of the ATCT. This could be due to line-of-sight issues and should be analyzed at such time as a new runway is ripe for consideration.

Ultimately, the decision to proceed with the relocation of the existing tower is that of the FAA. As many locations exist for such a facility, designation of a specific location for a new ATCT is not warranted at this time. Additional planning will be conducted when the demand triggers a need for the siting and missed approach criteria to be determined for a new parallel runway. Based upon preliminary analysis, TERPS for CAT III approaches does not appear to impact the existing ATCT, however, during advanced planning this initial finding should be confirmed. Therefore, the FAA can determine the need and location for such a facility in conjunction with the planning and implementation of any future runway(s).

### *4.3.2 Air Cargo Facilities*

Air cargo activity at RIC consists of all-cargo and belly cargo carriers. All-cargo carriers transport freight and express parcels from door to door using their own fleets of trucks and aircraft. The primary tenants at RIC that provide integrated carrier cargo services are United Parcel Service, Federal Express, DHL, and the United States Postal Service. Combined, these tenants account for 3 percent of the total operations at RIC.

Belly cargo is carried in the baggage or belly compartments of passenger airline aircraft. This type of cargo also includes some mail and is typically handled by the airlines.[2] However, belly cargo operations are included within passenger aircraft operations.

As stated in the Forecast, the critical aircraft for pure freighter operations has been identified as the Boeing 727-200 which is classified as ARC-CIII. With a Maximum Take-off Weight of 209,000 pounds and dual-wheel main landing gear, this aircraft places greater stress on runways and taxiways than larger aircraft with double-dual tandem main gear. Many integrated express carriers continue to operate 727-200 freighters and will continue to do so for the foreseeable future; however, , FedEx (one of the Airport’s current cargo carriers) has recently indicated that it will be acquiring 757-200 converted freighters to replace its 90-strong fleet of 727-200F's. FedEx also currently operates larger A300F4-600 freighter aircraft into RIC on a regular basis, but these aircraft are fitted with double-dual tandem main gear.

The four major cargo facilities are all located in the southwest corner of the airport. Together, these four buildings provide approximately 103,000 square feet of building space and approximately 124,700 square yards of apron pavement. As cargo operations at RIC continue to increase over the planning horizon, the aircraft size that is utilized is also expected to increase. Additionally, due to the expansion of the terminal core, air cargo facilities may be relocated to accommodate the existing demand for air cargo as well as the future demand. This change in aircraft size results in a growth rate for cargo volume that is 1.5 percent higher than the growth rate for freighter operations (which is 2 percent). Therefore, to determine the future facility requirements, a growth rate of 3.5 percent was used. **Table 4.29** depicts the air cargo facility requirement needs.

[2] Since 9/11/01, air mail restrictions have limited the types of mail carried by the passenger airlines.

**Table 4.29 Air Cargo Facility Requirements**

| Year | All-Cargo Facilities (S.F.) /2 | Apron Area (S.Y.) /3 |
|---|---|---|
| Base Year /1 | 103,000 | 124,700 |
| 2011 | 106,605 | 129,000 |
| 2016 | 110,336 | 133,600 |
| 2021 | 114,197 | 138,200 |
| 2026 | 118,194 | 143,100 |

1/ Existing Facilities
2/ Annual Growth Rate is 3.5 Percent from year to year.
3/ Square Yards for future years based on relationship between the existing building space and apron area.

While it is not known at this time which cargo tenants will require facility expansion over the planning horizon, total cargo building facilities will need to increase from 103,000 square feet to 118,194 square feet and the apron area will need to increase from 124,700 square yards to 143,100 square yards by the end of the planning horizon.

### *4.3.3 Airline Aircraft Maintenance*

Aircraft maintenance facilities provide a sheltered environment for repair and storage of aircraft. At RIC, Trans States Airlines and Continental Express are the airline tenants with dedicated maintenance facilities. Though this is not a demand-driven requirement, it is prudent planning to preserve space for any potential future carriers with a need for aircraft maintenance facilities based on the current airline environment.

### *4.3.4 Flight Kitchen*

The existing food and beverage concessionaire has flight kitchen facilities within its lease space; however, over recent years, meal service on domestic flights has diminished. As a result, the need for these dedicated on-airport flight kitchens has decreased. The forecasted increase in airline operations and enplanements at RIC is not expected to drive the need for any additional flight kitchen facilities through 2026.

### *4.3.5 Airport Maintenance*

Airport Maintenance facilities provide a sheltered environment for repair and storage of airport service vehicles and equipment. These facilities help protect valuable airport property from moisture, debris, and other environmental contaminants.

The airport maintenance facilities are located on the southern end of the airfield, east of the Runway 07 threshold. Although no detailed analysis has been completed regarding airport maintenance facilities, a new runway, for example, would require additional maintenance equipment and thus additional facilities. Therefore, for planning purposes it is recommended that the airport preserve space for airport maintenance facilities based on the projected average annual growth in aircraft operations over the planning period.

### *4.3.6 General Aviation/Fixed Base Operator*

General Aviation (GA) and Fixed Based Operators (FBO) facilities are placed in various locations around the airfield but primarily are consolidated in the north-northwest corner of the airport. The primary facilities are operated by Million Air and Richmond Jet Center. GA operations at RIC have experienced a 68 percent decrease between 1990 and 2006. Even with the sharp decline experienced over recent years, the Forecast projects GA operations will grow at a rate of 2.5 percent per year through 2026. At this rate, GA activity will maintain its current 20 percent of total operations, as shown below in **Table 4.30**

**Table 4.30 General Aviation Operations**

| Year | General Aviation | Total Operations | Percent of Total Operations |
|---|---|---|---|
| Base Year | 23,000 | 120,600 | 19.07% |
| 2011 | 26,600 | 136,300 | 19.52% |
| 2016 | 30,100 | 154,600 | 19.47% |
| 2021 | 34,000 | 172,300 | 19.73% |
| 2026 | 38,500 | 191,200 | 20.14% |

While the percent of the total operations remain constant, GA operations are increasing slightly. As stated in the Forecast of Aviation Activity, "the growing regional economy and growth of locally-based businesses, as well as increased disposable income in the community should have a positive impact on the number of aircraft based at RIC." An increase in the number of jet aircraft, including corporate aircraft and very light jets (VLJs), into the market will stimulate growth for FBOs and hangar space. As a part of this Master Plan Study, land has been set aside for GA/FBO operators to accommodate any future plans they may have for developing and expanding terminal buildings, corporate aviation hangars, FBO and support facilities. It is the intention of this Master Plan Study to remain as flexible as possible to allow for larger than expected growth of the GA/FBO Operators and that every effort will be made to accommodate those operators effectively and efficiently throughout the planning horizon. **Table 4.31** shows the projected based aircraft at RIC for the future planning years.

**Table 4.31 General Aviation Based Aircraft**

| Year | Base Aircraft | Average Annual Percentage Change |
|---|---|---|
| Base Year | 94 | 2.5% |
| 2011 | 106 | 2.5% |
| 2016 | 120 | 2.5% |
| 2021 | 136 | 2.5% |
| 2026 | 154 | 2.5% |

### 4.3.6.1 Fuel Storage Requirements

Jet-A fuel demands for commercial aviation are met by the two FBO operators on the airfield. The combined storage capacity of the fuel farm for Jet-A is approximately 7,381 barrels. The following methodology was used to determine future fuel storage requirements:

- Daily fuel demand for Jet-A was supplied by the FBO Operators.
- Using the Peak Month Average Day (PMAD) operations forecast, the gallons per PMAD operation ratio was determined. The current demand is 171.67 gallons per PMAD operation.
- The Base Year demand ratio was inflated by 5 percent per five-year period to take into account the change in fleet mix over the planning horizon.

Fuel storage requirements for Jet-A fuel are expected to grow from 7,381 barrels in the Base Year to 10,419 barrels in 2026 as shown in **Table 4.32**. These storage requirements indicate that the airport's fuel storage is currently at capacity (with a three-day supply) and a storage deficit of 3,038 barrels by year 2026.

There are approximately 950 barrels of Aviation Gasoline (AVGAS) storage on the airfield. The 2.5% increase in GA based aircraft and respective operations, as stated in *Chapter Three, Aviation Demand Forecasts,* is nominal. Therefore, the existing capacity for AVGAS is expected to remain adequate over the planning horizon.

**Table 4.32 Fuel Storage Requirements**

| Year | PMAD Operations | Average Day (gallons)/1 | Average Day Demand (Barrels)/2 | Gal./PMAD Operations | Storage Requirements (3-day supply) (Barrels) /3 | Surplus/ (Deficit) (Barrels)/4 |
|---|---|---|---|---|---|---|
| Base Year | 699 | 120,000 | 2,857.14 | 171.67 | 8,571.42 | (1,190.42) |
| 2011 | 856 | 126,000 | 3,000.00 | 147.20 | 9,000.00 | (1,619.00) |
| 2016 | 971 | 132,300 | 3,150.00 | 136.25 | 9,450.00 | (2,069.00) |
| 2021 | 1,073 | 138,915 | 3,307.50 | 129.26 | 9,922.50 | (2,541.50) |
| 2026 | 1,180 | 145,860 | 3,472.86 | 123.61 | 10,418.58 | (3,037.58) |

1/ Both FBOs at RIC supplied data. Approximately 60,000 gallons from both Million Air and Richmond Jet Center
2/ One Barrel of Fuel equals 42 US Gallons.
3/ Average Day Demand multiplied by 3 days
4/ Calculated based on existing storage capacity: 7,381 usable barrels

### *4.3.7 Aircraft Rescue and Fire Fighting Station*

The current Airport Rescue and Firefighting (ARFF) station at RIC has an array of ARFF vehicles that meet the requirements for Index C of Part 139. Requirements for ARFF facilities at the airport are established under Federal Aviation Regulation (F.A.R.) Part 139-*Certification and Operations: Land Airports Serving Certain Air Carriers.* This regulation governs airports with scheduled passenger service by aircraft with seating capacities over 30 passengers per aircraft. The present service provided by air carriers at RIC utilizing aircraft such as the Airbus 319/320, McDonnell Douglas-81, Boeing 737-300 and 400 are required to comply with Part 139 criteria. This regulation sets forth the requirements for each Index of ARFF services based on aircraft length. Categories range from A to E, with E being the largest. Richmond qualifies as an Index C airport since it serves aircraft at least 126 feet in length but not more than 159 feet in length.

The existing ARFF station for the airport is configured such that it can accommodate any anticipated equipment improvements. The requirements for ARFF facilities during this phase of planning remain consistent with the current station based upon specific requirements related to field design. Though the requirements have not changed, relocation of the existing ARFF station from airside to landside is being considered within the planning period, which will eliminate the need to cross active runways to access the facility and to better accommodate future growth of the airfield. The ARFF Response Time Test completed during the Airport's Annual Certification Inspection confirmed the Airport's selected location of the ARFF station meets current response requirements.

### *4.3.8 Deicing/Diversion Apron*

During inclement weather events, RIC is a primary location for diversion of aircraft traversing the Eastern Seaboard. These events often result in the airport needing additional parking positions for aircraft. On a related apron operational issue, the airport's aircraft deicing operations currently take place at the terminal gates which are not properly equipped to accommodate the drainage of deicing fluids. Ideally, aircraft deicing should take place away from the gates. The airport wishes to have a designated location for diverting aircraft which would also serve dual purposes – as a location for RON aircraft and for deicing activities. The provision of such an apron would alleviate the logistical problem of maneuvering RON aircraft to accommodate schedule air carrier operations on existing gates and would allow for the efficient deicing of aircraft.

### *4.3.9 Other Facilities*

Airport staff is pursuing other development which will increase the airport's non-aviation revenue. Additionally, several regional agencies continue to develop the land surrounding the airport with infrastructure and commercial facilities. The airport intends to develop an airport business park and a conference center which will potentially attract non-aviation related activities. Expanded interstate connectivity and new rail connections, planned by other modal agencies, will enhance access to the Airport and increase its marketability.

### *4.3.10 Utilities*

It is essential to determine if the existing utilities are able to accommodate the current demand of the airport facilities. Through discussions with airport personnel and various utility providers, it is assumed that the utilities described at RIC have sufficient capacity to support current demand. As facilities are developed on the airport, utilities will have to be added as necessary to accommodate the new demand. The facility requirements for utilities are more appropriately defined by the specific nature and timing of the development and should be determined during the respective planning and design phases.

# 4.4 GROUND ACCESS FACILITY REQUIREMENTS

This section describes requirements for roadways, vehicle parking areas, and rental car facilities.

## *4.4.1 Roadways*

Airport roadway facilities typically are designed for the peak-hour traffic on the design day, allowing for the splitting and recirculation of traffic within the various areas of the airport property. For the purposes of the Master Plan, roadway planning is typically conceptual and follows basic demand/capacity calculations comparing the peak hour demand of a roadway segment with the per-lane capacity, which is based on general guidelines for airport roadway networks. Detailed access roadway requirements and concepts are developed following the completion of detailed analyses and modeling efforts.

The airport roadways at RIC have been recently redesigned and redeveloped in conjunction with the new Terminal Building. For purposes of this Master Plan, the planning team has assumed that these roadways will meet demand throughout the planning horizon. As RIC continues to develop areas on the Airport (e.g., the area adjacent to the former Virginia Air National Guard on the east side of the airfield), roadway infrastructure will need to be in place to provide access as well as enhance the marketability of the development.

As the concept development and evaluation process commences, the focus of roadway development will be one of identifying access requirements that support facility development in areas where access does not yet exist or is known to be inadequate for the proposed development. The evaluation of the roadways within any of the concepts considered the following:

- Must be cost effective from a construction, operation, and maintenance perspective

- Should cause minimal impact to adjacent communities including, but not limited to, right-of-way impacts, construction impacts, and access/circulation impacts

- Provide for future expansion of the roadway system by state and local transportation agencies to accommodate roadways proposed in the region's long-range transportation plans

## *4.4.2 Public Parking*

There are two types of public parking facilities at RIC — short-term and long-term. Short-term parking is generally designed for vehicles parking for less than five hours and is located closer to the terminal for passenger/visitor convenience. Long-term parking is generally for any vehicles that will remain at the airport for over five hours. It is generally located farther from the terminal and is less expensive than parking in short-term parking facilities.

The following analysis compares the demand and capacity of short- and long-term parking at RIC.

### 4.4.2.1 Long-Term Parking

Long term public parking facility requirements were developed based on the existing correlation of peak month enplanements to available parking spaces and projected for the planning horizon based on the forecast of peak month enplanements. The relationship between the peak month enplanements of the Base Year and available parking stalls during the Base Year yielded a planning factor of 31.1 stalls per one thousand peak month enplanements. This factor is consistent with FAA guidelines established in *Advisory Circular 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities.* Additionally, based on the relationship between the existing number of short-term and long-term parking stalls, long-term parking requirements are assumed to be approximately 40 percent of total stalls. This results in 2,144 additional long-term parking spaces being required over the planning horizon as shown in **Table 4.33**.

**Table 4.33 Public Parking Facility Requirements**

| | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Peak Month Enplanements | 253,808 | 272,432 | 301,182 | 338,242 | 426,341 |
| Total Number of Stalls | 7,900/1 | 8,473 | 9,367 | 10,520 | 13,260 |
| **Total Economy Parking Stalls** | **3,160/1** | **3,389/2** | **3,747/2** | **4,208/2** | **5,304/2** |

1/ Existing number of spaces at RIC (Construction of new garage and expansion of Lot B, total number of existing stalls will be 11,900 when completed in 2009)
2/ Future years calculated utilizing 40% of total number of required stalls

*Calculated Data

### 4.4.2.2 Short-Term Parking

Similar to the long-term parking, short-term parking can utilize the same correlation between peak month enplanements and available parking spaces. Additionally, based on the relationship between the existing number of short-term and long-term parking stalls, short-term parking requirements are assumed to be approximately 60 percent of total stalls. This results in 3,216 additional short-term parking spaces being required over the planning horizon as shown in **Table 4.34**.

**Table 4.34 Public Parking Facility Requirements**

| | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Peak Month Enplanements | 253,808 | 272,432 | 301,182 | 338,242 | 426,341 |
| Total Number of Stalls | 7,900/1 | 8,473 | 9,367 | 10,520 | 13,260 |
| **Total Daily Parking Stalls** | **4,740/1** | **5,084/2** | **5,620 2** | **6,312/2** | **7,956/2** |

1/ Existing number of spaces at RIC (Construction of new garage and expansion of Lot B, total number of existing stalls will be 11,900 when completed in 2009)
2/ Future years calculated utilizing 60% of total number of required stalls

*Calculated Data

### *4.4.3 Employee Parking*

Employee parking facility requirements for employees working in the terminal were developed based on the existing correlation of total annual enplanements to available parking spaces and projected for the forecast planning years based on the forecast of total annual enplanements. A planning factor of approximately 0.394 employee parking spaces per 1,000 annual enplanements was used to calculate the future demand. **Table 4.35** summarizes parking requirements for the forecast years for employees working in the terminal building. By the end of the planning horizon (2026), 545 additional employee parking spaces will be needed to accommodate future demand.

**Table 4.35 Employee Parking Facility Requirements**

| | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Annual Enplanements | 1,647,700 | 2,093,900 | 2,402,700 | 2,709,400 | 3,031,000 |
| Total Number of Parking Spaces | 650/1 | 825/2 | 947 | 1,068 | 1,195 |

1/ Existing number of spaces at RIC
2/ Future years calculated utilizing 0.394 spaces per one thousand annual enplanements

### *4.4.4 Rental Car Facility*

There are a total of seven rental car agencies (RACs) currently operating at RIC. The RACs have customer counters and offices located on the lower level of the terminal building between the baggage claim areas. Ready/return vehicles for customers are housed in a consolidated Rental Car Garage located on the north side of the Terminal. The maintenance locations of the RACs are separate from their operations with some residing on-airport and others located off-airport. **Table 4.36** lists the seven rental car firms at RIC as well as each firm's Base Year market share.

**Table 4.36 Rental Car Market Share**

| Rental Car Company | Base Year Percentage of Market Share |
|---|---|
| Hertz | 31.3% |
| Avis | 22.3% |
| Alamo/National | 17.3% |
| Enterprise | 9.9% |
| Budget | 9.3% |
| Dollar | 5.4% |
| Thrifty | 4.4% |

Source: Capital Regional Airport Commission, 2007.

All customer transactions occur in the lower level of the terminal at the rental counters and in the ready/return garage. Vehicles are serviced at the service areas located on Ready Road.

The methodology utilized to determine future facility requirements for rental car operations is growing the spatial areas currently utilized for rental car operations at the same rate as future passenger growth. This approach assumes that the spaces currently utilized are at or near their capacity.

#### 4.4.4.1 Terminal Counters

Currently, there are approximately 4,452 square feet of counter and back office space utilized by all the rental car companies. **Table 4.37** depicts the existing and future terminal counter requirements. It should be noted that as rental car companies adapt to shifts in business models, companies consolidate operations and/or merge. Often terminal counter space requirements grow at a slower rate than other components of the operation. Therefore, for purposes of this analysis, the terminal counter space has been assumed to grow at half the rate of annual enplanements.

**Table 4.37 Terminal Counter Facility Requirements**

| | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Annual Enplanements | 1,647,700 | 2,093,900 | 2,402,700 | 2,709,400 | 3,031,000 |
| Terminal Counter Space Requirement (S.F.)/1 | 4,452 | 5,055 | 5,428 | 5,774 | 6,117 |

1/ The terminal counter space has been assumed to grow at half the rate of annual enplanements.

#### 4.4.4.2 Ready/Return Garage Parking Stalls

Today there are approximately 485 ready/return spaces dedicated in the rental car parking garage adjacent to the terminal. Similar to terminal counter space, Ready/Return Garage Parking Stalls have been assumed to grow at half the rate of annual enplanements. **Table 4.38** depicts the existing and future ready/return parking space needs.

**Table 4.38 Ready/Return Facility Requirements**

| | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Annual Enplanements | 1,647,700 | 2,093,900 | 2,402,700 | 2,709,400 | 3,031,000 |
| Ready/Return Requirement (Spaces) | 485 | 616 | 707 | 798 | 892 |

### 4.4.4.3 Service Sites

Today there are approximately 11.0 acres dedicated to rental car agencies leasing space from the airport. These companies include Alamo/National, Avis, Enterprise, and Hertz. Three rental car companies occupy space off-airport. Assuming that this relationship remains, **Table 4.39** depicts the existing and future service site needs.

**Table 4.39 Service Site Facility Requirements**

| | Base Year | 2011 | 2016 | 2021 | 2026 |
|---|---|---|---|---|---|
| Annual Enplanements | 1,647,700 | 2,093,900 | 2,402,700 | 2,709,400 | 3,031,000 |
| Service Site Requirements (Acres) | 19.0/1 | 24.1 | 27.7 | 31.2 | 35.0 |

1/ Assumes the three rental car companies' off-airport facilities average approximately 2.75 acres of land for Service Site Facilities. In the future years, all off-airport rental car companies will move operations on-airport.

## 4.5 SUMMARY OF FACILITY REQUIREMENTS

**Tables 4.40 – 4.43** summarize the recommended future facility requirements for the forecast years of 2011, 2016, 2021, and 2026.

**Table 4.40 Summary of Facility Requirements for 2011**

| **Facilities** | **Facility Requirements** |
|---|---|
| Airfield: | |
| Runways | 62% Capacity with a projected 136,300 operations. Planning for adding additional capacity to the Airfield commences |
| Runway Length Requirements | None Required |
| Taxiways | Bring non-compliant taxiway pavements strengths up to standard |
| Approach Lighting | Any improvements to the airfield will require all affected approach lighting systems to be improved as necessary |
| Navigational Aids | Any improvements to the airfield will require all affected navigational aids to be improved as necessary |
| Runway Design Standards | Any improvements to the airfield will require all design standards to be met |
| Terminal: | |
| Aircraft Gates | 28 actual Gates (NBEG gates have been reconverted to actual gates) |
| Apron Frontage | 4,350 Linear Feet based on 29 NBEG Gates |
| Terminal Building Area | 560,000 Square Feet (Square Feet Per Gate Method) |
| Ticketing Positions | Adequate throughout planning period |
| Security Checkpoints | None Required |
| In-Line Baggage Processing | 1 Additional Explosive Detection System Machine per concourse for a total of 6 machines |
| Baggage Claim Carousels | Adequate throughout planning period |
| Airport Concession Space | 21,086 Square Feet |
| Support/Ancillary: | |
| Airport Traffic Control Tower | None Required |
| Air Cargo | 106,605 S.F. of space (3,605 S.F. more than Base Year) |
| Airline Aircraft Maintenance | Preserve space as needed |
| Flight Kitchen | None required |
| Airport Maintenance | Preserve space as needed |
| General Aviation/Fixed Base Operator | None required |
| Fuel Storage | 9,000 Barrels are needed which is a deficit of 1,619 barrels from the Base Year |
| Airfield Rescue Fire Fighting | Relocate ARFF Station from airside to landside to eliminate crossing active runways when being accessed by vehicles |
| Deicing/Diversion Apron | Facility is developed in accordance with terminal and air cargo development |
| Utilities | Upgrade as needed based upon improvements to the airport |
| Ground Access: | |
| Roadways | Planning should occur as necessary |
| Public Parking | 8,473 Total Spaces – Daily Spaces – 5,084; Economy Spaces – 3,389 |
| Employee Parking | An additional 175 spaces for a total of 825 Spaces |
| Rental Car | 5,055 square feet of terminal space (Ticket Counter, Back Office, Queuing Areas); 616 Ready Return Spaces; 24.1 Acres for Service Sites |

**Table 4.41 Summary of Facility Requirements for 2016**

| Facilities | Facility Requirements |
|---|---|
| Airfield: | |
| Runways | 70% Capacity with a projected 154,600 operations. Planning for adding additional capacity to the Airfield should have already commenced |
| Runway Length Requirements | None Required |
| Taxiways | Make improvements as necessary |
| Navigational Aids | Any improvements to the airfield will require all affected approach lighting systems to be improved as necessary |
| Approach Lighting | Any improvements to the airfield will require all affected navigational aids to be improved as necessary |
| Runway Design Standards | Any improvements to the airfield will require all design standards to be met |
| Terminal: | |
| Aircraft Gates | 32 actual Gates (NBEG gates have been reconverted to actual gates) |
| Apron Frontage | 4,950 Linear Feet based on 33 NBEG Gates |
| Terminal Building Area | 640,000 Square Feet (Square Feet Per Gate Method) |
| Ticketing Positions | Adequate throughout planning period |
| Security Checkpoints | 1 additional lane per concourse for a total of 8 lanes |
| In-Line Baggage Processing | None required, airport keeps existing EDS Machines (total of 6 machines) |
| Baggage Claim Carousels | Adequate throughout planning period |
| Airport Concession Space | 24,196 Square Feet |
| Support/Ancillary: | |
| Airport Traffic Control Tower | None Required |
| Air Cargo | 110,336 S.F. of Building space (3,731 S.F. more than required in 2011) |
| Airline Aircraft Maintenance | Preserve space as needed |
| Flight Kitchen | None Required |
| Airport Maintenance | Preserve space as needed |
| General Aviation/Fixed Base Operator | None Required |
| Fuel Storage | An additional 450 barrels for a total of 9,450 barrels |
| Airfield Rescue Fire Fighting | None required |
| Deicing/Diversion Apron | Facility is developed in accordance with terminal and air cargo development |
| Utilities | Upgrade as needed based upon improvements to the airport |
| Ground Access: | |
| Roadways | Planning should occur as necessary |
| Public Parking | 9,367 Total Spaces - Daily Spaces – 5,620; Economy Spaces – 3,747 |
| Employee Parking | An additional 122 spaces for a total of 947 spaces |
| Rental Car | 5,428 square feet of terminal space (Ticket Counter, Back Office, Queuing Areas); 707 Ready Return Spaces; 27.7 Acres for Service Sites |

**Table 4.42 Summary of Facility Requirements for 2021**

| Facilities | Facility Requirements |
|---|---|
| Airfield: | |
| Runways | 78% Capacity with a projected 172,300 operations. Planning for adding additional capacity to the Airfield should have already commenced |
| Runway Length Requirements | Provide length requirements for future runway of 9,000 feet for all departure runways; 8,000 feet for all arrival runways; |
| Taxiways | Provide full length parallel taxiways for all new runway extensions and runways; Provide additional high speed exit taxiways |
| Navigational Aids | Any improvements to the airfield will require all affected approach lighting systems to be improved as necessary |
| Approach Lighting | Any improvements to the airfield will require all affected navigational aids to be improved as necessary |
| Runway Design Standards | Any improvements to the airfield will require all design standards to be met |
| Terminal: | |
| Aircraft Gates | 36 actual Gates (NBEG gates have been reconverted to actual gates) |
| Apron Frontage | 5,550 Linear Feet based on 37 NBEG Gates |
| Terminal Building Area | 720,000 Square Feet (Square Feet Per Gate Method) |
| Ticketing Positions | Adequate throughout planning period |
| Security Checkpoints | 1 additional lane per concourse for a total of 10 lanes |
| In-Line Baggage Processing | 1 Additional EDS Machine per concourse for a total of 8 machines |
| Baggage Claim Carousels | Adequate throughout planning period |
| Airport Concession Space | 27,284 Square Feet |
| Support/Ancillary: | |
| Airport Traffic Control Tower | Planning is necessary if a future runway is being planned and the existing ATCT has line of sight issues with the placement of a new runway |
| Air Cargo | 114,197 S.F. of Building space (3,861 S.F. more than required in 2016 |
| Airline Aircraft Maintenance | Preserve space as needed |
| Flight Kitchen | None Required |
| Airport Maintenance | Preserve space as needed |
| General Aviation/Fixed Base Operator | Minimum expansion required if demand warrants it |
| Fuel Storage | An additional 472.50 barrels for a total of 9,922.50 barrels |
| Airfield Rescue Fire Fighting | None required |
| Deicing/Diversion Apron | Facility is developed in accordance with terminal and air cargo development |
| Utilities | Upgrade as needed based upon improvements to the airport |
| Ground Access: | |
| Roadways | Planning should occur as necessary |
| Public Parking | 10,520 Total Spaces - Daily Spaces – 6,312; Economy Spaces – 4,208 |
| Employee Parking | An additional 121 spaces for a total of 1,068 spaces |
| Rental Car | 5,774 square feet of terminal space (Ticket Counter, Back Office, Queuing Areas); 798 Ready Return Spaces; 31.2 Acres for Service Sites |

**Table 4.43 Summary of Facility Requirements for 2026**

| Facilities | Facility Requirements |
|---|---|
| Airfield: | |
| Runways | 87% Capacity with a projected 191,200 operations. Planning for adding additional capacity to the Airfield should have already commenced |
| Runway Length Requirements | None Required |
| Taxiways | Make improvements as necessary |
| Navigational Aids | Any improvements to the airfield will require all affected approach lighting systems to be improved as necessary |
| Approach Lighting | Any improvements to the airfield will require all affected navigational aids to be improved as necessary |
| Runway Design Standards | Any improvements to the airfield will require all design standards to be met. |
| Terminal: | |
| Aircraft Gates | 41 actual Gates (NBEG gates have been reconverted to actual gates) |
| Apron Frontage | 6,300 Linear Feet based on 42 NBEG Gates |
| Terminal Building Area | 820,000 Square Feet (Square Feet Per Gate Method) |
| Ticketing Positions | Adequate throughout planning period |
| Security Checkpoints | None required |
| In-Line Baggage Processing | None required |
| Baggage Claim Carousels | Adequate throughout planning period |
| Airport Concession Space | 30,523 Square Feet |
| Support/Ancillary: | |
| Airport Traffic Control Tower | End of projected useful life. Additional analysis may be needed pursuant to condition of facility |
| Air Cargo | 118,194 S.F. of Building space (3,997 S.F. more than required in 2021) |
| Airline Aircraft Maintenance | Preserve space as needed |
| Flight Kitchen | None Required |
| Airport Maintenance | Preserve space as needed |
| General Aviation/Fixed Base Operator | Minimum expansion required if demand warrants it |
| Fuel Storage | An additional 496.08 barrels for a total of 10,418.58 barrels |
| Airfield Rescue Fire Fighting | None Required |
| Deicing/Diversion Apron | Facility is developed in accordance with terminal and air cargo development |
| Utilities | Upgrade as needed based upon improvements to the airport |
| Ground Access: | |
| Roadways | Planning should occur as necessary |
| Public Parking | 13,260 Total Spaces - Daily Spaces – 7,956; Economy Spaces – 5,304 |
| Employee Parking | An additional 127 spaces for a total of 1,195 spaces |
| Rental Car | 6,117 square feet of terminal space (Ticket Counter, Back Office, Queuing Areas); 892 Ready Return Spaces; 35.0 Acres for Service Sites |