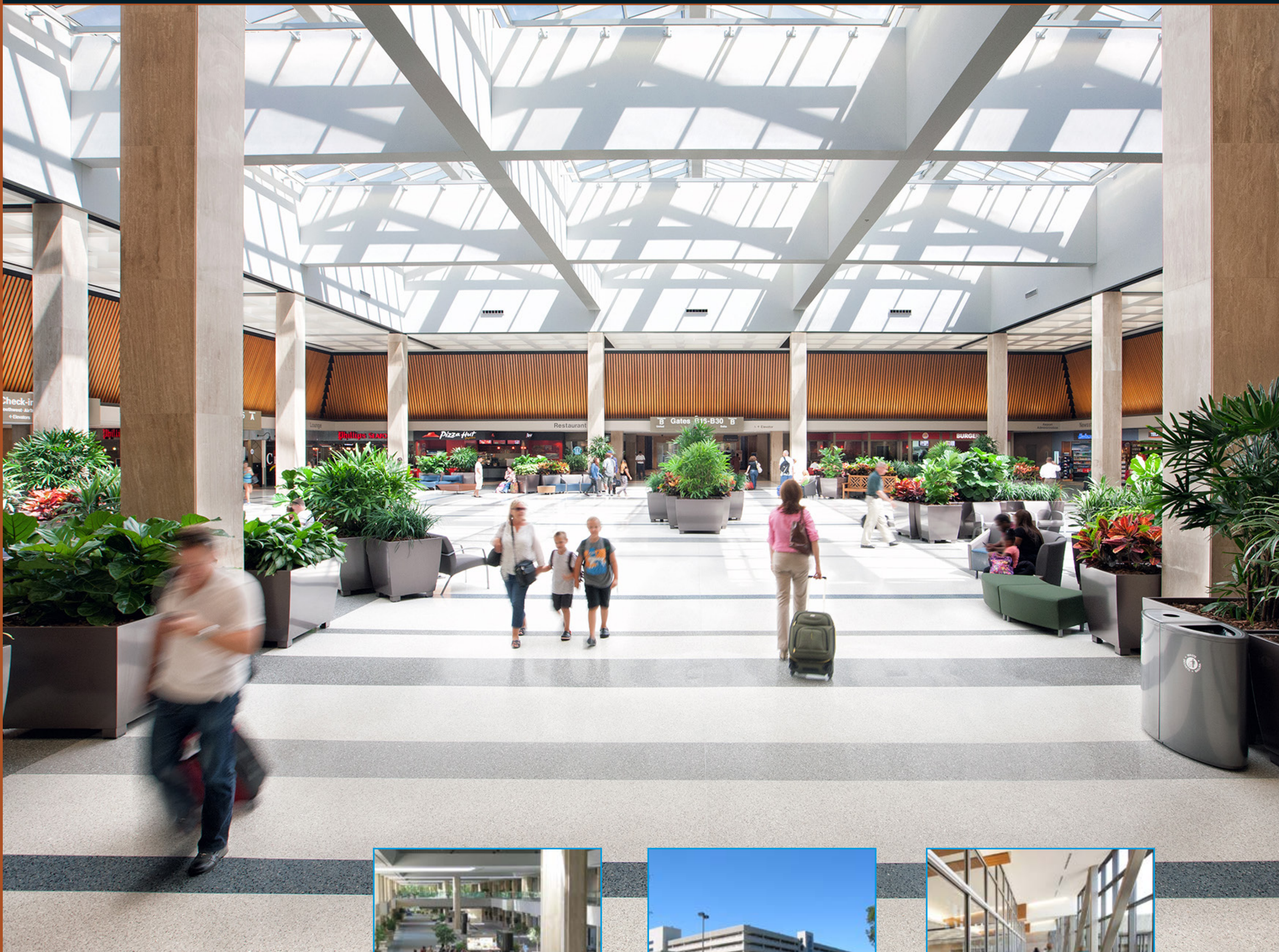
NORFOLK INTERNATIONAL AIRPORT

MASTER PLAN UPDATE



NORFOLK AIRPORT AUTHORITY

CHA

FEBRUARY 2020

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1 INTRODUCTION

The Norfolk Airport Authority ('NAA' or 'the Authority') retained CHA Consulting, Inc. ('CHA') to prepare a Master Plan Update (Study) for the Norfolk International Airport ('ORF' or 'the Airport'). The purpose of the Study was to evaluate the current space utilization and operational characteristics of the airfield, terminal facility, support facilities, ground access, and land development considerations. It was the intent to consider all alternatives that could be developed for the best use of space and logical guidance provided for the continued improvements necessary to accommodate projected aviation activity in a logical and financially-feasible manner throughout the 20-year planning period.

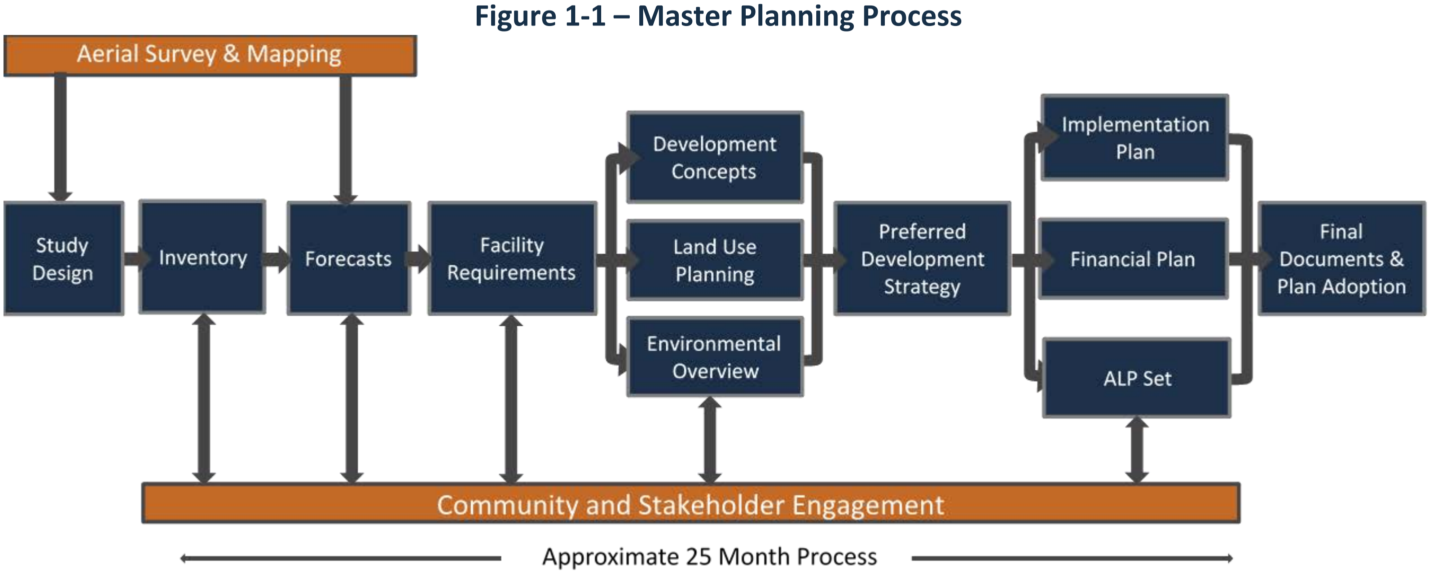
This introductory chapter provides a description of the project and a background overview of the Airport and its facilities. Additional information about the Airport and the Study can be found on its website at www.norfolkairport.com/about-us/master-plan-update. The Airport's website has destination and flight information, airport maps, driving directions, ground transportation, and parking information.

1.1 PROJECT DESCRIPTION

An airport master plan is a comprehensive study of an airport that is conducted via a systematic process that evaluates existing facility and market conditions, identifies anticipated stakeholders' needs, and formulates short-, medium-, and long-term development plans to meet future aviation demand. The process, methods, and ultimate products are guided by Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5070-6B, *Airport Master Plans*. Consistent with this guidance, the process followed for preparing the ORF Master Plan Update is outlined in **Figure 1-1**.

It is important to note that since this Study encompassed 2+ years to complete, some information contained in the inventory may not match existing conditions in early 2020. Data considered to be critical to the recommendations generated herein have been updated; however, updating all existing conditions to be consistent with those in early 2020 is beyond the project scope.

Figure 1-1 – Master Planning Process



1.1.1 Purpose and Objectives

The purpose of this Study is to provide long-term guidance for continued airport improvements necessary to satisfy projected aviation demand in a logical and financially-feasible manner. Consistent with this purpose, the Authority has indicated that the goals and objectives of the Study should include, at a minimum, the following:

- Airfield safety and standards, such as Runway Safety Areas (RSAs), Runway Protection Zones (RPZs), etc.
- Airfield considerations with a focus on the runway/taxiway system to meet the long-term needs of ORF's users
- Key terminal building planning issues, such as functional, safety, security, aesthetic, sustainability, and economic concerns
- Land use/economic development issues, such as infrastructure, access, and best use
- Surface access/parking considerations
- Environmental considerations, including air quality, storm water management, and sustainability
- Financial viability of recommended actions

In addition to addressing these objectives, this study will also fulfill the broad master planning goals set forth by the FAA in AC 150/5070-6B *Airport Master Plans*. These goals are:

- Document issues that the proposed development will address.
- Justify the proposed development through the technical, economic and environmental investigation of concepts and alternatives.
- Provide an effective graphic presentation of the development of the Airport and anticipated land uses in the vicinity of the Airport.
- Establish a realistic schedule for the implementation of the development proposed in the study, particularly the short-term capital improvement program.
- Propose an achievable financial plan to support the implementation schedule.
- Provide sufficient project definition and detail for subsequent environmental evaluations that may be required before the project is approved.
- Present a plan that adequately addresses the issues and satisfies local, state, and Federal regulations.
- Document policies and future aeronautical demand to support municipal or local deliberations on spending, debt, land use controls, and other policies necessary to preserve the integrity of the Airport and its surroundings.
- Set the stage and establish the framework for a continuing planning process. Such a process should monitor key conditions and permit changes in plan recommendations as required.

1.1.2 Public and Stakeholder Involvement Program

Public and stakeholder involvement is an integral part of any significant airport planning study, as it encourages information-sharing and collaboration among the community and airport stakeholders that hold a collective interest in the outcome of the Study. For the purpose of this study, stakeholders include the airport sponsor, airlines, tenants, users and travelers, local businesses, military interests, residents, resource agencies, elected and appointed officials, and the general public. During the Study, a variety of forums, such as committees, public information meetings/workshops, and public awareness campaigns, were necessary to mitigate setbacks that may arise from having a large, diverse stakeholder group.

For this Study, a Planning Advisory Committee (PAC) was established. The PAC consisted of technical level representatives of the Authority, airlines, airport tenants, general aviation users, the FAA, the Virginia Department of Aviation (DOAV), the U.S. Department of Defense (DOD), and other key agencies and interest groups. In addition, the PAC included representation from local municipalities, regional planning agencies, economic development organizations, land use and transportation planning groups, business-related organizations, and local neighborhood groups from Norfolk, Virginia Beach, and surrounding areas. The PAC was asked to provide guidance and advice on technical and local issues and also reviewed working papers at various milestones throughout the course of the project to ensure that all relevant issues were adequately addressed. The PAC was also asked to provide broad input and insight on non-technical issues affecting the community.

Three PAC meetings were held throughout the duration of the program as part of a coordinated series of meetings at key decision points in the study process. In addition to the PAC meetings and project meetings, other forms of stakeholder involvement utilized during this Study included two individual meetings on technical issues with the airlines, FAA, DOAV, DOD, and other key stakeholders, as well as three briefings for the Airport Authority Board and one briefing for special interest groups. The Airport Authority Board briefings covered topics of special concern or interest to the Authority. The purpose of the public meetings and workshops was to provide opportunities for the Authority to engage the public in purposeful conversation about the Airport and Master Plan Update. These meetings were conducted in an ‘open house’ format with interactive information stations staffed by Airport personnel and the consultant team. Other briefings were organized with key agencies, stakeholders, or public officials as needed for various topics. A Master Plan Update website, located on the Authority’s website, was made available to enable the public to conveniently access project specific information in a narrative and graphical format throughout the Study’s duration. **Table 1-1** lists each of the key involvement briefings, workshops, and meetings carried out and planned during the Study process.

Table 1-1 – NPIAS Airport Classifications

Meeting	Date
Project Kickoff Meeting	9/7/2017
PAC Meeting #1 (PAC Kick-Off)	1/24/2018
Board Briefing #1 (Inventory & Preliminary Forecast)	5/24/2018
PAC Meeting #2 (Inventory & Preliminary Forecast)	5/30/2018
Public Meeting #1 (Inventory & Preliminary Forecast)	5/30/2018
Briefings for Special Interest Groups (CBDA)	9/18/2018
State of the Airport Meeting (2018)	10/18/2018
Board Briefing #2 (Recommended Forecast & Facility Requirements)	6/27/2019
Board Working Session (Development Concepts)	7/31/2019
Public Meeting #2 (Facility Requirements & Development Concepts)	9/12/2019
PAC Meeting #3 (Facility Requirements & Development Concepts)	9/16/2019
State of the Airport Meeting (2019)	10/23/2019

Source: CHA, 2020.

1.2 AIRPORT BACKGROUND

Understanding the background of an airport and the region it serves is essential in making informed decisions pertaining to airport-related improvements. This section discusses ORF in the context of its location, service area, history, and role in the National Airspace System (NAS).

1.2.1 History

Norfolk International Airport can be traced back to the 1920s when World War I veteran, Ben Epstein, began operating an air taxi service between Norfolk and Richmond, Virginia, along with the first daily scheduled air service in the area by Ludington Lines and Eastern Airlines.

In 1938, the present Airport was opened after the city-owned golf course was converted to a municipal airport with a 3,500-foot runway. One airline operated at the airport when it opened, utilizing the renovated golf clubhouse as a passenger terminal.

In the 1940s, like many airports at the time, Norfolk Municipal Airport served as a vital resource to the war efforts of World War II, with the Army Air Corps assuming control of airport operations between 1942 and 1947. As a result, the 3,500-foot runway was extended, and two additional runways were developed to accommodate the increase in air traffic and size of aircraft. The Army Air Corps released control of airport operations after the war concluded, instigating new airlines to begin providing service to-and-from Norfolk, Virginia.

In 1948, the Airport began construction of a modernized terminal building, with construction concluding in 1951. In 1950, the newly established Norfolk Port and Industrial Authority (NPIA), which would become the Norfolk Airport Authority (NAA) in 1988, was given responsibility for the Airport. Air service continuously grew during the 1960s as propeller driven aircraft were replaced by jets, persuading the NPIA to change the Airport's name to Norfolk Regional Airport. The growth prompted the Airport to build a new terminal facility in the 1970s and change the Airport's name to Norfolk International Airport. The first portions of the present-day passenger terminal opened in 1974.

Additional changes occurred at the Airport in the 1980s, including the completion of a new fixed-base operator (FBO) and general aviation (GA) facilities, a new air cargo terminal, and an expansion of airport parking facilities. Changes to the Airport continued throughout the 1990s, with expansions to the air cargo terminal and renovations to public areas of the passenger terminal. In 1990, a 10-gate extension to Concourse B was completed. On January 22, 1995, a new Air Traffic Control Tower began operation. In the early 2000s, the Airport's Arrivals Terminal underwent construction. From 2000 to present day, the Airport has added new concessions, built new Aircraft Rescue and Firefighting (ARFF) facilities, and implemented renovations to the terminal building and general aviation facilities. As of May 2018, ORF owns 1,300 acres of land[1], approximately 212 acres of which are located outside of the ORF operational area.

Source: USGS Geology Survey (left), Norfolk International Airport (right)

1.2.2 Location and Service Area

Norfolk International Airport is a major airport for Southeastern coastal Virginia and northeastern North Carolina. As shown in **Figure 1-2** and **Figure 1-3**, the Airport is within 12 miles of downtown Norfolk and is located one mile east of Interstate I-64. As the primary commercial service airport in the America's First Region, which is tied to the Hampton Road's Partnership (a public-private partnership for economic development), the Airport's service area extends beyond Norfolk and into other parts of Virginia and northern North Carolina. ORF's location, regarding time[2] and distance in nautical miles (nm), in comparison to other major airports is as follows:

- Newport News/Williamsburg International Airport (PHF) – 20 nm; 40-minute drive; northwest of ORF
- Richmond International Airport (RIC) – 65 nm; 90-minute drive; northwest of ORF

The Airport is located within the Virginia Beach-Norfolk-Newport News VA-NC Metropolitan Statistical Area (MSA). The MSA, with a population of approximately 1.7 million people (Woods & Poole Economics, Inc., 2017), consists of the following cities and counties:

- Cities in Virginia – Chesapeake, Franklin, Hampton, Newport News, Norfolk, Poquoson, Portsmouth, Suffolk, Virginia Beach, and Williamsburg

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[1] Norfolk Airport Authority, "Norfolk International Airport History," Norfolk International Airport website, https://www.norfolkairport.com/about-us/mission-history, accessed November 15, 2017.

[2] Drive times may be impacted during certain times of the day due to traffic congestion and/or construction activity.

- Counties in Virginia – Gloucester, Isle of Wight, James City, Mathews, Southampton, and York
- Counties in North Carolina – Camden, Chowan, Currituck, Hertford, Pasquotank, and Perquimans

1.2.3 Airport Role

In addition to connecting the America's First Region to the global transportation network, the Airport plays a significant role in the nation's air travel system. The National Plan of Integrated Airports Systems (NPIAS) identifies existing and proposed airports that are important to national air transportation and provides a forward-looking estimate of the type and cost of Airport Improvement Program (AIP)-eligible development needed to meet the needs of civil aviation. Airports included in the NPIAS are considered significant to national air transportation and are eligible to receive grants under the FAA's Airport Improvement Program (AIP).

The NPIAS further categorizes the nation's airports based on types of service provided and quantity of passengers enplaned. In the 2017 to 2021 NPIAS, ORF is classified as a small-hub primary commercial service airport. Small hubs are defined as airports that enplane 0.05 percent to 0.25 percent of total U.S. passenger enplanements. The 72 small hub airports account for nine percent of all U.S. enplanements. **Table 1-2** outlines the specifics of each NPIAS category and provides examples of each type in the region.

Table 1-2 – NPIAS Airport Classifications

Airport Classifications		Hub Type: % of Annual Passenger Boardings	Example Airport
Commercial Service: *Publicly owned airports that have at least 2,500 passenger boardings each calendar year and receive scheduled passenger service*	**Primary**: *Have more than 10,000 passenger boardings each year*	**Large Hub**: *1% or more*	Ronald Reagan Washington National Airport (DCA) Washington Dulles International Airport (IAD)
		Medium Hub: *At least .25%, but less than 1%*	Pittsburgh International Airport (PIT)
		Small Hub: *At least .05%, but less than .25%*	**Norfolk International Airport (ORF)**
		Non-hub Primary: *More than 10,000, but less than .05%*	Newport News/Williamsburg International Airport (PHF)
	Non-primary	**Non-primary Commercial Service**: *At least 2,500, and no more than 10,000*	Shenandoah Valley Regional Airport (SHD)
Non-primary (*Except Commercial Service*)		**Reliever**	Chesterfield County Airport (FCI)
		General Aviation	Chesapeake Regional Airport (CPK)

Source: FAA 2017-2021 NPIAS Report.

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Figure 1-**2**
Location Map

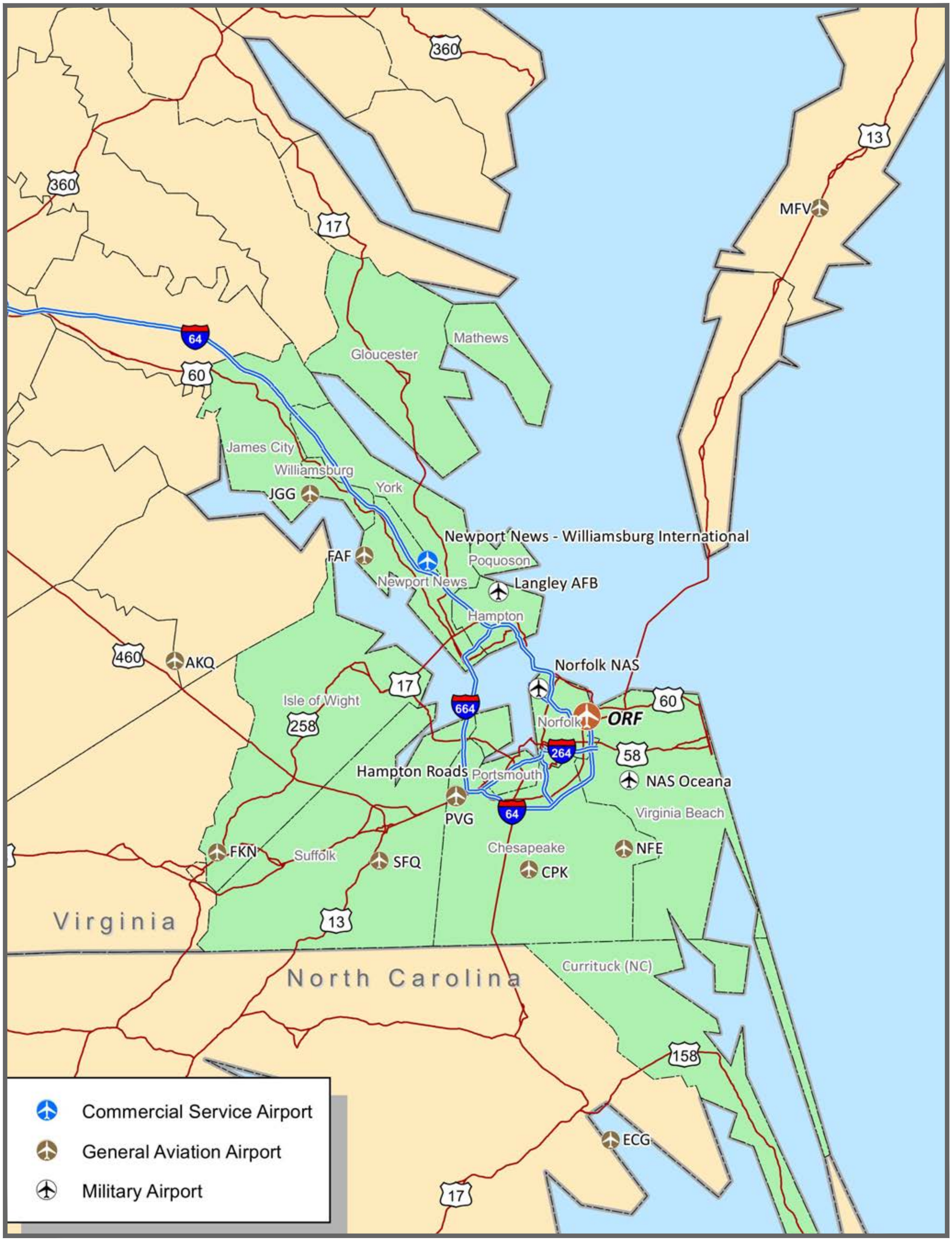

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Figure 1-3
Vicinity Map

1.3 AIRPORT GOVERNANCE

The NAA is a political subdivision of the Commonwealth of Virginia and is an independent agency of the City of Norfolk. The Authority is governed by a Board of Commissioners consisting of up to nine members appointed by Norfolk City Council for four-year terms, as well as an Executive Director that manages routine operations at the Airport. The Board is made up of representatives from various organizations and backgrounds.

1.4 MAJOR AIRPORT TENANTS

The Airport hosts a variety of aviation and non-aviation tenants that provide services to the traveling public and aviation community. The major tenants include the airlines, air cargo operators, FBO/GA facilities, a Maintenance Repair and Overhaul (MRO) facility, concessionaires, and rental car companies.

1.4.1 Passenger Airlines

At the commencement of the Study, ORF was ranked as the 70th largest primary airport in the United States in passenger arrivals and 72nd in passenger departures, serving over three-million passengers annually. Six airlines provide scheduled passenger service at the Airport. When the Study began, these airlines at ORF offered daily, non-stop service to 23 domestic destinations[3], as depicted in **Figure 1-4** and **Table 1-3**. Domestic service is primarily to key markets and hubs in the Northeast, Midwest, and South, as well as leisure markets in Florida.

The commercial passenger service airlines at ORF are:

Allegiant Air (Allegiant)

American Airlines (American)

Delta Air Lines (Delta)

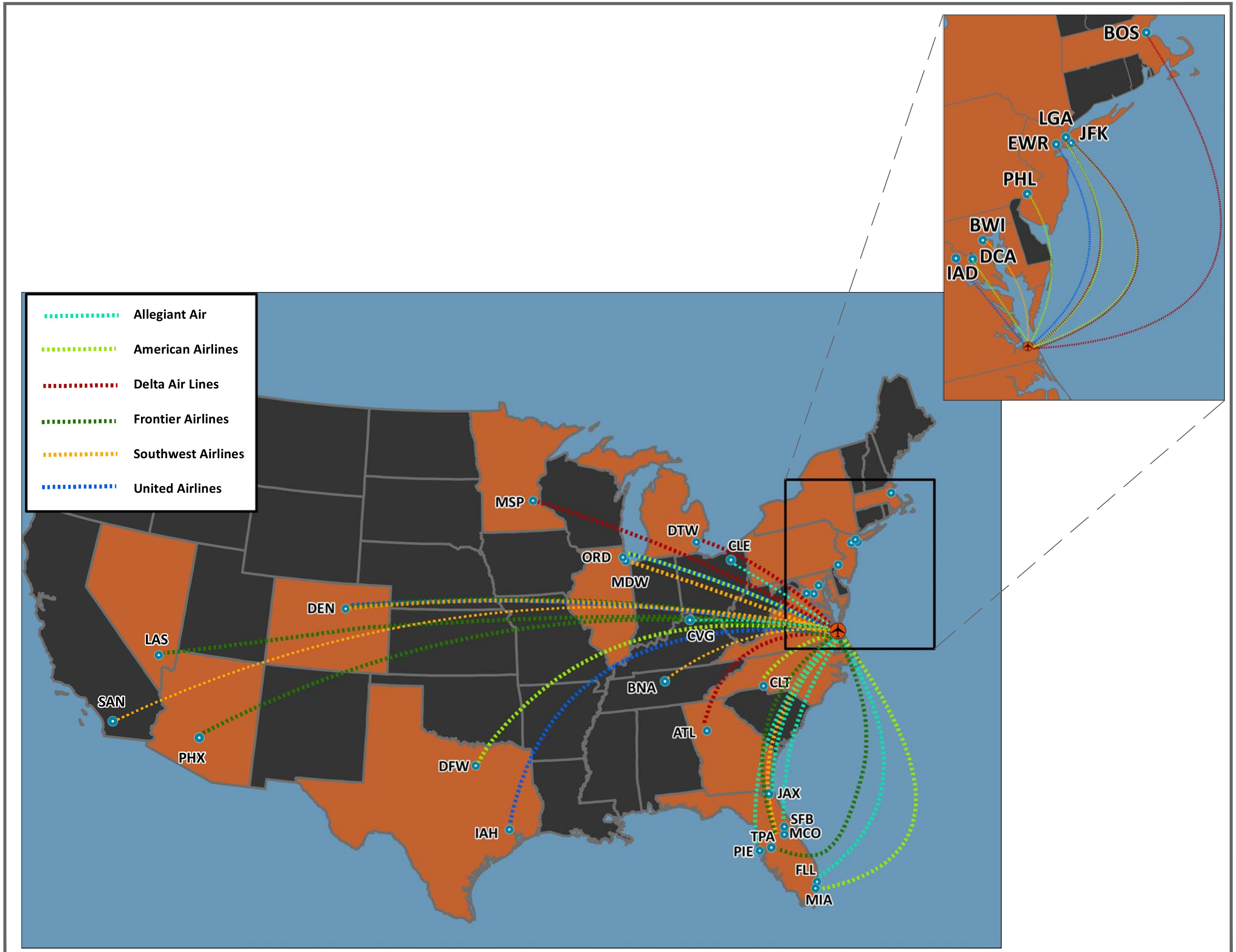
Frontier Airlines (Frontier)[4]

Southwest Airlines (Southwest)

United Airlines (United)

[3] Additional destinations have been added since the development of the Inventory.

[4] Services began in August 2018.



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NOT TO SCALE

Figure 3-6

ORF Non-Stop Route Map

*The map has been updated since completion of the Inventory to include recent service announcements (as discussed in **Chapter 3**, **Table 3-5**).

Table 1-3 – Non-Stop Air Service Destinations

Airlines	Destinations
Allegiant	Fort Lauderdale-Hollywood International Airport (FLL), Jacksonville International Airport (JAX), St. Pete-Clearwater International Airport (PIE), Orlando Sanford International Airport (SFB)
American	Charlotte Douglas International Airport (CLT), Ronald Reagan Washington National (DCA), Dallas/Fort Worth International Airport (DFW), John F. Kennedy International Airport (JFK), LaGuardia Airport (LGA), Miami International Airport (MIA), Chicago O'Hare International Airport (ORD), Philadelphia International Airport (PHL)
Delta	Hartsfield-Jackson Atlanta International Airport (ATL), Boston Logan International Airport (BOS), Detroit Metropolitan Wayne County Airport (DTW), John F. Kennedy International Airport (JFK), LaGuardia Airport (LGA), Minneapolis-St. Paul International Airport (MSP)
Frontier	Denver International Airport (DEN), Orlando International Airport (MCO)
Southwest	Baltimore Washington International Airport (BWI), Orlando International Airport (MCO), Chicago Midway International Airport (MDW)
United	Denver International Airport (DEN), Newark Liberty International Airport (EWR), Washington Dulles International Airport (IAD), George Bush Intercontinental Airport (IAH), Chicago O'Hare International Airport (ORD)

Note: Destinations presented represent those at the time the Inventory was developed. Additional service routes have since been added but are not reflected in this table.
Source: Airline Tenants, 2017.

1.4.2 Air Cargo Operators

ORF has two dedicated air cargo terminals and includes an aircraft parking apron dedicated to the loading and unloading of aircraft. The Airport has several types of air cargo activities being conducted including small freight operations (belly cargo), dedicated freight operations (cargo integrators, i.e., UPS, FedEx), and other all-cargo freight forwarding services. Most domestic passenger airlines listed in **Section 1.4.1** have transport cargo on scheduled passenger flights using the spare volume in the aircraft's baggage hold, or belly, that is not being used for passenger luggage. These operations include air freight and airmail services.

The cargo airlines that have regular operations at ORF include:

Federal Express (FedEx)

Mountain Air Cargo (MAC)

United Parcel Service (UPS)

FedEx and UPS are known as integrated carriers. Integrated carriers are companies that transport cargo via air, as well as ground-vehicular methods, such as delivery through the United States Postal Service (USPS). Mountain Air Cargo (MAC) provides cargo flight and maintenance services in the eastern half of the United States and Caribbean Islands and is a contract carrier for FedEx.

1.4.3 Fixed-Base Operator (FBO)

Signature Flight Support, previously Landmark Aviation, is the single full-service FBO providing aviation services and amenities to the airlines, GA users, and pilots operating out of ORF. Signature Flight Support is the world's largest FBO and distribution network for business aviation services. A summary of the services offered by Signature includes aircraft fueling, deicing, maintenance, ground handling, hangar storage, and tie-down areas, as well as a business center, conference rooms with conference call capabilities, crew transportation services and capabilities, and crew rooms and rest areas.

Source: Signature Flight Support.

1.4.4 Maintenance, Repairs, and Overhaul (MRO)

The maintenance of aircraft is strictly regulated to ensure aircraft are meeting the requirements set forth to ensure airworthiness and safety while transporting passengers and cargo. The MRO facility at ORF, located in the general aviation area, is leased to PSA Airlines.

Source: Google Earth.

1.4.5 Military

ORF does not have any designated Military facilities on the airfield; however, the Airport does recognize military personal through various services and facilities. On the second level of the Arrivals Terminal above baggage claim, active duty and retired military, as well as their families can utilize the Airport's United Service Organizations (USO) Welcome Center. Military personnel also receive discounts on ground transportation services at the Airport, as well as discounts at all of the Airport's retail shops and restaurants. The airlines providing services at ORF often extend discounted rates, per airline policy, to active duty military personnel and their dependents.

1.4.6 Rental Car Companies

Eight rental car companies provide services at ORF, along with one off-site service provider. Each on-site company has a separate counter in the Arrivals Terminal, dedicated ready parking in the parking garage, and return parking on the second level of Garage A. Quick Turn Around (QTA) services and vehicle maintenance for all rental car companies are handled off-site on Military Highway. The rental car operators at ORF have indicated that this split operation has created efficiency and safety issues, warranting some attention in future planning.

The rental car companies operating at ORF are:

Alamo

Avis

Budget

Dollar Rent a Car

Enterprise

Hertz

National

Thrifty

Payless (Off-Site)

1.4.7 Concessionaires

Concessionaires at an airport provide travelers in the sterile and non-sterile/non-secured areas (defined in **Section 1.4.8**), as well as meeters/greeters in the non-sterile area, with amenities such as restaurants / food vendors, newsstands, gift shops, and foreign currency exchange.

The following concessionaires operate at ORF:

HMS Host

Hudson Group

Travelex

1.4.8 Department of Homeland Security

The Department of Homeland Security provides ORF with services from the Transportation Security Administration (TSA), as well as Customs and Border Protection (CBP). Airports and airlines are required to meet security regulations established in Title 49 Code of Federal Regulations (CFR) Part 1542, *Airport Security,* and Title 49 CFR Part 1540, *Civil Aviation Security: General Rules*. As set forth in Title 49 CFR Part 1540.5, the "sterile area" refers to the most restrictive areas of the Airport (e.g. the concourses) and cannot be accessed by the public or badged personnel until being processed through security measures specified in 49 CFR Part 1542. "Secured areas" are areas outside the concourse that are accessible only to badged personnel (proximity of baggage makeup and aircraft parking). "Non-sterile/non-secure areas" do not have regulated security measures and are accessible to the general public. The Security Identification Display Area (SIDA), means that all personnel must display a SIDA badge issued by ORF. SIDA areas can include non-secure areas, as well as the airfield.

CBP is responsible for processing international passengers and baggage arriving at the Airport from international airports that do not have pre-screening facilities. CBP does not process passengers departing the Airport. Airlines are responsible for adequately screening passengers prior to departure.

1.5 STUDY FOCUS AREA

The ORF Master Plan Update encompasses the current utilization and operational characteristics of the Airport, which includes the passenger terminal complex, general aviation facilities, landside facilities, ground access, the airfield and airfield support areas, and future land development areas. The study focus area is bounded by the following:

- North – Norview Avenue
- Northeast – Airport Parking Departure Road and the Norfolk Botanical Garden
- East – Lake Whitehurst and U.S. 60
- South – Miller Store Road
- West – Military Highway (from Hampton Roads Beltway to Croft Street)
- Northwest – Robin Hood Road (east of Gurley Street) and Airport Road

2 INVENTORY OF FACILITIES AND EXISTING CONDITIONS

The initial step in the master planning process was to develop an inventory of the existing physical conditions and operational characteristics of the Airport and its surroundings. The information presented in this chapter was the basis for evaluating the Airport's existing and future facility requirements. The following elements are detailed in this chapter:

- Airfield
  - Airport Design Criteria
  - Runway System
  - Taxiway System
  - Aircraft Parking Aprons
  - Airfield Markings
  - Airfield Signage
  - Airside Pavement Condition
- Navigational Aids (NAVAIDs) and Instrument Procedures
  - En-Route NAVAIDs
  - Standard Terminal Arrival Routes
  - Types of Instrument Approach Procedures and Instrument Approach NAVAIDs
  - Standard Instrument Departures
  - Airfield Lighting
- Terminal Facility
  - Terminal Facility Layout
  - Terminal Building Functional Areas
  - Airline Ticketing Lobby
  - Checked Baggage Screening
  - Passenger Security Screening
  - Airline Gates and Holdrooms
  - Terminal Concessions and Amenities
  - Baggage Claim
  - Rental Car Counters
  - Airport Administrative and Support Areas
  - Airline Service and Support Areas
  - Concession Storage and Support Areas
  - Back Office Space
  - Federal Inspection Services (FIS)
  - Terminal Signage and Wayfinding
- Automobile Access and Parking
- Support Facilities
  - Airport Perimeter Fence
  - Airport Equipment Storage and Maintenance
  - Air Traffic Control Tower (ATCT)
  - Aircraft Rescue and Firefighting (ARFF)
  - Aircraft Fueling
  - Snow and Ice Control
  - Air Cargo Facilities
  - General Aviation (GA) Facilities and Activities
  - MRO Facility
  - Rental Car Facilities
- Airspace Environment
- Meteorological Conditions
  - Local Climate
  - Wind Coverage

2.1 AIRFIELD

The Airport's airside and airfield facilities generally include the facilities located within the airport perimeter fence that are most closely associated with the movement and operation of aircraft, such as taxiing, takeoff, landing, and parking. Additional elements related to airfield activity and infrastructure include the runway and taxiway systems, aircraft parking aprons and hangars, and airfield pavement, markings, signage, lighting, and NAVAIDs. The existing facilities, as well as descriptions of the characteristics and conditions are depicted in **Figure 2-1** and **Figure 2-2**.

Aircraft Landing on Runway 5/23

Source: NAA.

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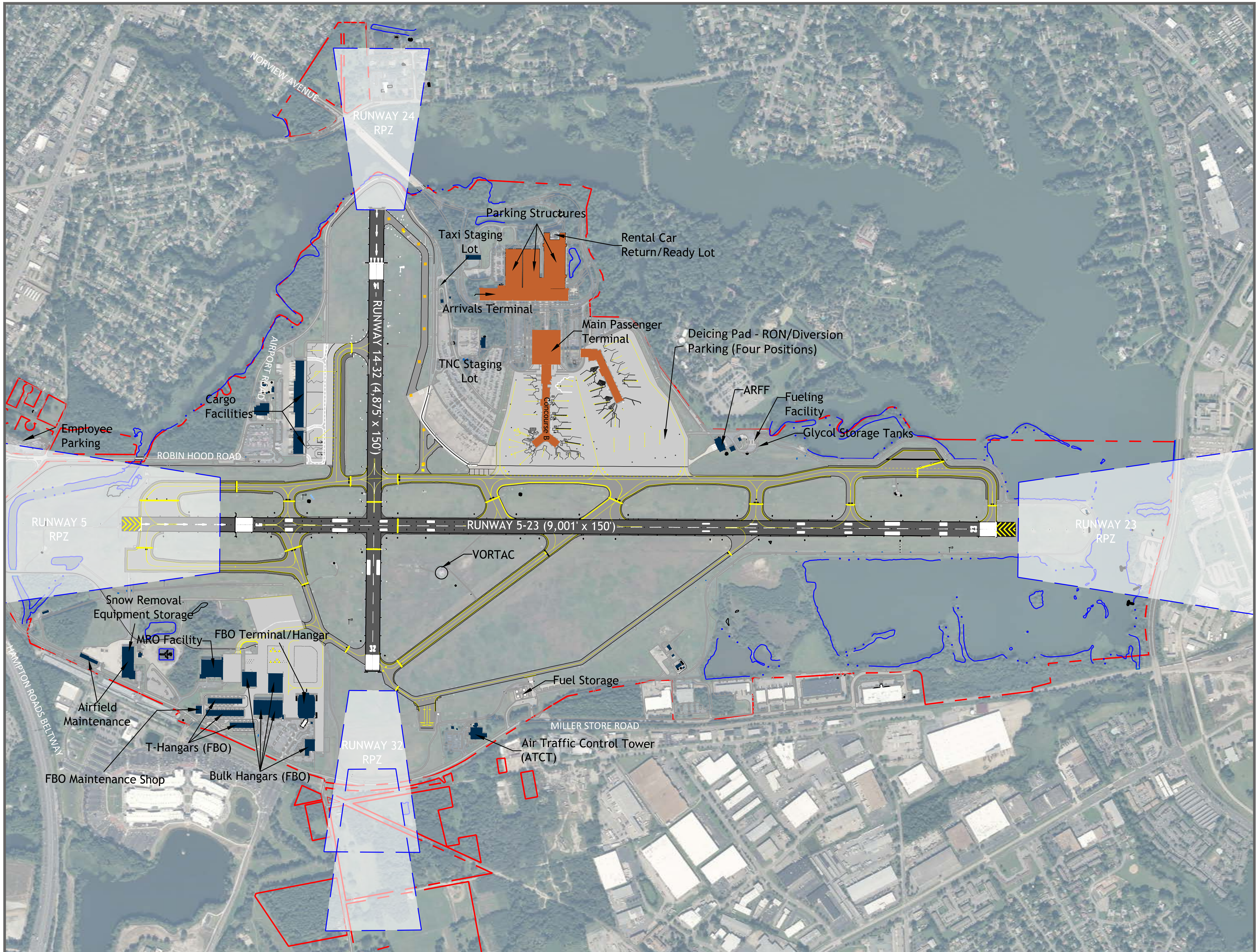

GRAPHIC SCALE (FEET)

0 500 1000

- Property Line
- RPZ
- Permimeter Fence
- Terminal Complex
- Support Facilities
- Runways
- Taxiways
- Aprons

Figure 2-1

Existing Facilities

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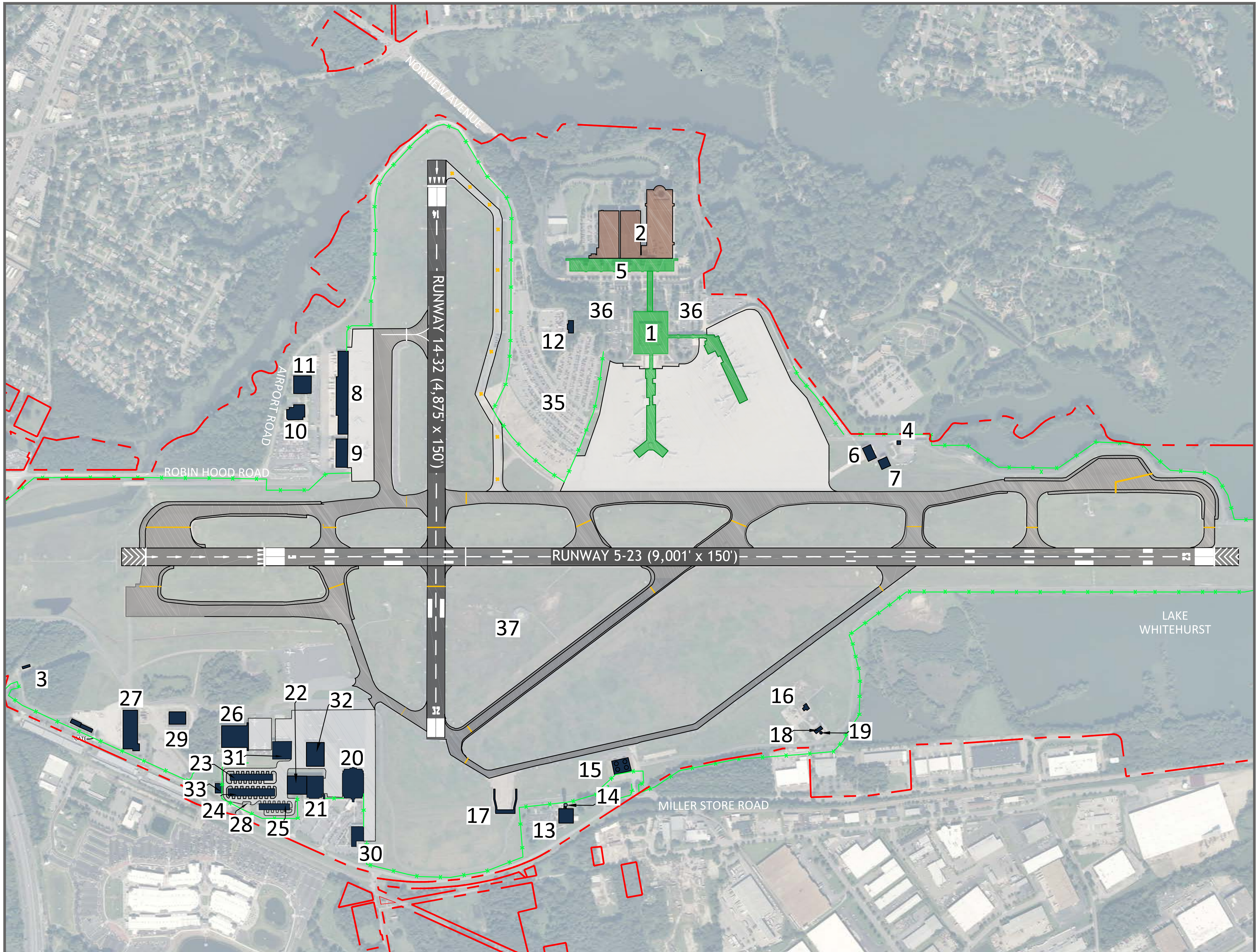


#	Name of Existing Facility
1	Main Terminal Complex
2	Automobile Parking Garage
3	Airfield Lighting Vault
4	Triturator
5	Arrivals Building and Baggage Claim
6	Aircraft Rescue and Firefighting Station
7	ARFF Storage Building
8	Air Cargo Building
9	Air Cargo Building
10	Catering Facility
11	FAA Remote Communications Facility
12	TNC Staging Area
13	FAA Support Building
14	FAA Air Traffic Control Tower
15	Fuel Farm
16	Former FAA Support Buildings (Abandoned)
17	Ground Run-Up Enclosure (GRE)
18	FAA Support Building
19	FAA ASR-9 Radar
20	GA Terminal/Hangar Facility C-1
21	Hangar C-2
22	Hangar C-2
23	T-Hangar Building #1
24	T-Hangar Building #2
25	T-Hangar Building #3
26	Aircraft Maintenance Hangar
27	Airfield Maintenance Facility
28	General Aviation Fuel Farm
29	ARFF Training Facility
30	Hangar C-5
31	Hangar C-3
32	Hangar C-4
33	FBO Maintenance Shop
34	Airfield Maintenance Building
35	Long-Term Parking Lot
36	Short-Term Parking Lot
37	VOR Facility

Figure 2-2
Building Diagram

2.1.1 Airport Design Criteria

The FAA uses a classification system, known as the Airport Reference Code (ARC), to signify the airport's highest Runway Design Code (RDC), the design standards to which the runway is to be built. RDC consists of three components: aircraft approach speed (AAC), airplane design group (ADG) relating to either the aircraft wingspan or tail height (whichever is more restrictive), and visibility minimums. ARC is determined by taking the highest RDC minus the visibility component. It affects runway and taxiway dimensions, separation standards, pavement marking standards, and other safety standards. Furthermore, it is used for planning and design only and does not limit the aircraft that may be able to operate safely at the airport. The relationship between the ARC and design standards is further described in FAA AC 150/5300-13A, *Airport Design*. The characteristics of the RDC are shown in **Table 2-1**.

As previously noted, the ARC is based on an aircraft's approach speed and wingspan or tail height, whichever is most restrictive. The most demanding aircraft is commonly referred to as the critical, or design, aircraft and must account for a minimum of 500 annual itinerant operations. An itinerant operation is the takeoff or landing of an aircraft going from one airport to another, at least 20-miles from each other. The ARC consists of a letter designating the aircraft approach category and a Roman numeral designating the Airplane Design Group (ADG). ORF is currently designated with an ARC D-IV. The critical aircraft at ORF is the Boeing 757-200.

Approach categories A and B include small piston-engine aircraft and corporate jets with approach speeds of less than 121 knots, while categories C, D, and E include larger aircraft with approach speeds of 121 knots or greater (those typically associated with commercial or military use). Similarly, design groups I and II typically include small piston-engine aircraft and light to midsize corporate jets, as well as single- and twin-engine turboprop aircraft. Design groups III, IV, and V include larger corporate jets and the majority of the commercial jet fleet, as well as numerous military aircraft. Design group VI includes very large jets such as the Airbus A380 and the military C-5 transport aircraft.

TDG represents the Taxiway Design Group, which relates to the undercarriage dimensions of the aircraft. Preliminary review of operations data for 2016 indicates that the MD-88 (ADG C-III, TDG IV) is the most demanding passenger aircraft and the B757 (ADG D-IV, TDG IV) is the most demanding cargo aircraft that operates regularly at ORF with over 500 annual operations. The existing and future ARC are analyzed in greater detail in **Chapter 4**, *Facility Requirements*.

Table 2-1 – Airport Reference Code

Approach Categories			
Approach Category	**Airspeed (Knots)**		**Example Aircraft**
A	<91		Beechcraft-E33 Bonanza, Cessna 152
B	91 ≤ 121		CRJ-200, ERJ-135/140/145
C	121 ≤ 141		B737-700W, MD-88
D	141 ≤ 166		A300, B757
E	166+		B-52H, B-2 Spirit
Airplane Design Group			
Design Group	**Tail Height (feet)**	**Wingspan (feet)**	**Example Aircraft**
I	<20	<49	Beechcraft-E33 Bonanza, Cessna 152
II	20-<30	49 ≤ 79	CRJ-700, ERJ-145
III	30-<45	79 ≤ 118	A319, CRJ-900
IV	45-<60	118 ≤ 171	Boeing 757, MD 11
V	60-<66	171 ≤ 214	A300, B757
VI	66-<80	214 ≤ 262	B-52H, B-2 Spirit

Source: FAA AC 150/5300-13 *Airport Design*, CHA, 2017.

2.1.2 Runway System

The existing airfield configuration at ORF consists of two intersecting runways, identified as Runway 5/23 and Runway 14/32. Runway 5/23 is oriented in a northeast/southwest direction, and Runway 14/32 is oriented in a northwest/southeast direction. **Table 2-2** presents the characteristics of each runway.

ORF's primary runway, Runway 5/23, is situated east of the terminal building. The runway is 150 feet wide and has a usable runway length of 8,001 feet, accompanied by a 1,000-foot-long displaced threshold, for a total pavement length of 9,001 feet. It is constructed of both asphalt and concrete, has a grooved surface, and is supplemented by 12.5-foot wide, paved shoulders along the asphalt-paved portion. The runway's load-bearing capacity is 150,000 pounds single-wheel; 200,000 pounds dual-wheel; 350,000 pounds duel tandem; and 475,000 pounds dual double tandem.

Situated south of the terminal building, Runway 14/32 is the Airport's crosswind runway. The runway is 150 feet wide and has a usable runway length of 4,300 feet, with a 575-foot displaced threshold, for a total pavement length of 4,875 feet. It is constructed of asphalt and has a grooved surface. The runway's load-bearing capacity is 75,000 pounds single-wheel and 100,000 pounds dual-wheel.

Table 2-2 – Existing Runway Specifications

	Runway 5/23	Runway 14/32
Runway Length (feet)	9,001	4,875
Displaced Threshold (feet)	1,000	575
Width (feet)	150	150
Runway End Elevation (feet above MSL)	**Runway 5:** 18.1 **Runway 23:** 15.5	**Runway 14:** 18.2 **Runway 32:** 22.1
Pavement Type	Asphalt/Concrete/Grooved	Asphalt/Grooved
Pavement Load Bearing	475,000 lbs. (Dual Double Tandem)	100,000 (Dual-Wheel)
Effective Runway Gradient	0.1%	0.1%
Aircraft Approach Category	D	C
Airplane Design Group	IV	III
Runway Markings	Precision	Non-Precision
Runway and Approach Lighting	HIRL, C/L **Runway 5:** TDZL, PAPI-4, MALSR **Runway 23:** PAPI-4, MALSR	MIRL, REIL **Runway 14:** PAPI-2 **Runway 32:** PAPI-2
Navigational Aids	ILS/DME, RNAV (RNP, GPS)	VOR/DME, RNAV (GPS)
Runway Design Code	D-IV	C-III

Sources: AirNav.com; FAA Form 5010-1, *Airport Master Record-February 2018*, CHA, 2017.

C/L – Centerline Lights
DME – Distance Measuring Equipment
GPS – Global Positioning System
HIRL – High Intensity Runway Lights
ILS – Instrument Landing System
MALSR – Medium-Intensity Approach Lighting System with Runway Alignment Indicator
MIRL – Medium-Intensity Runway Lighting
PAPI-4 – Four-Box Precision Approach Path Indicator
PAPI-2 – Two-Box Precision Approach Path Indicator
REIL – Runway End Identifier Lights
RNAV – Area Navigation
RNP – Required Navigational Performance
TDZL – Touchdown Zone Lights

2.1.3 Taxiway System

An airport's taxiway system connects the runways to aircraft parking aprons, storage hangars and other facilities. ORF has nine operative taxiways. The Airport also utilizes one taxiway holding bay at the Runway 23 approach end. A taxiway holding bay allows standing space for an aircraft that is waiting to receive takeoff clearance or small piston aircraft performing ground run-up procedures to allow aircraft already cleared for takeoff to move to their runway takeoff position. **Table 2-3** provides the characteristics and specifications of each taxiway. **Figure 2-3** displays the existing taxiway system at ORF.

Table 2-3 – Existing Taxiway Specifications

Taxiway	Description	Width (feet)	Airplane Design Group (ADG)	Taxiway Design Group (TDG)	Taxiway Shoulder (feet)
A	Provides access from TWY ‘C’ and from the GA area to RWY 5/23; Provides access from the GA area to RWY 32; Provides access to TWY ‘J’.	75	IV	5	30
B	Provides access from RWY 5/23 to TWY ‘C’ / Terminal Ramp (Highspeed TWY).	75	IV	5	40
C	Parallel to RWY 5/23 and the Terminal Ramp.	75	IV	5	40
E	Provides access from RWY 5/23 to TWY ‘C’	75	IV	5	40
F	Connects RWY 5/23 to RWY 32; Provides access to Ground Run-up Enclosure (GRE)	50	III	3	20
G	Provides access from RWY 5/23 to TWY ‘C’ / Terminal Ramp (Highspeed TWY); Connects RWY 5/23 to TWY ‘F’ and RWY 32.	75	IV	5	40
H	Provides access from RWY 5/23 to TWY ‘C’	75	IV	5	30
J	Partial Parallel to RWY 5/23; Connects TWY ‘A’ and RWY 5	75	IV	5	30
V	Partial Parallel to RWY 14/32 and the Cargo Ramp; Provides access to RWY 14/32 and TWY ‘C’ from the Cargo Ramp	75	IV	5	30

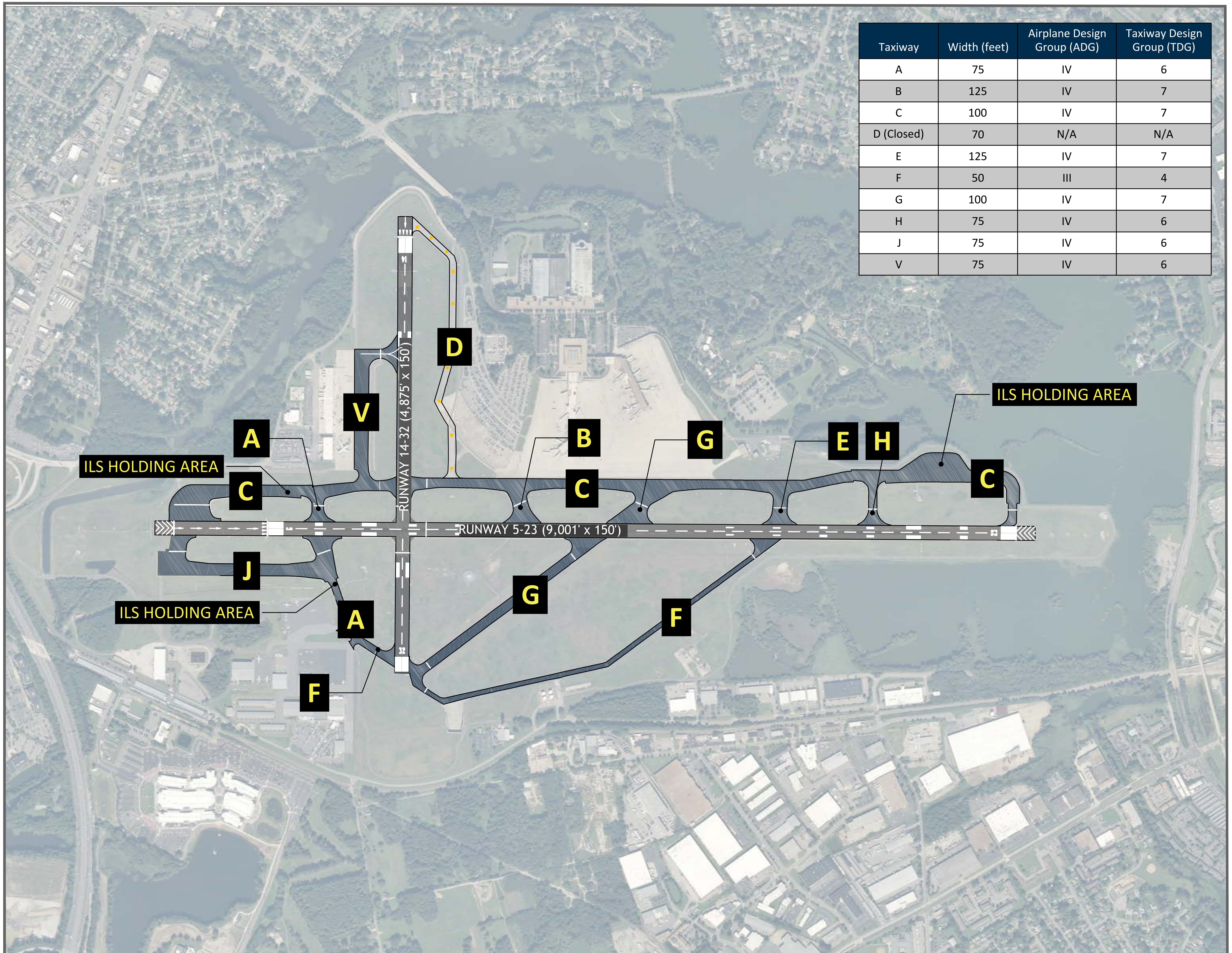
Source: FAA Airport Diagram, AC 150/5300-13A, CHA 2017.

RWY – Runway

TWY – Taxiway

GRE – designated area for mitigating noise disturbance from aircraft running-up engines prior to takeoff

.



Taxiway	Width (feet)	Airplane Design Group (ADG)	Taxiway Design Group (TDG)
A	75	IV	6
B	125	IV	7
C	100	IV	7
D (Closed)	70	N/A	N/A
E	125	IV	7
F	50	III	4
G	100	IV	7
H	75	IV	6
J	75	IV	6
V	75	IV	6

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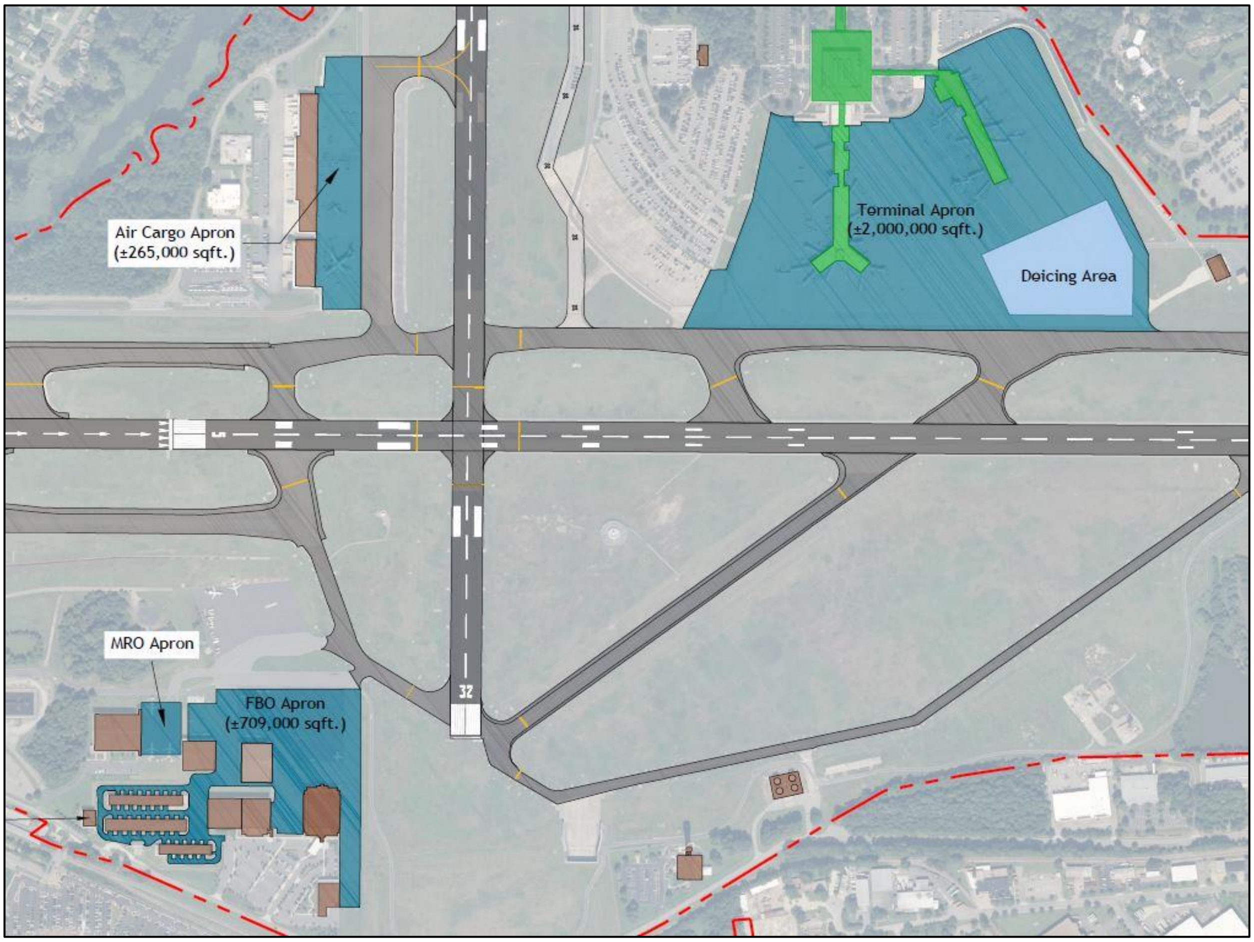
Figure 2-3
Taxiway Configuration

2.1.4 Aircraft Parking Aprons

Airport aprons, also referred to as ramps, provide space for short-term and long-term aircraft parking and deicing operations, as well as the loading/unloading of passengers and goods. As depicted in **Figure 2-4** and described below, ORF has three aprons: a terminal apron, a general aviation/Fixed Base Operator (FBO) apron, and an air cargo apron.

Figure 2-4 – Aircraft Parking Aprons



Source: Norfolk International Airport, CHA 2017.

Terminal Apron

The terminal apron consists of approximately 2,000,000 square feet of cement/concrete pavement. Activities on the terminal apron primarily include passenger airline and belly cargo loading and unloading. The terminal has 23 gate positions. **Table 2-4** provides gate specifications, while a schematic of the gate layout is presented in **Figure 2-5.** Approximately 371,591 square feet of the apron is utilized for gate parking at Concourse A, and approximately 528,842 square feet of the apron is utilized for gate parking at Concourse B. The remainder of the apron is utilized for aircraft maneuvering, Remain Overnight Parking (RON), and aircraft deicing services.

Table 2-4 – Gate Specifications

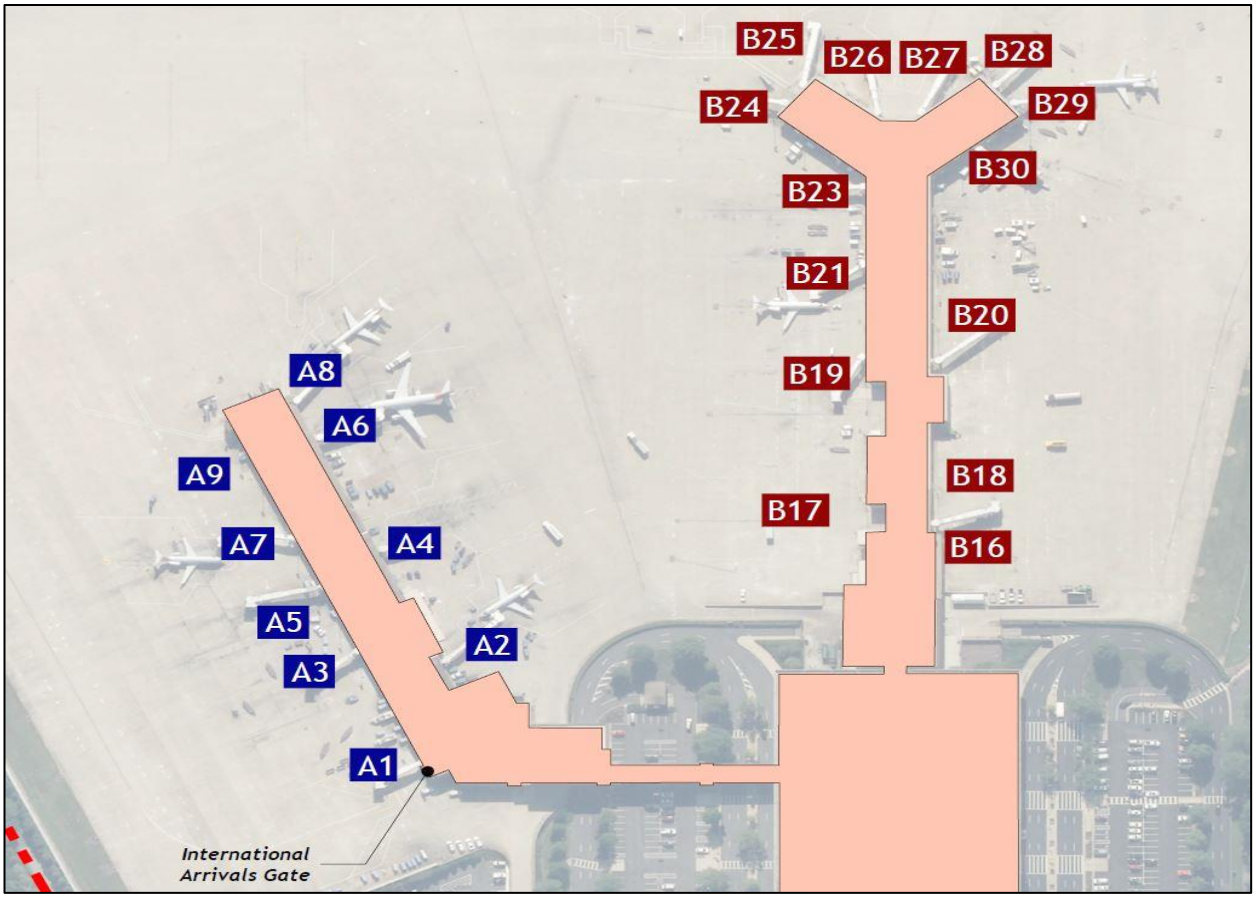
Gate Position	Apron Area (Sq. Feet)	Aircraft Design Group
Gate A1	41,370	III
Gate A2	35,096	III
Gate A3	34,155	III
Gate A4	45,195	III
Gate A5	28,980	III
Gate A6	32,747	III
Gate A7	28,834	III
Gate A8	35,616	III
Gate A9	27,712	III
Gate A (Unassigned)	29,270	III
Gate B16	31,121	II
Gate B17	37,849	III
Gate B18	37,932	III
Gate B19	44,962	III
Gate B20	59,715	III
Gate B21	40,854	III
Gate B23	42,400	III
Gate B24	31,829	III
Gate B25	26,793	III
Gate B26	31,484	II
Gate B27	33,480	III
Gate B28	30,429	II
Gate B29	30,291	III
Gate B30	49,703	III

Source: NAA, 2017.

ADG III (Example Aircraft): A320-200, Boeing 737-300, EMB 170 STD

ADG II (Example Aircraft): CRJ-700, ERJ 145

Figure 2-5 – Gate Layout



Source: Norfolk International Airport, CHA, 2017.

General Aviation (GA) Use Aprons

The GA apron area is broken-up into sections including bulk hangars and T-hangars. The total apron area comprising the GA area is approximately 709,200 square feet. These aprons provide parking for transient aircraft, allow access to the GA facilities and fixed-base operator facilities, and provide space for aircraft tie-downs.

Air Cargo Use Aprons

The air cargo-dedicated area, which is shared by FedEx, Mountain Air Cargo, and UPS, is served by one apron. The apron is used for cargo transfer operations, aircraft storage, and maintenance. The apron, measuring approximately 265,000 square feet, is located on the east side of the cargo facilities and south of Runway 14/32.

Remain Overnight (RON) and Diversion Ramp Parking

At ORF, remain overnight (RON) and diversion parking support operations for commercial and general aviation traffic. RON and diversion parking at ORF vary for each airline. Typically, there are 15 RON aircraft which are parked overnight at gates or designated RON parking stands on the terminal ramp, or in hangars located on the southside of the airfield.

American Airlines typically has six RON aircraft. Two of the aircraft are positioned on the terminal ramp, while the remaining four aircraft park inside hangars in the GA area. Delta Air Lines leases four gates for regularly scheduled arrivals and departures. A fifth gate is leased for overnight operations. Delta utilizes all five gates (Gates B19, B21, B23, B24, & B25) for RON aircraft, with three additional RON aircraft parked on the terminal ramp. Southwest has two RON aircraft that utilize Gates A3 and A5. United regularly has two RON aircraft that each utilize one of United's leased gates (Gates B27, B28, B29, & B30), though this is increasing to five RON aircraft. Allegiant does not have scheduled RON aircraft at ORF.

An aircraft diversion is when an aircraft that was originally intended to fly to a specific airport unexpectedly experiences a situation requiring the pilot to change his or her route to an alternate airport. ORF can accommodate diverted aircraft on a case-by-case basis and, on occasion, provide terminal gate parking if available. When gate parking is not available, the diverted aircraft are parked on the northeast side of the main terminal apron where the RON parking positions and deicing operations are performed during unfavorable weather conditions.

2.1.5 Airfield Markings

FAA AC 150/5340-1L, *Standards for Airport Markings*, provides the standards for surface markings used on airfield roadways and airfield pavements, such as runways, taxiways, and aprons, assuming the surfaces are built in accordance to the standard dimensions and layouts in AC 15/5300-13, *Airport Design* (this excludes privately owned apron areas). The most recent version of this guidance was published in September 2013; however, the FAA released a draft version of FAA AC 150/5340-1M in March 2017 that includes new standards for enhanced taxiway centerline markings, surface-painted hold sign markings and the extension of the runway holding position markings onto the paved shoulders. These standards apply to all airports certificated under Title 14 CFR Part 139, which establishes certification requirements for airports serving scheduled air carrier operations in aircraft designed for more than nine passenger seats but fewer than 31 passenger seats. Examples of airfield markings are provided in **Table 2-5**, **Figure 2-6**, and **Table 2-6**.

Table 2-5 – Runway Markings

Type of Marking	Purpose of Marking
Designation	Numbers and letters are determined from approach direction; labeled according to Compass Rose
Centerline	Identifies the center of the runway; Provides alignment guidance during takeoff and landings
Threshold	Delineates the beginning of the runway that is available for landing
Aiming Point	Serve as a visual aiming point for a landing aircraft, located approximately 1,000 feet from the landing threshold
Touchdown Zone	Identify the touchdown zone for landing operations and are coded to provide distance information in 500 feet increments
Runway Edge Marking	Define the edge of the usable, full-strength surface

Figure 2-6 – Runway Markings

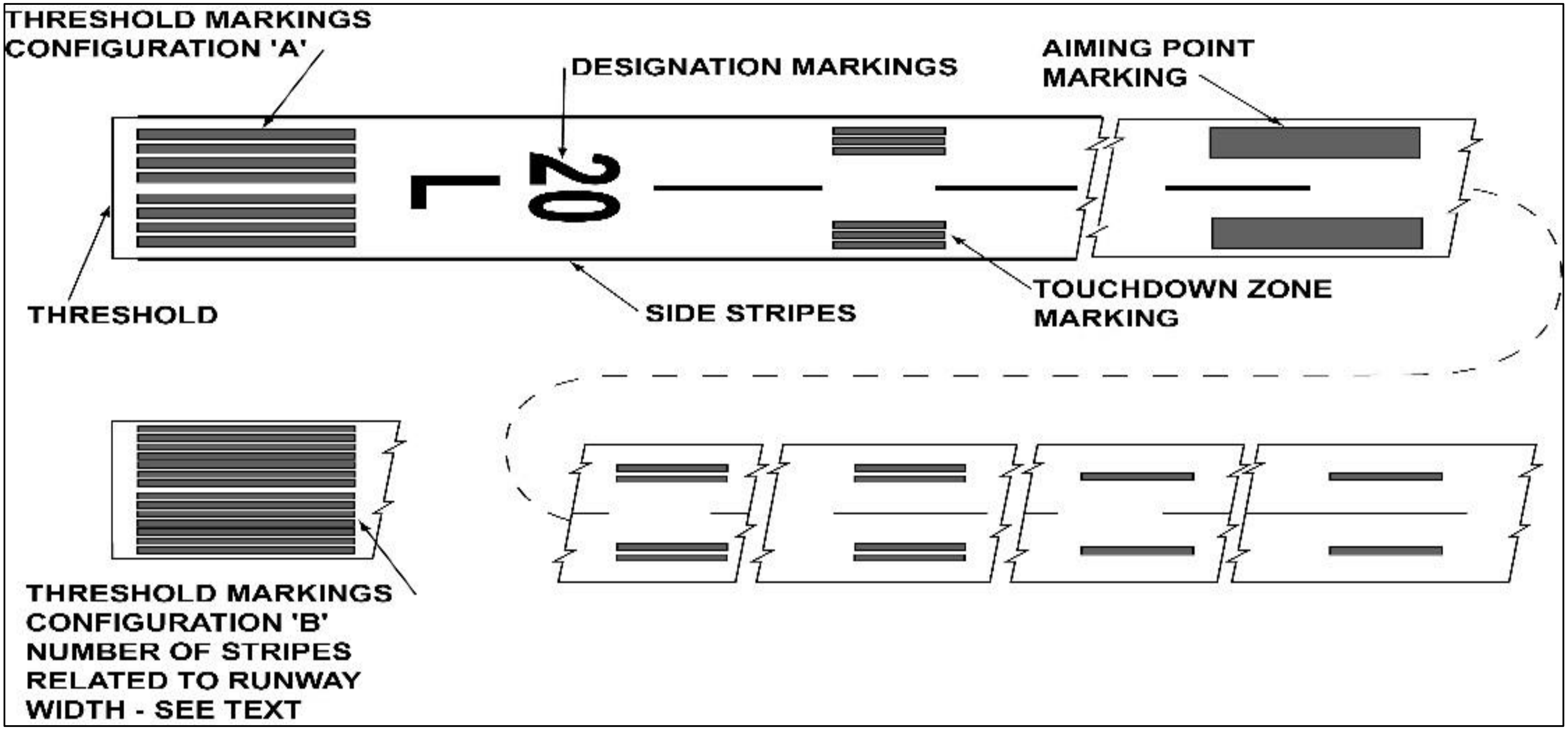
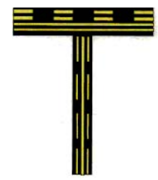
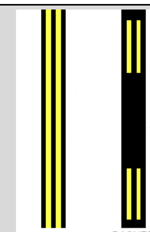
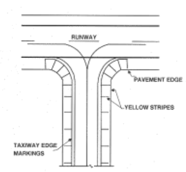
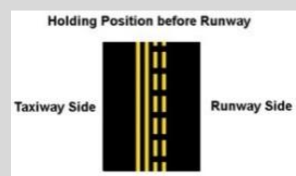
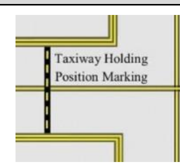


Table 2-6 – Taxiway Markings

Type of Marking	Purpose of Marking	Visual Representation of Marking
Normal Centerline	Provides a visual cue to permit taxiing along a designated path	
Enhanced Centerline	Intended to warn the pilot that he/she is approaching a runway holding position marking and should prepare to stop unless he/she has been cleared onto or across the runway by ATC; Usually at larger, commercial service airports	
Edge Markings	Continuous- Define the taxiway edge from the shoulder or other abutting paved surface not intended for use by aircraft; Dashed- Defines the taxiway edge from the adjoining pavement intended for use by aircraft	
Shoulder Markings	Identifies paved shoulders (areas intended to prevent blast and water erosion); not intended for use by aircraft (may not be full-strength pavement)	
Runway Holding Position	Indicate where an aircraft is supposed to stop when approaching a runway	
Taxiway/Taxiway Intersection	Indicate where an aircraft is supposed to stop when approaching intersecting taxiways	

2.1.6 Airfield Signage

According to Title 14 CFR Part 139.311, *Marking, Signs, and Lighting*, each certificate holder, such as ORF, must provide and maintain sign systems for air carrier operations on the airport that are authorized by the Administrator and consist of at least the following:

- Signs identifying taxiing routes on the movement area.
- Holding position signs.
- Instrument Landing System (ILS) critical area signs.

The holding position signs, as well as the ILS critical area signs, must be internally illuminated. FAA AC 150/5340-18F, *Standards for Airport Sign Systems*, contains all regulations pertaining to airfield signage for Part 139 airports, while specifications are contained in AC 150/5345-44K, *Specifications for Runway and Taxiway Signs*. A further description of typical airfield signage is included in **Table 2-7**. See AC 150/5340-18F's Glossary of Sign Types for additional sign type descriptions.

Upon visual inspection, lighted airfield signage currently found on ORF's airfield consists of all required signage for a Part 139 certificated airport including airfield location signage, mandatory instruction signage, and runway hold position signage. Additional signage may be required to accommodate future improvements or additions to airfield pavements.

Table 2-7 – Airfield Signage

Type of Sign	Purpose of Sign	Visual Description of Sign
Mandatory Instruction Sign	Denote taxiway/runway intersections, runway/runway intersections, Instrument Landing System (ILS) critical areas, Precision Obstacle Free Zone (POFZ) boundaries, runway approach areas, CAT II/III operations area, military zones, and no entry zones	White Inscription/Red Background
Location Sign	Identify the taxiway or runway apron upon which the aircraft is located	Yellow Inscription/Black Background
Boundary Sign	Identify the boundary of the Runway Safety Area (RSA)/Object Free Zone (OFZ) or ILS critical are for a pilot exiting the runway	Black Inscription/Yellow Background
Directional Sign	Indicate directions of other taxiways leading out of an intersection	Black Inscription/Yellow Background; Always Contains an Arrow
Destination Sign	Indicate the direction to a remote location	Black Inscription/Yellow Background; Always Contains an Arrow
Runway Distance Remaining Sign	Provide distance remaining information to pilots during takeoff and landing operations	White Inscription/Black Background

Source: FAA AC 150/5340-18F.

2.1.7 Airfield Pavement Condition

ORF has an established pavement management plan (PMP) that provides a consistent and systematic procedure for making decisions about pavement maintenance and rehabilitation. The load-carrying capacity of the pavement for unrestricted operations is expressed as a Pavement Classification Number (PCN). According to AC 150/5335-5C, *Standardized Method of Reporting Airport Pavement Strength-PCN*, in 1977, the International Civil Aviation Organization (ICAO) adopted the Aircraft Classification Number-Pavement Classification Number (ACN-PCN) method. The PCN is a five-part number which includes a numerical PCN value [indicating the load-carrying capacity of a pavement (between 0 and 100)], pavement type (flexible-F or rigid-R), subgrade category (high-A, medium-B, low-C, ultra-low-D), allowable tire pressure (unlimited/no pressure-W, high/pressure limited to 254 psi-X, medium/pressure limited to 181 psi-Y, and low/pressure limited to 73psi-Z), and the method used to determine the PCN (via technical study-T or evaluation based on using aircraft experience-U). The PCN for each runway at ORF is shown in **Table 2-8**, while existing airfield pavement conditions are shown in **Figure 2-7**.

Table 2-8 – Airside Pavement Condition

Runway	PCN Classification	Numerical Value (0-100)	Pavement Type	Subgrade Strength Category	Allowable Tire Pressure	Method
5/23	PCN 53/R/C/W/T	53	Rigid	Low	Unlimited / No-Pressure	Technical Study
14/32	PCN 27/F/A/W/T	27	Flexible	High	Unlimited / No-Pressure	Technical Study

Source: NAA, 2018.
psi: pounds per square inch

Source:
ORF 2016 Pavement Management System Update -
Applied Pavement Technology, Delta Airport Consultants

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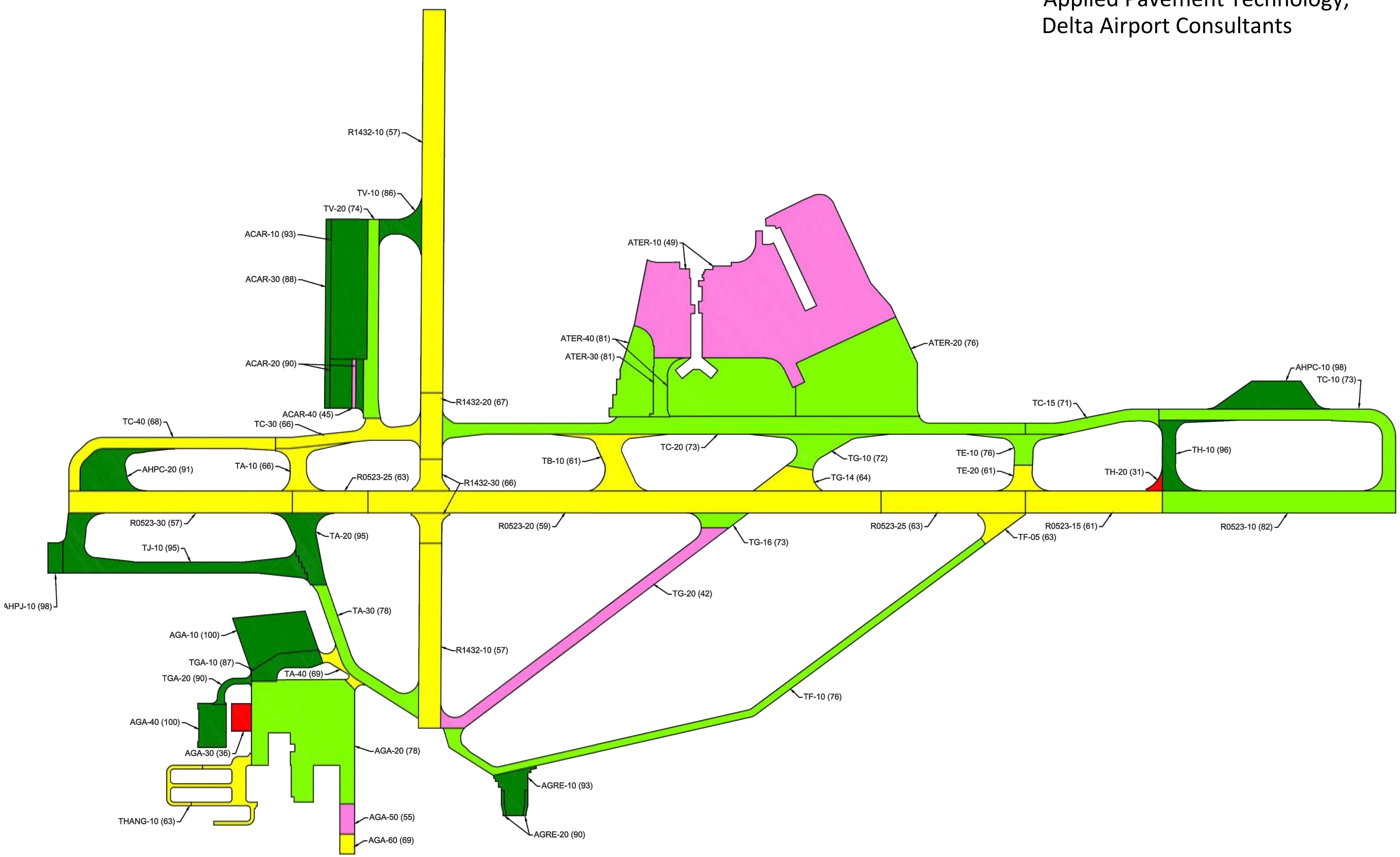
NOT TO SCALE



LEGEND

PAVEMENT CONDITION INDEX

PCI	REPAIR
100–85	PREVENTIVE MAINTENANCE
85–70	PREVENTIVE MAINTENANCE
70–55	MAJOR REHABILITATION
55–40	MAJOR REHABILITATION
40–25	RECONSTRUCTION
25–10	RECONSTRUCTION
10–0	RECONSTRUCTION

Figure 2-7
Existing Pavement Airfield Pavement Conditions

2.2 NAVIGATIONAL AIDS (NAVAIDS) AND INSTRUMENT PROCEDURES

Pilots utilize a variety of navigational aids (NAVAIDs) and instrument procedures, including Very High Frequency (VHF) Omni Direction Range (VORs), standard terminal arrival routes (STARs), instrument approach procedures (IAPs) and NAVAIDs, approach lighting systems (ALS), airfield lighting, and rotating beacons. By providing point-to-point guidance information or position data, NAVAIDs assist pilots to safely and efficiently locate airports, land aircraft, taxi aircraft, and depart from airports during nearly all meteorological conditions. **Table 2-9** summarizes the Airport's existing instrument approach procedures, by runway, and the NAVAIDs required.

Table 2-9 – Navigational Aids (NAVAIDs) and Airfield Lighting

Runway	Runway Markings	Navigational Aids	Lighting	Minimum Ceiling (AGL)/ Visibility	Instrument Approach Types
5	Precision	ILS/DME, RNP, GPS	HIRL, PAPI-4, MALSR, C/L, TDZL	200 ft. / ½ mile	ILS or LOC, RNAV (RNP), RNAV (GPS)
23	Precision	ILS/DME, RNP, GPS	HIRL, PAPI-4, MALSR, C/L	200 ft. / ½ mile	ILS or LOC, RNAV (RNP), RNAV (GPS)
14	Non-Precision	GPS, VOR/DME	MIRL, PAPI-2, REIL	500 / 1 mile	RNAV (GPS), VOR/DME
32	Non-Precision	GPS, VOR/DME	MIRL, PAPI-2, REIL	500 / 1 mile	RNAV (GPS), VOR/DME

Source: FAA Airport Master Record (Form 5010), Accessed 2017.

C/L – Centerline Lights
DME – Distance Measuring Equipment
GPS – Global Positioning System
HIRL – High Intensity Runway Lights
ILS – Instrument Landing System
MALSR – Medium-Intensity Approach Lighting System with Runway Alignment Indicator
MIRL – Medium-Intensity Runway Lighting
PAPI-4 – Four-Box Precision Approach Path Indicator
PAPI-2 – Two-Box Precision Approach Path Indicator
REIL – Runway End Identifier Lights
RNAV – Area Navigation
RNP – Required Navigational Performance
TDZL – Touchdown Zone Lights

2.2.1 En-route NAVAIDs

En-Route NAVAIDs assist pilots during navigation between airports. These facilities are usually ground-based and electronically emit signals that are received by aircraft on a specific radio frequency. They are almost always used in some manner by pilots operating on Instrument Flight Rule (IFR) flight plans but can also be used during Visual Flight Rule (VFR) flights for position information. At ORF, Runway 14 and Runway 32 utilize VOR/DME, which are ground-based en-route NAVAIDs.

2.2.2 Standard Terminal Arrival Routes (STARs)

Standard Terminal Arrival Routes (STARs) are preplanned IFR air traffic control arrival procedures published for pilot use. STARs serve as a critical form of communication between pilots and ATC by providing a method and criteria for descent, routing, and communications when navigating to the destination after leaving the en-route structure. The STAR and approach procedures virtually connect to each other in such a way as to create a seamless transition.

Once a flight crew has accepted a clearance for a STAR, they have communicated with the controller what route, and in some cases what altitude and airspeed, they will fly during the arrival, depending on the type of clearance.

When air traffic is arriving to the Norfolk region, ORF's ATC has two STAR procedures: *DRONE ONE* and *TERKS TWO*. The *DRONE ONE* arrival utilizes the *RALEIGH/DURHAM and KINSTON* VORTACs (RDU and ISO, respectively), which feed traffic from the west and south. The *TERKS TWO ARRIVAL* utilizes the *MONTEBELLO (MOL) VOR/DME* intersection, which feeds traffic from the north.

2.2.3 Types of Instrument Approach Procedures (IAPs) and Instrument Approach NAVAIDs

Based on current FAA classifications, there are four types of instrument approach categories:

- Visual (V) – Approaches performed under visual flight rules only, when meteorological conditions include a cloud ceiling height of 1,000 feet or greater and visibility of 3 miles or greater. None of the runways at ORF operate strictly under this category.
- Non-Precision Approach (NPA) – Instrument approach procedures providing only lateral guidance with a ceiling minimum of 400 feet above the threshold. These can include VHF Omnidirectional Range (VOR), non-directional beacon (NDB), area navigation (RNAV), lateral navigation (LNAV), localizer performance (LP), and localizer (LOC) equipment. At ORF, Runways 5, 23, 14, and 32 all have a NPA procedure.
- Approach Procedure with Vertical Guidance (APV) – Instrument approach procedures providing vertical guidance minimums of 250 feet above the threshold and visibility minimums as low as ¾ mile. These can include an ILS, LNAV/Visual Navigation Aids (VNAV), Localizer Performance with Vertical Guidance (LPV) or Area Navigation (RNAV) Required Navigation Performance (RNP). Runways 5, 23, 14, and 32 maintain this type of procedure.
- Precision Approach (PA) – Instrument approach procedures providing vertical guidance less than 250 feet above the threshold and visibility minimums lower than ¾ mile. These can include an ILS, LPV, and Global Navigation Satellite System (GNSS) Landing System (GLS). This category applies to Runways 5 and 23.

The precision approach is one component that determines the minimum ceiling and visibility for each runway (other variables may influence the minimums - obstructions to the approach, buildings, terrain, etc.). The NAVAIDs that make up the ground-based equipment required to perform the approach procedures are divided into two categories: precision and non-precision. The NAVAIDs supporting traditional ground-based precision approaches are collectively called an Instrument Landing System (ILS). According to FAA Order 6750.16E, *Siting Criteria for Instrument Landing Systems*, the ILS provides guidance to pilots of properly equipped aircraft to assist them in landing safely under conditions of reduced ceilings and lowered visibility. The Airport operates an ILS for approaches to Runway 5 and Runway 23.

Two components of an ILS include: a localizer (LOC) and a glide slope (GS). A localizer is situated 1,000 feet past the departure-end of the runway that has the approach and provides lateral positioning guidance to pilots. It utilizes radio frequencies (RF) to transmit signals to aircraft by focusing the RF beam down the centerline of the runway toward the approach end of the runway for approximately 10 miles, focused within 35 degrees to the left or right of the runway centerline. The glide slope is located near the runway approach end at a distance from the threshold to provide optimum crossing height, with a preferred offset of 400 feet from the runway centerline. It transmits a signal for approximately 10 nautical miles, with a horizontal coverage of eight degrees on each side of the localizer course, measured from the origin of the glide slope beam. The glide slope must be established between 2.0 and 4.0 degrees and is typically established with a glide path angle of 3.00 degrees.

Additionally, all runways at ORF utilize Global Positioning System (GPS) based technology to enable vertically-guided instrument approach procedures with approach capabilities similar to ILS approaches without the need for the traditional ground-based ILS NAVAID components.

Approach Lighting Systems (ALS)

The third component of an ILS, in addition to the localizer and glideslope, is the approach lighting system (ALS). The ALS provides a lighted approach path along the extended centerline of the runway. Runway alignment indicator lights flash in sequence as a series of white lights moving toward the runway threshold, which emphasize runway centerline alignment. Roll indication is emphasized by a single row of white lights located on either side of, and symmetrically, along the column of approach lights.

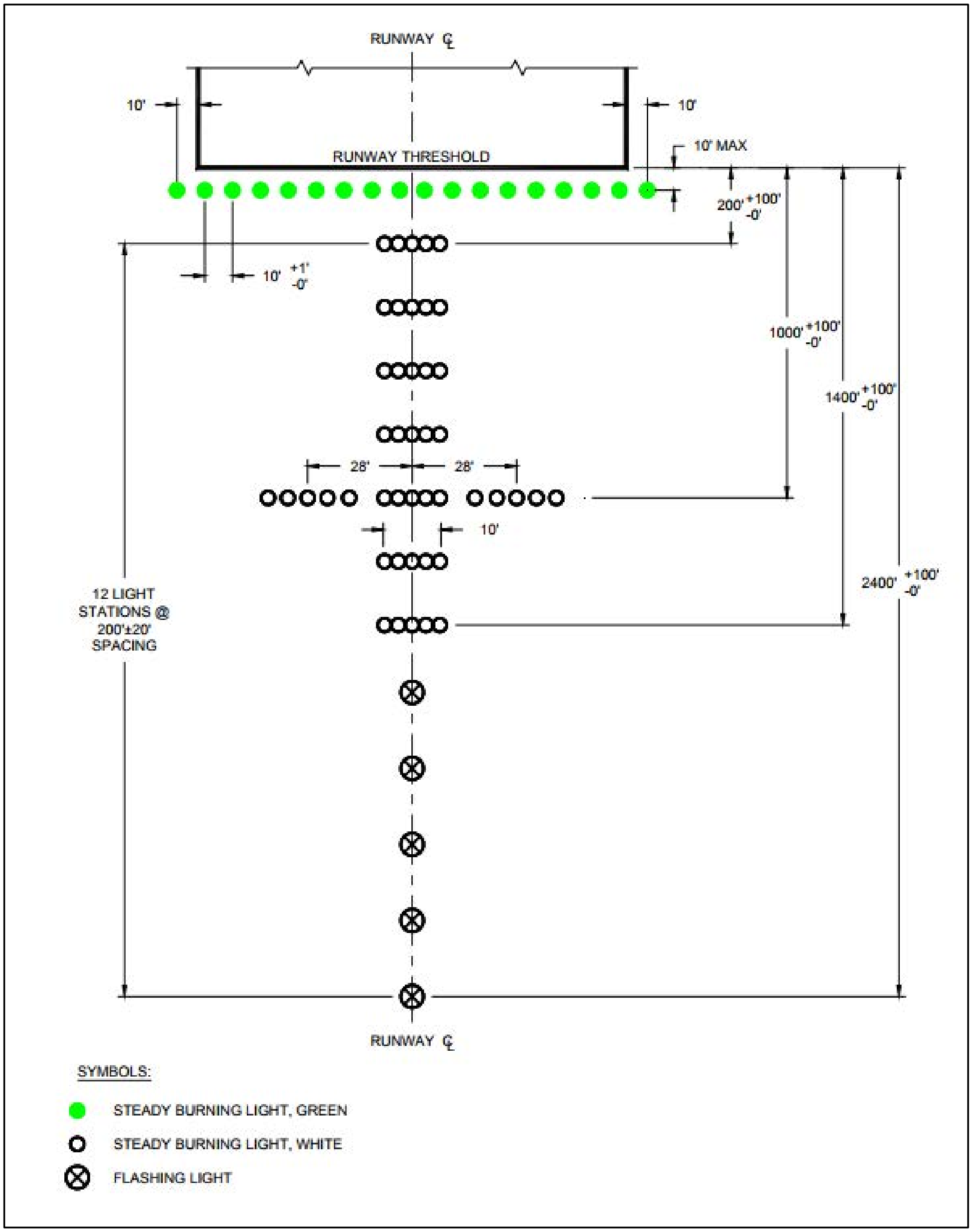
Typically, airports with non-precision approaches utilize Medium Intensity Approach Lighting Systems (MALS), along with Runway Alignment Indicator Lights (RAILS). Together, these systems form the Medium Intensity Approach Lighting Systems with Runway Alignment Indicator Lights (MALSR) that are utilized for precision runways, such as Runway 5 and Runway 23 at ORF.

According to FAA Order 6850.2B, *Visual Guidance Lighting Systems*, the MALSR consists of a threshold light bar and seven five-light bars located on the extended runway centerline, the first bar being located 200 feet from the runway threshold, with the remaining bars each at 200-foot intervals out to 1,400 feet from the threshold. One additional five-light bar is located on each side of the centerline bar, 1,000 feet from the runway threshold, to form a 66-foot-long crossbar known as a roll bar. The individual lights in all bars are approximately 2½ feet apart and are aimed into the approach to the runway, away from the runway threshold. All lights in the MALSR system are steady burning white, except for the threshold lights, which have green filters. The threshold lights are a row of lights on 10-foot centers located coincident with and within the runway edge lights near the threshold and extend across the runway threshold.

At ORF, the runway centerline lights within the displaced area of Runway 5 are non-compliant with two conditions set-forth in AC 150/5340-30H, *Design and Installation Details for Airport Visual Aids*. According to regulations and standards set forth in paragraph 3.3 (a), for threshold displacements over 700 feet, the centerline lights in the displaced area are to be circuited separately from the centerline lights in the non-displaced runway area and the MALSR lights are to interlock with the runway centerline on the displaced area to ensure that when the approach lights are "on," the displaced area centerline lights are "off," and vice versa. In 2010, as a result of Runway 5 being non-compliant with both the previously mentioned standards, the Norfolk Airport Authority submitted a request to the FAA Washington Airports District Office (WAS-ADO) to re-approve and extend the time of the Modification of Standards (MOS) to continue the use of the existing configuration of the runway centerline lights within the displaced area of Runway 5 at ORF. The FAA approved the MOS under the condition that the non-standard conditions will be eliminated when the existing MALSR is replaced with a High Intensity ALS with Sequenced Flashers (ALSF-II) system.

RAIL's consist of five sequenced flashers located on the extended runway center line, the first being located 200 feet beyond the approach end of the MALS with successive units at each 200-foot interval, out to 2,400 feet from the runway threshold. All lights are aimed into the approach to the runway, away from the runway threshold, and flash in sequence toward the threshold at the rate of twice per second. A diagram for the commonly used MALSR configuration is depicted in **Figure 2-8**.

Figure 2-8 – MALSR Configuration



Source: FAA Order 6850.2B, *Visual Guidance Lighting Systems*.

2.2.4 Standard Instrument Departures (SIDs)

Standard Instrument Departure (SID) routes, also known as departure procedures, are published flight procedures followed by aircraft on an IFR flight plan immediately after takeoff from an airport. They provide an easy to understand departure procedure that airports use to balance terrain and obstacle avoidance, noise abatement (if necessary), and other airspace management considerations. SIDs are always printed graphically, rather than textually.

ORF has one SID procedure for departing IFR aircraft. The SID, identified as *KISRR THREE*, instructs aircraft to maintain runway heading after departure and expect ATC to advise the radar vectors to the assigned departure. FAA Joint Order (JO) 7400.2L, *Procedures for Handling Airspace Matters*, identifies specific turns off each runway end to avoid residential areas. Pilots should reference any Special Take-Off Minimums/Departure Procedures that may apply.

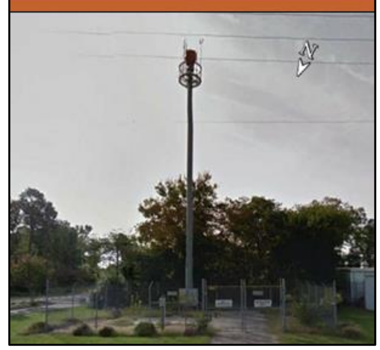
2.2.5 Airfield Lighting

In addition to the visual aids previously described, lighting on the airfield includes the rotating beacon, Precision Approach Path Indicator (PAPI) lights, runway threshold lighting, runway edge lighting, Runway End Identifier Lights (REILs), runway centerline lights, Runway Touchdown Zone Lights (TDZLs), taxiway edge lighting and apron lighting. Each of the lighting systems/types are described below:

Rotating Beacon:

The rotating beacon functions as the universal indicator for locating an airport at night. For a civilian airport, it has one clear and one green lens, 180 degrees apart, and is generally visible 10 miles from the airport. According to the Aeronautical Information Manual, October 2017, at Class C airports, the operation of the airport beacon during the hours of daylight often indicates that the ground visibility is less than three miles, and/or the ceiling is less than 1,000 feet. The rotating beacon at ORF is located south of the airfield and on the south side of Miller Store Road, near the GA facilities and the airfield maintenance facilities.

ORF's Rotating Beacon



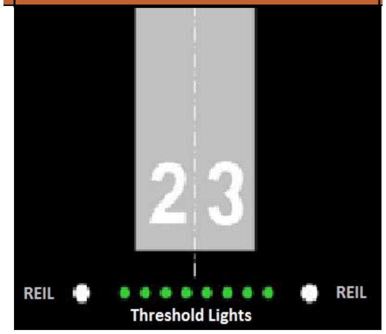
***Precision Approach Path Indicator (PAPI) Lights**:*

A PAPI is a system of lights located near a runway end. It provides pilots with visual glide slope guidance information during an approach to the runway. PAPIs typically have an effective visual range of at least three miles during the day and up to 20 miles at night and inform pilots if they are high, low or on the correct approach descent path for the threshold. Runways 5 and 23 are equipped with PAPI-4 (four-light unit) systems, while Runways 14 and 32 are equipped with PAPI-2 (two-light unit) systems.

PAPIs; Runway Threshold, Edge, & Centerline Lighting

Runway Threshold Lighting:
Runway threshold lighting emits green light outward from the runway and red light toward the runway to mark the ends of the runway. The green lights indicate the landing threshold to arriving aircraft, whereas the red lights indicate the end of the runway for departing aircraft. The red and green lights are usually combined into a single fixture and special lenses or filters are used to emit the desired light in the appropriate direction. For displaced thresholds, the red lights and green lights are in separate fixtures. The fixtures containing the green lights are positioned at the displaced threshold, while the fixtures containing the red lighting are located in the area before the threshold. At ORF, Runways 23 and 32 have standard runway threshold lighting. Runway 5 has a 1,000-foot displaced threshold, and Runway 14 has a 575-foot displaced threshold; Therefore, they utilize the displaced threshold lighting system.

Threshold & REIL Lighting



Runway Edge Lighting:
Runway edge lighting is white in color and is used to outline the edges of a runway during periods of darkness or restricted visibility. The runway edge lights are positioned parallel to the runway centerline at least two feet from the edge of the full-strength pavement designated for runways not used by jet aircraft and 10 feet from the edge of the full-strength pavement designated for runways used by jet aircraft. The spacing of the light units must not exceed 200 feet. These systems are classified according to their intensity, or brightness: High-Intensity Runway Light (HIRL), Medium-Intensity Runway Light (MIRL), and Low-Intensity Runway Light (LIRL). Some airports utilize a pilot-controlled system where the light-intensity can be changed, or stepped up/down, by clicking a button located on the radio. Runway 5/23 is equipped with a HIRL system, while Runway 14/32 is equipped with a MIRL system.

Runway End Identifier Lights (REILs):
The primary function of the REIL is to provide rapid and positive identification of the end of the runway. The REIL system consists of two synchronized, unidirectional flashing white lights that are positioned on each corner of the runway landing threshold, facing the approach area and aimed at an angle of 10 to 15 degrees. Runway 14/32 is equipped with REILs.

Runway Centerline Lights:
Runway centerline lights are required for Category (CAT) II and III precision approach runways, as well as CAT I approaches, where the Runway Visual Range (RVR) is less than 2,400 feet. The lighting system consists of embedded lights located along the centerline at 50-foot, equally spaced, longitudinal intervals. The lights are white in color, except for the last 3,000 feet. From 3,000 feet to 1,000 feet, the centerline lights consist of alternating red and white lights, with the last 1,000 feet being all red. Runway 5/23 has runway centerline lights.

Runway Touchdown Zone Lights (TDZL):
The TDZLs indicate the touchdown zone when landing under adverse visibility conditions. They consist of two rows of transverse light bars disposed symmetrically about the runway centerline. The system consists of steady-burning white lights beginning 100 feet beyond the landing threshold and extend to 3,000 feet beyond the landing threshold or to the midpoint of the

runway, whichever is less. All ORF runways have touchdown point markings, but only Runway 5 has TDZLs.

Taxiway Edge Lighting:
Taxiway lighting delineates the taxiway' guidance to pilots during periods of low visibility and at night. The most commonly used type of taxiway lighting is a series of blue fixtures, which are sometimes supplemented by blue edge reflectors, set at 200-foot intervals along the taxiway edges, but not more than 10 feet outward from the edge of the full-strength pavement. All the Airport's taxiways are equipped with Medium-Intensity Taxiway Lighting (MITL) systems.

Taxiway Edge Light

Apron Lighting:
Apron floodlight systems illuminate the terminal apron, the general aviation apron, and the air c cargo apron.

2.3 TERMINAL FACILITY

An assessment of the ORF terminal was completed based on site visits and tenant interviews, as well as analysis of historical airport data and reviews of previous studies. The intention of this effort was to develop a general understanding of the existing terminal facility.

Documents Reviewed:

- GA Aircraft Requirements, 2006
- Airline Operational Surveys, January/March 2008
- Norfolk International Airport Master Plan Update, October 2008
- Norfolk International Airport Supplemental Technical Analyses, December 2008
- Norfolk International Airport Executive Summary, December 2008
- Modification of Standards: MALSRs, September 2010
- ORF Revised Airfield Plan, December 2010
- ORF Existing ALP, October 2011
- Norfolk International Airport Parking Space Inventory, July 2016
- Air Carrier Schedules, 2017

Tenants Interviewed:

- Norfolk Airport Authority (NAA)
- Allegiant Air
- American Airlines
- Delta Air Lines
- Southwest Airlines

- United Airlines
- Transportation Security Administration (TSA)
- Customs and Border Protection (CBP)
- HMS Host
- Hudson Group
- Avis/Budget Car Rental
- Enterprise/Alamo/National Car Rental
- Hertz/Dollar/Thrifty Car Rental

2.3.1 Terminal Facility Layout

The terminal facility at ORF is separated into an Arrivals Terminal and Main Passenger Terminal. The Arrivals Terminal is primarily utilized by passengers concluding their flight at ORF and contains baggage claim services, as well as rental car and transportation network companies. The Main Passenger Terminal serves as the primary terminal for passenger processing, passenger security screening, and passenger enplaning and deplaning. The terminal is based on a pier layout. **Figure 2-9** depicts the layout for the Arrivals Terminal, while **Figure 2-10**, **Figure 2-11**, and **Figure 2-12** depict the layout for the three levels of the Main Passenger Terminal Building.

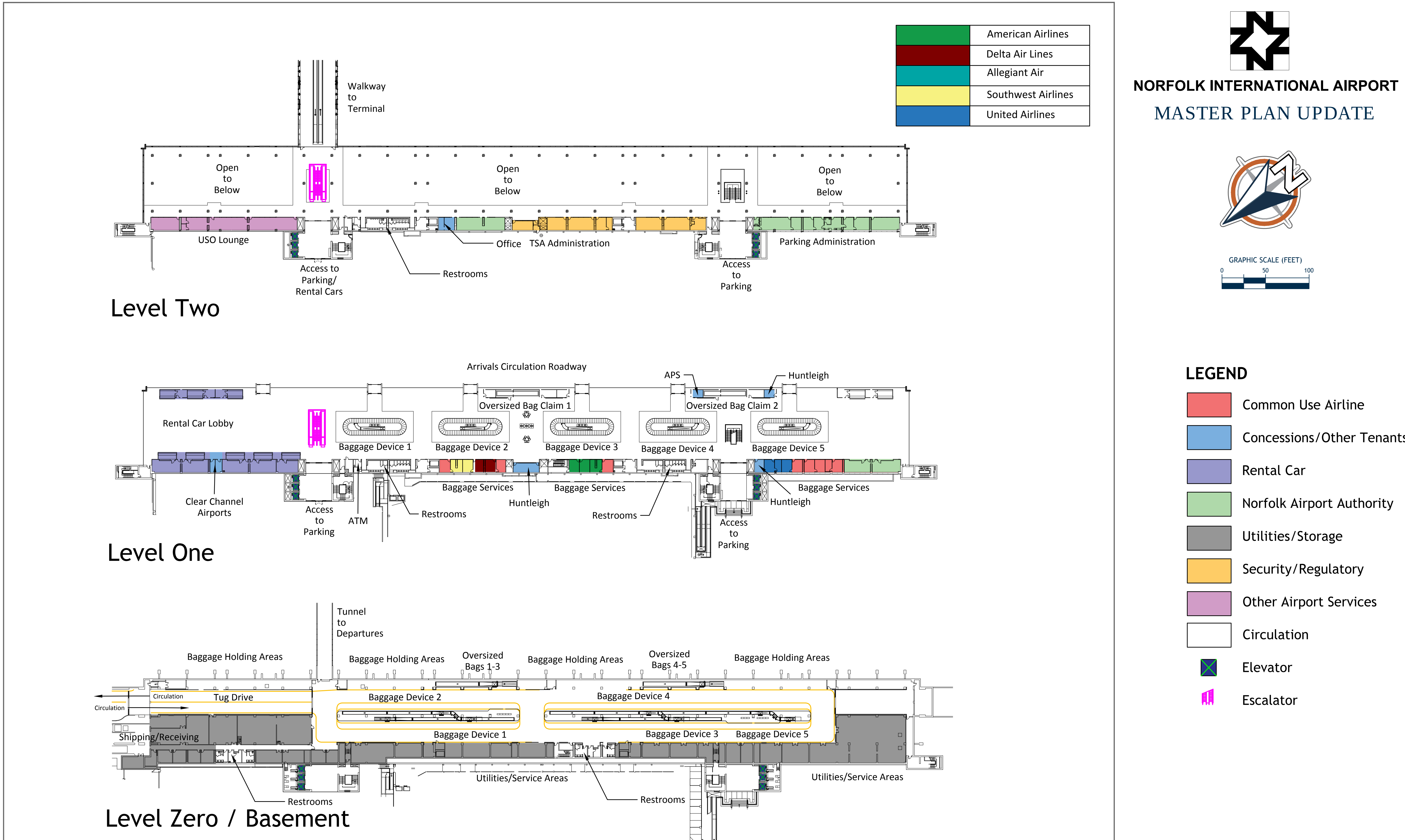


Figure 2-9
Arrivals Terminal

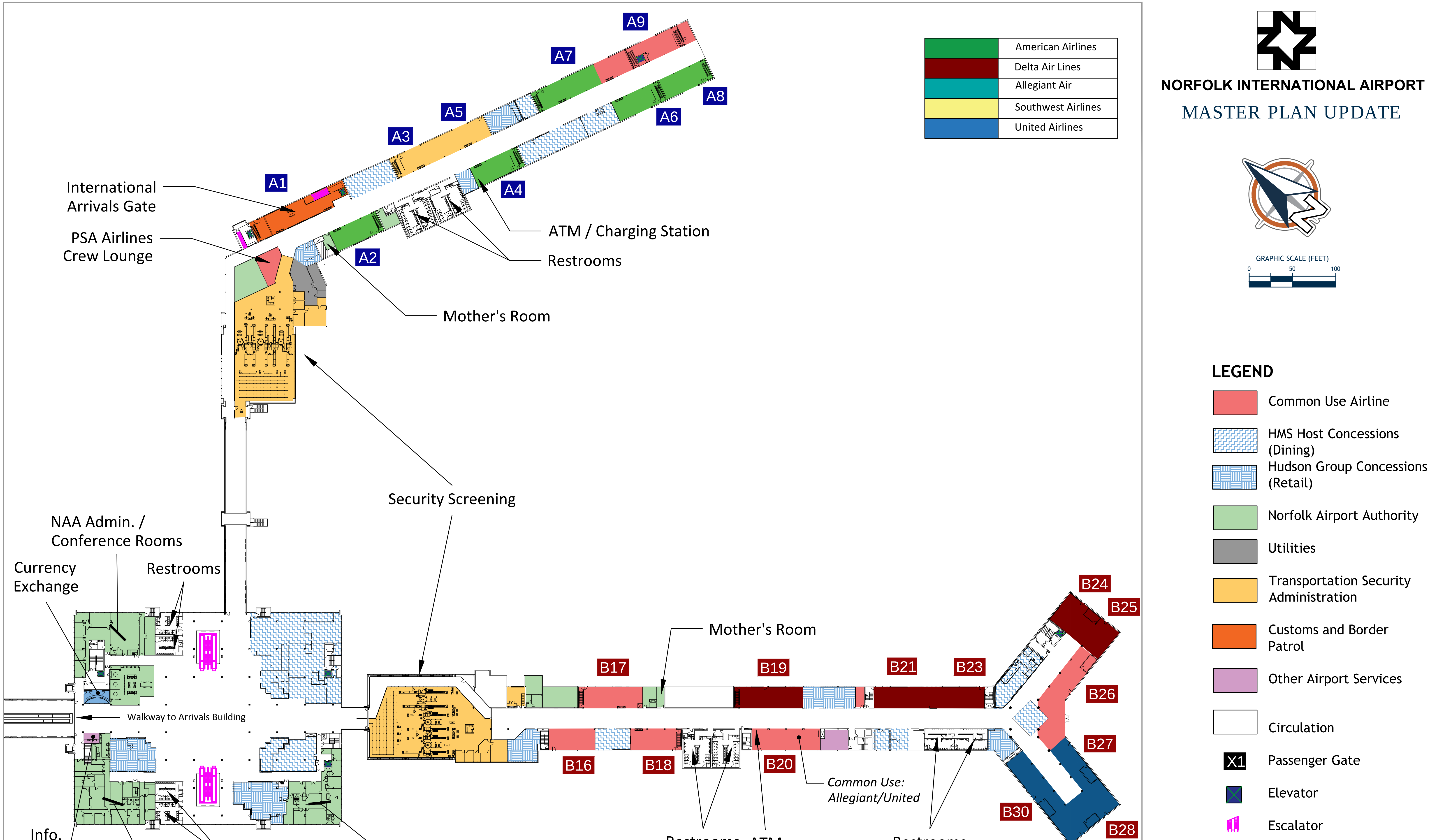


Figure 2-10
Departure Building - Level Two

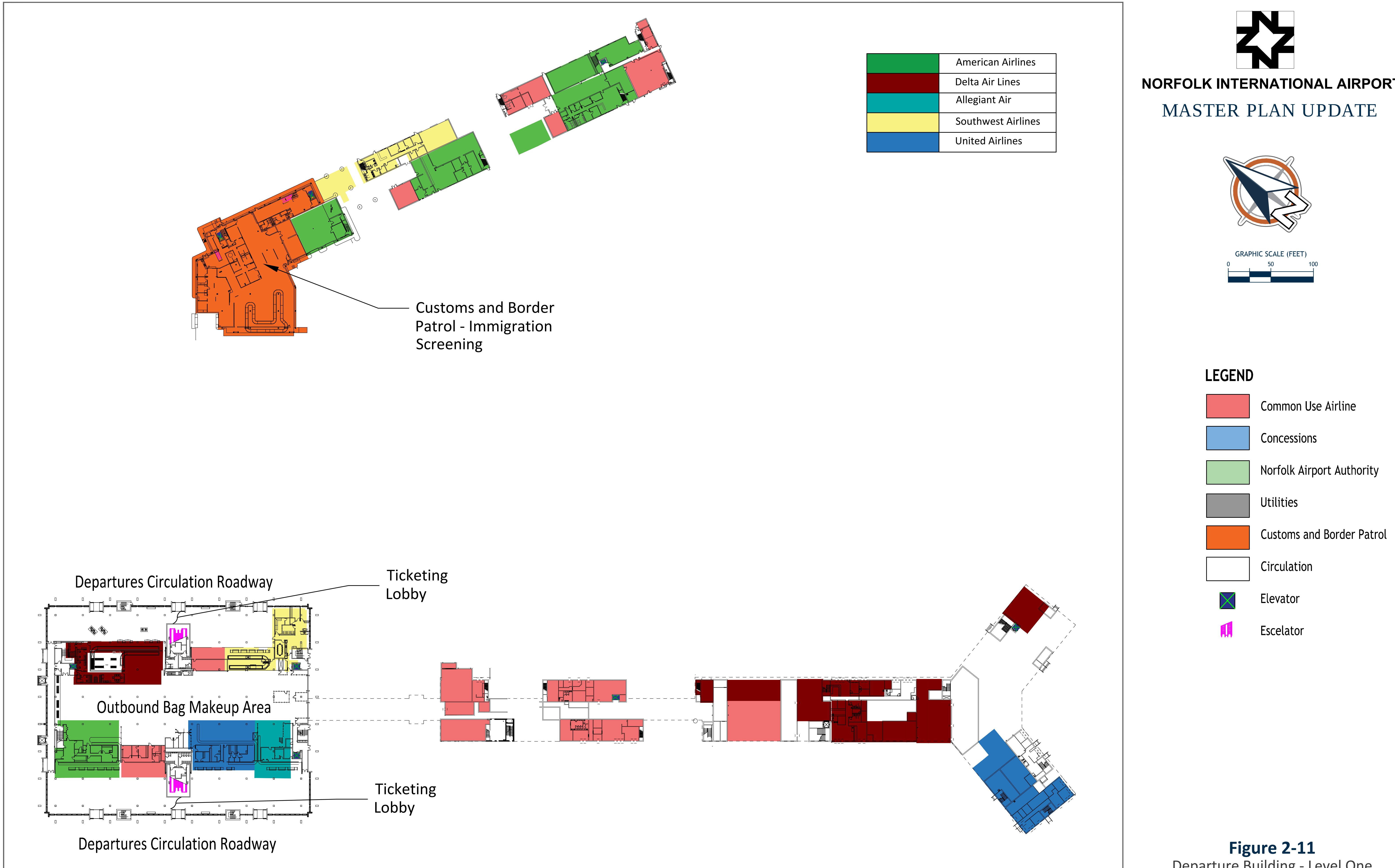
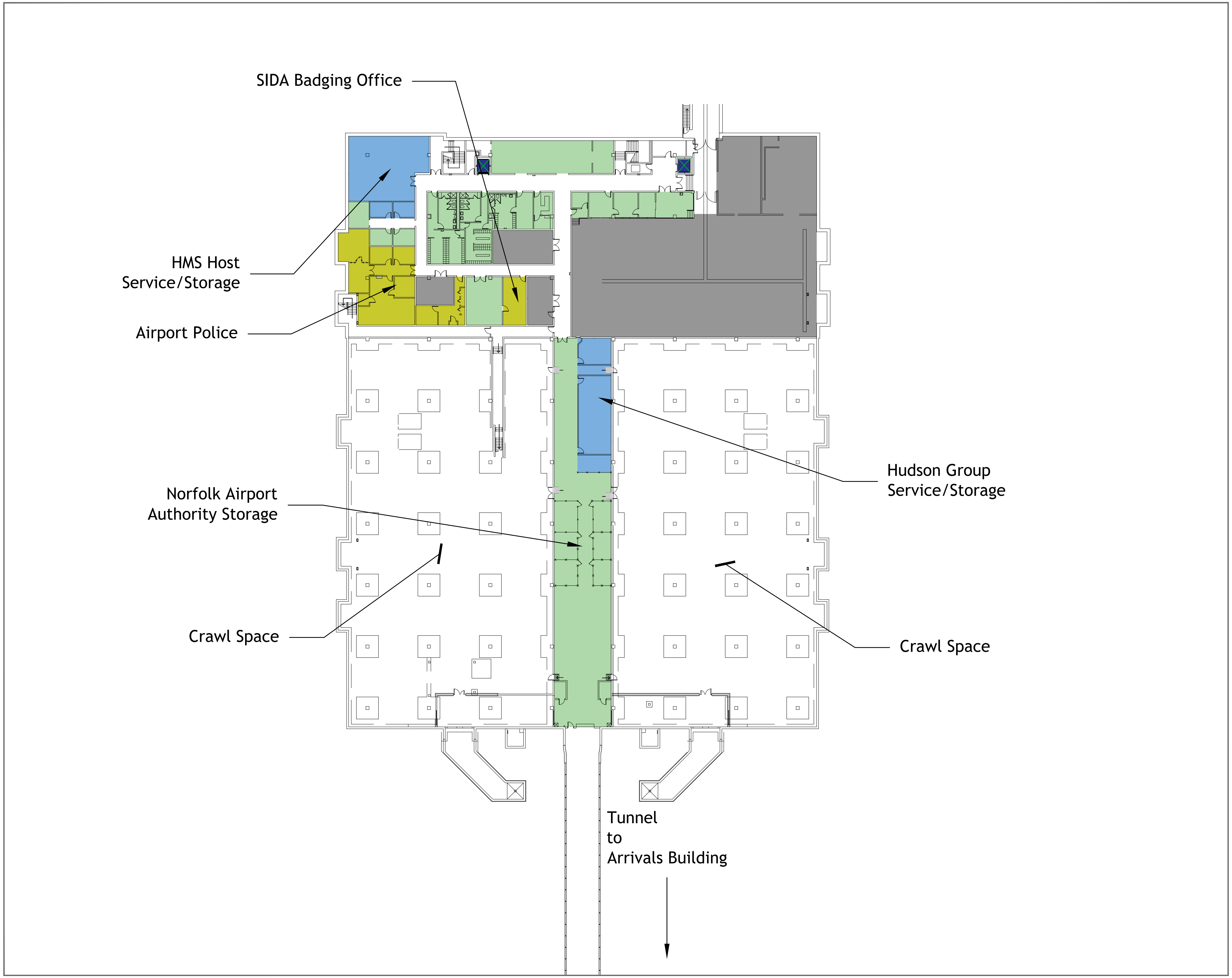


Figure 2-11
Departure Building - Level One



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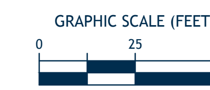


LEGEND

- Concessions
- Norfolk Airport Authority
- Utilities
- Airport Police
- Circulation
- Elevator

Figure 2-12
Main Passenger Terminal - Lower Level / Basement

2.3.2 Main Passenger Terminal Building and Arrivals Building Functional Areas

The Airport terminal is comprised of several areas, each accommodating multiple stakeholder functions including law enforcement, airline services, administrative services, concessions, ground transportation services, CBP offices and processing areas, and TSA security screening and administrative offices. **Table 2-10**, **Table 2-11**, and **Table 2-12** provide an inventory of the terminal facility, listed by location, primary function, and area.

Table 2-10 – Main Passenger Terminal Building Functional Areas

Location and Use	Element Length (LF)	Area (SF)
Main Passenger Terminal: Lower Level		
Airport Police Department		2,160
Storage Space		12,075
TOTAL LOWER LEVEL		**14,235**
Main Passenger Terminal: First Level		
Airline Ticketing Functions		
Airline Ticket Counters – LF & SF	238	3,230
Airline Ticket Offices		7,170
Departures Curbside (East and West)	600	
Outbound Airline Baggage Makeup	-	7,578
Airline Operation Space		
Concourse A		15,685
Concourse B		21,575
TOTAL FIRST LEVEL	**838**	**55,238**
Main Passenger Terminal: Second Level (Non-Sterile Area)		
ATRIUM SERVICES		
Airport Administration		14,240
Conference Center		2,164
ATM/Foreign Currency Exchange/Mailbox Area		690
Business Center		2,165
CONCESSION SPACE		
Burger King		2,435
Discover Hampton Roads		1,980
The Local at ORF		8,457
Starbucks		1,048
Tech on the Go/Hudson News		2,430
TOTAL SECOND LEVEL (NON-STERILE)		**35,627**

Table 2-11 – Main Passenger Terminal Building Functional Areas (Continued)

Location and Use	Element Length (LF)	Area (SF)
Main Passenger Terminal: Second Level (Passenger Security Screening & Sterile Area)		
PASSENGER SECURITY SCREENING		
TSA Screening for Concourse A		10,752
TSA Screening for Concourse B		10,720
TSA Office Space		1,750
AIRLINE GATES/HOLDROOMS		
Concourse A		13,375
Concourse B		22,270
CONCESSION SPACE		
$10 Boutique (Concourse B)		515
Back Bay Bistro (Concourse B)		2,475
Great American Bagel (Concourse A)		450
Here’s to the Heroes (Concourse A)		1,415
Hudson News (Concourse A)		925
Hudson News (Concourse B-Location 1)		800
Hudson News (Concourse B-Location 2)		920
James River Grill (Concourse A)		1,880
MKT at ORF (Concourse B)		850
Starbucks (Concourse A)		940
Starbucks (Concourse B)		950
Tech on the Go (Concourse A)		455
Unoccupied (Concourse A)		130
Mother’s Rooms		363
TOTAL SECOND LEVEL (STERILE)		**72,655**
TOTAL MAIN PASSENGER TERMINAL FUNCTIONAL SPACE	**820**	**142,128**

Table 2-12 – Arrivals Terminal Building Functional Areas

Location and Use	Element Length (LF)	Area (SF)
Arrivals Terminal: First Level		
AIRLINE BAGGAGE CLAIM		
Baggage Claim		19,385
Arrivals Curbside	730	40,356
GROUND TRANSPORTATION CENTER		
Rental Car Counter Services		5,943
Rental Car Counters – Linear Footage	163	
Transportation Services		292
TOTAL FIRST LEVEL	**893**	**65,976**
Arrivals Terminal: Second Level		
ADMINISTRATIVE OFFICES		
Airport Parking Office		2,506
TSA Administration		2,828
MILITARY		
USO Welcome Center		2,000
TOTAL SECOND LEVEL		**7,334**
TOTAL ARRIVALS TERMINAL FUNCTIONAL SPACE		**73,310**
Unsure of Location or has Multiple Locations		
Concession Storage		2,217
Public Restrooms		11,600
Escalators		1,280
TOTAL		**15,097**
TOTAL AIRPORT FUNCTIONAL SPACE (MAIN PASSENGER TERMINAL, ARRIVALS, & OTHER)	**1,731**	**230,535**

Note: Concession operators are subject to change.
Source (Tables 2-8, 2-9, & 2-10): NAA, 2017.

2.3.3 Airline Ticketing Lobby

The ticketing lobby is located on the first level of the Main Passenger Terminal and serves as the primary space for departing passengers to check-in for flights, obtain boarding passes, and drop-off baggage to be checked and screened prior to enplaning. The ticketing lobby can be accessed by various means. When parking in the Airport's parking garage, passengers will make their way from the Arrivals Terminal to the Main Passenger Terminal via a pedestrian bridge, which disperses into the atrium on the second level of the Main Passenger Terminal. Passengers can then take an elevator, escalator, or stairs down to the ticketing lobby. The most direct method of accessing the ticketing lobby is via one of the eight enclosed passageways between the outer door and inner door, also known as vestibules. The vestibule configuration for the Main Passenger Terminal is as follows: three to the south, two to the west, and three to the north. The ticketing lobby has a square/rectangular shape.

Within the first floor of the Main Passenger Terminal, there are two separate ticketing lobbies on the north and south sides, with a combined five commercial air carrier ticket counters in service. In the west side lobby, Delta operates from three counters, each measuring approximately 18 feet. Southwest operates from the opposite side of the lobby from one counter measuring approximately 46 feet in length. At the south side lobby, American operates from one counter measuring approximately 60 feet. Allegiant and United are co-located at the opposite side, with

Allegiant operating from one ticket counter measuring approximately 36 feet, and United operating from two counters, measuring approximately nine feet and 33 feet. Located between the north and south ticket lobbies is the outbound baggage makeup area, a common space shared by the carriers.

Airlines also provide passengers with access to self-serve, automated kiosks. The kiosks provide passengers with capabilities and amenities including checking-in for flights and printing boarding passes, as well as making alterations to seat assignments. With the exception of two kiosks, passengers are also able to check baggage and print checked baggage tags.

2.3.4 Checked Baggage Screening

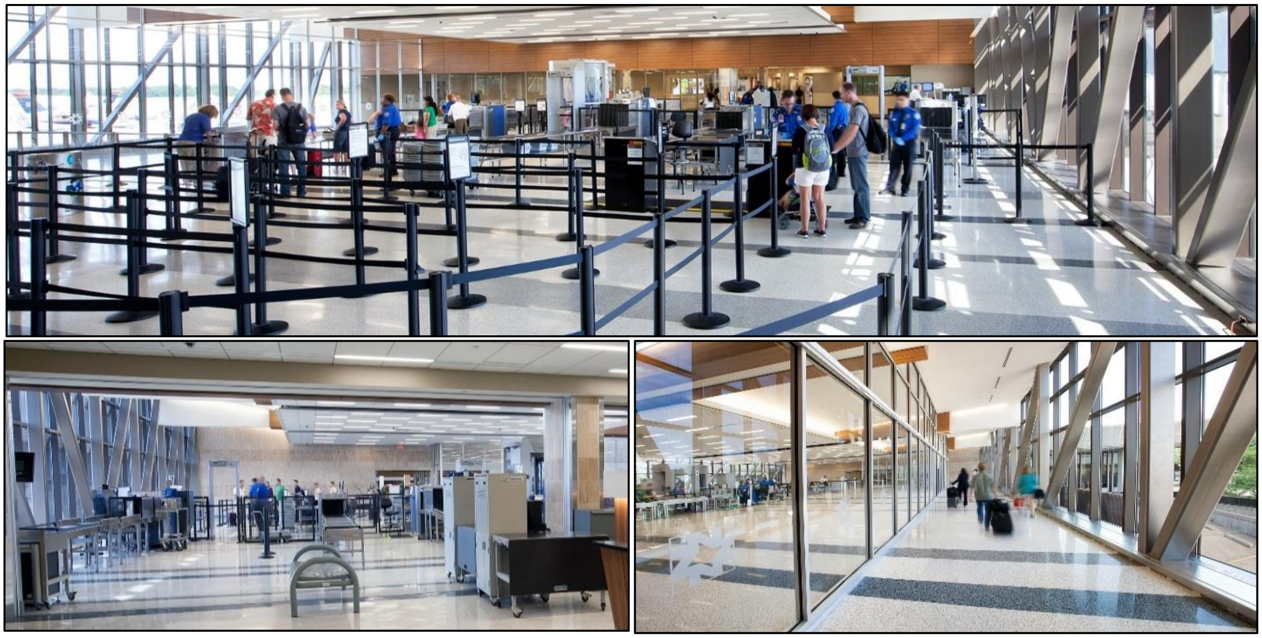
To meet federal mandates, all checked baggage must go through the sort-controlled Checked Baggage Inspection System (CBIS). Bags are screened by one of the seven CT-80 Explosive Detection System (EDS) machines, operated by TSA personnel. The bag scan machines for Allegiant, American, Southwest, and United are positioned in front of the airline ticket counters, between the queue space. To maximize the use of the queuing area, TSA and the airlines have been in the process of relocating the baggage screening machines from the ticketing lobby floor to a secure area behind the ticket counters, in line with the baggage conveyor belt system. When the Study began, only the baggage screening device for Delta had been relocated. In addition, the Authority is working with United, Allegiant, and TSA to procure a second EDS machine for joint use on the east side of the ticketing lobby, as there is one EDS machine for both carriers. The baggage transfer process is further explained in **Section 2.3.8**.

2.3.5 Passenger Security Screening

ORF has two separate TSA passenger screening checkpoints: one for Concourse A and one for Concourse B. Prior to accessing either concourse, all enplaning passengers must pass through the TSA security screening checkpoint (SSCP) that corresponds to the concourse where their departing gates are located. The checkpoint for Concourse A has three pre-screening stands and Concourse B has two pre-screening stands located outside the checkpoints, where passengers have their travel documents verified prior to proceeding through the SSCP. TSA pre-check passengers and employees/crews have separate lanes at both checkpoints that are commonly accommodated by the active stand during non-peak hours. During peak hours, pre-check and employee lanes are accommodated via separate lanes and stands.

The checkpoint for Concourse A consists of four passenger screening lanes (with room for an additional fifth lane when capacity warrants expansion) containing two passenger walk-through metal detectors, and one Millimeter Wave Advanced Imaging Technology (AIT) scanner. Concourse B checkpoint consists of four passenger screening lanes (with room for up to six lane) containing a total of two passenger walk-through x-ray machines and one AIT scanner. Separate Advanced Technology (AT) X-ray systems, utilized to detect threats in carry-on baggage by providing a high-definition x-ray image, are also located at each checkpoint, four at the checkpoint for Concourse A and four for the checkpoint at Concourse B. Once on the sterile side, passengers circulate to their respective gate areas. Passengers are unable to access the alternate concourse without being reprocessed through the SSCP at the respective concourse. Arriving passengers exit the concourse via exit hallways, located adjacent to each of the SSCPs. After exiting, arriving passengers will disperse in the Main Passenger Terminal. Meeter/greeter seating is located throughout the lobby area.

The Authority has space available, and a plan in place to expand each other the security checkpoints in both concourses when capacity throughput warrants opening more security lanes to maintain a high level of service at the Airport. These expansion plans are reflected in the Demand Capacity and Alternatives analysis of this Master Plan Update.



Source: NAA, 2017.

2.3.6 Airline Gates and Holdrooms

ORF has 23 air carrier gates, with an additional gate dedicated to Federal Inspection Services (FIS). The existing Gates are dispersed throughout concourse A and B, with Gates 1 through 9 (future) on Concourse A and Gates 16 through 30 on Concourse B. As currently constructed, Gates 7, 9, and 11 are on the end of Concourse A. The Airport has identified a potential extension to Concourse A that will consolidate Gates 7 and 9 into larger holdrooms to accommodate larger airframes, while eliminating Gate 11. American and Southwest operate from Concourse A, while Allegiant, Delta, Frontier, and United operate from Concourse B.

A fully-functioning FIS facility is located at Gate A1. It is used for international flights and charters but can be used as a swing-gate, or a multi-function gate, when needed. Multi-function gates are gates within the terminal concourse that can be used for multiple purposes. As international flights arrive, these gates allow temporary barriers to separate international passengers that have not been pre-cleared and provides access to CBP booths via separate corridors. The FIS can process up to 175 passengers per hour (PPH).

All active gates are located on the second level of each concourse and are equipped with passenger boarding bridges, except for Gates A9, B17, and B18. When occupied, these gates utilize ground-level boarding via stairs accessible from the Concourse. The active gates are also equipped with a conveyance system to carry gate-checked baggage from the gate area to the ramp level.

Table 2-13 presents the air carrier gate assignments based on existing lease agreements when the Study commenced.

Table 2-13 – Air Carrier Gate Assignments

Concourse A Holdroom/Gate	Airline	Boarding Bridge Owner	Concourse B Holdroom/Gate	Airline	Boarding Bridge Owner
Gate A1	CBP: FIS Facility	NAA	Gate B16	Unoccupied	NAA
Gate A2	American	American	Gate B17	Unoccupied	-
Gate A3	Southwest	NAA	Gate B18	Unoccupied	-
Gate A4	American	American	Gate B19	Delta	NAA
Gate A5	Southwest	NAA	Gate B20	Common Use*	NAA
Gate A6	American	American	Gate B21	Delta	Delta
Gate A7	American	NAA	Gate B23	Delta	Delta
Gate A8	American	American	Gate B24	Delta	NAA
Gate A9	Unoccupied	-	Gate B25	Delta	NAA
			Gate B26	Unoccupied	NAA
			Gate B27	United	NAA
			Gate B28	United	NAA
			Gate B29	United	NAA
			Gate B30	United	NAA

Note: * - Gate shared by Allegiant Air, Frontier Airlines, and United Airlines; Assigned gates are subject to change.
Source: NAA, 2017.

2.3.7 Terminal Concessions and Amenities

Concessions throughout the terminal facility provide a varied selection of goods and services for passengers, employees, and meeters/greeters. Concessionaires include food and beverage services, magazine, book, and gift shops.

Hudson Group operates retail concessions throughout the Airport. A gift shop, as well as a separate, co-located retail and news shop, were located prior to screening in the atrium at the center of the Main Passenger Terminal when the Study began. Two news shops and one gift shop were also located in Concourse B. Concourse A had one news store and two retail stores. In the future, Hudson Group would like to open a larger store on Concourse A. They do not see a need for additional pre-security sales space. Normal operating hours for Hudson Group retail services are 3:30 am to 8:30 pm, local time, with the busiest times typically being 2:00 pm to 4:00 pm on Concourse A and 3:00 pm to 5:00 pm on Concourse B.

HMS Host operates food and beverage concessions at the Airport. When this Study began, three food and beverage concessions were located prior to screening in the main lobby of the Main Passenger Terminal. Four additional food and beverage concessions operated out of Concourse A, as well as three additional on Concourse B. In the future, HMS Host would like to operate a second full-service restaurant on Concourse B. The kitchen facilities are currently inadequate, per HMS designs. HMS Host's dining services on Concourses A and B are typically busiest around 11:00 am, as well as 4:00 pm to close, which is dependent on flight delays. **Table 2-14** depicts the concessions and amenities within the airport terminal facility, including location, at the time this Study originated.

Table 2-14 – Concessions

Concession/Amenity	Type	Operator	Location
Main Passenger Terminal/Atrium – Pre-Security			
Burger King	Food/Beverage	HMS Host	South Corner of Atrium
Discover Hampton Roads	Gift	Hudson Group	West Corner of Atrium
The Local at ORF	Full-Service Food & Beverage	HMS Host	East Corner of Atrium
Starbucks (24-Hours)	Café	HMS Host	East Corner of Atrium
Tech on the Go/Hudson News	Retail/News	Hudson Group	South Corner of Atrium
Travelex	Foreign Currency Exchange	Travelex	North Side of Atrium
Concourse A			
Great American Bagel	Food/Beverage	HMS Host	Gate A7
Here's to the Heroes	Full-Service Food & Beverage	HMS Host	Gate A3
Hudson News	News	Hudson Group	Gate A5
James River Grill	Full Service Food & Beverage	HMS Host	Between Gates A4 & A6
Starbucks	Café	HMS Host	Between Gates A4 & A6
Sweet Indulgences	Candy Store	Hudson Group	Between SSCP & Gate A2
Tech on the Go	Retail	Hudson Group	Gate A4
Concourse B			
$10 Boutique	Gift	Hudson Group	Between Gates B19 & B21
Back Bay Bistro	Full-Service Food & Beverage	HMS Host	Gate B23
Hudson News - Location 1	News	Hudson Group	Between Gates B19 & B21
Hudson News - Location 2	News	Hudson Group	Across from Gate B27
MKT at ORF	Express Food & Beverage	HMS Host	Across from Gate B21
Starbucks	Café	HMS Host	Between Gates B16 & B18
FAO Sweets (Summer 2018)	Candy Store	Hudson Group	Near SSCP

Note: The concessions depicted in this table represent those present when this Study began. Concessions are subject to change.
Source: Hudson Group/HMS Host, 2017.

Additional Amenities

Additional amenities within the main lobby and concourses include three mother's mooms: one in the main lobby near the family restrooms, one on Concourse A next to Gate A2, and one on Concourse B next to Gate B17. The NAA is in the process of developing a business center in the main passenger terminal atrium pre-security screening, in the northeastern quadrant. This will be located adjacent to the Authority's existing conference center. NAA also operates an information center, previously located in the baggage claim area, now located at the entry to the Level 2 Atrium, from the Arrivals Building. Travelex operates a Currency Exchange directly across from the Information Center, and there is an ATM located in the baggage claim, atrium, Concourse A, and Concourse B. The USO Lounge is located on the upper level of the Arrivals Building.

Concession Storage and Support Areas

Each concessionaire has its own storage area, which is not accessible or in view of the public. Prior to being transported from the storage area, located in a non-SIDA location, to the stores on the Concourses, TSA requires that all merchandise, boxes, bags, and containers be scanned at the security checkpoint to ensure that ORF's safety and security is not being compromised. Since each concessionary item must be individually scanned by TSA, concessionaires are limited to screening only during non-peak hours. After being cleared, the items are permitted to be taken to the Concourses.

Hudson Group has a storage area pre-security behind Discover Hampton Roads in the basement of the Departures Terminal, as well as a storage area post-security, which have both reached capacity.

HMS Host's food and beverage storage, located pre-security in a central storage area in the basement of the Airport, has reached capacity. When transporting goods to and from the storage area, employees must utilize a freight elevator.

2.3.8 Baggage Claim

The baggage claim area is located on the first floor of the Arrivals Terminal and serves as the location for deplaning passengers to retrieve their checked baggage. Arriving passengers can access baggage claim by passing through the Main Passenger Terminal lobby, located on the second level, and proceeding across the pedestrian bridge that connects to the Arrivals Terminal. Seating for meeters/greeters is available throughout the baggage claim area. At ORF, there are five baggage claim carrousels and two oversized baggage claim areas. The five carrousels are identified numerically from one to five, staring at the north end of baggage claim. The baggage claim units are centered in the Arrivals Terminal, each measuring approximately 20 feet by 73 feet. The oversized baggage claims, each approximately 1,550 square feet, are located against the wall on the east side of the Arrivals Terminal. International arrivals utilize a separate baggage claim area housed within the FIS facility, and is controlled by CBP (see **Section 2.3.13**).

Baggage Makeup Areas

Each airline operating at ORF has its own baggage makeup space, located behind the ticketing lobby. The space includes a conveyer system that collects passengers' checked luggage from the ticketing counter, runs back parallel to the airline office and support facilities, and discharges into the baggage make-up area beneath the Main Terminal Building. Delta Air Lines has an enclosed baggage make-up room to process outbound baggage prior to loading luggage on the bag carts to transport to the aircraft. The general baggage make-up area is comprised of two lanes, each one adjacent to the airline operating areas on the north and southsides of the building. Each baggage makeup room has access to the terminal aprons via ramps from the lower level of the Main Terminal building underneath Concourse B. As previously noted, the baggage screening machines in the ticketing lobby queuing area are in the process of being relocated to the baggage makeup area. Due to the size of the machines, the amount of usable space in Delta's baggage makeup room has been greatly reduced.

When this Study began, the other airlines advised that the space in the baggage makeup rooms, without having the TSA baggage screening machine, was adequate but constrained during peak hours.

Inbound Baggage Systems

Inbound baggage, which has been loaded to baggage tugs from the aircraft, is transported from the Terminal Apron to the Arrivals Building via an underground tunnel on the northside of the Terminal Apron. Direct access to the tunnel is available from both sides of Concourse A, and the north side of Concourse B. Due to gate layout and movement restrictions at the end of Concourse B, airline and baggage operations on the south side of Concourse B must return to the baggage make-up ramp and cross under Concourse B to the north in order to access the baggage tunnel to the Arrivals Building.

Inbound baggage has access to the Arrivals building via a tug ramp on the north end of the building. There are five baggage devices with a circulation road that navigates around the central devices returning to the tug ramp with 2-way traffic. Once unloaded, baggage tugs are stored in the GSE areas for each airline, or under the Main Terminal Building in the baggage make-up area.

2.3.9 Rental Car Counters

Rental car counters are located along the east and west walls on the north end of the first level of the Arrivals Terminal. Eight rental car companies operate at the Airport, each one having a separate reservation desk. Along the west wall, in order from south to north and measuring approximately 22 linear feet each, are the counters for Avis, Hertz, Enterprise, Budget, and Alamo. Along the east wall, in order from south to north and measuring approximately 17.5 linear feet each, are the counters for National, Dollar, and Thrifty.

2.3.10 Airport Administrative and Support Areas

Airport administration is located on the second level of the Departures Terminal, in three separate areas surrounding the atrium. This area includes administrative offices, a conference center, a break room, a future business center, and restroom facilities.

2.3.11 Airline Service and Support Areas

Beyond those operated by the Airport, airlines and tenants also lease dedicated space for service and support functions. During the summer 2018, PSA Airlines began operating a crew lounge in Concourse A, adjacent to the security screening area.

2.3.12 Back Office Space

Tenants at the Airport, such as airlines, concessionaires, and rental car providers, each utilize back office space within the terminal. Airline storage space is located in the secure area; however, the airlines have offices in both the secure and non-secure areas of the terminal. Rental car offices are in the non-secure area of the terminal and are sometimes shared depending on lease agreements. TSA Administration and Airport Parking office spaces are located on the second level of the Arrivals Terminal. Employees can only access office space for their respective employer.

2.3.13 Federal Inspection Services (FIS)

ORF has a fully-functioning FIS facility at Gate A1. Based on discussions with the Airport's CBP representative, there are approximately 20 full-time employees; however, the staffing levels are based on the capacity and demand for each international operation. The number of staff at a given time are based on demand of number of operations and passengers. The fully-equipped FIS meets the needs for the Airport's current demand and can handle up to 175 passengers per hour. The Airport does not currently have scheduled international service; however, on occasion, diversions do occur. In the event a flight is diverted to ORF, CBP will process the passengers and baggage. CBP also handles approximately three charter flights per year and can accommodate aircraft as large as a Boeing 747, with constraints. After being processed, passengers will gather luggage from a baggage claim area designated for international arrivals only.

The current FIS facility will need to be upgraded before being able to process scheduled international service.

2.3.14 Terminal Signage and Wayfinding

A main contributor to customer and passenger satisfaction is effective wayfinding. Signage and wayfinding in the airport terminal should be clear and intuitive. Efficient wayfinding systems can create a sense of comfort and security; however, too much information can have the opposite effect and cause confusion and disorientation. It is important that the airport's signage and wayfinding system is simple and well organized. Airport wayfinding systems can include the following types of signage: directional signs, identification signs, informational signs, and regulatory signs. Signage and wayfinding regarding vehicular circulation and parking are discussed later in this chapter.

When approaching the Airport, signage increases to include information pertaining to the Arrivals Terminal and Main Passenger Terminal, as well as their relative functions. Outside the Main Passenger Terminal, signage designates the entryway closest to each airline ticket counter, in addition to signage for airlines providing curb-side check-in. Inside the Main Passenger Terminal, enplaning passengers can utilize signage to locate the airline ticketing counters, airport security, or the appropriate gate departure concourse. Signage also depicts directions and information for various concessions and amenities such as food and beverage providers, technology charging stations, ATM machines and a foreign currency exchange location (Western Union at Travelex), a mail drop-box, and the conference center. Deplaning passengers can utilize signage in the Main Passenger Terminal to locate the gate for a connecting flight or to exit the concourse for baggage claim or ground transportation located in the Arrivals Terminal.

Once in the Arrivals Terminal, passengers utilize Airport signage to locate the appropriate baggage claim device based on their flight information. The rental car agencies, as well as the shuttle and transportation network companies, have designated signage to aid passenger flow in the Arrivals Terminal. Signage for other amenities incudes wayfinding and location information for the United Service Organizations (USO) Lounge, ATM machines, and the Airport Information desk. Signage and wayfinding in the Arrivals Terminal also assists passengers and other customers needing to access the Main Passenger Terminal. Signage at ORF also includes regulatory signage depicting prohibited areas, secure areas, employee or airport authorized areas only, etc.

2.4 AUTOMOBILE ACCESS AND PARKING

This section of the report details the existing inventory of parking, both on- and off-Airport, as well as the existing traffic conditions at the Airport's departure and arrival curbside. The data presented was gathered from a variety of sources, including on-site observations by CHA, information provided by the Norfolk Airport Authority, and other public data sources.

The on-site observations were conducted on Tuesday, January 23, 2018 and Wednesday, January 24, 2018, days of the week identified by the NAA as typical busy weekdays at ORF.

2.4.1 Existing ORF Parking

The on-Airport parking facilities are owned and operated by the NAA and provide parking for a combination of public parkers, NAA and other airport employees, rental cars, and taxis. In addition, the NAA maintains an employee parking lot off-site at the corner of N. Military Highway and Robin Hood Road. A taxi queuing lot is located on Airport Road, adjacent to the Long-Term Lot.

The Airport parking functions consist of three parking garages and six surface parking lots (five on-site and the off-site Employee Lot). In total, ORF controls 8,582 parking spaces, of which 7,258 (85%) are for public parking, 636 (7%) are for rental cars and 688 (8%) are for Airport employee and NAA parking.

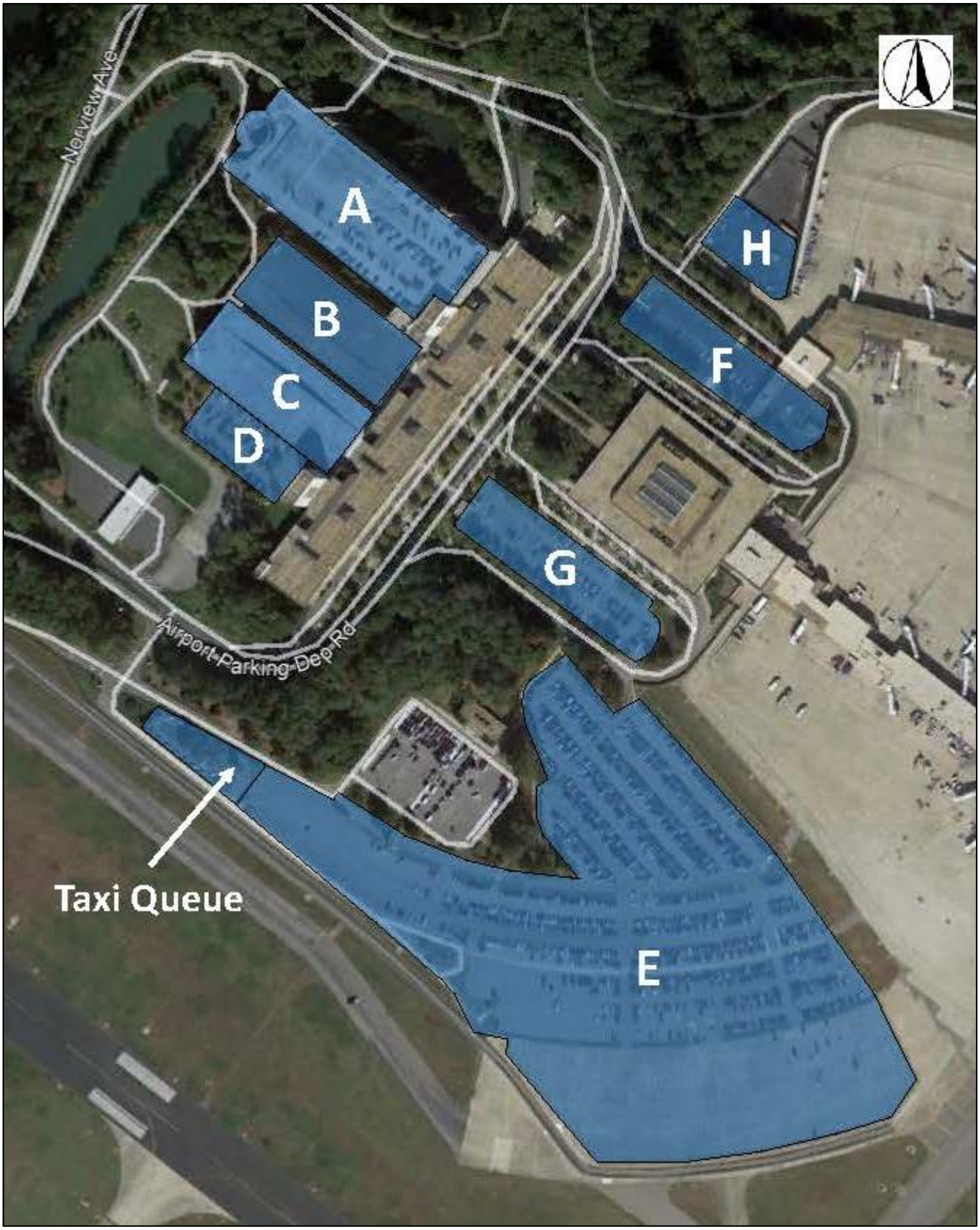
Table 2-15 presents a detailed breakdown of the existing ORF parking inventory by facility and type of user served. As shown in the "Facility ID" column in the table, each parking facility has been assigned a letter designation, which helps to identify the geographical locations of the on-Airport parking facilities in **Figure 2-13**, as well as the off-site Employee Lot in **Figure 2-14**.

Table 2-15 – Existing NAA Parking Facilities

Facility ID	Facility Name	Short-Term	Long-Term	Accessible Parking (ADA)	Employee	Reserved or Permit	Rental Car	TOTAL SPACES
A	Garage A	275	2,260	37	0	0	636	**3,208**
B	Garage B	0	1,090	21	0	2	0	**1,113**
C	Garage C	0	1,089	21	0	0	0	**1,110**
D	Surface Lot D	0	72	4	0	6	0	**82**
E	Long-Term Lot	0	1,999	42	0	11	0	**2,052**
F	Departures North	146	0	6	0	0	0	**152**
G	Departures South	171	0	6	0	0	0	**177**
H	Permit Lot	0	0	5	0	87	0	**92**
I	Employee Lot	0	0	12	580	4	0	**596**
TOTAL PARKING INVENTORY		**592**	**6,510**	**154**	**580**	**110**	**636**	**8,582**

Source: NAA, 2018.

Figure 2-13 – ORF On-Airport Parking Facilities



Source: DESMAN, 2018.

Figure 2-14 – Off-Site Employee Parking Lot

Source: DESMAN, 2018.

A few items of note related to the existing parking inventory:

- In Garage A, the rental car ready spaces are located on the ground level and rental car return is on the second level, which are physically separated from the short- and long-term spaces. The short-term spaces are also physically separated from the long-term spaces in this facility.
- While the Long-Term Lot is shown as one facility, it is possible to block off the southern portion of the Lot, while still allowing access to the rest of the facility.
- All three garages, including the Short-Term Garage, and Surface Lot D share a common exit plaza where customer payments are processed. Garage A also has a separate exit lane from the rental car level of the Garage which allows rental car customers to avoid exiting through the regular exit plaza.
- All of the public parking facilities typically have cashiers stationed at the exits to collect payments, in addition to automated payment machines located in a number of the exit lanes.

ORF does not offer shuttle buses to move public parkers from any of the previously mentioned parking facilities due to the walking distances being in proximity to the terminal building; however, shuttle buses are provided to transport employees to and from the off-site Employee Lot.

2.4.2 Observed Utilization of Parking

The on-site observations of parking and traffic activity at ORF parking facilities on a Tuesday and Wednesday were intended to capture and understand typical levels of parking demand at the Airport. While the absolute peak activity period for most airports in the U.S. is around the Thanksgiving holiday, in terms of providing an adequate quantity of parking capacity, the objective is to try and accommodate the typical peak demand, not these periods of extraordinary demand. If airports constructed enough parking spaces to accommodate these occasional demand spikes, a large number of spaces would sit empty for all but a few days out of the year.

Table 2-16 presents a summary of the number of vehicles observed parking in each of the NAA's parking facilities on Tuesday, January 23, 2018 and Wednesday, January 24, 2018, between noon (12:00 pm) and 2:00 pm, Eastern Standard Time (EST). For comparison, further on-site observations will take place during the peak demands of summer and Thanksgiving.

Table 2-16 – Observed Utilization of ORF Parking Facilities

Facility ID	Facility Name	Inventory	Parked Vehicles January 23rd	Utilization %	Parked Vehicles January 24th	Utilization %
A	Garage A	3,208	2,652	83%	2,704	84%
B	Garage B	1,113	624	56%	669	60%
C	Garage C	1,110	235	21%	271	24%
D	Surface Lot D	82	64	78%	70	85%
E	Long-Term Lot	2,052	919	45%	691	34%
F	Departures North	152	46	30%	39	26%
G	Departures South	177	95	52%	96	54%
H	North Lot	92	60	65%	62	67%
I	Employee Lot	596	236	40%	258	43%
TOTALS		**8,582**	**4,931**	**57%**	**4,860**	**57%**
Public Parking Spaces		**7,258**	**3,999**	**55%**	**3,904**	**54%**
All Other Spaces		**1,324**	**932**	**70%**	**956**	**72%**

Source: NAA, 2018.

Ideally, during a typical peak demand period, 5 percent to 15 percent of the spaces in a parking facility remain available to accommodate new parkers. Maintaining an inventory of available spaces, even during the peak demand period, makes it easier for parkers to find a space, reduces the amount of time drivers spend searching for empty spaces and generally results in a more positive parking experience. This concept, referred to as "practical capacity", refers to that point at which a parking facility or system has reached its functional limit and is unable to efficiently or safely accommodate additional parking demand.

As shown in the table, with an observed peak utilization of 3,999 spaces, ORF's public parking inventory is currently operating at approximately 55 percent of capacity. This data indicates that, ORF has an ample supply of parking to accommodate it existing needs.

2.4.3 Parking Rates

Table 2-17 presents the rates charged for public parking in each of the ORF facilities.

Table 2-17 – ORF Public Parking Facility Rates

Facilities	Current Parking Rates
Garage A Short-Term Departures North Departures South	$1.00 per 30 minutes, or any part thereof; $24.00 maximum per day
Garage A Long-Term Garage B Garage C Surface Lot D Long-Term Lot	$1.00 per 30 minutes, or any part thereof; $10.00 maximum per day

Note: Prices are subject to change.
Source: NAA, 2020.

2.4.4 Off-Airport Competing Parking

In addition to researching public data sources, CHA spent time in the field working to identify private property owners offering long-term off-Airport parking; however, companies do not appear to be offering off-airport competing parking locations in the vicinity of ORF.

2.4.5 Curb-Front Traffic

In order to determine the capacity of the airport curb front to accommodate future levels of vehicular activity, it was necessary to first understand the functionality of the curb front during periods of peak demand. For this reason, observations of traffic flow and congestion were performed at the Airport on the same days as the observations of parking activity, Tuesday, January 23, 2018 and Wednesday, January 24, 2018.

The terminal curb front on the departure side has five lanes on each side of the building that are separated by an island, (3 lanes and 2 lanes) with the addition of a small parking lot on each side. The five lanes are each approximately 400 feet in length, for a total of 2,000 curb front feet on either side of the building. The arrivals curb front consists of five lanes running the length of the terminal, which are approximately 900 feet long. The 4,500 lane feet are divided into 2,700 feet adjacent to the building and 1,800 feet beyond the island.

On both days, over the course of the day, CHA never observed any significant traffic issues of note. At no time did passenger pick-up or drop-off activity, whether by personal vehicle, hotel shuttle, rideshare vehicle, or other means, appear to significantly block traffic or create significant congestion on the roadways near the Airport terminal. In conclusion, the terminal curb front and the departure lanes are adequate to accommodate the existing passenger activity.

2.4.6 Regional Roadway Network

Primary regional access to the airport terminal is provided from I-64 via Norview Avenue (RT 247), with additional access from I-64 available at Robin Hood Road. Route 192 (Azalea Garden Road) provides access from the northeast and southwest. See **Figure 2-15**.

I-64 is a six-lane Interstate Highway encircling Norfolk, Portsmouth, and Hampton and connecting to Richmond and on to St. Louis, MO. It provides easy access to the Airport from southeast Virginia, northwest North Carolina, southern Delaware, and southern Maryland.

Norview Avenue (RT 247) is a four-lane arterial road connecting the Airport with I-64 and points to the west. Route 192 varies between a two- and four-lane arterial which accesses the terminal via Route 247.

Together, these and other adjacent roads provide quick and easy access to the local and regional roadway network. See **Figure 2-16**.

2.4.7 Airport Roadway System

Norview Avenue terminates at the Airport. When it reaches the Airport, it divides into a two- lane departure road and a two-lane arrival road. These encircle the terminal and parking garages and provide direct access for passengers, providing as many as six lanes in certain areas. The departure road also provides access to surface parking lots on either side of the terminal building. There are over seven miles of roadways adjacent to the parking lots, garages and terminal curb front. These roadways are adequate to accommodate the current peak volumes of traffic with little or no congestion observed. See **Figure 2-17**.

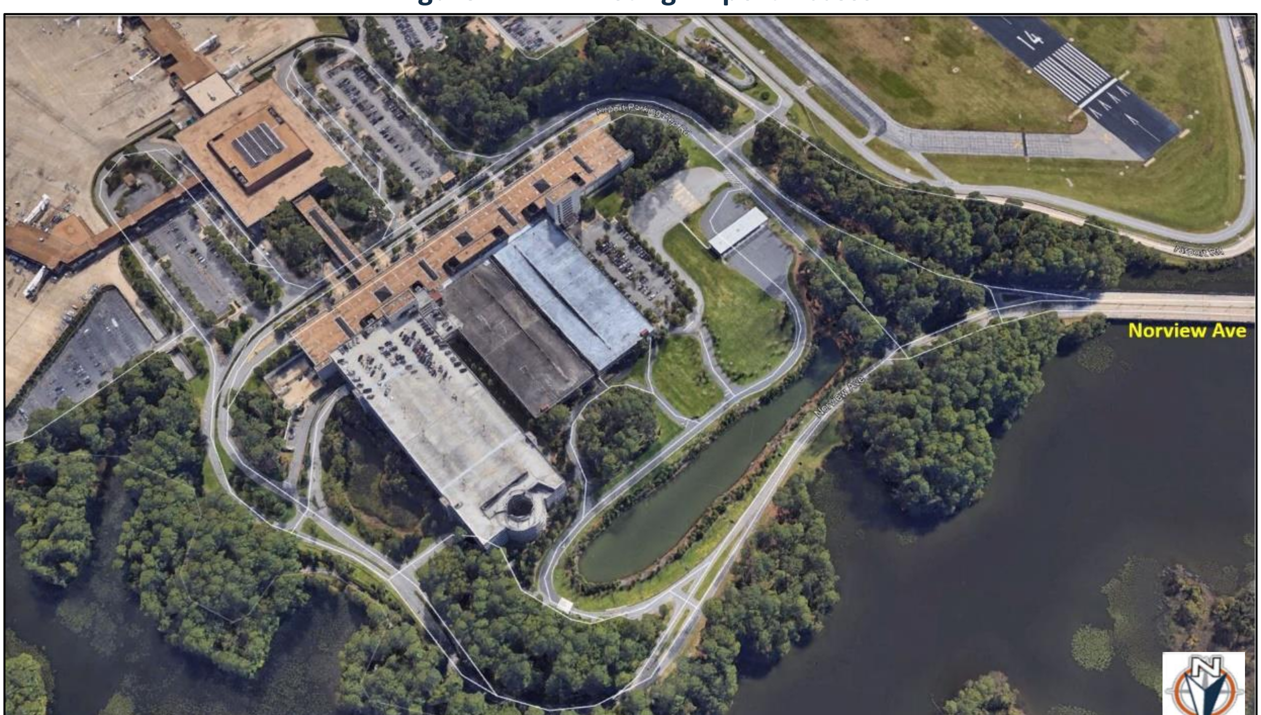
Figure 2-15 – Regional Roadway Network

Source: Google Earth, CHA, 2018.

Figure 2-16 – Local Roadway Network Access

Source: Google Earth.

Figure 2-17 – Existing Airport Access



Source: Google Earth.

2.5 SUPPORT FACILITIES

Support facilities provide vital functions related to the overall operation of the Airport and typically include facilities related to the following: airport fencing, airport equipment storage and maintenance, Air Traffic Control (ATC), Aircraft Rescue and Firefighting (ARFF), aircraft fueling, snow and ice control, air cargo, FBO/GA and Maintenance/Repair/Overhaul (MRO) services, and rental cars. **Figure 2-1** depicts the location of key facilities around the airfield.

The following tenants were interviewed in addition to those previously mentioned in **Section 2.3**:

- Signature Flight Support – Fixed Base Operator (FBO)
- United Parcel Service (UPS)

2.5.1 Airport Perimeter Fence

As required by TSA, the airfield is protected by a chain-link fence that encloses the runways, taxiways, and aircraft movement and non-movement areas. The airfield fence, which has 16 gates that provide access to various points of the airfield, is eight feet high, with various areas of fencing reaching 10 feet high for wildlife hazard mitigation. The entire airfield fence is topped with three-strands of barbed wire, totaling one-foot high.

Source: Google Earth

2.5.2 Airport Equipment Storage and Maintenance

Located on the southeast end of the airfield are ORF's maintenance and equipment storage facilities. The Airport's airfield maintenance area consists of two facilities: one on the north side and one in the southeast corner. The northern facility is approximately 40,000 square feet and includes three bay doors and two roll-up doors. This facility houses the Airport's snow removal equipment. The southeastern facility is approximately 6,000 square feet and includes seven bay doors, serves as the sand storage facility, and houses the Airport's maintenance and utility vehicles.

Source: Google Earth.

2.5.3 Air Traffic Control Tower (ATCT)

The current ATCT opened on January 22, 1995 and is located on the east side of the airfield. In addition to administrative and support facilities for local FAA operations at ORF, this facility includes the Norfolk Tower Terminal Radar Approach Control (TRACON). The 134-foot-high facility manages traffic in a 30 to 50 nautical mile radius around ORF, with radar coverage provided by an ASR-9 terminal system with a six-level weather detection capability. The ATCT is in operation 24 hours a day, 365 days a year.

Source: Google Earth.

2.5.4 Aircraft Rescue and Firefighting (ARFF)

ARFF vehicles are designed to provide an invaluable service to the commercial and private users of the Airport and the passengers and cargo they transport. The aviation industry is reliant on prompt and effective fire and rescue services during aircraft emergencies. These services include fire containment and suppression, passenger and crew rescue, airframe and cargo preservation, and maintenance of the site to aid in after-incident investigations. The vehicles that airport fire departments employ serve as the medium to deliver firefighters, specialized tools and equipment, and firefighting agents to the scene of an aircraft incident. They must be designed to perform specific functions, constructed for longevity and ease of maintenance, and tailored to the airport's needs.

Within three minutes from the initial alarm, a minimum of one required ARFF vehicle must reach the midpoint of the farthest runway serving air carrier aircraft from its assigned post or must reach any other specified point of comparable distance on the movement area that is available to air carriers and begin application of the extinguishing agent. Within four minutes from the initial alarm, all other required vehicles must reach the previously stated locations and begin application of the extinguishing agent. ORF has one ARFF facility on the north side of the airfield, northeast of the terminal building. The location of the ARFF facility allows firefighting equipment to access any airfield pavement within the required time established by Federal regulations.

A training aircraft for the ARFF department is located on the southeast side of the airfield, north of the airfield maintenance building.

The document used to determine an airport's index is Title 14 CFR Part 139.315, *Aircraft Rescue and Firefighting: Index Determination*. ORF operates as an ARFF Index C. The requirements for ARFF vehicles to transport a specific quantity and type of firefighting agents are established by Title 14 CFR Part 139.317, *Airport Rescue and Firefighting: Equipment and Agents*. As an ARFF Index C, the Airport can choose to have a minimum of either three or two vehicles; however, specifications of the vehicles depend upon the total number of vehicles chosen. ORF has chosen to keep a minimum of three ARFF vehicles.

ORF currently has a rapid intervention vehicle and four ARFF trucks meeting the specifications as described below:

- Two vehicles carrying the following extinguishing agents:
  - 500 pounds of sodium-based dry chemical, halon 1211, or clean agent or
  - 450 pounds of potassium-based dry chemical and water with a commensurate quantity of Aqueous Film Forming Foam (AFFF) to total 100 gallons for simultaneous dry chemical and AFFF application
- Two vehicles carrying an amount of water and commensurate quantity of AFFF so the total quantity of water for foam production carried by all three vehicles is at least 3,000 gallons

Source: Google Earth.

2.5.5 Aircraft Fueling

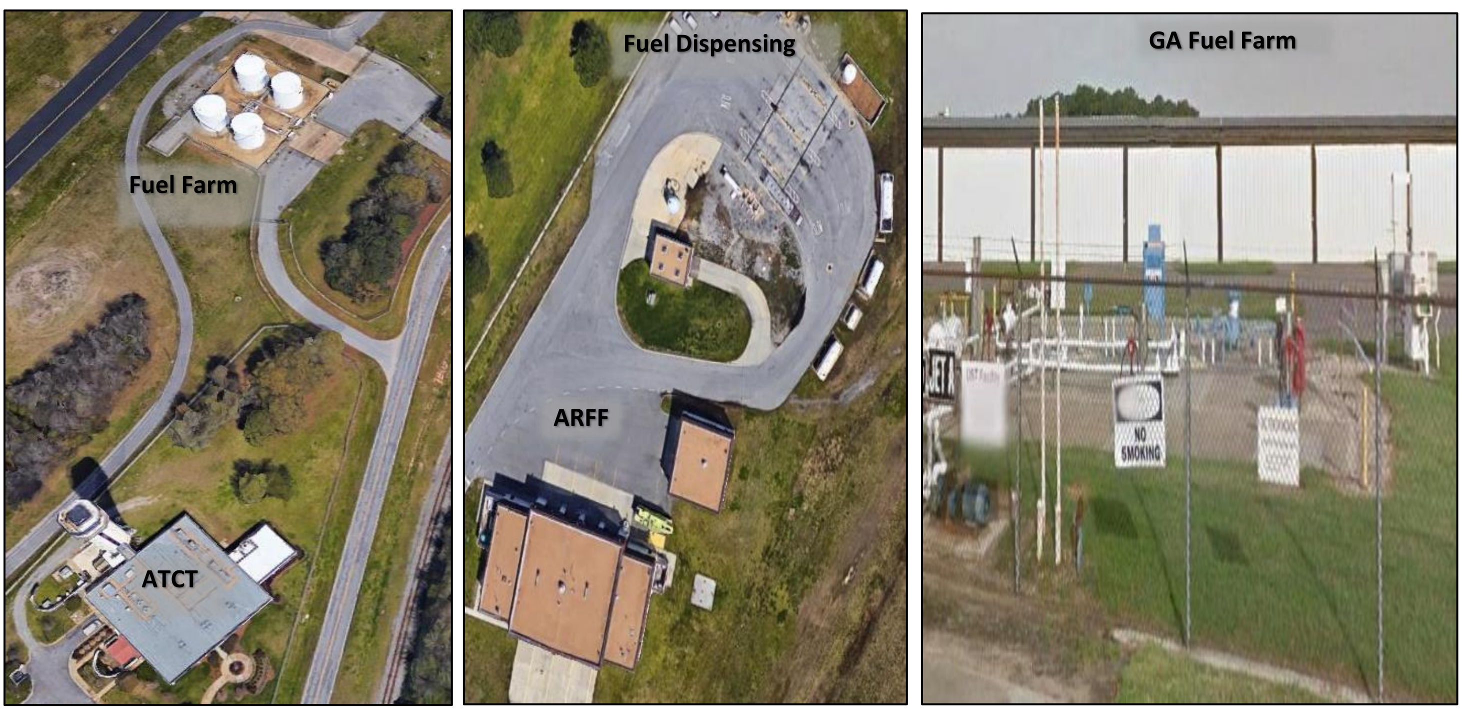
Signature Flight Support is responsible for operating the fuel farm, the GA fuel farm, and the fuel dispensing area at ORF. These operations include services to commercial, GA, and cargo aircraft. The Airport's fuel farm is located north of the Air Traffic Control Tower and includes four above-ground fuel tanks with fuel storage capacities of 210,000-gallons per tank (Jet-A).

Fuel is transported from the fuel farm and GA fuel farm via underground pipes to a dispensing area located north of the ARFF facility. Fuel is then transported from the dispensing area to aircraft via specialized fuel trucks, which make approximately 13 to 15 deliveries per day. The types of trucks and their carrying capacities are as follows:

- One 750-gallon truck (Avgas)
- One 1,000-gallon truck (Avgas)
- Ten 5,000-gallon trucks (Jet-A)
- One 10,000-gallon truck (Jet-A)

The GA fuel farm is located in the general aviation area, south of the T-Hangars. This fueling location includes three underground storage tanks with fuel storage capacities as follows:

- Two 10,000-gallon tanks (Jet-A)
- One 10,000-gallon tank (Avgas)



Source: Google Earth.

2.5.6 Snow and Ice Control

As guided by FAA AC 150/5200-30D, *Airport Winter Safety and Operations,* snow, ice, and slush should be removed as expeditiously as practicable to maintain runways, high-speed turnoffs, and taxiways in a “no worse than wet” (i.e., no contaminant accumulation) condition. To meet these guidelines during the winter months, personnel at ORF are on-call at all times for snow removal to ensure adequate response to weather events. In addition to regularly mandated inspections, airfield conditions are monitored throughout the day, or as often as needed by the on-duty airfield maintenance and airport operations personnel. The inspections are conducted visually and with runway friction measuring equipment. Airfield conditions are transmitted electronically to pilots via NOTAMS (Notice to Airmen). Other sources of information include reports from the National Weather Service (NWS), the Airport’s Automated Surface Observation System (ASOS) weather station, and pilot reports (PIREPs). Based on these observations and information, Airport personnel can determine the proper equipment and surface treatment to be used. Approved equipment for contaminant removal includes high-speed rotary plows, snow plows, material spreaders, and runway brooms. Approved chemicals include fluid deicers/anti-icers and solid deicers/anti-icers. Fluid deicers/anti-icers consist of glycol-based fluids, potassium acetate base, and potassium formate-based fluids. Solid deicers/anti-icers consists of sodium formate and sodium acetate.

Most equipment is stored in the airfield maintenance building so that it is protected from weather and to prolong the operational life expectancy.

Aircraft Deicing

Deicing operations at ORF are confined to the main terminal apron and the cargo apron on the west side of the airfield. The Airport’s main deicing facility/pad is located on the northeast side of the main terminal apron and consists of four deicing positions, which are utilized on a first-come-first-serve basis. Signature Flight Support provides the deicing services for aircraft operating at ORF including Allegiant, American, Delta, United, FedEx, and UPS.

Southwest handles its own deicing services. Signature provides deicing services via two 1,100-gallon deicing trucks.

Sweeper trucks are utilized to collect glycol from the pavement after application and to transfer the collected material to the glycol storage tanks near the fuel dispensing area. After deicing services have ceased for the season, the glycol tanks are taken to an off-site facility where the recovered fluid is analyzed and disposed of accordingly. Although Signature provides deicing services, each airline stores its own glycol. Delta and Southwest have their own storage tanks located beside the fuel farm, while the storage tanks for American and United are located under the concourse.

Deicing services on the cargo apron are authorized in the non-movement area parallel to Taxiway ‘V’. Deicing services are not permitted within 100 feet of a storm-drain or on the GA side of the airfield at ORF.

2.5.7 Air Cargo Facilities

ORF leases property to Aeroterm for air cargo in a dedicated area that is shared by FedEx, Mountain Air Cargo, and UPS. The cargo area is located on the west side of the airfield, south of the terminal. It consists of two multipurpose processing buildings, providing users with 88,000 square feet of space. The western facility is the largest of the two facilities, measuring approximately 65,000 square feet. FedEx is the primary operator of the facility, along with Mountain Air Cargo (MAC), which is a major contract carrier for FedEx. The second building, measuring approximately 23,000 square feet, is primarily operated and maintained by UPS. Adjacent to the air cargo facilities is an aircraft ramp which is approximately 265,000 square feet. The ramp provides the cargo operators with direct access to Taxiway ‘V’, which connects directly to Taxiway ‘C’ and Runway 14/32.

Source: Google Earth.

Air cargo service destinations are depicted in **Table 2-18**.

Table 2-18 – Cargo Service Destinations

Airlines	Destinations
Federal Express (FedEx)	Indianapolis International Airport (IND), Memphis International Airport (MEM), Dare County Regional Airport (MEO), McGhee Tyson Airport (TYS)
United Parcel Service (UPS)	Louisville International Airport (SDF), Richmond International Airport (RIC), Roanoke-Blacksburg Regional Airport (ROA)

** MAC is a contract carrier for FedEx and is not included in the table as its operations are unscheduled, have varying destinations, and are inconsistent.

Note: Destinations are subject to change.

Source: FedEx, UPS, U.S. DOT, T-100 statistics, CHA.

Non-aviation tenants also utilize the cargo facilities, including Quantem, Wright Bros. Aero, Philadelphia Truck Lines, and Coinmach.

2.5.8 General Aviation (GA) Facilities and Activities

Signature Flight Support, the airports sole FBO, operates a 29.5-acre site which includes hangars, a terminal building, and apron space.

The FBO operates six bulk-storage hangars, three sections of T-hangars, and a large aircraft parking apron. The largest hangar on the southwest side of the GA area is used for MRO services and is leased to PSA Airlines (see **Section 2.5.9**). Five additional box hangars ranging from approximately 18,000 square feet to 46,500 square feet are used for aircraft storage. Three T-hangars, ranging from approximately 12,700 square feet to 24,200 square feet are used for small aircraft storage and leased by the FBO. A large apron area that can provide up to 36 tie-down positions (depending on aircraft size), is used for short term storage of transient aircraft parking.

Signature primarily hosts corporate jets and on standard to busy days, has 35 to 50 itinerant aircraft, with 50 percent remaining overnight.

In addition to supporting GA parking and infrastructure, Signature provides fueling and deicing services to tenants and operators at ORF, in addition to ground handling services for UPS. Small flight schools periodically sublease approximately 10 aircraft from the FBO. A detailed depiction of Signature Flight Support's facilities is shown in **Figure 2-18**.

2.5.9 MRO Facility

ORF leases property for one MRO-dedicated facility, located in the general aviation area and measuring approximately 49,000 square feet, to PSA Airlines. It is a full-service, overnight MRO facility that provides maintenance support for all aircraft operating at the Airport. The MRO facility is also depicted in **Figure 2-18**.

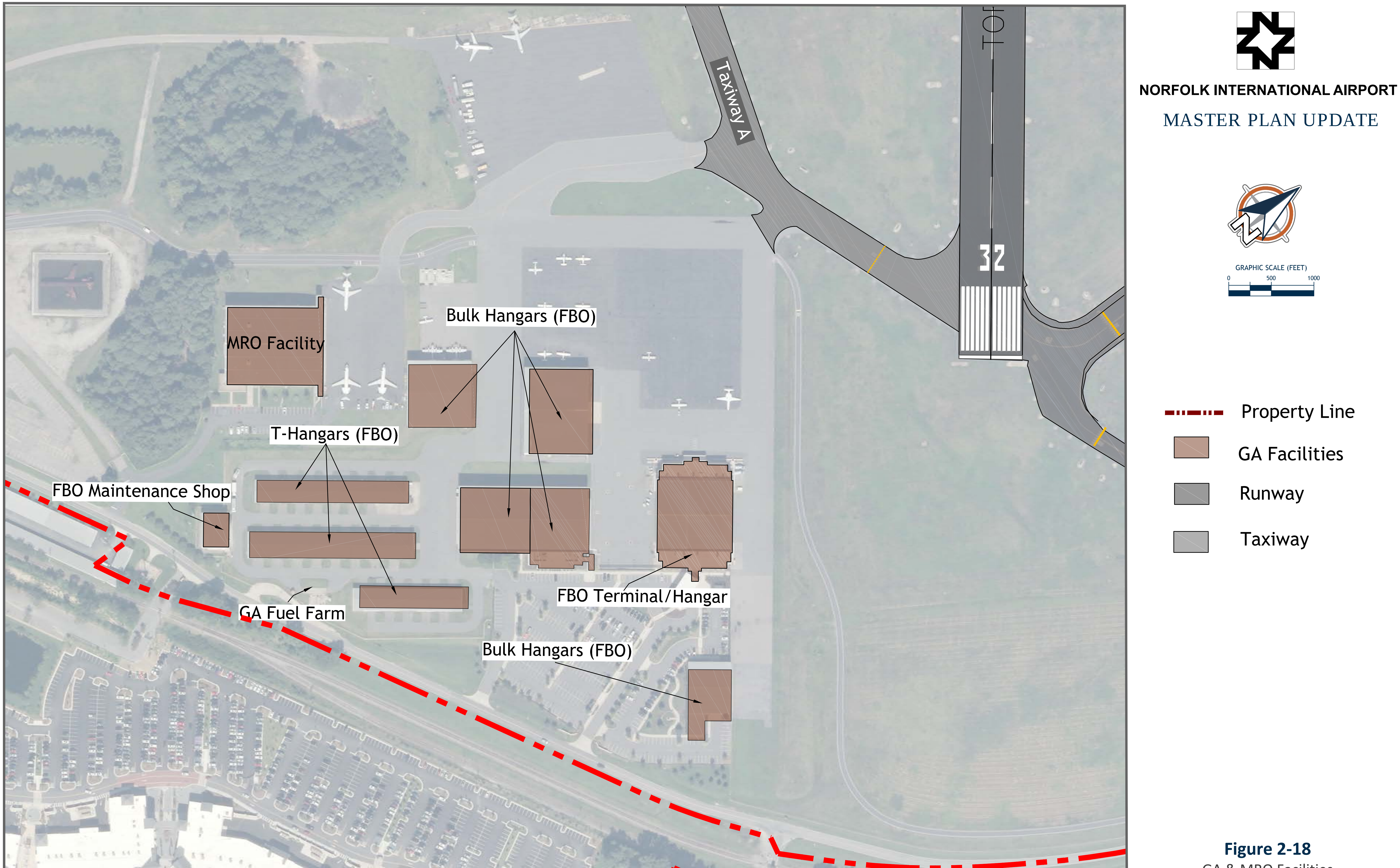


Figure 2-18
GA & MRO Facilities

2.5.10 Rental Car Facilities

When picking up rental cars, passengers first proceed to the rental car counters, located in the Arrivals Terminal. Bypass booths are installed in the Airport Parking Garage that allow VIP customers to go directly to the Ready booth and bypass the rental car counters, saving the customer time. After being processed, passengers pick up rental cars at the Rental Car Ready lot, located in the Airport Parking Garage. When finished with rental vehicles and after completing rental return paperwork, customers can proceed to the rental car return area on the second level of Garage A. After rental cars have been returned, the vehicles are taken to a remote QTA facility, located west of Airport property on Military Highway.

2.6 AIRSPACE ENVIRONMENT

The National Airspace System (NAS) is made up of a network of air navigation facilities, Air Traffic Control (ATC) facilities, airports, technology, and appropriate rules and regulations that are needed to operate the system. The FAA created the NAS to protect persons and property on the ground, and to establish a safe and efficient airspace environment for civil, commercial, and military aviation within the United States. Airspace is broken down into two categories: regulatory and non-regulatory. Within the regulatory airspace category, there are two types of airspace: controlled and uncontrolled. Categories and types of airspace are defined based on their complexity or density of aircraft movements, or the nature of the operations conducted within the airspace, which dictates the level of safety required and the level of national and public interest.

The purpose of controlled airspace is to provide adequate separation between IFR and VFR aircraft, thus, IFR services are available, but not required, within all controlled airspace. Airspace designated as Class A, B, C, D, and E is controlled airspace.

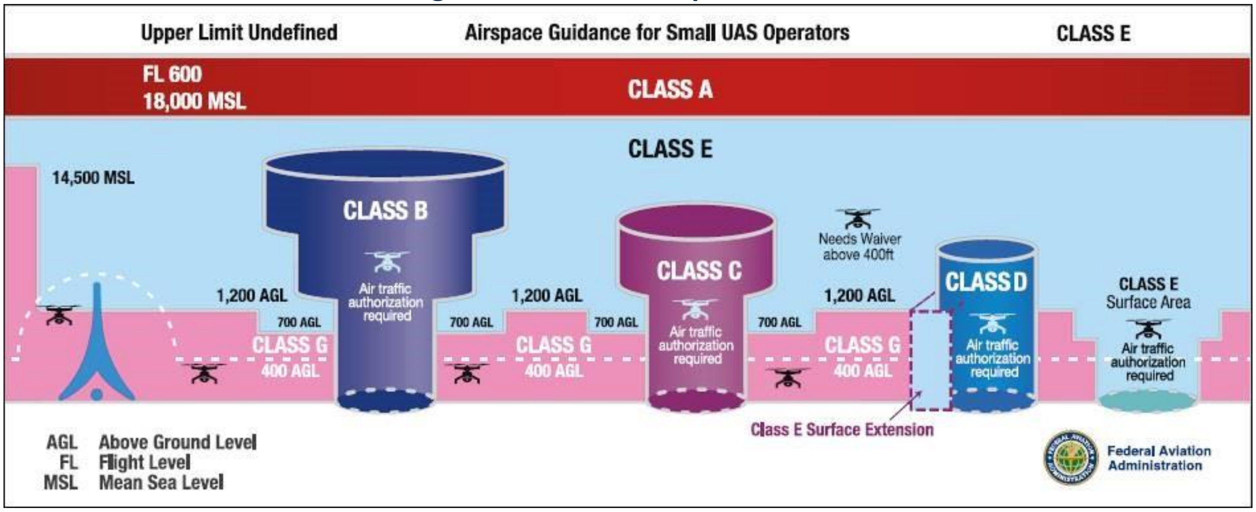
VFR aircraft operating in Class B, C, or D airspace must be in contact with ATC. This gives ATC the authority to manage IFR and VFR traffic in the proximity to airports and ensure proper separation. Controlled airspace designations do not affect IFR traffic, as IFR traffic is cleared through controlled airspace by ATC.

Class G airspace is uncontrolled and IFR services may or may not be available.

Large sections of controlled and uncontrolled airspace have been designated as special use airspace. Special use airspace is further defined as prohibited, restricted, warning, military operations, and alert areas. Civil operations within special use airspace may be limited or even prohibited, depending on the area, as operations within these areas are considered hazardous to civil aircraft.

ORF is located within Class C airspace, extending from the runway surface up to 4,000 feet mean sea level (MSL) for a 5-nm radius, and from 1,200 feet MSL to 4,000 feet MSL for a 10-nm radius. A graphic of the U.S. Airspace Profile is presented in **Figure 2-19**.

Figure 2-19– U.S. Airspace Profile



Source: Federal Aviation Administration.

The National Aeronautical Charting Office (NACO) of the FAA publishes special aeronautical charts used by pilots to navigate through the National Airspace System. These charts are called sectional charts, or sectionals. A sectional chart provides detailed information on airspace classes, ground-based NAVAIDS, radio frequencies, longitude and latitude, navigational waypoints and navigational routes. It also offers topographical features, such as terrain elevations and ground features that are important to aviators, such as landmarks that will be identifiable from a given altitude. Although these charts are used for VFR and IFR navigation, they are a VFR pilot's primary navigation tool.

Figure 2-20 displays a segment of the Washington Sectional Chart, centered on ORF.

Figure 2-20– Washington Sectional, 103rd Edition [Effective 1 Feb 2018]

Source: aeronav.faa.gov

2.7 METEOROLOGICAL CONDITIONS

Meteorological conditions affect airport operations at an airport in many ways. Winds, precipitation, and temperature influence decisions pertaining to NAVAIDs, runway orientation, and required runway length. ORF is equipped with an Automatic Surface Observation System (ASOS), a highly sophisticated weather data sensing, processing, and dissemination system that is designed to support weather forecast activities and aviation operations. While meteorological readings are taken every minute, 24-hours a day, every day of the year, these systems generally report at hourly intervals, but also report special observations if weather conditions change rapidly and cross aviation operation thresholds. Maintained, controlled, and operated by the FAA and the National Weather Service, the ASOS automatically observes, formats, archives, and transmits observations.

When weather conditions exceed predetermined weather element thresholds, a special report is transmitted through an automated very-high-frequency (VHF) airband radio frequency (127.15 MHz) to pilots operating at or near ORF. These messages are also available via phone by calling 757-460-9348.

2.7.1 Local Climate

The average annual temperature in Norfolk, Virginia is 60.05 degrees Fahrenheit. The average low is 52.00 degrees Fahrenheit, while the average high is 68.10 degrees Fahrenheit. When the Study commenced, July was the warmest month, with a mean temperature of 87.00 degrees Fahrenheit. Average monthly precipitation ranges from 3.11 inches to 5.51 inches, with annual precipitation averaging 46.55 inches. Average monthly snowfall during the months of December through February range from one to two inches, with an annual average of five inches of snowfall. The local climate requires the Airport to support snow removal and aircraft deicing services.

This climate data for Norfolk, Virginia was obtained from the National Oceanic and Atmospheric Administration (NOAA) and the NWS.

2.7.2 Wind Coverage

In addition to climate data, the ASOS (Station 13737 – Norfolk International Airport) at ORF collects wind speed and direction data, which can influence airfield development decisions on runway orientation and length. Local wind conditions at an airport are a key factor in determining runway use. Aircraft operational safety and performance is enhanced when aircraft depart and land into the wind; therefore, runways that are not oriented to take full-advantage of the prevailing wind patterns are not utilized as frequently as runways that are appropriately oriented. According to FAA AC 150/5300-13A, *Airport Design*, the desirable wind coverage for an airport is at least 95 percent at all speeds, meaning that the primary runway at an airport has at least 95 percent wind coverage and that the wind at the airport is within certain limits of crosswind conditions. Wind coverage is calculated using the highest crosswind component that is acceptable for the type of aircraft expected to use the runway system. Larger aircraft have a higher tolerance for crosswinds than smaller aircraft due to their size, weight, and operational speed. **Table 2-19** provides the standard crosswind component by aircraft size. **Table 2-20** outlines the weather classification criteria and the number of recorded observations at ORF between 2007 and 2016.

Table 2-19 – Crosswind Components

Runway Design Code (RDC)	Maximum Crosswind Component
A-I and B-I aircraft*	10.5 knots
A-II and B-II aircraft	13.0 knots
A-III, B-III, C-I through D-III D-I through D-III	16.0 knots
A-IV, B-IV, C-IV through C-VI, D-IV through D-VI	20.0 knots
E-I through E-VI	20.0 knots

Source: FAA AC/5300-13A *Airport Design*

Table 2-20 – Weather Classification Criteria

Weather Class	Recorded Observations at ORF (2007-2016)
All Weather	131,281
VFR Conditions	15,056
IFR Conditions	92,646

Source: NOAA, National Climate Center; Station 723080 (2007-2016)

VFR – Visual Flight Rule

IFR – Instrument Flight Rule

The combination of the crosswind and the weather classification allows for the calculation of the wind coverage, which is presented in **Table 2-21** for ORF. Wind coverage is the percent of time crosswind components are below an acceptable velocity. The 95 percent wind coverage is computed on the basis of crosswinds not exceeding 10.5 knots for ARC A-I and B-I; 13 knots for ARC A-II and B-II; 16 knots for ARC A-III, B-III, and C-I through D-III, and 20 knots for ARC A-IV through D-VI. The calculated wind coverage for ORF facilities shows that all runways exceed the 95 percent wind coverage threshold when combined in all modeled weather conditions (all weather, VFR-only, and IFR-only), as well as individually for crosswind coverage of 20 knots.

Runway 5/23 meets the 95 percent wind coverage threshold for each crosswind speed in all modeled weather conditions, with the exception of during IFR conditions when the crosswind speed is 10.5 knots.

Runway 14/32 does not meet the 95 percent wind coverage threshold in IFR conditions when the crosswind speed is 16 knots or in any modeled weather conditions when the crosswind speed is 10.5 knots or 13 knots.

Table 2-21 – ORF Wind Coverage

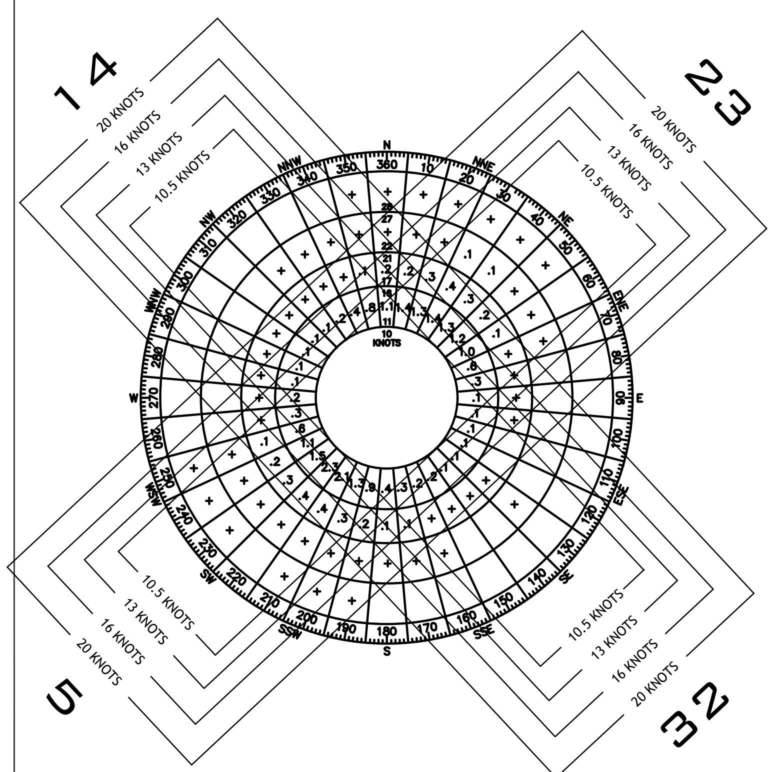
	Runway	10.5 Knots	13 Knots	16 Knots	20 Knots
AW	5/23	95.56%	98.14%	99.62%	99.93%
	14/32	80.00%	87.77%	95.89%	98.81%
	All Combined	98.58%	99.64%	99.93%	99.99%
VFR	5/23	95.75%	98.27%	99.70%	99.96%
	14/32	78.79%	87.17%	96.01%	99.04%
	VFR Combined	98.77%	99.72%	99.96%	100%
IFR	5/23	92.05%	96.34%	98.9%	99.75%
	14/32	76.67%	84.58%	92.52%	96.68%
	IFR Combined	96.51%	98.88%	99.75%	99.98%

Source: NOAA, National Climate Center; Station 725080 (2007-2016)

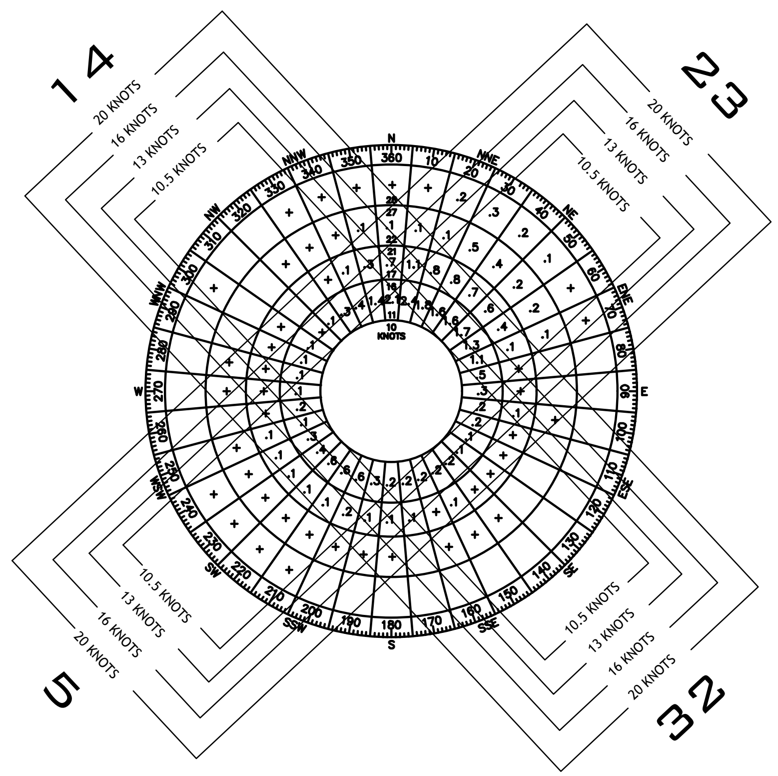
Weather observations are presented in a format that is specifically designed by the FAA to be useful for evaluating weather conditions at an airport. Wind direction is grouped according to a 16-point compass rose (N, NNE, NE, ENE, E, ESE, SE, SSE, S, SSW, SW, WSW, W, WNW, NW and NNW).

Wind speed is organized into groups of 0-3, 4-6, 7-10, 11-16, 17-21, 22-27, 28-33, 34-40, and 41 knots per hour or greater. This data is typically displayed on a wind rose for each weather classification. Windroses are depicted in **Figure 2-21**.

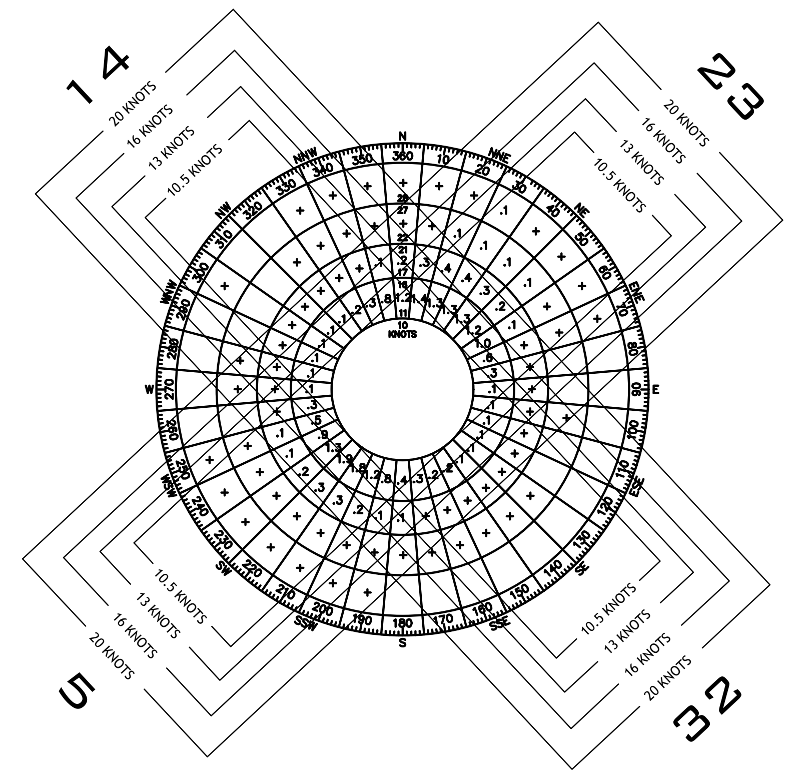
VFR Windrose



IFR Windrose



All-Weather Windrose



VFR Observations

RUNWAY	10.5 KNOTS	13 KNOTS	16 KNOTS	20 KNOTS
Runway 5/23	95.75%	98.27%	99.70%	99.96%
Runway 14/32	78.79%	87.17%	96.01%	99.04%
Combined	98.77%	99.72%	99.96%	100%

DATA SOURCE: NOAA National Center for Environmental Information - Southeast Regional Climate Center
Chapel Hill, NC
Norfolk International Airport
Norfolk, VA
Station 723080

OBSERVATIONS: 92,646 Observations
2007-2017

IFR Observations

RUNWAY	10.5 KNOTS	13 KNOTS	16 KNOTS	20 KNOTS
Runway 5/23	92.05%	96.34%	98.90%	99.75%
Runway 14/32	76.67%	84.58%	92.52%	96.68%
Combined	96.51%	98.88%	99.75%	99.98%

DATA SOURCE: NOAA National Center for Environmental Information - Southeast Regional Climate Center
Chapel Hill, NC
Norfolk International Airport
Norfolk, VA
Station 723080

OBSERVATIONS: 15,056 Observations
2007-2017

All-Weather Observations

RUNWAY	10.5 KNOTS	13 KNOTS	16 KNOTS	20 KNOTS
Runway 5/23	95.56%	98.14%	99.62%	99.93%
Runway 14/32	80.00%	87.77%	95.89%	98.81%
Combined	98.58%	99.64%	99.93%	99.99%

DATA SOURCE: NOAA National Center for Environmental Information - Southeast Regional Climate Center
Chapel Hill, NC
Norfolk International Airport
Norfolk, VA
Station 723080

OBSERVATIONS: 131,281 Observations
2007-2017

Figure 2-21
Windroses

3 FORECASTS OF AVIATION ACTIVITY

3.1 INTRODUCTION

This chapter of the Master Plan Update projects aviation demand over a 20-year planning horizon for the Norfolk International Airport (ORF). Facility sizing and capacity recommendations, both airside and landside, are directly impacted by the projected aviation activity levels presented in this chapter. The projections were derived from approved methodologies in accordance with the requirements provided in Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5070-6B, *Airport Master Plans*.

To develop these forecasts, an understanding of current and historical airport operations, industry trends, and economic conditions within ORF's market was necessary. These variables were detailed and factored into individual forecast scenarios that comprise the commercial passenger and operations forecasts. For the purposes of this Study, the Airport's historical calendar year (January-December) data was organized according to the FAA fiscal year (October-September) and was used in the scenarios, forecasts, and FAA forecast comparisons within this chapter. It is important to reaffirm that all scenarios and forecast projections of enplanements and operational activity (Air Carrier and General Aviation) were developed according to the FAA's fiscal year (FY) for the purposes of direct comparison to the FAA Terminal Area Forecast.

The assumptions, methodologies, and data used to create the various projections are presented and analyzed in the following sections. The specific activity elements for which forecasts were prepared include:

- Enplaned Passengers
  - 5-, 10-, and 20-year forecasts
  - Load Factors
- Air Carrier Activity
  - Operations
  - Fleet Mix
- Air Cargo Activity
  - Operations
  - Cargo Volume
- General Aviation Activity (GA)
  - Based Aircraft
  - Operations
- Military Aviation Activity
  - Operations
- Peak Activity
  - Enplaned Passengers
  - Operations

3.1.1 Forecast Data Sources

Information factored into both the planning and the forecasting efforts included commercial air carrier industry trends, airframe orders and retirement programs, GA operational trends, and anticipated changes in the aircraft fleet mix operating at ORF. The data and assumptions used to define baseline conditions and future activity trends were derived from the following data sources:

- Airport Management – Airport management representatives typically provide the most accurate historical data and future assumptions at the Airport. Data provided by the Airport included passenger and operational activity, facility needs, gate requirements, fleet mix transition, and anticipated service growth.

- FAA Terminal Area Forecast (TAF)[5] – TAF activity estimates are derived by the FAA from national estimates of aviation activity. These estimates are then assigned to individual airports based upon multiple market and forecast factors. The FAA looks at local and national economic conditions, as well as trends within the aviation industry, to develop each forecast.
- Airline Management – Airline representatives provided insight on planned and future airline routes and airframe changes, which were directly factored into the assumptions and methodologies of the demand projections.
- FAA Aerospace Forecast 2018-2038 – This forecast provided an overview of aviation industry trends and expected growth for the commercial passenger air carrier activity segments. National growth rates in enplanements and operations, as well as growth and mix for commercial fleets, were provided over a 20-year forecast horizon. For the purposes of this forecast, the FAA Aerospace Forecasts were used as comparisons for the basis of determining the growth of the ORF general aviation and commercial fleet. This forecast also provided insight into future air cargo growth trends on a national and international level.
- The Boeing Commercial Market Outlook 2018-2038 – This market outlook provided information detailing future fleet mix transitions, such as new aircraft entering the market and future equipment retirements, for commercial and air cargo carriers.
- Airbus Global Market Forecast FY 2018-2037 & Boeing World Air Cargo Forecast 2016-2017 – These forecasts provided insight into future commercial cargo fleet growth and anticipated fleet mix of both domestic and foreign airlines. These insights were used to assist in developing and confirming the validity of future ORF cargo carrier fleet mix and projected volume assumptions.
- Woods & Poole Economics, Inc. – Woods & Poole Economics, Inc. is an independent firm that specializes in developing long-term economic and demographic projections. Their database includes every State, Metropolitan Statistical Area (MSA), and county in the United States (U.S.) and contains historical data and projections from 1970 through 2050, utilizing more than 900 economic and demographic variables.
- Aviation DataMiner (Boyd Group International) – This data source provided access and analyzation of metrics and projections related to air traffic, cost factors, schedules, revenue sources, fares, and other customizable data. This data was used to derive T-100 data including specific route load factors, seats per departure, fleet mix, airline schedules, and other related data sets.

3.1.2 ORF Catchment and Core Area

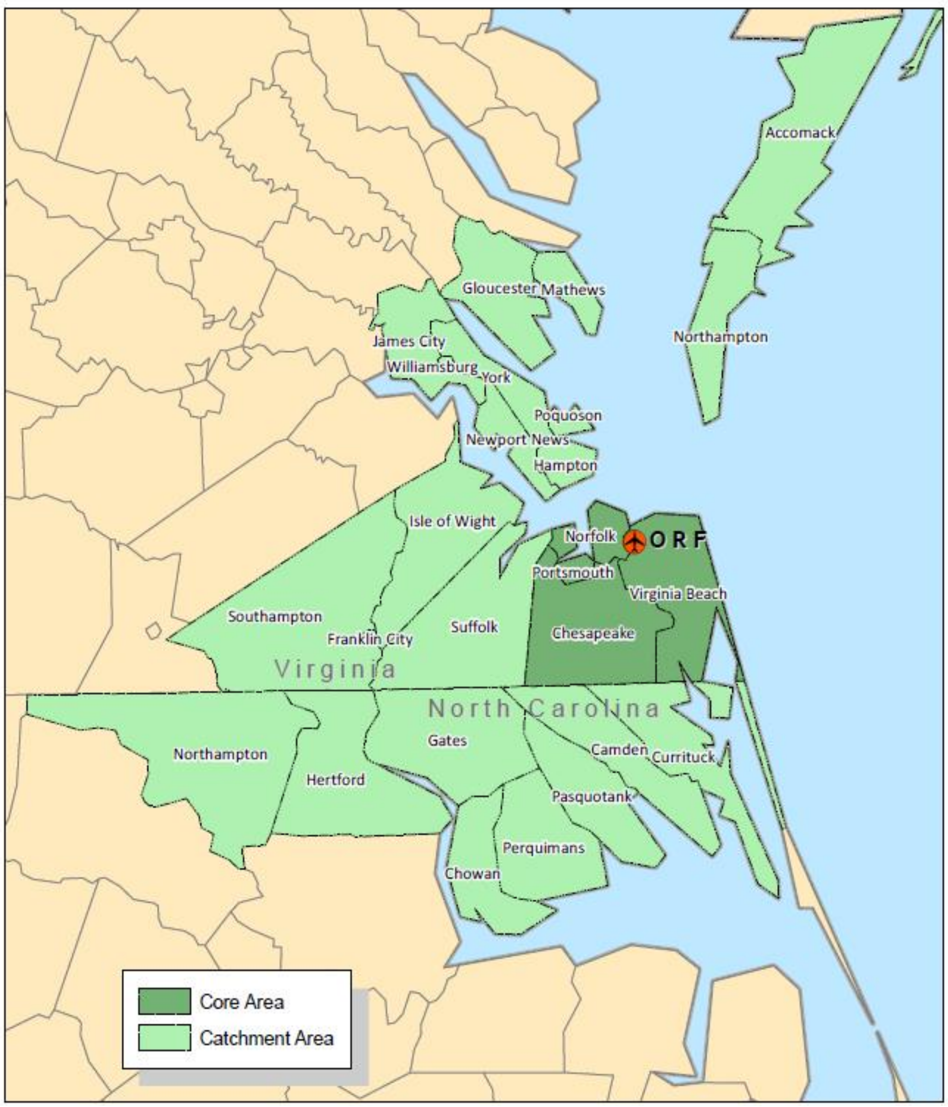
An airport's catchment area, or market, is defined as the area in which an airport captures the majority of its airport users. To determine the catchment area, an evaluation using socioeconomic factors was conducted to identify which airports the local area population are

[5] Note, the 'FAA 2018 TAF', which was pulled in February 2019, represents the TAF containing all data from FY 2018.

most likely to use, based on the proximity with respect to other airports in the region, drive-time, and demographics. For the purposes of this forecast, the catchment area for ORF traffic exists primarily in the following Virginia Counties and *Independent Cities: Accomack, *Chesapeake, Gloucester, *Hampton, Isle of Wight, James City & Williamsburg, Mathews, *Newport News, *Norfolk, Northampton, *Portsmouth, Southampton & *Franklin, *Suffolk, *Virginia Beach, and York & *Poquoson. The catchment area also extends partially into North Carolina to include the following Counties: Camden, Chowan, Currituck, Gates, Hertford, Pasquotank, and Perquimans.

Based on its location relative to major airports in Virginia and North Carolina and drive times associated with the surrounding roadway network, ORF depends on a core region within its catchment area for a large portion of its passenger activity. The core region consists of areas located within a 30-minute drive-time. This region includes portions of Chesapeake, Norfolk, Portsmouth, and Virginia Beach, which are all in the top-six most populated counties within the region. **Figure 3-1** shows the catchment area, as well as the core area.

Figure 3-1 – ORF Catchment and Core Areas



Source: CHA, 2018.

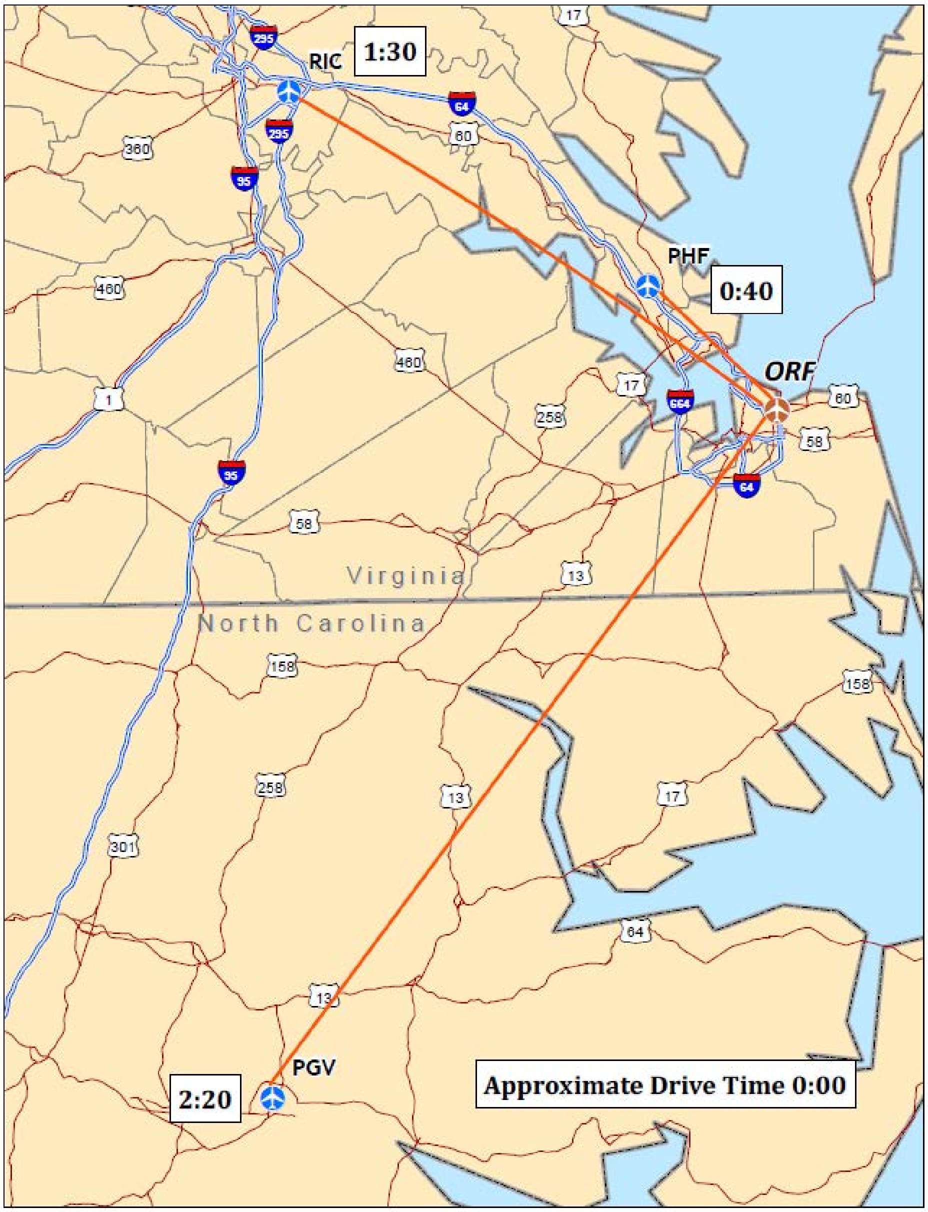
3.1.3 Nearby Airports

As shown in **Figure 3-2**, ORF is located within 20 to 95 nautical miles (nm) and a 40-minute to a 2 ½-hour drive-time of the following major airports:

- Newport News/Williamsburg International Airport (PHF) – 20 nm; 40-minute drive; northwest of ORF
- Richmond International Airport (RIC) – 65 nm; 90-minute drive; northwest of ORF
- Pitt-Greenville Airport (PGV) – 95 nm; 150-minute drive; southwest of ORF

ORF and RIC are primary, small-hub airports, while PHF and PGV are both primary, non-hub airports.

Figure 3-2 – Drive Time to Nearby Major Airports



Source: CHA, 2018.

3.2 SOCIOECONOMIC DATA

The factors that have the greatest impact on the growth prospects of an airport are the socioeconomic characteristics (i.e., population, income, and employment) present within the Airport's catchment, or market, area. In addition to the common demographic factors, the ORF area has a large contingent of military personnel. According to a survey conducted by the NAA, *Characteristics of Passengers Using Norfolk International Airport: 2018*, members of active duty and their dependents accounted for approximately 16 percent of the passengers utilizing the Airport in 2018. Of all passengers interviewed, 30 percent had a military connection. According to Dragas Center for Economic Analysis and Policy's report, *The State of the Region*[6], Hampton Roads is home to more than 80,000 military personnel, with approximately four percent of national defense spending occurring in this area. From 2000 to 2012, the Department of Defense (DOD) spending was booming but became dissolute with the onset of sequestration in 2013 and remained fairly constant through 2016. In 2017, the DOD had an increase of approximately one-billion dollars in spending.

As such, changes in military missions, assignments, and programs have large impacts on the socioeconomic variables within the region. The economic and demographic growth patterns for this core area will have major impacts on future demand for air service at ORF.

Population

In 2017, the Virginia Beach-Norfolk-Newport News VA-NC Metropolitan Statistical Area (MSA), consisting of Chesapeake, Gloucester, Hampton, Isle of Wight, James City & Williamsburg, Mathews, Newport News, Norfolk, Portsmouth, Suffolk, Virginia Beach, York & Poquoson, and Currituck Counties, had a population of approximately 1.7 million while the ORF catchment area had a population of approximately 1.9 million. The Average Annual Growth Rate (AAGR) for the Virginia Beach-Norfolk-Newport News VA-NC MSA and the ORF catchment area were 0.5 and 0.4 percent, respectively, which were below the Commonwealth of Virginia AAGR of 0.9 percent and the National AAGR of 0.7 percent, despite having a steady increase in population from 2008-2017. The Virginia Beach-Norfolk-Newport News VA-NC MSA and the ORF catchment area are both projected to grow, with AAGRs of 0.6 percent, a lesser rate of growth than the projected AAGRs for the Commonwealth of Virginia (1.1 percent) and the United States (0.9 percent).

The lesser growth rate indicates that the Airport is dependent upon more than resident travelers for passenger activity growth and relies on passenger leakage from nearby airports in the Hampton Roads and surrounding area. It also indicates that the Airport is heavily impacted by Federal decisions with respect to military operations, such as sequestration. Passenger leakage occurs when travelers choose to utilize airports outside their core area when flying. See **Table 3-1** and **Figure 3-3.**

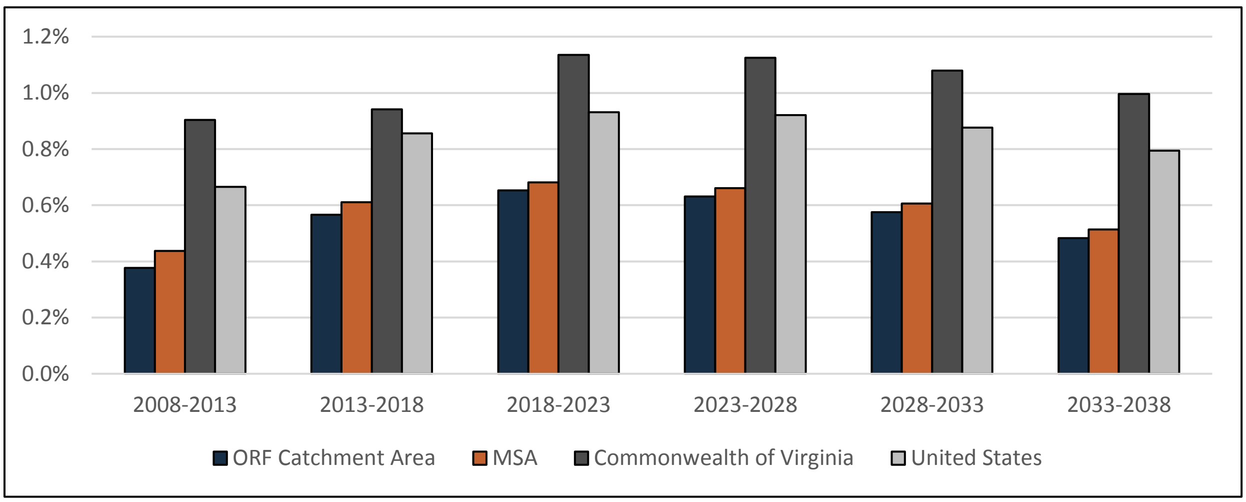
[6] Dragas Center for Economic Analysis and Policy (2018). State of the Region: Hampton Roads 2018 [PDF file]. Retrieved from https://www.ceapodu.com/wp-content/uploads/2018/10/SOR-2018-FINAL090518.pdf

Table 3-1 – Population (Historical & Projected)

Year	ORF Catchment Area (000)	AAGR	MSA (000)	AAGR	Commonwealth of Virginia (000)	AAGR	United States (000)	AAGR
2008	1,839.3	-	1,662.5	-	7,833.5	-	304,093.9	-
2013	1,881.2	0.4%	1,706.7	0.4%	8,267.9	0.9%	316,427.3	0.7%
2017	1,922.5	0.4%	1,747.4	0.5%	8,567.5	0.7%	327,167.9	0.7%
AAGR 2008-2017	-	**0.4%**	-	**0.5%**	-	**0.9%**	-	**0.7%**
2018	1,935.1	0.7%	1,759.4	0.7%	8,664.6	1.1%	330,206.7	0.9%
2023	1,999.1	0.7%	1,820.2	0.7%	9,167.6	1.1%	345,864.6	0.9%
2028	2,062.9	0.6%	1,881.2	0.7%	9,694.7	1.1%	362,086.9	0.9%
2033	2,123.0	0.6%	1,938.8	0.6%	10,229.1	1.1%	378,237.1	0.9%
2038	2,174.7	0.5%	1,989.1	0.5%	10,748.6	1.0%	393,507.4	0.8%
AAGR 2018-2038	-	**0.6%**	-	**0.6%**	-	**1.1%**	-	**0.9%**

Note: Woods & Poole Economics, Inc. data is estimated.
Source: 2017 – Woods & Poole Economics, Inc., CHA, 2018.

Figure 3-3 – Population (Historical & Projected)



Note: Woods & Poole Economics, Inc. data is estimated.
Source: 2017 – Woods & Poole Economics, Inc., CHA, 2018.

Employment

In 2017, the Virginia Beach-Norfolk-Newport News VA-NC MSA had employment levels of approximately 1.0 million, while the ORF catchment area had employment levels of approximately 1.1 million. The AAGR for the Virginia Beach-Norfolk-Newport News VA-NC MSA and the ORF catchment area were both 0.2 percent, which was below the Commonwealth of Virginia and National AAGRs of 0.7 and 0.9 percent, respectively.

The lower AAGRs for the ORF catchment area and Virginia Beach-Norfolk-Newport News VA-NC MSA were due to a decline in employment levels in 2009. The decline in employment levels for the catchment area ended in 2011; however, the decline for the MSA continued through 2013. As mentioned previously, the military impact on socioeconomics in the ORF area is significant as much of this decline in employment in the primary catchment area was due to military sequestration leading up to and in 2013.

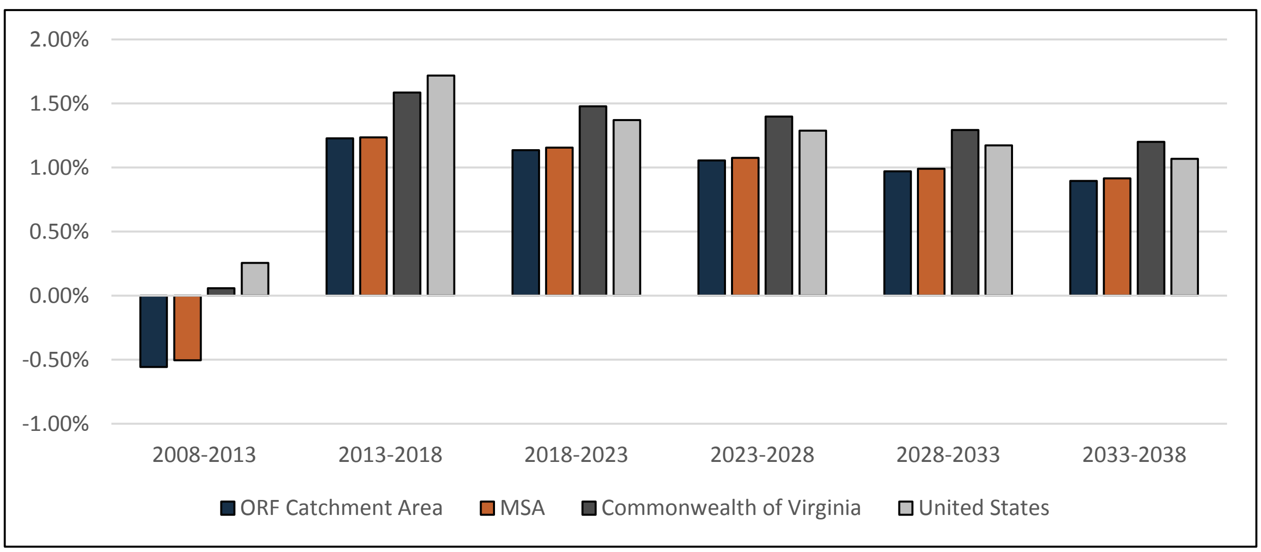
According to the Bureau of Labor Statistics, after a large spike in the unemployment rate from 2008 to 2009 (the peak resulting in 9.4 percent in October 2009), except for sequestration in 2013, the resulting unemployment rate in the MSA has been steadily declining since 2010, with the unemployment rate falling to 4.0 percent in March 2018. This coincides with the projections of employment growth within the Virginia Beach-Norfolk-Newport News VA-NC MSA and the ORF catchment areas, which are projected to grow at the same rate, with AAGRs of 1.0 percent. The Commonwealth of Virginia and the United States are projected to grow at a higher rate, with AAGRs of 1.3 and 1.2 percent, respectively. Possibly most important is the evidence that the MSA and catchment areas are not anticipated to experience declines in employment levels as they had historically. See Table 3-2 and **Figure 3-4.**

Table 3-2 – Employment (Historical & Projected)

Year	ORF Catchment Area (000)	AAGR	MSA (000)	AAGR	Commonwealth of Virginia (000)	AAGR	United States (000)	AAGR
2008	1,123.0	-	1,035.3	-	4,882.8	-	179,639.9	-
2013	1,086.0	-0.6%	1,004.3	-0.5%	4,899.8	0.1%	182,408.0	0.3%
2017	1,140.6	1.0%	1,055.0	1.0%	5,220.6	1.3%	195,849.2	1.4%
AAGR 2008-2017	-	**0.2%**	-	**0.2%**	-	**0.7%**	-	**0.9%**
2018	1,154.3	1.2%	1,067.8	1.2%	5,300.7	1.5%	198,635.3	1.4%
2023	1,221.3	1.1%	1,130.9	1.2%	5,704.3	1.5%	212,627.0	1.4%
2028	1,287.1	1.1%	1,193.0	1.1%	6,114.2	1.4%	226,668.6	1.3%
2033	1,350.8	1.0%	1,253.2	1.0%	6,519.5	1.3%	240,285.0	1.2%
2038	1,412.4	0.9%	1,311.6	0.9%	6,920.0	1.2%	253,386.2	1.1%
AAGR 2018-2038	-	**1.0%**	-	**1.0%**	-	**1.3%**	-	**1.2%**

Note: Woods & Poole Economics, Inc. data is estimated.
Source: 2017– Woods & Poole Economics, Inc., CHA, 2018.

Figure 3-4 – Employment (Historical & Projected)



Note: Woods & Poole Economics, Inc. data is estimated.
Source: 2017 – Woods & Poole Economics, Inc., CHA, 2018.

Income

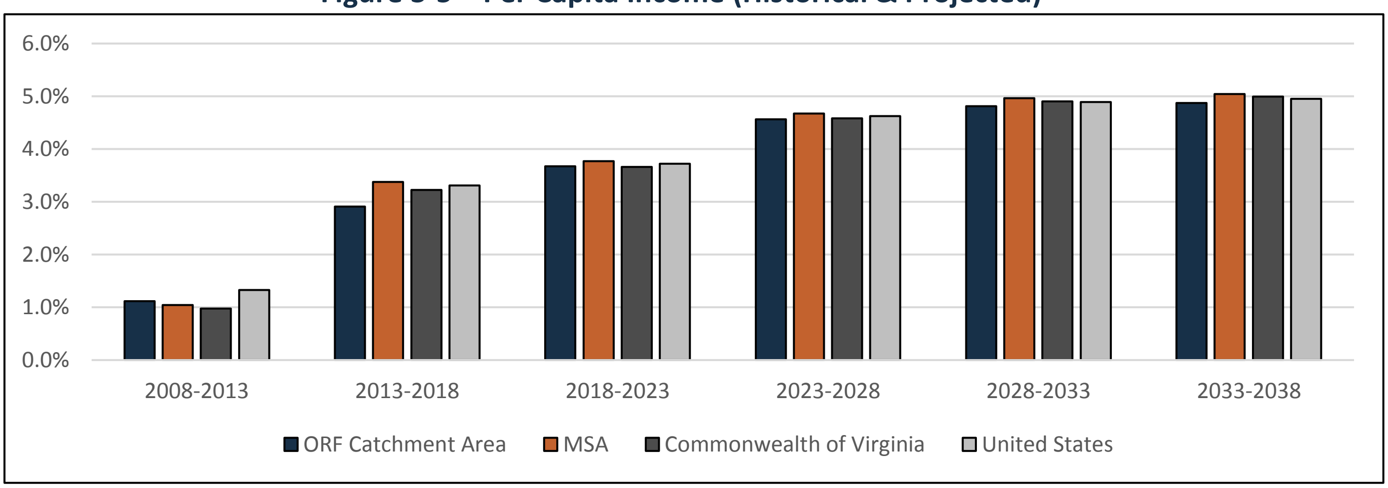
In 2017, the Virginia Beach-Norfolk-Newport News VA-NC MSA had a per capita income of approximately $50,000, while the ORF catchment area had a per capita income of approximately $45,000. The AAGR for the Virginia Beach-Norfolk-Newport News VA-NC MSA was 2.0 percent, while the AAGR for the catchment area was 1.8 percent. The AAGR for the Commonwealth of Virginia and the United States were 1.9 percent and 2.1 percent, respectively, which were above the ORF catchment area and MSA AAGRs. Despite having the lowest AAGR, the ORF catchment area is projected to grow at the same rate as the Commonwealth of Virginia and United States, with AAGRs of 4.5 percent. The per capita income for the MSA is projected to grow at a rate of approximately 4.6 percent. See **Table 3-3** and **Figure 3-5**.

Table 3-3 – Per Capita Income (Historical & Projected)

Year	ORF Catchment Area ($)	AAGR	MSA ($)	AAGR	Commonwealth of Virginia ($)	AAGR	United States ($)	AAGR
2008	37,255.0	-	40,639.0	-	45,707.0	-	41,082.0	-
2013	39,821.6	1.1%	43,245.0	1.0%	48,460.0	1.0%	44,462.0	1.3%
2017	44,649.0	2.3%	49,550.0	2.8%	55,176.0	2.6%	50,801.0	2.7%
AAGR 2008-2017	**-**	**1.8%**	**-**	**2.0%**	**-**	**1.9%**	**-**	**2.1%**
2018	45,968.9	3.0%	51,056.0	3.0%	56,793.0	2.9%	52,321.0	3.0%
2023	55,060.0	3.7%	61,431.0	3.8%	67,973.0	3.7%	62,813.0	3.7%
2028	68,830.3	4.6%	77,190.0	4.7%	85,034.0	4.6%	78,738.0	4.6%
2033	87,070.3	4.8%	98,339.0	5.0%	108,019.0	4.9%	99,977.0	4.9%
2038	110,462.2	4.9%	125,762.0	5.0%	137,841.0	5.0%	127,307.0	5.0%
AAGR 2018-2038	**-**	**4.5%**	**-**	**4.6%**	**-**	**4.5%**	**-**	**4.5%**

Note: Woods & Poole Economics, Inc. data is estimated.
Source: 2017 – Woods & Poole Economics, Inc., CHA, 2018.

Figure 3-5 – Per Capita Income (Historical & Projected)



Note: Woods & Poole Economics, Inc. data is estimated.
Source: 2017 – Woods & Poole Economics, Inc., CHA, 2018.

3.3 COMMERCIAL ACTIVITY REGION AND DESTINATIONS

This section provides a brief overview of recent commercial aviation trends at ORF. The section then identifies four different methodologies analyzed for developing the commercial passenger forecast and makes the final recommendation for commercial passengers and operations through FY 2038. Cargo trends and the forecast are covered later in the chapter.

3.3.1 Region and Destinations

As of the August 2018 published schedule, ORF had service to 26 destinations (23 year-round and three seasonal destinations), via six air carriers: Allegiant Air (G4), American Airlines (AA), Delta Air Lines (DL), Frontier (F9), Southwest (WN), and United Airlines (UA). Southwest was the largest airline at ORF in terms of seats per departure in FY 2017, followed by Delta, United, and American, respectively. Since Allegiant did not begin operating at ORF until September 2017, it was not incorporated in the seats per departure evaluation. As shown in **Table 3-4**, ORF, Richmond International Airport, Newport News/Williamsburg International Airport, and Pitt-Greenville Airport have varied numbers of destinations and non-stop domestic flights.

Table 3-4 – Comparison of Airports in the Region

Flights	ORF	RIC	PHF	PGV
Nonstop Destinations	26	17	3	1
Avg. Daily Flights	137	200	16	8

Source: Airport Websites (ORF, RIC, PHF, PGV), NAA, CHA, 2018.

New Service Announcements

Although common for airports to receive new service, in the case of ORF, the amount of new service announcements occurring as of recent is uncommon. Between September 2017 and the development of the forecasts herein, ORF saw 13 new service announcements from five different carriers. These new service announcements included nine new destinations and multiple carriers to Denver International Airport (DEN). In addition to new destinations, airlines increased capacity and frequency to existing destinations, as detailed in subsequent sections of this chapter. See **Table 3-5** and **Appendix H**.

Table 3-5 – New Service Announcements/Increases in Capacity[7]

Airline	Destination	Service Launch
Allegiant	CLE	June 7, 2019
	CVG	June 7, 2019
	JAX	June 14, 2018
	SFB	November 17, 2017
	FLL	November 17, 2017
	PIE	October 4, 2017
Delta	BOS	September 10, 2017
	MSP	June 14, 2018

Airline	Destination	Service Launch
Frontier	DEN	August 12, 2018
	LAS	August 12, 2018
	MCO	August 12, 2018
	PHX	November 17, 2018
	TPA	November 17, 2018
Southwest	BNA	June 9, 2019
	SAN	June 9, 2019
	DEN	June 7, 2018
United	DEN	June 7, 2018

Source: Airport and Airline Representatives, CHA, 2018.

[7] Nashville International Airport (BNA), Boston Logan International Airport (BOS), Cleveland Hopkins International Airport (CLE), Cincinnati/Northern Kentucky International Airport (CVG), Fort Lauderdale-Hollywood International Airport (FLL), Jacksonville International Airport (JAX), McCarran International Airport (LAS), Orlando International Airport (MCO), Minneapolis-St. Paul International Airport (MSP), Phoenix Sky Harbor International Airport (PHX), St. Pete-Clearwater International Airport (PIE), San Diego International Airport (SAN), Orlando Sanford International Airport (SFB), Tampa International Airport (TPA). (See **Figure 1-4** for ORF's Non-Stop Route Map).

3.4 COMMERCIAL ACTIVITY HISTORICAL TRENDS

Enplanements

An enplanement is defined as a revenue-paying passenger boarding an aircraft at a given airport. Enplanements are the primary measure of a commercial service airport's passenger activity and are key factors for terminal building and parking facility requirements. In addition to being an important trend tracking tool for airport management, an airport's reported annual enplanements are also used by the FAA to calculate Airport Improvement Program (AIP) passenger entitlement funding through its apportionment formula. For the purposes of this Study, forecast enplanements serve as the basis for the Airport's facility requirements and financial projections. These include:

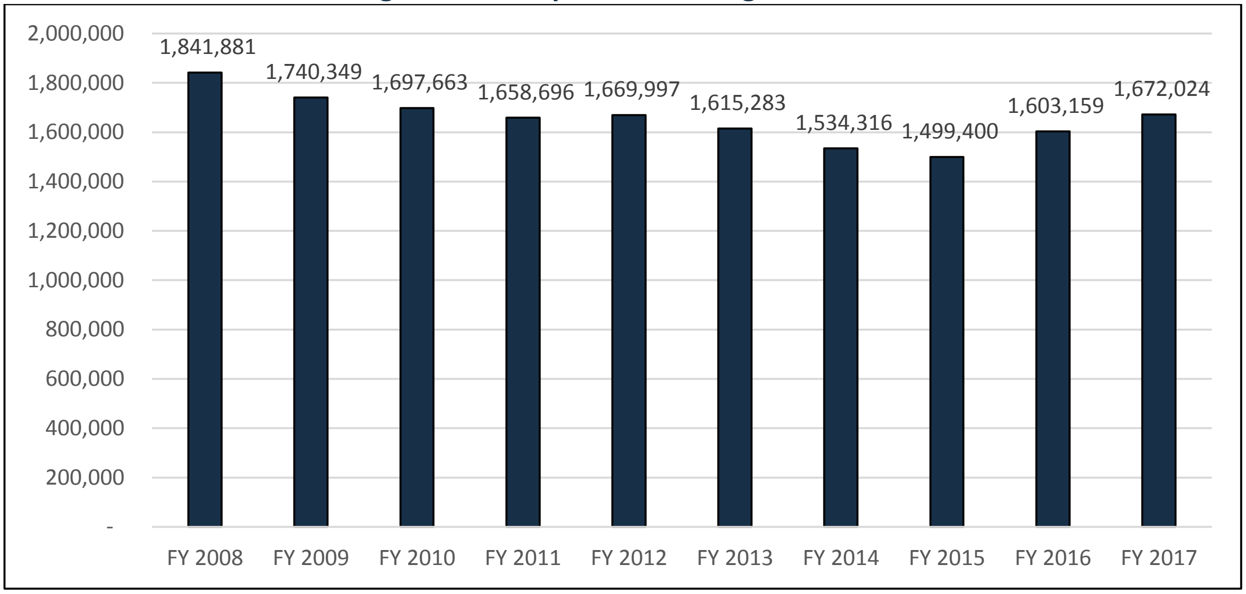
- Airfield Requirements
- Airline Support Functions
- CBP/FIS Facilities
- Non-Public Areas
- Secured Public Areas
- Non-Secured Public Areas
- Concessions
- Surface Transportation and Parking Requirements
- Service Animal Relief Area

Historical enplanements at ORF have shown to ebb and flow consistent with most small-hub commercial service airports since FY 2008, showing fluctuating enplanement levels over the historical period; however, in FY 2017, ORF reached its highest level of enplanements since FY 2010 with approximately 1,672,024 enplanements, as shown in **Figure 3-6**. The historical decline in enplanements can be attributed to the 2007-2009 economic recession which had a heavy impact on the aviation industry, specifically smaller commercial service airports, including ORF. Additional factors include higher fare rates on legacy carriers, military sequestration that impacted the Hampton Roads region, and the lack of low-cost options in the market; however, after sequestration and the introduction of ultra-low-cost carriers, ORF began to see consistent growth in enplanements beginning in FY 2015. From 2015 to 2016, enplanements grew by 6.9 percent, with an additional increase of 4.3 percent from FY 2016 to FY 2017. Based on the previously mentioned influx of new airlines, ultra-low-cost carriers, and travel destinations, this trend is anticipated to continue through the short-term (five-year) time frame, ultimately resulting in steady growth for ORF.

Operations

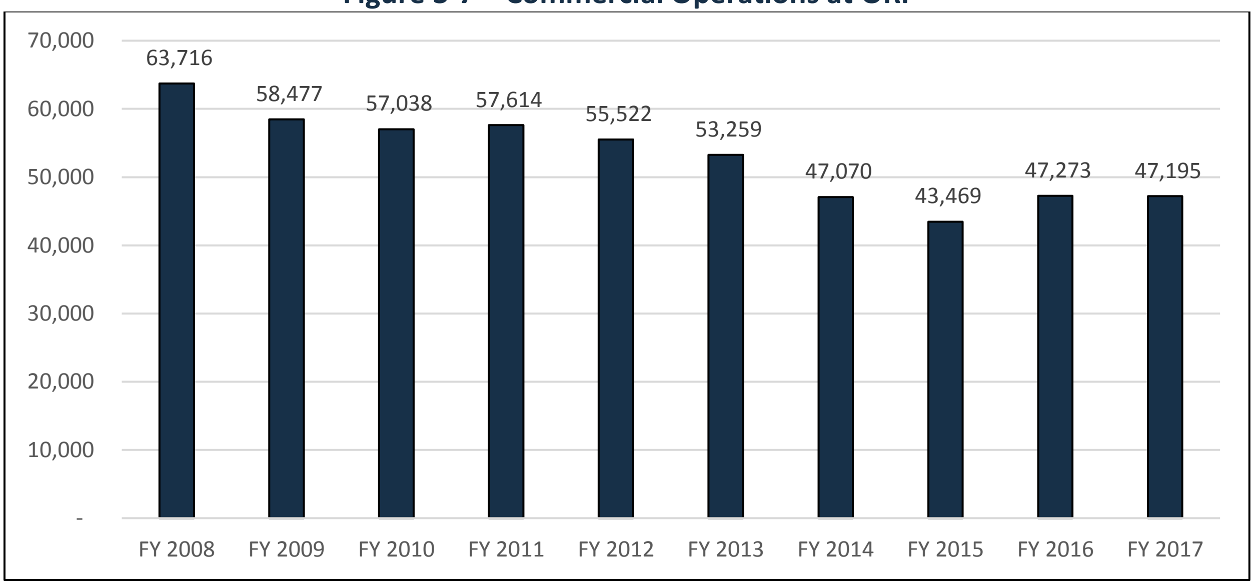
Commercial operators include scheduled air carriers and their regional partners. Similar to enplanements, ORF has seen a decline in air carrier operations since FY 2008, as shown **in Figure 3-7**, specifically reaching the lowest number of operations in FY 2015, the lowest in 10-years for the Airport. The drastic decline in air carrier operations can be attributed to a number of factors including airline bankruptcies and consolidation, higher fuel prices, the economic recession, and airlines transitioning their fleets from smaller 50-seat regional jet to larger 60-90 seat regional jet and narrow-body aircraft. On the surface, the decrease is significant, resulting in lower flight frequencies on some routes; however, this is not indicative of passenger activity at the Airport. Although operations are still below their peak in FY 2008, with the recent airline transitions to larger aircraft equipment, passenger enplanements have steadily increased; however, the number of operations necessary to accommodate the increased demand is lesser with larger 90-177 seat aircraft.

Figure 3-6 – Enplaned Passengers at ORF



Source: NAA, CHA, 2018.

Figure 3-7 – Commercial Operations at ORF



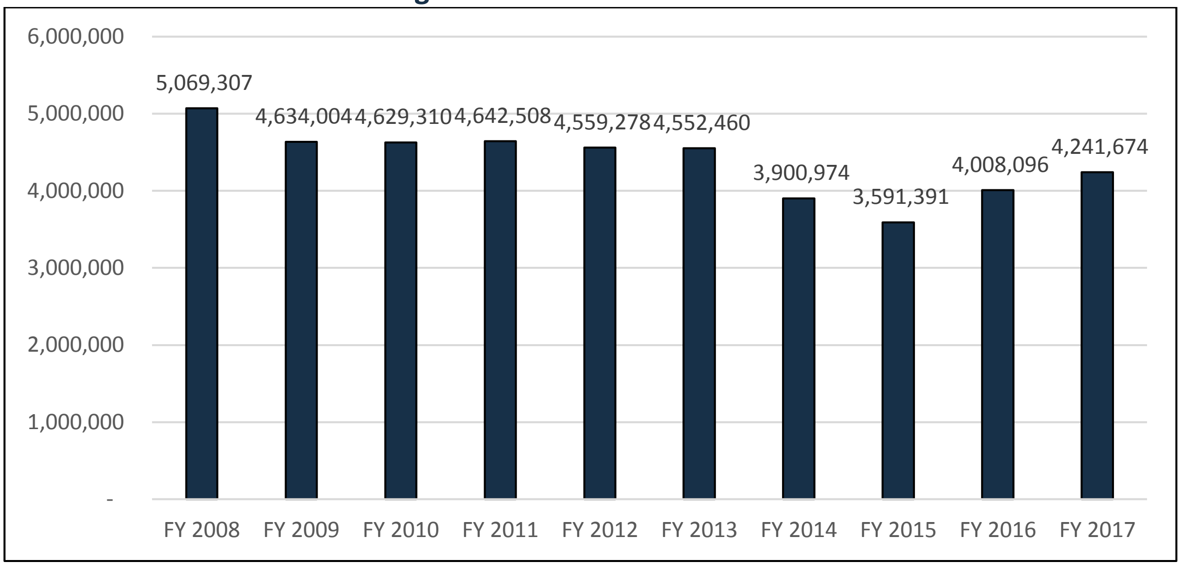
AAGR Change in Operations 2008-2017: -3.0%
Source: NAA, CHA, 2018.

Commercial Seats and Average Aircraft Size

ORF'S approximate 4.2 million scheduled seats in FY 2017 was relatively consistent with the previous nine years, with fluctuations between approximately 5.1 million in FY 2008 and 3.6 million in FY 2015. As shown in **Figure 3-8**, FY 2008 was the peak year with approximately 5.1 million seats. The number of seats decreased between FY 2011 and FY 2015, averaging 4.2

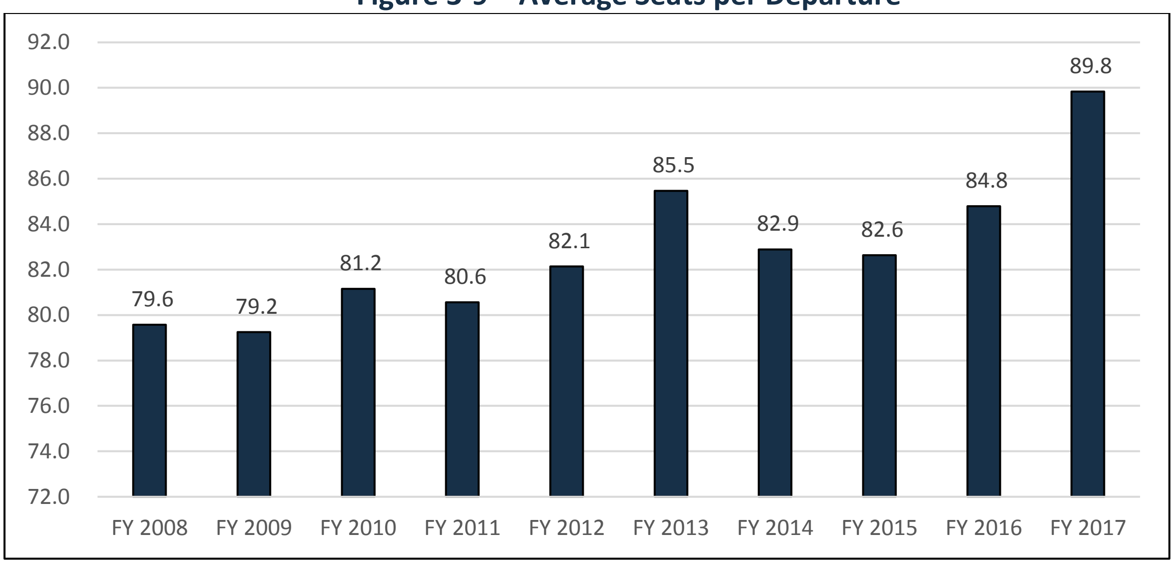
million. During the nine-year period, ORF's scheduled seats reached its lowest count in FY 2015 with 3.5 million seats. This can be attributed to the previously mentioned transition in airframe from smaller 50-seat aircraft with increased frequency to larger regional jets (RJs) and narrow-body aircraft. It is important to note the sharp increase in seats per departure in FY 2017 because of this transition. See **Figure 3-9** for average seats per departure.

Figure 3-8 – Scheduled Seats at ORF



Source: NAA, CHA, 2018.

Figure 3-9 – Average Seats per Departure



Source: NAA, CHA, 2018.

Historical Commercial Fleet Mix

The types of commercial aircraft serving ORF in a typical week in July, the Airport's peak month, in the years 2008, 2013, and 2017 are shown in **Table 3-6** below. July was chosen because it showed to have schedule continuity. ORF continues to be served, in large part, by 50-seat regional jets; however, as shown below, with the recent announcements by Allegiant and

Frontier, the transition from smaller 50-seat CRJ200s to larger regional jet and narrow-body aircraft will be sooner than originally anticipated.

Table 3-6 – Commercial Aircraft Serving ORF (July)

Aircraft Type	July 2008	July 2013	July 2017	Seating Capacity
CRJ-2/4	1,108	1,180	1,176	50
ERJ145	741	678	642	50
MD80	414	208	503	130-172
CRJ900	76	233	418	76
B737-7	534	537	361	140
CRJ700	630	454	257	65-70
A319	57	163	206	130-140
B757-2	-	111	123	169-185
A320-1/2	72		116	150-177
E175	257	77	109	76
B737-8	2	10	90	162, 189
B737-9	-	-	86	177, 189
B737-3	393	316	80	145-188
DHC8-200	-	-	30	37
E170	252	76	22	70
DHC8-300	2	-	12	48-50
MD90	-	220	10	158
B737-4	-	-	2	143-180
PC-12	-	-	2	8
B737-5	5	3	-	143-180
DASH8-1	264	157	-	37
DASH8-Q4	302	279	-	68-90
DC-9-30	2	-	-	105
DC-9-40	5	-	-	125
DC-9-50	54	-	-	139
EMB120	-	29	-	21-40
ERJ135	16	-	-	37
E190	181	2	-	100-124
CRJ100/ER	226	-	-	50
TOTAL	**5,593**	**4,733**	**4,245**	**-**

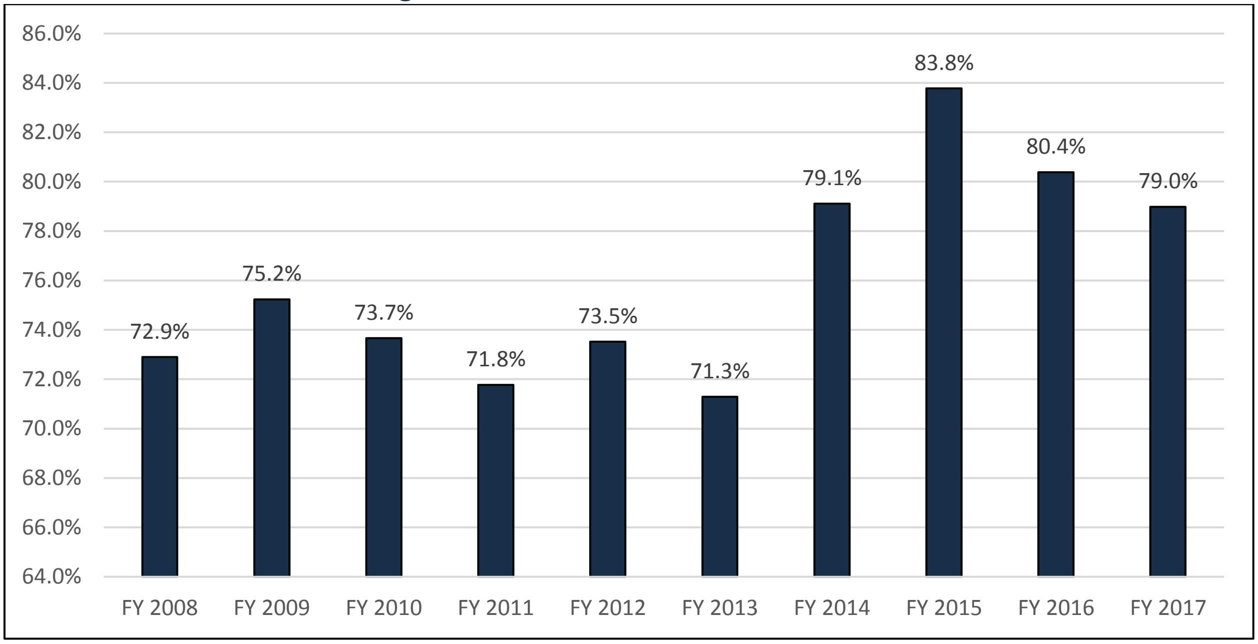
Source: NAA, CHA, 2018.

Load Factor

Load factor (LF) measures the capacity utilization and was used to measure efficiency in filling air carrier seats and in generating revenue. LF was calculated by dividing the total number of revenue passengers by total available seats. The LF at ORF, as depicted in **Figure 3-10**, decreased from 75.2 percent in FY 2009 to a low of 71.3 in FY 2013, a 3.9 percent drop. LFs began rising in FY 2014 and reached a high of 83.8 in FY 2015, a 12.5 percent increase from FY 2013. From FY 2008 to FY 2017, ORF experienced a 6.1 percent increase in LF; however, LF began decreasing again in recent years (FY 2015 to FY 2017). The decrease in LF can be attributed to the airlines' transitions in fleet mixes. Currently, airlines are increasing aircraft seating capacities at a quicker rate than what is dictated by demand. From FY 2015 to FY 2017, ORF experienced a growth of

18.1 percent in the number of available seats, while total passenger counts only increased by 11.4 percent.

Figure 3-10 - Commercial Load Factors



Source: NAA, CHA, 2018.

3.5 COMMERCIAL ACTIVITY DEMAND FORECASTS

To determine the facility sizing requirements necessary to adequately accommodate the current and future activity demand, a forecast of annual enplaned passengers and annual commercial aircraft operations was developed. The most basic indicator of activity demand for a commercial service airport is the number of annual enplaned passengers. It is the number of forecast enplanements that drive passenger terminal sizing requirements, and to a lesser extent, commercial air carrier operations and fleet mix. Historical and forecast enplanement data can provide relevant evidence that improvements and/or expansions to an airport may be necessary. Commercial aircraft operations and fleet mix influence the requirements for passenger terminal and airside infrastructure.

This section provides the methodology for the development of the forecasts of commercial enplanements and operations at ORF, as well as the methodologies analyzed for developing the commercial forecast, and details the final recommendation for commercial passengers and operations through FY 2038.

3.5.1 Enplanements Forecast

Forecast Methodologies

Several FAA-approved forecast methodologies and statistical analyses were used to provide a range of potential passenger activity levels. From these forecasts, a recommended forecast was developed that represents the most likely projection of future activity based on existing data and current trends (detailed in the following section) in passenger activity.

Four different methodologies were considered and analyzed in the development of the recommended ORF enplanement forecast. Each of the methodologies, along with accompanying enplanement forecasts, are shown below and then compared to each other.

Forecast Methodologies

- Historical Trend – A method to predict the future based on past results. The 5- and 10-year annual growth rates were calculated and used to estimate growth at ORF.
- Market Share Analysis – A "top-down" method where projected growth rates of larger aggregates (e.g., the nation, the state, and/or the region) are used to derive forecasts for smaller areas (e.g., airports). In other words, a market share forecast essentially applies national, state, and/or regional forecast growth rates to airport-specific market areas. For this analysis, future ORF enplanements were estimated by applying the future share trend and the FAA's National TAF enplanement numbers.
- Regression Analysis – An examination of aviation and passenger activity through the scope of current and historical activity levels, seeking to find a relationship between the activity levels and the socioeconomic conditions prevalent during that period. Causal relationships between population, employment, and income are examined to determine if there is a statistically valid correlation that may assist in projecting future activity. Demographic projections for the catchment area, provided by Woods & Poole Economics, Inc., were used to estimate growth at ORF.
- Air Service Analysis – ORF enplanements and operations were estimated based on FY 2017 schedules filed by the air carriers and included expected service changes, as well as the potential for additional air carriers and service routes, for FY 2018 through FY 2038. Key forecast assumptions were developed to include expected schedule changes, average seats per departure, and percentage of seats filled (load factor). This methodology included multiple facets, such as air service growth in varying market sectors including the Ultra Low-Cost Carrier (ULCC), Legacy Carrier, and International market segments. Although this methodology was a singular methodology, it was linear in nature as varying air service scenarios can be combined to determine a service analysis across multiple market platforms.

Appendix B presents the findings of all the previously described methodologies.

Historical Trend

A historical trend forecast is a simple time-series model that relies on extrapolating historical enplanements and operations growth, specific to the Airport, into the future. Examining the historical growth rates and projecting them forward provides a picture of growth, assuming the market area and the state of the commercial passenger airline industry reflect past trends through the forecast period. For the historical trend scenario, the historical enplanement data was projected forward through the forecast horizon.

As previously mentioned (in **Section 3.4, Commercial Activity Historical Trends**), ORF's historical trend of passenger enplanements have shown to ebb and flow consistent with most small-hub commercial service airports since FY 2008, showing fluctuating enplanement levels over the historical period. In FY 2017, ORF reached its highest level of enplanements (1,672,024 in FY 2017) since FY 2010 (1,697,663 in FY 2010). The AAGR from FY 2008 to FY 2017 was negative 1.0 percent; however, from FY 2015 to FY 2016, ORF experienced a 6.92 percent growth in enplanements, along with another 4.3 percent growth from FY 2016 to FY 2017. For the purposes of the Historical Trend Analysis, two scenarios were identified in the evaluation (5-year and 10-year) of the time series model, as shown in **Table 3-7**.

As shown in **Figure 3-11**, the historical time trend analysis resulted in varying degrees of growth rates. The cyclical nature of passenger growth of the previous 10-year period at ORF revealed a steady drop in enplanements between the 5- and 10-year period. The following details the AAGR within the various time periods included in this evaluation:

- 5-Year Historical Trend – resulted in a 0.7 percent AAGR FY 2013-2017
- 10-Year Historical Trend – resulted in a negative 1.0 percent AAGR FY 2008 -2017

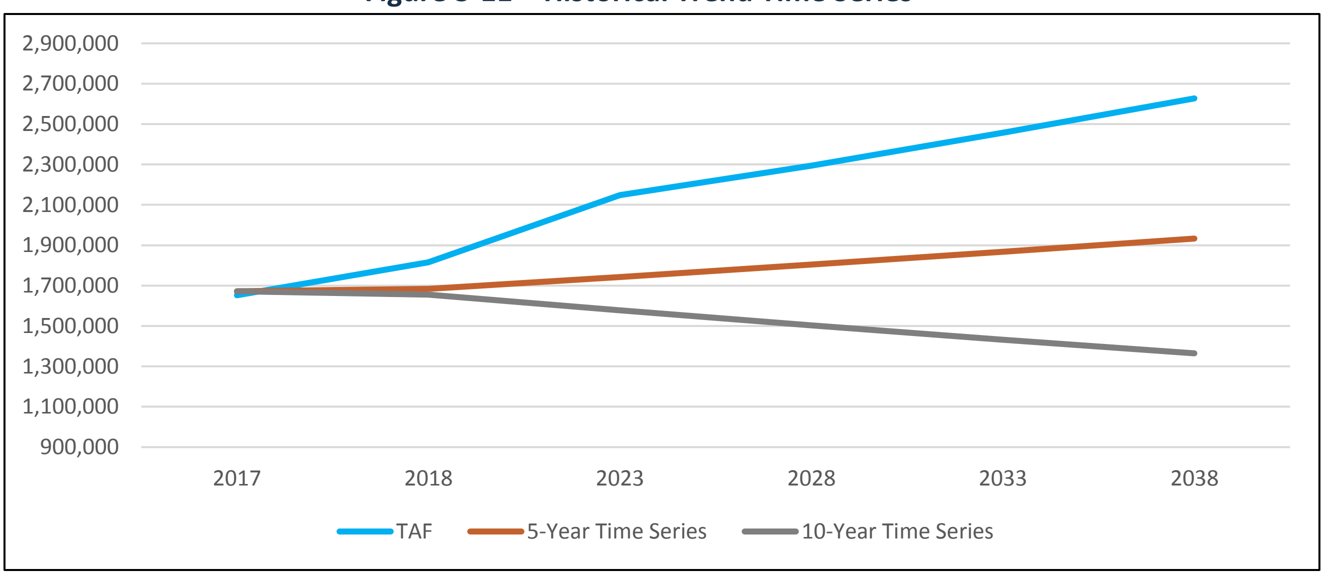
Table 3-7 – Historical Trend Forecast Comparisons

Fiscal Year	TAF	5-Year Time Series	10-Year Time Series
2017	1,652,323	1,672,024	1,672,024
2018	1,815,241	1,683,609	1,655,925
2023	2,147,644	1,742,750	1,577,724
2028	2,294,704	1,803,969	1,503,217
2033	2,458,050	1,867,338	1,432,228
2038	2,627,295	1,932,933	1,364,591
AAGR 2018-2038	**1.9%**	**0.7%**	**-1.0%**
Growth 2018-2038	**44.7%**	**14.8%**	**-17.6%**

Source: FAA 2018 TAF, NAA, CHA, 2019.

The 5-year and 10-year time trend scenarios represented projections that are significantly less than the TAF (19.5 percent and 43.2 percent, respectively); therefore, based on recent growth trends, these scenarios were not considered to be reliable projections.

Figure 3-11 – Historical Trend Time Series



Source: FAA 2018 TAF, NAA, CHA, 2019.

Market Share Analysis

In a market share forecast, the dependent variables of the item being forecast (i.e., airport specific operations or enplanements) are compared to independent variables of a larger aggregate (i.e., region, state, or national operations or enplanements). For example, ORF had an identified enplanement level within each fiscal year. When this level was compared to a total of a larger whole (national enplanements), a percentage (i.e., market share) could be determined. This analysis showed that growth in an airport's market can be correlated to aviation activity on a larger scale. Through a direct comparison of various levels of enplanement projections versus ORF market area growth rates, the forecasts were adjusted to reflect differing larger scale markets to local growth trends. (See **Appendix A** for a breakdown of annual market share for each scenario including historical market share).

- Average National Market Share – This methodology used the aggregate, national level forecast of commercial enplanements identified in the FAA's 2018 TAF to derive forecasts for the Airport based on market share. This forecast assumed that ORF will maintain a level market share based on its 10-year average, or static market share, of commercial enplanements (0.22 percent) relative to national activity projections throughout the planning period.
- Static State Market Share – While similar to the National Market Share methodology, this forecast used State activity projections derived from the 2018 TAF[8] and airport reported enplanement levels as the basis for determining market share. This forecast assumed that ORF will maintain its current FY 2017 level of commercial enplanements (6.24 percent) relative to State market activity projections throughout the planning period. The Static State Market Share forecast was considered a relatively conservative range of potential commercial activity based on market conditions within the State; therefore, for the purposes of this forecast, this scenario was chosen to represent the low-end range of possible enplanements for ORF. See **Section 3.5.4 (Effective Enplanements Range)** for further detail.
- Static Regional Market Share – This methodology used the aggregate, regional level forecast of commercial activity projections from the FAA's 2018 TAF for the individual commercial service airports in the Virginia and northeast North Carolina region, which includes ORF, RIC, PHF, and PGV, to derive forecasts for the Airport based on market share. This forecast assumed that ORF will maintain its current level, or static market share (44.96 percent), of commercial enplanements relative to regional activity projections throughout the planning period.

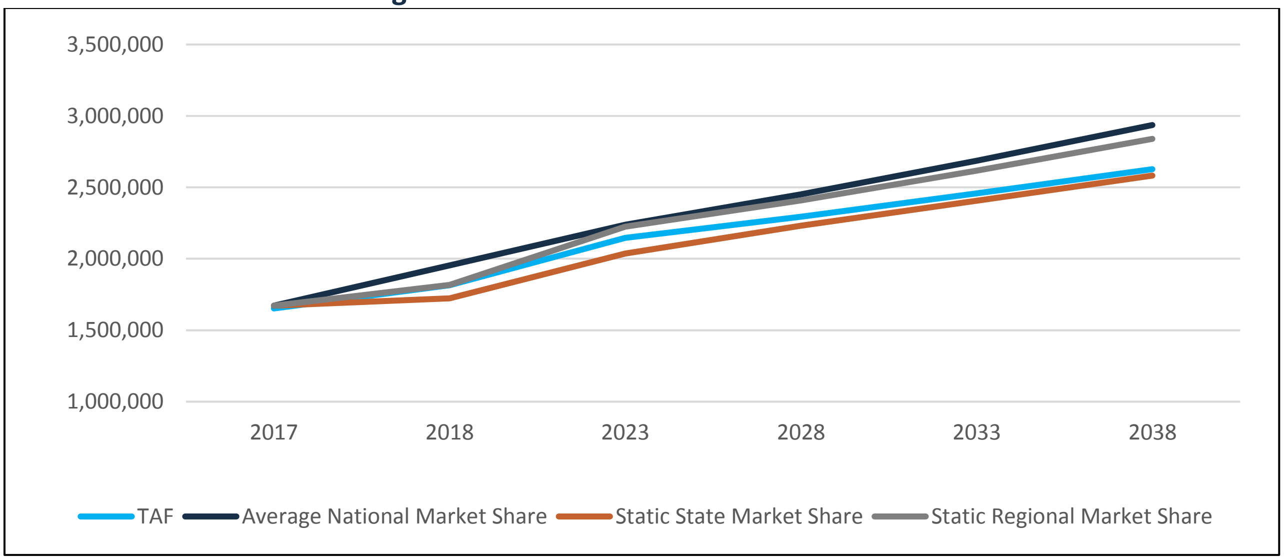
[8] In this scenario, it is important to note that in addition to the TAF for Virginia, the 2018 TAF for the District of Columbia was incorporated because the TAF accounts for three airports located in Virginia: Ronald Reagan Washington National Airport (DCA), Washington Dulles International Airport (IAD), and Manassas Regional Airport (HEF).

Table 3-8 – Market Share Comparisons

Year	TAF	Average National Market Share	Static State Market Share	Static Regional Market Share
2017	1,652,323	1,672,024	1,672,024	1,672,024
2018	1,815,241	1,953,884	1,723,608	1,816,656
2023	2,147,644	2,237,531	2,035,945	2,224,870
2028	2,294,704	2,450,873	2,231,077	2,407,978
2033	2,458,050	2,686,764	2,407,453	2,617,059
2038	2,627,295	2,936,370	2,582,498	2,839,646
AAGR 2018-2038	**1.9%**	**2.1%**	**2.0%**	**2.3%**
Growth 2018-2038	**44.7%**	**50.3%**	**49.9%**	**56.3%**

Source: FAA 2018 TAF, NAA, CHA 2019.

Figure 3-12 – Market Share Time Series



Source: FAA 2018 TAF, NAA, CHA, 2019.

Regression Analysis

As mentioned previously, regression-based forecasts examine aviation and passenger activity to determine if there is a causal relationship between the activity levels and the socioeconomic conditions prevalent during that period. Several different economic-, income- and population-based regression analyses were performed. The first step was to conduct a regression analysis to determine if there was a relationship between any of the socioeconomic factors (i.e., population, income, and employment) addressed earlier in the chapter and the historical level of enplanements. The output of a regression analysis is the 'coefficient of determination', or R^2, which ranges from 0 to 1.0. If the R^2 of an analysis falls between 0.85 and 1.0, there is a statistical correlation; if it falls below 0.85, there is not a statistical correlation. In other words, the higher the R^2 value, the stronger the correlation is between the variables; however, if the R^2 of an analysis is above 1.0, an anomaly, or outlier, has been detected.

The following regression analyses were conducted:

- Population-Based Regression: R2-value = 0.48
- Employment Based Regression: R2-value = 0.00
- Income-Based Regression: R2-value = 0.36
- Population-Income Regression: R2-value = 0.64
- Employment-Income Based Regression: R2-value = 0.67
- Population-Income-Employment Regression: R2-value = 0.71

Though the socioeconomic indicators have grown at rates that are consistent with those at the state and national levels, the 10-year historical ORF enplanements have shown to primarily trend down, with small pockets of annual growth in first seven years of the 10-year historical period: declining from 2008 to 2010, increasing in 2010, and then declining again until 2016. In FY 2016, enplanements began rising and continued throughout FY 2017. As discussed in **Section 3.4**, the overall decline in passengers and cyclical nature of growth and declines within the 10-year historical period can be attributed to regional and national economic impacts. For example, national recession, military sequestration, and high fare prices all contributed to decreasing enplanement activity at ORF. Based on these parameters and fluctuations in Airport activity, it is evident that there may be poor correlation between the 10-year relatively stable socioeconomic history in the study area and the Airport.

Recently, with the introduction of ultra-low-cost carriers, and competitive service routes, ORF enplanement figures have begun to rebound and trend towards historical highs. As such, the 10-year historical socioeconomic regression analyses did not show a strong correlation to enplanements to serve as the preferred forecast scenario. The results of these analyses are presented in **Table 3-9**. Additional, more in-depth regression analyses were performed, and similar to the forecast, were not considered realistic for representation of enplanements at ORF. All additional regression analyses are summarized in **Appendix C**.

Table 3-9 – Regression Comparison

Year	TAF	Population -Based	Employment-Based	Income-Based	Population-Income Based	Employment-Income Based	Population-Income-Employment-Based
2017	1,652,323	1,672,024	1,672,024	1,672,024	1,672,024	1,672,024	1,672,024
2018	1,815,241	1,513,586	1,657,072	1,524,971	1,546,545	1,585,688	1,575,919
2023	2,147,644	1,356,750	1,661,755	1,326,358	1,617,702	1,428,578	1,547,086
2028	2,294,704	1,200,085	1,666,352	1,025,523	2,047,371	1,080,783	1,602,247
2033	2,458,050	1,052,830	1,670,798	627,038	2,856,304	547,830	1,755,160
2038	2,627,295	925,988	1,675,099	116,000	4,140,458	-197,307	2,041,693
AAGR 2018-2038	**1.9%**	**-2.4%**	**0.1%**	**-12.1%**	**5.0%**	**-9.9%**	**1.3%**
Growth 2018-2038	**44.7%**	**-38.8%**	**1.1%**	**-92.4%**	**167.7%**	**-112.4%**	**29.6%**

Source: FAA 2018 TAF, NAA, CHA, 2019.

Air Service Forecasts

The air service analysis acknowledged historic market share growth and recent airline activity trends including the new routes, increased airframes on specific routes, and high load factors. In addition, this scenario took into account the new service announcements made during the 12-month period prior to the development of the forecasts and anticipated service announcements within the following 12-month period, as discussed with airline representatives at ORF. The following describes the methodology and development of the air service analysis in further detail.

As assessed in **Section 3.4**, per the FAA TAF for the Airport, ORF experienced record growth in enplaned passengers from FY 2015 to throughout FY 2018. Though this spike in growth is not directly sustainable throughout the 20-year forecast period, it was assumed to continue through the short-term forecast period (five-years), as evidenced by the increasing number of new service announcements and announcements of service expansion to existing destinations (discussed in **Section 3.3.1**). This indicates that ORF continues to maintain a strong aviation presence within the regional and national air transportation systems.

As mentioned previously, the TAF considers socioeconomic and demographic factors, local industry growth, and regional commercial service growth on market basis. This scenario utilized the 2017 FAA TAF for baseline short-term growth (which at the time of the development of these forecasts, was the most recent TAF available) and applied additional airlines service that was recently announced, but not included in the FAA TAF, and included these new service operations for the first five years of the forecast period. For forecast years 2024 through 2038, long-term 10-year population regression variables (2014 though 2023) were applied and projected throughout the remainder of the forecast period. Although previous historical socioeconomic growth did not show a strong correlation, since the rebound of the recession and the end of military sequestration, the local and regional economic variables have been strong (**Section 3.2**), and future Airport growth can be directly attributable to population growth in the region.

This resulted in an analysis of non-stop route destinations from ORF that were experiencing higher than normal load factors operated by specific airlines. The following table provides load factors per airline destination, from FYs 2008 through FY 2017, which at the time of this report was the most recent Airport Authority-reported LF data.

The new service routes and the increase in airframe size and fleet mix transitions currently underway are anticipated to result in ORF capturing a larger percentage of travelers within the Airport's core market area. Through FYs 2015, 2016, and 2017, airlines serving ORF increased service to their existing network of hub airports [Hartsfield-Jackson Atlanta International Airport (ATL), Baltimore Washington International Airport (BWI), Charlotte Douglas International Airport (CLT), Ronald Reagan Washington National Airport (DCA), LaGuardia Airport (LGA), Chicago Midway International Airport (MDW), Miami International Airport (MIA), Chicago O'Hare International Airport (ORD), Denver International Airport (DEN), and Orlando Sanford International Airport (SFB)]. **Table 3-10** shows the historical load factors for ORF.

Table 3-10 – Historical Load Factor Percentages by Destination

Destination	FY 2008	FY 2009	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017
ATL	83.9%	86.2%	79.5%	78.4%	76.4%	70.6%	80.8%	87.4%	86.6%	83.6%
BOS	50.5%	63.5%	88.5%	75.9%	67.1%	53.9%	55.7%	81.0%	86.9%	74.4%
BWI	68.6%	70.1%	75.8%	75.0%	75.4%	68.8%	78.3%	83.7%	82.0%	77.4%
CLT	72.4%	79.9%	78.7%	76.5%	80.8%	81.0%	84.5%	89.2%	84.0%	84.8%
DCA	55.9%	61.8%	54.3%	47.6%	56.8%	62.5%	66.6%	76.8%	67.4%	67.7%
DEN	82.5%	-	-	-	95.4%	50.0%	-	91.4%	98.6%	93.5%
DFW	75.8%	80.9%	81.0%	80.7%	78.7%	77.6%	83.6%	84.4%	81.8%	82.6%
DTW	80.6%	82.0%	74.4%	75.0%	79.3%	76.3%	77.4%	81.2%	78.9%	76.4%
EWR	68.6%	65.9%	60.9%	56.6%	66.1%	65.9%	72.1%	78.4%	79.3%	75.5%
FLL	75.2%	87.3%	92.0%	91.2%	87.1%	66.6%	88.2%	91.9%	64.6%	83.7%
IAD	80.2%	78.1%	76.8%	72.5%	75.5%	78.7%	81.8%	82.8%	85.9%	77.7%
IAH	89.8%	89.7%	88.2%	84.1%	74.3%	84.1%	88.9%	85.1%	83.3%	85.1%
JAX	71.8%	66.7%	71.1%	63.8%	58.6%	62.2%	64.0%	94.9%	84.7%	91.1%
JFK	65.8%	-	-	69.8%	69.3%	65.0%	72.7%	66.6%	66.9%	69.6%
LGA	45.4%	59.4%	54.2%	51.9%	54.3%	46.9%	53.9%	63.9%	60.5%	58.8%
MCO	69.6%	71.3%	73.2%	67.5%	72.4%	65.9%	88.8%	88.9%	83.8%	87.3%
MDW	68.9%	68.5%	76.1%	78.5%	78.3%	76.6%	89.4%	89.6%	78.4%	78.9%
MIA	79.7%	81.3%	68.2%	72.5%	78.0%	80.2%	82.9%	83.6%	77.3%	81.3%
MSP	79.0%	67.4%	80.9%	74.5%	82.1%	82.9%	79.6%	85.4%	84.2%	75.5%
ORD	84.3%	81.6%	79.8%	76.5%	80.9%	83.7%	87.5%	87.9%	83.2%	80.6%
PHL	63.8%	68.2%	60.8%	61.5%	68.2%	67.7%	76.0%	85.3%	77.3%	80.1%
SFB	0.0%	-	-	98.7%	-	-	-	88.3%	-	89.8%

Source: NAA, CHA, 2018.

The air service assumptions that were used in this analysis were then developed by applying historical load factor assumptions projected through the forecast period. The load factor was derived by using data, which was provided by Aviation DataMiner, to compute the estimated number of passengers per departure. The additional load factor assumptions were made based on fleet mix restructuring by individual airlines transitioning from smaller regional jets to larger regional and narrow-body jets.

The air service scenario was broken down into domestic short-term growth and domestic medium- to long-term growth scenarios. The domestic short-term growth scenario first built out a five-year annual schedule based on likely routes and services that were announced within the 12-month period prior to the development of the forecasts or are expected to be introduced soon. The domestic medium- to long-term growth scenario considered possible future routes that are either not guaranteed or are an aggressive assumption.

The following sections provide the assumptions applied to develop the domestic short-term growth and domestic medium- to long-term growth scenarios, assuming no loss in frequencies. It was assumed that the load factors will grow consistent with the overall airport load factors.

Domestic Short-Term Growth Assumptions:

Service Route Expansions

- ORF will experience an increase in enplanements in 2018 due to a legacy carrier expanding services in the fall to two of its current destinations. The routes will become year-round routes the following year.
  - Delta Air Lines to BOS
    - CRJ700, 65 seats/departure
      - 52 flights in 2018, increasing to 104 annual flights in 2019
  - Delta Air Lines to MSP
    - CRJ900, 96 seats/departure
      - 140 flights in 2018, increasing to 364 annual flights in 2019

New Routes Announced:

- In the summer of 2018, an airline currently serving ORF will begin seasonal service to two new destinations.
  - Allegiant Air to JAX
    - A320, 177 seats/departure
      - 26 annual flights throughout the planning period
  - Allegiant Air to FLL
    - A320, 177 seats/departure
      - 52 annual flights (2018) increasing to 104 throughout the planning period

- In 2018, a new ULCC service provider will provide service to three destinations new to ORF, expanding or potentially expanding to year-round in 2019.
  - Frontier Airlines to LAS
    - A320, 180 seats/departure
      - 60 flights in 2018, increasing to 156 annual flights in 2019
  - Frontier Airlines to PHX (Seasonal beginning Winter 2018)
    - A320, 180 seats/departure
      - 14 flights in 2018, increasing to 26 annual flights in 2019
  - Frontier Airlines to TPA (Seasonal beginning Winter 2018)
    - A320, 180 seats/departure
      - 14 flights in 2018, increasing to 26 annual flights in 2019

Additional Services

- In 2018, ORF will experience growth resulting from airlines currently operating, providing additional services to current locations serviced by competing airlines from ORF.
  - Southwest Airlines to DEN
    - B737, 143 seats/departure
      - 40 annual flights throughout the planning period
  - United Airlines to DEN
    - A319, 128 seats/departure

            - 203 flights in 2018, increasing to 364 annual flights in 2019

- In 2018, a new ULCC service provider will be introduced, providing additional service to destinations serviced by other airlines operating at ORF. These routes will be serviced daily, year-round starting in 2018.
    - Frontier Airlines to DEN
        - A320, 180 seats/departure
            - 104 flights in 2018, increasing to 364 annual flights in 2019
    - Frontier Airlines to MCO
        - A320, 180 seats/departure
            - 104 flights in 2018, increasing to 364 annual flights in 2019

Table 3-11 – Short-Term Growth Scenario

Fiscal Year	Enplanements
2017	1,672,024
2018	1,857,487
2023	2,115,424
2028	2,376,990
2033	2,622,848
2038	2,834,623
AAGR 2018-2038	**2.1%**
Growth 2018-2038	**52.1%**

Source: NAA, CHA, 2019.

Domestic Medium- to Long-Term Growth Assumptions:

New Routes

- In the long-term, ORF will experience growth resulting from an airline currently operating at ORF beginning services to new destinations.
    - Two destinations to the southwest
        - A320, 177 seats/departure
            - 26 annual flights throughout the planning period (Starting in 2021)
        - A320, 177 seats/departure
            - 26 annual flights throughout the planning period (Starting in 2023)
    - One destination to the northeast
        - A320, 177 seats/departure
            - 26 annual flights throughout the planning period (Starting in 2023)

- In the long-term, new ULCC service providers will provide services to destinations not currently serviced by ORF.
    - Destination to the south
        - CRJ200, 50 seats/departure
            - 26 annual flights throughout the planning period (Starting in 2028)
    - Destination to the west
        - A320, 150 seats/departure
            - 104 annual flights throughout the planning period (Starting in 2028)

Additional Services

- In the long-term, ORF will experience growth resulting from airlines currently operating at ORF, as well as a new carrier, providing additional services to current locations only serviced by competing airlines from ORF.
  - Destination to the northeast
    - A320, 177 seats/departure
      - 26 annual flights throughout the planning period (Starting in 2023)
  - Destination to the west
    - B737, 143 seats/departure
      - 26 annual flights throughout the planning period (Starting in 2028)

Table 3-12 – Medium-Long-Term Growth Scenario

Fiscal Year	Enplanements
2017	1,672,024
2018	1,857,487
2023	2,234,279
2028	2,640,381
2033	3,022,093
2038	3,350,889
AAGR 2018-2038	**2.99%**
Growth 2018-2038	**80.4%**

Source: NAA, CHA, 2019.

The analysis for the Short-Term Air Service scenario resulted in an R^2 value of 0.85, and the Medium- to Long-Term resulted in an R^2 value of 0.90. Although the Medium- to Long Term forecasts considered new service routes and anticipated service route expansions and had a higher R^2 value, projecting Airport enplanement growth purely based on assumptions was not practical when trying to identify demand capacities in different areas of the Airport. As such, the Short-term forecast incorporated actual new service route and service route expansion announcements made at ORF within the 12-month period prior to developing the forecast. The 20-year projections made within these scenarios combined and incorporated recent airline activity trends at the Airport, socioeconomic variables within the Airport's catchment area, anticipated new service announcements within CY 2019, and strong socioeconomic growth throughout the forecast period; therefore, for planning purposes, the Short-Term Air Service forecast was used as the recommended commercial enplanement forecast in the Master Plan Update.

It is important to note that based on the comparison with the FAA TAF, the recommended forecast scenario projections fall within the FAA criteria for commercial forecasts as required by FAA AC 150/5070-6B, *Airport Master Plans*, which states enplanement and operational forecasts must be within 10 percent in the short-term (five-year) period and 15 percent within the 10-year period. **Table 3-13** details the recommended enplanement forecast against the FAA TAF for the 20-year forecast period.

Table 3-13 – Recommended Commercial Enplanements Forecast vs. FAA TAF

Fiscal Year	Enplanements		
	2018 ORF TAF	Recommended Forecast	Recommended Forecast vs. TAF
2017	1,652,323	1,672,024	1.2%
2018	1,815,241	1,857,487	2.3%
2023	2,147,644	2,115,424	-1.5%
2028	2,294,704	2,376,990	3.6%
2033	2,458,050	2,622,848	6.7%
2038	2,627,295	2,834,623	7.9%
AAGR 2018-2038	**1.9%**	**2.1%**	-
Growth 2018-2038	**44.7%**	**52.1%**	-

Source: FAA 2018 TAF, NAA, CHA, 2019.

3.5.2 Commercial Operations Forecast

As assessed in **Section 3.4,** and as shown by the FAA TAF and Airport records provided by the NAA, ORF experienced dramatic growth in enplaned passengers from FY 2015 through FY 2017. It is highly likely that ORF's growth in enplanements will not be sustained at the rate of the past three years; however, it is anticipated that enplanements and air carrier operations will continue to incrementally increase throughout the 20-year planning horizon, which is acknowledged in the FAA TAF. Growth in commercial air carrier operations will likely be at a lesser pace than enplanements due to the expected transition to larger aircraft.

Methodology

The operations forecast from 2018 to 2022 came from the monthly schedule used for the creation of the domestic short-term growth scenario. The schedule was broken down by market, airline and equipment type. The long-term operation forecast from 2023 to 2038 was estimated by taking the recommended enplanement forecast, growth trends in percentage of seats filled, and average seats per departure to derive the long-term commercial operations forecast.

Commercial Load Factors

The forecast of ORF percentage of seats filled for FY 2018 through FY 2038 was calculated by dividing the forecasted enplaned passengers by the forecasted percentage of seats that were filled by year. The percentage of seats filled was determined by taking the estimated 2017 to 2022 percentage of seats filled and growing the seat factor modestly each year through 2038. Once the percentage of seats filled reached 85.0 percent per route, it was capped[9] at this value for all future years. This methodology was also included in the FAA TAF which had the national load factor continuing to grow each year through the end of the TAF period, capping between 86 and 87 percent[10].

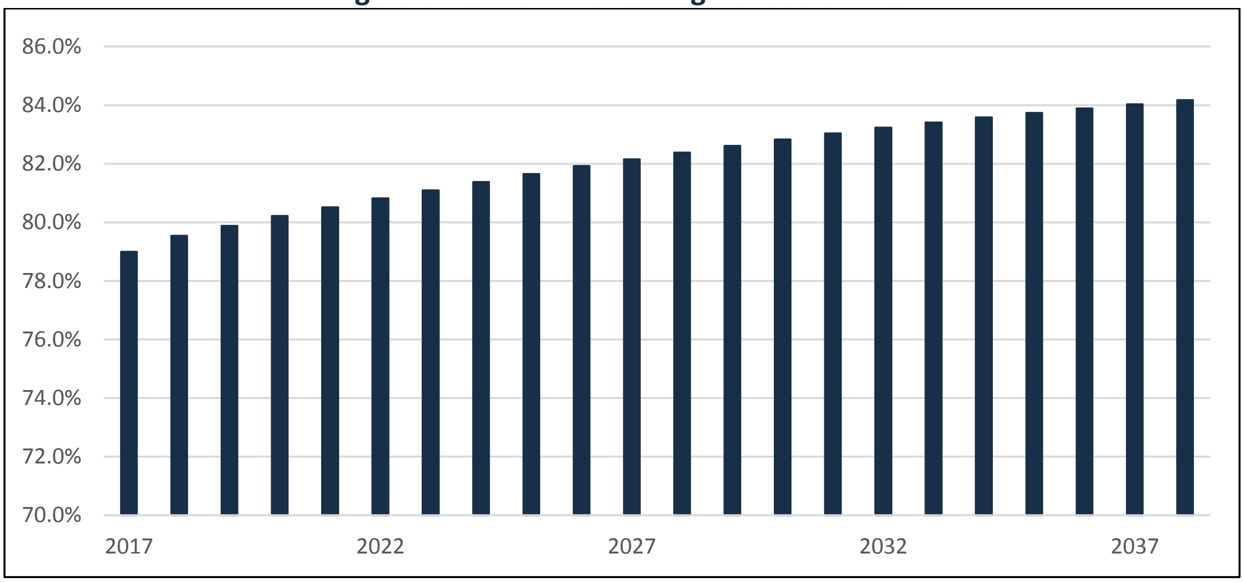
To determine the estimated total seats-departures, the forecasted enplaned passengers per year were divided by the estimated percentage of annual seats filled. Total operations were forecast by multiplying total seats-departures by two (to get to total seats) and then dividing by the

[9] The 85% is a proxy, or benchmark, as airlines approach an 85 (or higher) percent load factor, they typically evaluate the cost and benefits of either increasing frequency of that route or upgrading to larger aircraft for the high-load factor routes. As such, for the purposes of this forecast, it was assumed that airlines would up-gauge aircraft.

[10] Provided in the Load Factor section of the 2017 National Forecast and FAA Aerospace forecast.

forecast of seats per departure by year. The forecast for average seats per departure was assumed to grow by 0.6 percent per year after 2022. The growth rate of 0.6[11] percent was a proxy from the 2017 National Forecast for domestic average aircraft seats per mile. Assumed within the forecast, by 2038, is the replacement of several equipment types currently flying at ORF with younger, more fuel-efficient aircraft of similar capacity. The resulting estimate for percentage of seats filled is shown in **Figure 3-13.**

Figure 3-13 – ORF Percentage of Seats Filled



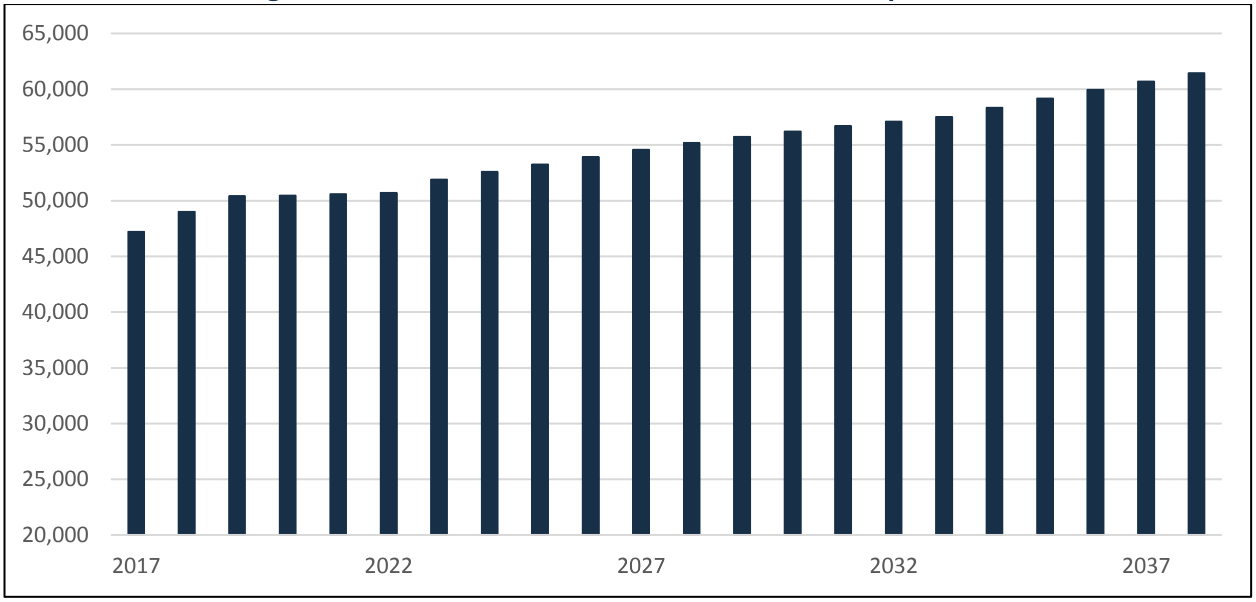
Source: NAA, CHA, 2018.

Operations

As previously mentioned, aircraft size and service routes were both taken into consideration when determining load factors. The departure seats were calculated by taking each year's projected enplanements and multiplying by the corresponding year's average projected load factor. Average seats per departure were calculated by taking the total projected departure seats each year and dividing by the number of commercial departures during the corresponding year. Operations were then determined by multiplying the previously calculated departure seats by the average seats per departure, with the result then being doubled to account for departures and arrivals. The resulting forecast for total operations is shown in **Figure 3-14**.

[11] Provided in the Load Factor section of the 2017 National Forecast and FAA Aerospace forecast.

Figure 3-14 – ORF Estimated Total Commercial Operations



Source: NAA, CHA, 2018.

Table 3-14 shows a summary of the recommended commercial enplanements and operations forecast, with average seats per departure and percent of seats filled detailed. As mentioned earlier in this section, average aircraft size grows at 1.5 percent per year after 2022, similar to the 2018 National FAA TAF change in domestic average aircraft seats per mile, and the percentage of seats filled results in 84.2 percent in 2038, an approximate total growth of 5.2 percent over the forecast period.

Table 3-14 – Recommended Commercial Forecast

Fiscal Year	Enplanements	Operations	Average Seats Per Departure	Load Factor
2017	1,672,024	47,195	89.8	79.0%
2018	1,857,487	48,986	96.0	79.5%
2023	2,115,424	51,889	100.5	81.1%
2028	2,376,990	55,177	104.6	82.4%
2033	2,622,848	57,488	109.4	83.4%
2038	2,834,623	61,430	109.6	84.2%
AAGR 2018-2038	**2.1%**	**1.1%**	**0.7%**	**0.3%**
Growth 2018-2038	**52.1%**	**25.4%**	**14.2%**	**5.8%**

Source: FAA Terminal Area Forecast, CHA, 2018.

3.5.3 Commercial Carrier Fleet Mix

The commercial aircraft fleet mix projections are a function of the scheduled commercial passenger air carriers that operate (or are expected to operate) at the Airport during the forecast period. Each carrier's anticipated future fleet mix (i.e., aircraft acquisitions, aircraft phase-outs, retirements, route demand, etc.) and forecast enplanement levels influence a carrier's aircraft type and level of operations. This data is then coupled with the forecasted commercial air carrier operations to determine the number of annual departures by aircraft type to the greatest extent practical. It is important to note that the assumptions provided within this section are a function of seats per departure and annual seats applied to an assumed LF. The operational fleet mix forecast provided within this section serves as practical planning activity levels for the purposes of developing airside and terminal development initiatives.

The first step in determining ORF's future commercial carrier fleet mix was to identify the overall market trends that will drive future airline fleets, as well as aircraft fleet mix decisions specific to each airline operating at the Airport and its demand associated with individual routes by load factor. It is important to reiterate that overall passenger enplanements are projected to grow incrementally and maintain a positive stable growth throughout the planning period. With the increase in the number of short to medium haul, low-cost air carriers, and the replacement of older larger aircraft, such as early versions of the Boeing B737, Boeing 757, Airbus A320, and the MD80, the demand for smaller single-aisle aircraft has grown within the past two decades, trending the industry toward aircraft with fewer seats, peaking in 2007. In general, this has translated to a higher passenger load factor per flight; however, per the Boeing Commercial Market Outlook (2018-2037), domestic air carriers have begun trending away from regional jet aircraft and retiring smaller 50-seat aircraft at an accelerated rate.

These 50-seat aircraft are being replaced with larger 70- and 90-plus seat regional jets, as well as larger narrow-body aircraft; however, replacements will not keep pace with retirements. Boeing predicts that in 2030, the fleet of regional jets will consist of 760 aircraft, down from 1,780 in 2010. Single-aisle mainline aircraft will continue to comprise much of the domestic fleet and will increase market share from 56 percent in 2009 to 73 percent in 2030.

As with the predicted national fleet shift toward newer, larger, and more efficient aircraft, ORF-specific fleet mix characteristics and trends were identified and applied directly to the preferred passenger carrier forecasts through 2038. To provide a detailed picture of future ORF operations, the following assumptions were based upon airline-specific fleet plans and aircraft orders, as well as overall industry trends:

- Based on Airbus Fleet Orders and on discussions with airline representatives, Allegiant's McDonnell Douglas MD80 aircraft (166-seats) will be phased out of service and replaced with A319 and A320 series aircraft. Although most Allegiant sources (AllegiantAir.com) show the phase out of the MD80 aircraft happening by calendar year (CY) 2019, according to airline representatives the final MD80/90 series flight is expected to be completed in November 2018. For forecasting purposes, it was assumed that the smaller A319 (128 to 132-seats) will be used to service non-peak routes and the larger A320 (177-seats) will be used during peak periods and high demand flights. Based on the age of the aircraft, and no orders or deliveries of the A319 aircraft identified on the Airbus website, it was assumed that the A319 operations will be transitioned to the newer A320s.
- As announced in 2016 (Delta.com), Delta is currently planning an aggressive overhaul of their small-plane fleet both through the mainline carrier and Delta Connection carriers. According to Delta.com, the airline plans to buy larger regional jets with a list value up to $2.3 billion, pending pilot union approval. This will provide Delta the option of adding 50 aircraft, each with 70-76 seats. This is indicative of the airline progressing towards eliminating their fleet of 50-seat aircraft.

- Delta Air Lines regional jet aircraft with a passenger capacity of 50-seats or under (CRJ200, ERJ145, ERJ140, etc.) will be gradually phased out of service and replaced with larger 70-seat plus regional jet aircraft (CRJ700/900) and larger narrow-body B717s, which were leased from Southwest after the Southwest/Air Tran merger.
- In addition to transitioning to larger RJs and B717s, according to a Delta Air Lines press release (Delta.com), and according to Bombardier Orders & Deliveries, Delta Air Lines has ordered 75 A220 (formerly Bombardier CS100s) airplanes (pending congressional legislation on imports). This aircraft will be utilized on the short- and medium-haul routes and will host a two-class 100-seat configuration. It is unlikely that ORF will see this airframe in the short-term, however in the five- to 15-year time frame it is likely this airframe will serve the ORF-ATL route.
- According to SkyWest Airlines representatives, the airline is in transition to flying primarily dual-class aircraft on its CRJ operations (specifically through ExpressJet) by reducing the number of CRJ200s in service. This will result in an increase of ERJ145 operations as the airline (ExpressJet) will not phase out these aircraft until a later date (unannounced). Currently, the ExpressJet fleet consists of 35 CRJ700s, 28 CRJ900ERs, and 164 ERJ145s. In December 2016, SkyWest announced that ExpressJet and American Airlines have agreed to place 12 dual-class CRJ700s into a multi-year service term.
- CRJ200 operations on short stage length flights (i.e., ORF to BWI) via smaller regional feeder airlines are expected to remain in the short-term period and are expected to transition out of service in the short- to medium-term time periods. This transition is assumed to take place over the next five years.

Using ORF's commercial air carrier schedule data provided by Aviation DataMiner and supplemented by the NAA, the commercial air carrier fleet mix forecast considered the assumptions listed above, as well as the projected annual departures for the Airport associated with the enplanement projections listed in the recommended forecast. A departure is considered a single operation, while an arrival is another. Simply put, departures equal one-half of total operations. For future facility planning purposes, annual commercial operations were converted to operations by aircraft type for select years. The 2017 fleet mix was taken as the baseline, with adjustments for retiring fleet types (e.g. MD80s, Dash-8s, 50-seat regional jets) and reasonable replacement aircraft types through the forecast period. **Table 3-15** below shows the fleet mix and departures for FYs 2018, 2023, 2028, 2033, and 2038.

Table 3-15 – Commercial Fleet Mix

Aircraft Series	Operations					
	FY 2017	FY 2018	FY 2023	FY 2028	FY 2033	FY 2038
B737-7	4,108	7,175	7,600	8,082	8,420	8,998
CRJ-700	3,205	2,687	4,524	6,159	7,822	8,358
ERJ-170/175	2,701	2,900	4,340	5,964	7,619	8,142
EMB-190/195	0	378	5,053	5,373	5,598	5,982
A320	840	3,077	5,049	5,369	5,594	5,977
A220	0	0	3,560	4,362	4,544	4,856
A319	2,699	3,583	3,795	4,036	4,205	4,493
B737-8	1,821	3,402	3,603	3,832	3,992	4,266
EMB E2*	0	0	1,866	3,575	3,724	3,980
CRJ-900	1,685	2,728	2,890	3,073	3,202	3,421
B737-9	904	1,441	1,526	1,623	1,691	1,807
A321	0	119	538	1,009	1,051	1,123
B767-4	4	17	18	20	20	22
CRJ-2/4	14,209	7,184	5,073	2,697	0	0
EMB-145	5,940	2,824	1,496	0	0	0
B717-2	374	703	542	0	0	0
B757-2	1,205	776	411	0	0	0
MD-80 Series	5,959	5,882	0	0	0	0
DASH8-1	777	386	0	0	0	0
ATR 42s		94	0	0	0	0
B737-3	756	0	0	0	0	0
B737-4	48	0	0	0	0	0
A330-3	4	0	0	0	0	0
Other	5	5	5	6	6	6

*E2 represents the new E2 Boing Embraer line including the E175/109/195
Source: NAA, CHA, 2018.

3.5.4 Effective Enplanements Range

The purpose of this forecast is to reasonably predict future airport activity to support development at the Airport throughout the forecast period and to provide a realistic range of annual enplanements which drive all other aspects of commercial activity at the airport. **Figure 3-15** depicts a range of enplanement forecasts in comparison to the FAA TAF. This range was considered during the demand capacity and facility requirements evaluation in the subsequent chapters of this Study. The purpose of this range is to provide the Norfolk Airport Authority (NAA) with a basis from which to plan future development at the Airport. The range (used in the subsequent chapter for facility demand capacity calculations), provides varying Planning Activity Levels (PALs), described in subsequent chapters, which were used as benchmarks for future development.

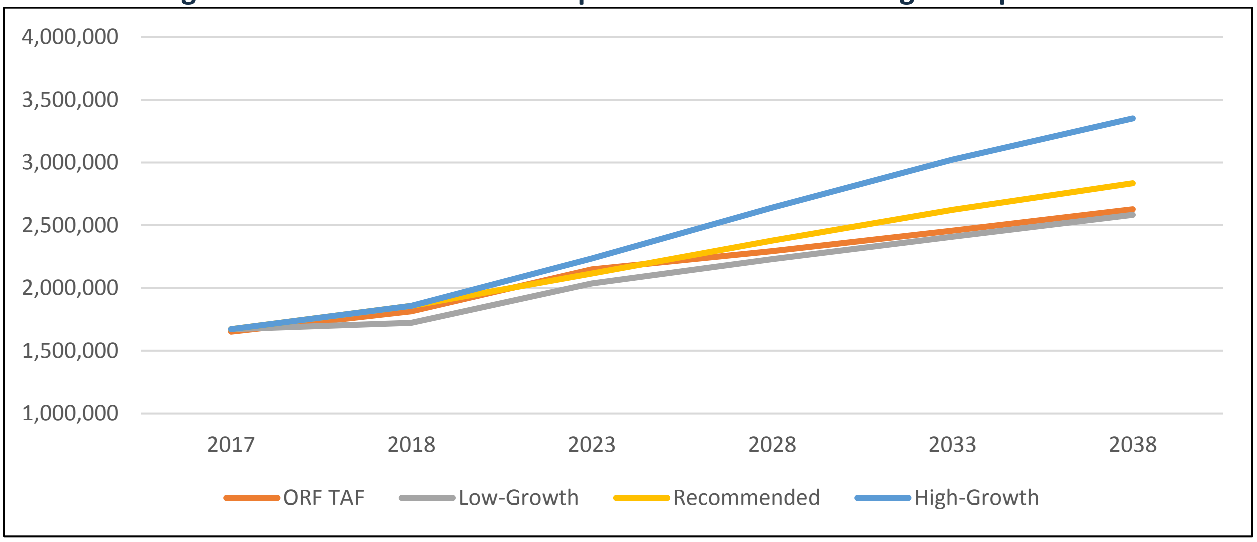
As mentioned previously, the Low-Growth scenario was derived from the Static State Market Share forecast described in **Section 3.5.1 (Market Share Analysis)**. The High-Growth forecast (Medium- to Long-Term Air Service Scenario) shown was derived from a similar methodology as the recommended forecast (five-year schedule through 2022 and long-term regression variables determining projections through 2038), and the High-Growth forecast incorporates the remainder of non-population socioeconomic variables (employment, income, GRP) to determine the long-term forecast. This resulted in an R^2 value of .90 and 3,167,611 enplanements by 2038.

Table 3-16 – Comparison of Enplanements Forecast Scenarios

Fiscal Year	Enplanements			
	ORF TAF	Low-Growth	Recommended	High-Growth
2017	1,652,323	1,672,024	1,672,024	1,672,024
2018	1,815,241	1,723,608	1,857,487	1,857,487
2023	2,147,644	2,035,945	2,115,424	2,234,279
2028	2,294,704	2,231,077	2,376,990	2,640,381
2033	2,458,050	2,407,453	2,622,848	3,022,093
2038	2,627,295	2,582,498	2,834,623	3,350,889
AAGR 2018-2038	**1.9%**	**2.04%**	**2.1%**	**2.99%**
Growth 2018-2038	**44.7%**	**49.83%**	**52.6%**	**80.4%**

Source: FAA 2018 TAF, NAA, CHA, 2019.

Figure 3-15 – Recommended Enplanement Forecast Range Comparison



Source: FAA Terminal Area Forecast, CHA, 2018.

3.6 AIRPORT CATEGORIZATION

Based on FAA guidelines, ORF is categorized as a Commercial Service Airport – Primary, within the National Plan of Integrated Airport Systems (NPIAS). Primary airports are grouped into four categories defined as: large, medium, small, and non-hub airports. Primary airports receive an annual apportionment of federal grants based on the number of enplaned passengers at the airport. Based on the CY 2017 enplanements at ORF, the Airport qualifies as a primary, small-hub airport.

Small-hub airports are defined as airports that enplane 0.5 to 0.25 percent of the total U.S. passenger enplanements annually. Additionally, at the end of FAA CY 2017, ORF was ranked the 72nd largest airport in the United States by total number of enplanements (1,694,232 per FAA). This qualifies ORF as a small-hub airport within the NPIAS. **Table 3-17** below breaks down the categories of airport activities by classification and percentage of annual passenger boardings.

Based on the information shown below, and the FAA National Forecast for all commercial service airports, ORF is expected to remain in the small-hub category throughout the forecast period.

Table 3-17 – NPIAS Airport Classifications

Airport Classifications		Hub Type: Percentage of Annual Passenger Boardings	Common Name
Commercial Service: Publicly owned airports that have *at least 2,500* passenger boardings each calendar year and receive scheduled passenger service **§47102(7)**	**Primary:** Have *more than 10,000* passenger boardings each year **§47102(16)**	**Large:** 1% or more	**Large-Hub**
		Medium: At least 0.25%, but less than 1%	**Medium-Hub**
		Small: At least 0.05%, but less than 0.25%	**Small-Hub**
		Non-hub: More than 10,000, but less than 0.05%	**Non-hub Primary**
	Nonprimary	**Non-hub:** At least 2,500 and no more than 10,000	**Non-primary Commercial Service**
Nonprimary (Except Commercial Service)		**Not Applicable**	**Reliever §(47102(23))**
			General Aviation §(47102(8))

Source: FAA, CHA, 2018.

3.7 AIR CARGO FORECAST

Air cargo traffic is comprised of freight, express, and airmail. Air cargo is typically transported via three different methods: commercial air carrier “belly cargo”, dedicated commercial cargo carriers (integrators), or all-cargo charter services. Air cargo activity and demand is cyclical in nature and fluctuates based on national and global economic trends. Factors that affect air cargo growth are fuel price volatility, movement of real yields, and globalization.

This section analyzes historical trends in air cargo traffic and aircraft operations and develops forecasts of commercial cargo (integrator) traffic and all-cargo aircraft operations by type, based on projected economic trends in the Hampton Roads Region. For the purposes of this forecast, only domestic air cargo analyses were evaluated. ORF does not currently have, and is not anticipated to receive, international air cargo services within the forecast period.

3.7.1 Historical Trends

Based on FAA records, ORF’s cargo activity ranked 88th among U.S. airports in CY 2017 (in terms of all-cargo cargo landed weights). ORF’s cargo activity is dominated by domestic traffic for the U.S. integrated air carriers, FedEx and UPS, which accounted for 85.4 to 99.4 percent of the Airport’s total landed weight from FY 2008 to FY 2017 (**Table 3-18**), resulting in the total integrator landing weight increasing by 66.6 percent from FY 2008 to 2017. In 2017, the United States’ domestic cargo industry revenue ton miles (RTMs) was 14.6 billion, 120 thousand tons of which were at ORF. The forecasts of RTMs were based on the following assumptions:

- ✈ The FAA and TSA security regulations and restrictions on air cargo transportation will remain in place and continue to be enforced.
- ✈ The shift from air to ground transportation has occurred.
- ✈ Long-term cargo activity will correspond to economic growth.

The integrator flights at ORF connect the local market with the U.S. domestic market. FedEx operates jet flights to its national hub at Memphis International Airport (MEM), with additional flights to Newark Liberty International Airport (EWR). UPS similarly operates jet flights to and from its national hub at Louisville International Airport (SDF), with additional flights to Richmond International Airport (RIC).

According to *Hampton Roads Regional Freight Study, 2017 Update*., in 2012 over 146 million tons of domestic freight was transported by all modes to, from, within, and through the Hampton Roads region, which included ORF, as the primary mode for air cargo for all the Hampton Roads Region and is expected to increase by 53 percent in tonnage to 223 million tons by 2040. As shown in the table below, the Airport was on a steady increase in cargo operations from 2008 through 2012; however, like the economic impacts on ORF commercial passenger and operations, during the CY 2013 and 2014, is when military sequestration had a significant fiscal and economical impact on the local and regional demographic, leading to declines in all economical categories. This had an impact on ORF cargo as well, showing declines from historical highs from 2012 through 2014. As sequestration ended, the local economy has continued to recover and surpass previous historical cargo activity. As such, ORF is experiencing even more record growth in cargo at the Airport, aligning the Hamptons Roads Region with original forecasts of 53 percent growth in all cargo modes by 2040.

In FY 2017, 2,429 cargo operations occurred, 93.3 percent of which were integrator flights (see **Table 3-19**). From FY 2008 to 2017, integrator operations increased by 8.1 percent; however, other all-cargo operations declined by 71.7 over the same period. The decrease can be attributed to recent industry trends, as previously stated, showing a shift from air to other modes (especially truck).

Table 3-18 – ORF All-Cargo Traffic Weight by Carrier Type

Fiscal Year	Integrators		Other All-Cargo		Belly Cargo		Total Cargo Weight	% Total Integrators
	Freight	% Change	Freight	% Change	Freight/Mail	% Change		
2008	71,793	-	11,354	-	913	-	84,059	85.4%
2009	94,062	31.0%	2,776	-75.6%	676	-26.0%	97,513	96.5%
2010	101,694	8.1%	3,866	39.3%	770	13.9%	106,330	95.6%
2011	107,606	5.8%	726	-81.2%	727	-5.5%	109,059	98.7%
2012	110,206	2.4%	12	-98.3%	679	-6.7%	110,897	99.4%
2013	105,546	-4.2%	2	-87.3%	731	7.8%	106,279	99.3%
2014	99,125	-6.1%	236	15033.6%	729	-0.3%	100,090	99.0%
2015	98,160	-1.0%	10	-95.8%	727	-0.2%	98,897	99.3%
2016	103,895	5.8%	17	71.3%	603	-17.1%	104,515	99.4%
2017	119,622	15.1%	12	-32.1%	703	16.5%	120,337	99.4%
AAGR 2008-2017	**5.2%**	**-**	**-49.8%**	**-**	**-2.6%**	**-**	**3.7%**	**-**
Growth 2008-2017	**66.6%**	**-**	**-99.9%**	**-**	**-23.0%**	**-**	**43.2%**	**-**

Note: Units are in tons.
Source: Data Miner, US DOT T-100, NAA, CHA, 2018.

Table 3-19 – ORF All-Cargo Flight Operations by Carrier Type

Fiscal Year	Integrators	% Change	Other All-Cargo	Total Cargo Operations	% Total Integrators
2008	2,096	-	576	2,672	78.4%
2009	2,416	15.3%	24	2,440	99.0%
2010	2,590	7.2%	22	2,612	99.2%
2011	2,618	1.1%	4	2,622	99.8%
2012	2,378	-9.2%	4	2,382	99.8%
2013	2,522	6.1%	1	2,523	99.96%
2014	2,392	-5.2%	6	2,398	99.7%
2015	2,388	-0.2%	793	3,181	75.1%
2016	2,338	-2.1%	640	2,978	78.5%
2017	2,266	-3.1%	163	2,429	93.3%
AAGR 2008-2017	**0.8%**	**-**	**-11.9%**	**-0.9%**	**-**
Growth 2008-2017	**8.1%**	**-**	**-71.7%**	**-9.1%**	**-**

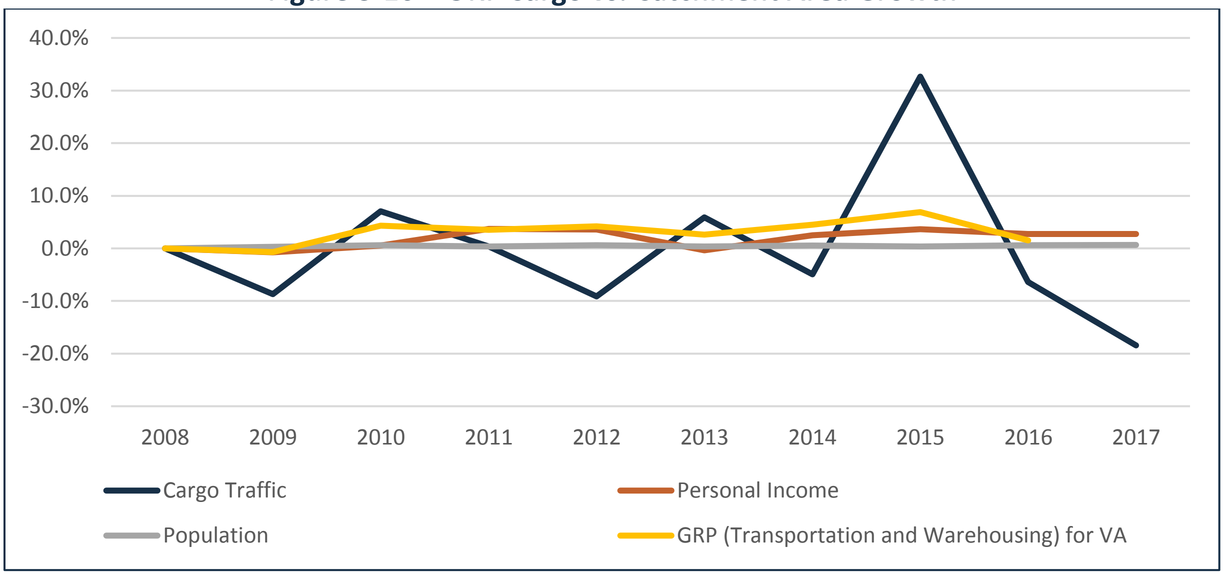
Note: Excludes Belly Cargo.
Source: NAA, CHA, 2018.

As shown in **Figure 3-16**, the pattern of growth since 2007 for all cargo has been cyclical, with major declines in traffic in 2009 and 2012. The cyclical nature of cargo operations at ORF correlates with military sequestration. As discussed in **Section 3.2**, Hampton Roads is home to more than 80,000 military personnel, with approximately four percent of national defense spending occurring in this area. Department of Defense (DOD) spending became dissolute with the onset of sequestration in 2013 and remained fairly constant through 2016. In addition to military sequestration, as discussed in the publication, *State of the Region*[12], the Great Recession also contributed to the cyclical nature of cargo in the area surrounding ORF, as the Great

[12] Dragas Center for Economic Analysis and Policy (2018). State of the Region: Hampton Roads 2018 [PDF file]. Retrieved from https://www.ceapodu.com/wp-content/uploads/2018/10/SOR-2018-FINAL090518.pdf

Recession resulted in an immediate decline in cargo tonnage in 2008 and 2009. Many factors contributed to the Great Recession and instability in the market. The ability to create new lines of credit changed, drying up the flow of money and slowing new economic growth over several markets, decreasing the buying and selling of assets in the United States. This, in turn, hurt individuals, financial institutions, and businesses (including cargo companies). The Bureau of Transportation Statistics (BTS) measures movement of freight and models the data using a BTS's Freight Transportation Services Index (TSI). BTS identified that the air freight was impacted more than any other source of freight movement, as air freight saw a 26.5 percent decrease from January 2008 to April 2009[13].

Figure 3-16 – ORF Cargo vs. Catchment Area Growth



Source: U.S. DOT, T-100 statistics, Woods & Poole Economics, Inc., NAA, CHA, 2018.

3.7.2 Cargo Traffic Forecast

The future growth of cargo activity at ORF will primarily depend on growth in the demand for integrator cargo services provided by FedEx and UPS. Most of the traffic is next-day and second-day delivery traffic, which is affected by local consumer and business demand for both inbound and outbound services, specifically the continued expansion of e-commerce-based traffic. Based on smaller contract and non-integrator cargo traffic carried on non-integrator cargo, operations will likely continue to contribute a minor amount of traffic throughout the forecast period, though is not anticipated to incrementally increase. ORF does not have scheduled international all-cargo service due to a low level of demand within ORF's service area. International cargo is typically received at the integrators hubs and distributed domestically thereafter.

Due to the cyclical nature of cargo and poor correlation with historical socioeconomic factors, the cargo forecasts were based on research and findings by industry experts, such as those found in the FAA Aerospace Forecast (2018-2038), Boeing World Air Cargo Forecast (2016-2017), and

[13] Bureau of Transportation Statistics (2017). Freight by Mode Since the Recession. Retrieved from https://www.bts.gov/newsroom/freight-mode-recession

the Airbus Global Market Forecast (FY 2018-2037), and the Hampton Roads Regional Freight Study, 2017 Update.

Integrated Carrier Cargo Traffic

The current and historical traffic levels for the integrated carriers at ORF are representative of the demand and can be used as a basis for forecasting. As previously mentioned, cargo demand in specific regions is predicated upon economic and socioeconomic variables. As such, it was necessary to examine the comparison between socioeconomic factors described in **Section 3.2** (**Socioeconomic Data**) and economic variables (Gross Regional Product (GRP), Manufacturing Earning, Transportation & Warehousing Earnings, etc.) in the Hampton Roads area to identify growth patterns directly associated with cargo imports and exports.

The industry forecasts of RTMs presented in this section were developed by world cargo experts and were based on models that link cargo activity to Gross Domestic Product (GDP). These forecasts of domestic cargo RTMs were developed with real U.S. GDP as the primary driver. The distribution of RTMs between passenger and all-cargo carriers were forecast based on an analysis of historical trends in shares, changes in industry structure, and market assumptions. The U.S. economic recovery is projected to continue, influencing the forecast for domestic cargo in the U.S. In 2018, domestic air cargo RTMs in the U.S. were forecast to grow 1.3 percent and were projected to maintain that growth throughout the forecast period. According to the Boeing World Cargo Forecast, the domestic economy is forecast to grow at an average annual rate of 2.3 percent through 2025 and 2.2 percent over the entire forecast period.

In addition to UPS and FedEx, Amazon has recently begun service within the air cargo industry and, according to industry experts, is expected to become a primary competitor to integrated carriers. Although it is unknown to what extent Prime Air will serve the air cargo industry, it is not unreasonable to expect the new cargo service to arrive at ORF sometime within the forecast period.

Air cargo is also affected by local economic factors, such as local demographics, socioeconomics, commodity and fuel prices, the need or desire for merchandise, and the behaviors of local shippers (public customers). As discussed in **Section 3.2** (**Socioeconomic Data**), data collected from Woods & Poole Economics, Inc. for the years 2008 through 2017 was analyzed prior to examining trends and projecting growth for integrated cargo and other all-cargo passenger traffic. The data analyzed included personal income, population, GRP, manufacturing earnings, and transportation and warehousing earnings. As shown, the population, employment rate, and income in the local economy around ORF is expected to incrementally increase during the forecast period. These increases will drive the need and desire for merchandise, as well as increase the amount of online purchases and needs for quick delivery.

Other All-Cargo and Passenger Volume

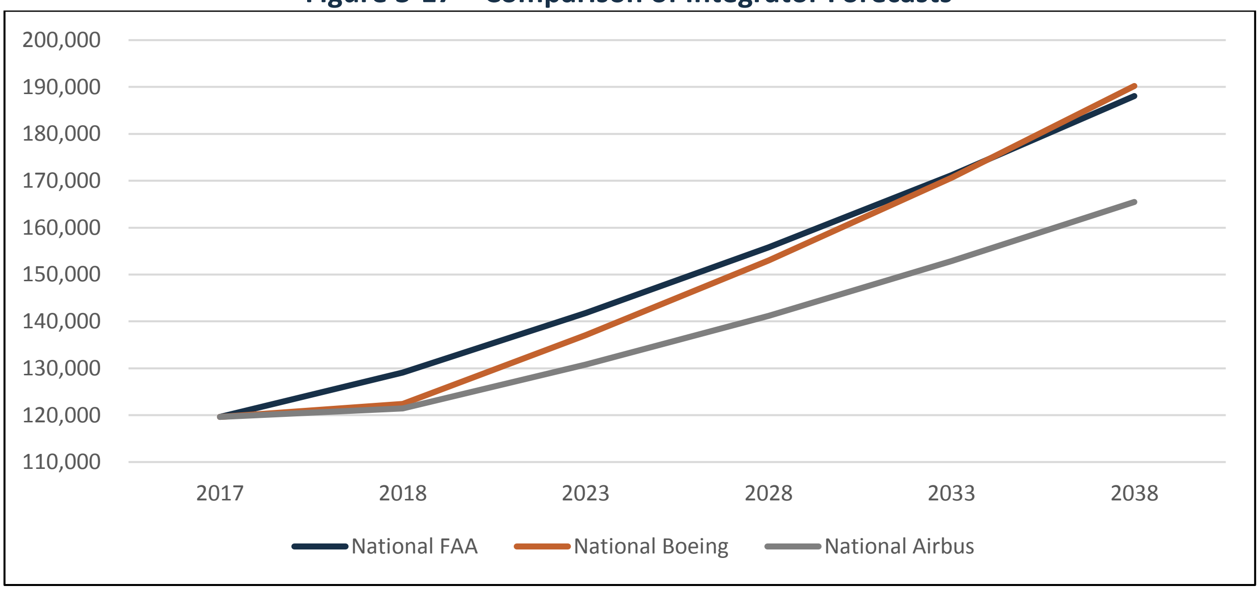
GDP, as previously mentioned, is the main driver in air cargo activity and is used as the basis for the FAA, Boeing, and Airbus forecasts. The integrator traffic growth and service patterns, as well as the other categories of cargo traffic ("Other All Cargo" and "Passenger"), have been cyclical in the historical 10-year time frame. The other all-cargo and belly cargo traffic show no indication of any future growth in flight or traffic activity outside of typical national growth patterns for mail and belly cargo; therefore, the FY 2018 level and future projections were set at the FY 2017 levels and incremental growth was based on national trends in aviation and projected throughout the forecast period. The resulting volume levels for each of the traffic forecasts are shown in **Table 3-20**. As shown in **Figure 3-17**, the Boeing forecast produced the highest growth rate while the Airbus forecast had the lowest growth for total cargo operations.

Table 3-20 – Air Cargo Traffic Forecasts Summary

Fiscal Year	Integrators			Other All-Cargo		
	National FAA	National Boeing	National Airbus	National FAA	National Boeing	National Airbus
2017	119,622	119,622	119,622	12	12	12
2018	129,073	122,374	121,417	13	12	12
2023	141,809	137,109	130,800	14	13	13
2028	155,803	153,019	141,187	15	15	14
2033	171,178	170,608	152,849	17	17	15
2038	188,069	190,219	165,475	18	18	16
AAGR 2018-2038	**1.9%**	**2.2%**	**1.6%**	**1.9%**	**2.2%**	**1.6%**
Growth 2018-2038	**45.7%**	**55.4%**	**36.3%**	**45.7%**	**55.4%**	**36.3%**

Note: Units are in tons; Excludes Belly Cargo.
Source: FAA Aerospace Forecast FY 2018-2038, Airbus Global Market Forecast FY 2018-2037, Boeing Commercial Market Outlook 2018-2037, CHA, 2018.

Figure 3-17 – Comparison of Integrator Forecasts



Source: FAA Aerospace Forecast FY 2018-2038, Airbus Global Market Forecast FY 2018-2037, Boeing Market Outlook 2017, CHA, 2018.

3.7.3 All-Cargo Traffic by Volume Forecast

The recommended forecast is the average of the three forecasts, which falls between the Boeing-based and the Airbus-based forecasts. The average for the integrated carriers and all-cargo carriers is 1.9 percent.

The volume forecast for the integrators and other all-cargo operators assumed that the average load for 2017 will apply for the entire forecast period. **Table 3-21** shows the forecasted totals in this scenario (see **Table 3-18** for historical cargo volume at ORF).

Table 3-21 – All-Cargo Volume Forecast

Fiscal Year	Integrators	Other All-Cargo	Total
2017	119,622	12	119,634
2018	121,891	12	121,903
2023	133,897	13	133,910
2028	147,086	14	147,101
2033	161,574	16	161,590
2038	177,489	17	177,506
AAGR 2018-2038	**1.9%**	**1.9%**	**1.9%**
Growth 2018-2038	**45.6%**	**45.6%**	**45.6%**

Note: Units are in tons; Excludes Belly Cargo.
Source: NAA, CHA, 2018.

3.7.4 Operations Forecast

Similar to the all-cargo volume forecast, the recommended all-cargo operations forecast was based on the average of the FAA, Boeing, and Airbus forecasts. The averages for the integrators and other all-cargo were less than 2 percent.

Table 3-22 presents the estimated number of operations by ORF's integrated and all-cargo carriers based on annual operations. It is anticipated that any additional capacity required will likely be accommodated by upsizing the aircraft in lieu of adding an additional flight (**Table 3-19** for historical cargo operations at ORF).

Table 3-22 – All-Cargo Operations Forecast

Fiscal Year	Integrators	Other All-Cargo	Total
2017	2,266	163	2,429
2018	2,309	166	2,475
2023	2,536	182	2,719
2028	2,786	200	2,987
2033	3,061	220	3,281
2038	3,362	242	3,604
AAGR 2018-2038	**1.9%**	**1.9%**	**1.9%**
Growth 2018-2038	**45.6%**	**45.6%**	**45.6%**

Note: Excludes Belly Cargo.
Source: NAA, CHA, 2018.

Fleet Mix of Operations

Future fleet mix patterns for integrator cargo should remain relatively unchanged due to the consistency of the fleet mix over the historical time-period. For the integrators, the stability of ORF's role in their networks, the long operating life for freighter aircraft, and the ability to add converted passenger aircraft to replace aging freighter models contributes to this assumption. It is likely that the split between narrow body and wide body jets will be maintained, although it is probable that there will be some shift between wide body jet aircraft types as determined by the likely future composition of cargo carrier fleets.

Air cargo fleet mix directly correlates to growth of air cargo traffic; therefore, as air cargo experiences growth, fleet mix expands to meet the projected needs. The freighter aircraft fleet is categorized as standard-body, medium-widebody, and large-widebody freighters. The projected fleet growth in the United States from 2016 to 2036 is depicted in **Table 3-23**.

Table 3-23 – Domestic Cargo Freighter Fleet Forecast

Year	Widebody	Standard-Body	Total
2016	1,150	660	1,810
2036	1,780	1,250	3,030

*Standard body freighters: less than 45 tons of carrying capacity. (Boeing 737-800).
*Widebody freighters include Medium widebody and large freighters

The change in domestic freighter fleet mix will consist of 1,260 aircraft being retired and replaced by new freighter deliveries, along with 920 freighter deliveries that will be added to expand the fleet mix, meeting projected traffic growth. As the cargo fleet mix becomes more concentrated with standard-body passenger aircraft, the industry will experience a decline in the medium-widebody and large-widebody aircraft comprising the fleet mix.

According to the FAA Aerospace Forecast, the cargo carrier large jet aircraft fleet is forecast to increase from 855 aircraft in 2017 to 1,178 aircraft in 2038, driven by the growth in freight RTMs. The narrow-body cargo jet fleet is projected to increase by less than one aircraft a year as B757s and B737s are converted from passenger use to cargo service aircraft. The wide-body cargo fleet is forecast to increase by 15 aircraft per year as new B747-800, B777-200, and the new and converted B767-300 aircraft are added, replacing older MD11, A300/310, and B767-200 freighters. According to the Boeing World Air Cargo Forecast, the freighter fleet forecast calls for 3,010 airplanes in service by 2035, an increase of 70 percent compared to the in-service 2015 fleet of 1,770.

The integrated carriers serve the ORF market with a mix of turbo-prop, narrow body, and wide-body jet aircraft. The standard weekday hub flights are supplemented with additional peak capacity supplied by: (1) more flights from the hubs and other airports; and (2) the use of larger aircraft in some cases. The fleet mix of cargo aircraft is shown in **Table 3-24**. Wide-body aircraft are further broken down into three general categories based on average traffic load: standard wide body, medium widebody, and large wide-body. Standard wide-body freighters have less than 45 tons of cargo capacity. The standard wide-body fleet (Boeing 757) is not expected to increase during the forecast period. Medium wide-body freighters (Boeing 767-300F) have 40 to 80 tons of cargo capacity. Large wide-body freighters (Airbus A300) have a minimum of 80 tons of cargo capacity.

In early 2018, UPS announced a purchase agreement with Boeing of 14 additional B747-8 freighters, as well as four (4) B767 freighters. In 2017, FedEx announced a purchase agreement with ATR of 30 ATR 72-600 aircraft, with the option of purchasing up to 20 additional aircraft. FedEx is scheduled to begin receiving the ATRs in 2020 and will continue to receive them over a five-year period until all purchased aircraft are received. In June 2018, FedEx also announced a new order for 12 B767 Freighters (to be delivered between FY 2020 and 2022) and 12 B777 Freighters (to be delivered between FY 2021 and 2025). According to FedEx.com, the freight company is phasing out Boeing 757-200 and McDonnell Douglas MD-11 aircraft and replacing those operations with new Boeing 767 and 777 aircraft respectively. According to Airfleets.net, which tracks individual aircraft by registration and ownership, as of June 2018, FedEx owns and operates over 65 Airbus A300 aircraft, replacing B757-200 operations in smaller markets; however, the average age of these A300 aircraft have over 23 years of operational life. With the FedEx trend of retiring aircraft before 30-years of operational life (see Boeing 757-200, MD-11, A310), it was assumed that within the next 10 years, FedEx will begin to phase-out A300 aircraft and replace those with newer B767 and B777 aircraft as orders have continued.

As with the traffic forecasts, it was assumed that the fleet mix for other all-cargo operations at ORF will be relatively constant throughout the forecast period; however, due to the increase in B767 orders, it was projected that ORF will see B767 operations within the long-term forecast period. As such, the future critical aircraft for ORF airfield and pavement design is projected to be the B767-3 (D-IV). See **Section 3.11** (**Current and Projected Critical Aircraft**).

Operations of other all-cargo aircraft by non-integrated all-cargo carriers are conducted via Dassault Falcon, McDonnell Douglas DC-9s, and minimal Cessna 208 Caravans. Based on industry trends, the Falcons and DC-9s are expected to be phased out within the short-term time frame in favor of smaller turboprop aircraft (i.e. Cessna 208 Caravan, Metroliner Metro 23, etc.) and older retrofitted narrow-body passenger aircraft (i.e. Boeing 737-400).

Table 3-24 – Cargo Carrier Fleet Mix at ORF

Aircraft Configuration/Group	Aircraft Type
Current	
Integrators	
Jet, 2-Engine	Airbus A300, Airbus A600, Boeing 757
Turbo-Prop	Cessna 208 Caravan
Other All-Cargo	
Jet, 2-Engine	McDonnell Douglas DC-9-30, McDonnell Douglas MD-83, Dassault Falcon, Learjet
Projected	
Integrators	
Jet, 2-Engine	Airbus A300, Airbus A600, Boeing 757, Boeing 767
Turbo-Prop	Cessna 208 Caravan
Other All-Cargo	
Jet, 2-Engine	Dassault Falcon, Learjet

Source: NAA, CHA, 2018.

3.8 GENERAL AVIATION AND MILITARY FORECAST

General aviation (GA) includes all segments of the aviation industry except commercial air carriers/regional/commuter service, scheduled cargo, and military operations. General aviation represents the largest percentage of civil aircraft in the U.S. and accounts for most operations handled by towered and non-towered airports. Its activities include flight training, sightseeing, recreational, aerial photography, law enforcement, and medical flights, as well as business, corporate, and personal travel via air taxi charter operations. General aviation aircraft encompass a broad range of types, from single-engine piston aircraft to large corporate jets, as well as helicopters, gliders, and amateur-built aircraft.

Military activity is often included in the based aircraft and operations projections but are not forecast in the same manner as general aviation activity since their number, location, and activity levels are not a function of anticipated market and economic conditions, but are rather a function of military decisions, national security priorities, and budget pressures that cannot be predicted over the course of the forecast period. Typically, military based aircraft and military operations, for forecasting purposes, remain static at baseline year levels throughout the forecast period.

General aviation and military operations are further categorized as either itinerant or local operations. Local operations are those performed by aircraft that remain in the local traffic pattern or within a 20-mile radius of the tower. Local operations are commonly associated with training activity and flight instruction and include touch and go operations. Itinerant operations are arrivals or departures, other than local operations, performed by either based or transient aircraft that do not remain in the airport traffic pattern or within a 20-nautical mile radius. It is important to note that as shown in **Table 3-25**, the 2018 TAF indicated essentially no growth in GA operations at ORF, however shows a considerable spike in based aircraft. For GA operations at FAA facilities, the FAA TAF used trend models to project growth in the future. Based on the historical decline in GA activity, the TAF does not project growth at ORF until trends show incremental growth in consecutive years.

Table 3-25 – FAA TAF (Condensed to GA Only)

Fiscal Year	Itinerant Operations			Local Operations				Based Aircraft
	GA	Military	Total	GA	Military	Total	Total Ops	
2017	17,289	521	17,810	1,167	92	1,259	19,069	95
2018	15,944	590	16,534	413	82	495	17,029	95
2023	14,846	590	15,436	519	82	601	16,037	105
2028	14,846	590	15,436	524	82	606	16,042	115
2033	14,846	590	15,436	529	82	611	16,047	125
2038	14,846	590	15,436	534	82	616	16,052	135
AAGR 2018-2038	**-0.4%**	**0.0%**	**-0.3%**	**1.3%**	**0.0%**	**1.1%**	**-0.3%**	**1.8%**
Growth 2018-2038	**-6.9%**	**0.0%**	**-6.6%**	**29.3%**	**0.0%**	**24.4%**	**-5.7%**	**42.1%**

Source: FAA 2018 TAF, NAA, CHA, 2019.

3.8.1 Historical General Aviation Activity

Much like national general aviation activity trends, ORF has seen a decline in GA activity at the Airport over the historical 10-year period. Based on interviews and evaluations of GA activity at ORF with the Airport's FBO, Signature Flight Support, this can be attributed to many different factors with the predominate factor being based aircraft. Like commercial and cargo activity, the economic recession and sequestration in the Hampton Roads Region has had an impact on the decrease in total activity. Based on cost of operations, fuel, and time, many of the smaller recreational based aircraft have seen a dramatic drop in activity over the past few years. According to the FBO, based aircraft activity at the airport has been volatile, with fluctuations in total based aircraft and transition of smaller based aircraft to larger GA airframes. GA operational activity is dominated by the based aircraft at ORF. Local operations from based aircraft, and itinerant traffic from those same based aircraft have created significant impacts, not just to operational activity, but the FBO's ability to grow the number of active based aircraft, and the ability to replace inactive based aircraft that utilize valuable hangar space at the Airport. As shown in **Table 3-26**, itinerant and local traffic have decreased, in totality, at the same rate, with total operations decreases in each category by approximately 10 thousand operations.

In discussions with the FBO, the decrease in total based aircraft since 2008 can be largely attributed to aircraft that were previously stored via tie-downs on the FBO apron and have since sought out covered hangar storage for their aircraft, this is especially true as the year over year numbers from 2017 to 2018 showed a change from 95 based aircraft to 87 in June of 2018. Hangar space at the Airport is in high demand, and the FBO currently has no vacancy; thus, the

FBO is unable to accommodate new based aircraft at the Airport. Additionally, current tenants have expressed the desire to store larger airframes, which the FBO is unable to support, leading to current and potential tenants to seek other airports in the area for hangar aircraft storage. The FBO has expressed that there is a significant demand, i.e., waitlist, for hangar storage for new and current aircraft (aircraft currently stored via tie-downs on the FBO apron), and new hangar facilities would be immediately filled.

Table 3-26 – ORF's Historical General Aviation Activity

Year	Itinerant	Local	Total Operations	Based Aircraft
2008	31,713	11,553	43,266	106
2009	25,720	7,719	33,439	103
2010	25,865	5,558	31,423	103
2011	26,390	4,274	30,664	107
2012	24,680	3,152	27,832	95
2013	22,011	2,491	24,502	96
2014	22,756	4,091	26,847	91
2015	21,044	1,488	22,532	94
2016	21,287	1,943	23,230	93
2017	21,207	1,157	22,364	95

Note: Excludes Cargo and Military operations.
Source: Signature, NAA, CHA, 2018.

3.8.2 GA Based Aircraft Forecasts

Forecast Methodologies

Like commercial operations forecasts, the FAA provides multiple methodologies to be used to forecast GA based aircraft. To determine the most reasonable scenario for ORF, it was necessary to compare and eliminate those forecasts that did not support the key factors and variables that comprise the specific direction of the Airport and its market. This section provides the methodology used, as well as methodologies that were analyzed, for the development of the forecasts of GA based aircraft at ORF. The following methodologies, and results therein, are described in the following sections and the results are shown in Table 3-27.

- FAA Aerospace Forecast Analysis – A forecasting approach that analyzes data provided in the FAA Aerospace Forecasts (FY 2018-2038), such as annual based aircraft projections by category, and then projects growth for based aircraft at the Airport based on these growth rates. This assumes that the Airport's GA based aircraft will grow at the FAA projected national rates while maintaining their respective share of fleet throughout the forecast period. As shown in **Table 3-27**, the growth was conservative compared to the TAF; however, detailed evaluation of the Aerospace methodology (See **Appendix D**), identified the single- and multi-engine market at ORF decreasing (46 single-engine and 10 multi-engine aircraft in 2017 to 37 and 9, respectively, by 2038), while the Jet and Turbo-Prop market have much more significant growth (12 additional Jet and 4 additional Turbo-Prop aircraft by 2038). See **Appendix D** for a breakdown by aircraft type.

- Market Share Analysis (Static)[14] – Similar to enplanements, a Market Share forecast is a "top-down" method where projected growth rates of larger aggregates (e.g., the nation) are used to derive forecasts for smaller areas (e.g., airports). Future ORF based aircraft were estimated by multiplying the future share trend and the Federal Aviation Administration's (FAA) Terminal Area Forecast (TAF) for National, Eastern Region, and State based aircraft numbers. **Table 3-27** and **Appendix D** (same table and Appendix as above) depict the results of this evaluation. As shown, between the State, Eastern Region, and National projections, ORF ranges from 87 to 102 based aircraft, resulting in relatively conservative growths within the ORF market for based aircraft.
- TAF Based Growth Forecast Analysis – Takes the FAA's projected based aircraft annual growth for FY 2018-2038 and applies that assumption to actual airport-reported data[15]. In other words, the TAF growth is applied to an actual FY 2017 based aircraft count and projected throughout the forecast period. For example, the 2018 TAF had an estimated 2017 based aircraft count of 95 which was correct at year end 2017; however, according to airport records, the actual number of based aircraft was 87 as of June , 2018. The year to year TAF growth rate was then applied to the actual 87 based aircraft and projected from FY 2018 through FY 2038. The result of this methodology was 126 based aircraft in 2038, approximately 6.8 percent below the 135 reported in the TAF. **Table 3-27** depicts the results of this evaluation. This scenario was believed to be the most reasonable scenario for projecting-based aircraft at ORF and was chosen to serve as the recommended forecast for based aircraft. See **Appendix D** for the full scenario results which includes historical market share data.

Table 3-27 – Based Aircraft Forecast Comparisons

Fiscal Year	FAA TAF	TAF Based Growth	FAA Aerospace	Market Shares		
				Static National	Static State	Static Regional
2017	95	87	87	87	87	87
2018	96	89	87	88	87	88
2023	106	97	88	91	91	92
2028	116	106	89	95	93	95
2033	126	115	91	99	96	99
2038	136	126	95	103	99	102
AAGR 2018-2038	**1.8%**	**1.8%**	**0.4%**	**0.8%**	**0.6%**	**0.8%**
Growth 2018-2038	**42.1%**	**42.1%**	**8.8%**	**17.3%**	**12.8%**	**16.6%**

Source: FAA Aerospace Forecast FY 2018-2038, FAA 2018 TAF, Signature, NAA, CHA, 2019.

3.8.3 GA Operations Forecast

According to the FAA, the "Air Taxi & Commuter" category of FAA reported operations data includes both scheduled Air Carrier operations with 60-seats or less (i.e., this includes all 50-seat regional jet operations) and Part 135 business and charter operations. As such, the Air Taxi & Commuter category of the 2018 FAA TAF included both scheduled airlines and non-airline

[14] ORF's GA Based Aircraft Percent Market Shares in 2017: National (0.05), Eastern Region (0.60), and State (3.40).

[15] Note: ORF-Reported numbers and data contains the most recent information, which has been updated since the development of the FAA 2018 TAF.

passenger operations. The following describes the difference between Air Carrier and Air Taxi & Commuter operations, as defined by the FAA.

- Air Carrier – Operations with aircraft designed to have a seating capacity of more than 60 seats or a maximum payload capacity of more than 18,000 pounds carrying passengers or cargo for hire or compensation. This includes US and foreign flagged carriers.
- Air Taxi & Commuter – Operations with aircraft designed to have a maximum seating capacity of 60 seats or less or a maximum payload capacity of 18,000 pounds or less carrying passengers or cargo for hire or compensation.

To accurately gauge commercial airline passenger carrying operations in comparison to GA and Part 135 operations when examining air taxi & commuter operations data, it was necessary to split Air Taxi & Commuter operations from the commercial airline operations to account for the scheduled air carrier operations using regional jet aircraft less than 60-seats.

The total scheduled commercial air carrier operations at ORF (which were derived from T-100 data) were calculated and applied the split to account for operations categorized under Air Taxi & Commuter operations and reclassifying those operations as commercial airline operations. By removing the commercial airline operations from the Air Taxi & Commuter operations (which contribute to the steep decline in operations due to 50-seat aircraft phasing out) and categorizing operations at the Airport by Air Carrier and GA, both categories then projected growth throughout the forecast period.

Table 3-28 shows a comparison between ORF-reported operations with the previously described split, as well as the FAA-reported operations numbers for 2017. Based on schedule data and commercial airline operations counts, these operations were performed by commercial airlines utilizing 50-seat or less regional jet/turbo-prop aircraft; therefore, they were counted in the commercial airlines category. It is important to note that all cargo operations (schedule, and non-scheduled) were included within the GA Itinerant operations counts.

Table 3-28 – FAA TAF Vs. ORF- Reported Operations (With Split)

Source	Fiscal Year	Itinerant Operations					Local Operations			
		Commercial Airline	Air Taxi	GA	Military	Total Itinerant	GA	Military	Total Local	Total Operations
FAA	**2017**	29,067	24,649	17,289	521	71,526	1,167	92	1,259	72,785
ORF (adjusted)	**2017**	47,195	-	23,636	508	71,339	1,157	92	1,249	72,588

Note: Cargo operations are included in GA operations.

Note: ORF-Reported numbers and data contains the most recent information available at the time the evalautaion was conducted, which has been updated since the development of the FAA 2018 TAF.

Source: FAA 2018 TAF, Signature, NAA, CHA 2019.

Adjustment calculation example: (All numbers provided by NAA and shown in **Appendix E**)

- Air Carrier + Air Taxi = Total Air Carrier and Air Taxi Operations
  28,992 + 24,590 = **53,582**
- Total Air Carrier and Air Taxi Operations – Actual Air Carrier Operations = Adjusted Air Taxi
  53,582 – 47,195 = **6,387**
- Adjusted Air Taxi + Airport Reported Itinerant GA = Actual Itinerant GA
  6,387 + 17,249 = **23,636**
- Actual Itinerant GA + Local GA = Actual Air Taxi and GA
  23,636 + 1,157 **= 24,793 (Combined GA Itinerant and Local Operations)**

Forecast Methodologies

Like commercial operations forecasts and GA based aircraft forecasts, several methodologies exist that could be used to forecast GA operations. To determine the most plausible and reasonable scenario for ORF, it was necessary to compare and eliminate those forecasts that did not support the key factors and variables that comprise the specific operational direction of the Airport. This section provides the methodology used, as well as methodologies that were analyzed, for the development of the forecasts of general aviation operations at ORF. It is important to note that all cargo operations were extracted prior to performing the methodologies listed below.

- Historical Trend Analysis – Historical trend is a time trend analysis that uses the airport's historical activity as a metric to provide future growth projections. These historical trends are typically developed as 5- and 10-year historical trends. These historical growth rates are then extrapolated over the forecast horizon (20 years). ORF experienced a sharp decline in GA activity, from 43,266 total itinerant and local ops in 2008 to 22,364 total ops in FY 2017. The Historical Growth Scenario was considered unreliable and was not used for this forecasting effort.
- TAF-Based Growth Analysis – A straightforward forecasting methodology which assumes the total number of annual operations is representative of the number or aircraft based at ORF. At ORF, itinerant traffic makes up approximately 94.8 percent of all GA activity at the Airport. These operations are typically performed by aircraft based at ORF flying charter and corporate aviation operations or flight training (where the flights leave the local airport airspace and return, i.e., cross country flight training). When projecting operations using the based aircraft growth for ORF, it was assumed that GA operations [Air Taxi & GA – (Local and Itinerant)] will grow commensurate with based aircraft growth (AAGR of 1.8 percent; 42.1 overall growth). See **Table 3-29** and **Appendix D** (includes a breakdown between itinerant and local GA operations.) The results of this scenario serve as the recommended GA operations forecast for ORF.

- Market Share Analysis (Static)[16] – Compares local GA activity levels with aggregate level trends. This methodology assumes that the activity of any one airport is regular and predictable in accordance with the average of airports within the market. An evaluation of local, regional, State, and national FAA GA projections was performed and is detailed in **Table 3-29**. (See **Appendix D** for the full results of the methodology).

Table 3-29 – General Aviation Operations Forecast Comparisons

Fiscal Year	TAF Based Growth	Market Shares		
		Static National	Static State	Static Regional
2017	22,364	22,364	22,364	22,364
2018	22,760	22,598	22,428	22,192
2023	24,850	23,031	22,692	22,385
2028	27,132	23,441	22,955	22,827
2033	29,624	23,882	23,225	23,289
2038	32,344	24,358	23,502	23,782
AAGR 2018-2038	**1.8%**	**0.4%**	**0.2%**	**0.3%**
Growth 2018-2038	**42.1%**	**7.8%**	**4.8%**	**7.2%**

Note: Excludes Cargo and Military Operations.
*Scenario results based on the recommended based aircraft forecast
Source: FAA 2018 TAF, Signature, NAA, CHA 2019.

3.8.4 General Aviation Recommended Forecast Summary

The following table presents a summary of the recommended GA activity forecasts for based aircraft and operations, along with military activity as detailed in the previous sections. Although conservative, based on the transient nature of the corporate growth market at ORF, the OPBA Scenario was believed to be the most reasonable scenario for the ORF forecast based on the nature of GA itinerant operations of aircraft based at the Airport's FBO.

The recommended forecasts are the preferred projections on which future planning for the Airport are based. **Table 3-30** presents the complete summary of the preferred GA forecast for based aircraft and operations by type. The full recommended GA Forecast can be found in **Appendix D**.

[16] ORF's GA Operations Percent Market Shares in 2017: National (Itinerant 0.1) (Local 0.003), Regional (Itinerant 0.7) (Local 0.03), State (Itinerant 4.1) (Local 0.2).

Table 3-30 – Recommended GA Forecast

Fiscal Year	Based Aircraft	Operations				Total GA Operations
		Itinerant	Local	Total Civil	Military	
2017	87	21,207	1,157	22,364	600	22,964
2018	89	21,583	1,178	22,760	600	23,360
2023	97	23,565	1,286	24,850	600	25,450
2028	106	25,729	1,404	27,132	600	27,732
2033	115	28,091	1,533	29,624	600	30,224
2038	126	30,670	1,673	32,344	600	32,944
AAGR 2018-2038	**1.8%**	**1.8%**	**1.8%**	**1.8%**	**0.0%**	**1.7%**
Growth 2018-2038	**42.1%**	**42.1%**	**42.1%**	**42.1%**	**0.0%**	**41.0%**

Note: Excludes Cargo Operations.
Source: Signature, CHA, 2018.

3.9 RECOMMENDED FORECAST SUMMARY

To ensure that factors specific to the ORF market were accurately integrated into this forecast scenario, as stated in **Section 3.5.1**, the Air Service Scenario was developed based upon the following factors:

- Steady enplanement and airport growth based on strong socioeconomic variables (see **Section 3.2**)
- New service announcements made within the past 12-months[17] (**Section 3.3**)
- A shift from smaller 50-seat regional jets to larger 63-76 seat regional jets and 124-160 seat narrow-body aircraft

The following tables present a summary of the preferred aviation activity forecasts for air carrier activity (operations and enplanements), GA activity (based aircraft and operations), and military activity as detailed in the previous sections. Additionally, direct comparisons to the FAA's TAF for ORF are provided for evaluation purposes. The recommended forecasts are the preferred projections on which future planning for the Airport was based and are the result of the analysis provided in the previous section and is intended to be for summary purposes. **Table 3-31** presents the complete summary of the preferred forecast for based aircraft, enplanements, and operations by type.

Table 3-32 details the recommended forecast of enplanements and total airport operations (all activity types) in comparison to the FAA 2018 TAF forecast. At the end of the planning period, the recommended forecast predicts a level of enplanements 7.9 percent above the ORF TAF, and total Airport operations 7.6 percent above what was reported in the TAF. Per FAA requirements, forecasts should be within 10 percent of the TAF in the first 5 years and 15 percent in 10 years, as set forth by the FAA in AC 150/5070-6B*, Airport Master Plans,* for approval of Master Plan forecasts. Although the Airport operations forecast is outside of the FAA's recommended range,

[17] The past 12-month period is representative of the 12 months prior to the development of the forecasts herein.

the growth is considered acceptable because ORF is not expected to experience decreases in operations as it had historically.

Table 3-31 – Recommended Forecast Summary

Fiscal Year	Based Aircraft	Enplanements	Total Operations				
			Air Carrier	GA	Cargo	Military	Total
2017	87	1,672,024	47,195	22,364	2,429	600	72,588
2018	89	1,857,487	48,986	22,760	2,475	600	74,821
2019	90	2,003,360	51,752	23,164	2,522	600	78,038
2020	92	2,038,176	51,944	23,574	2,570	600	78,688
2021	93	2,072,287	52,135	23,992	2,619	600	79,346
2022	95	2,104,678	52,275	24,418	2,668	600	79,961
2023	97	2,115,424	51,889	24,850	2,719	600	80,058
2024	98	2,168,171	52,577	25,291	2,770	600	81,239
2025	100	2,220,800	53,249	25,739	2,823	600	82,412
2026	102	2,273,199	53,898	26,195	2,877	600	83,570
2027	104	2,325,316	54,551	26,660	2,931	600	84,742
2028	106	2,376,990	55,177	27,132	2,987	600	85,896
2029	107	2,428,333	55,704	27,613	3,043	600	86,960
2030	109	2,479,279	56,206	28,103	3,101	600	88,010
2031	111	2,528,677	56,673	28,601	3,160	600	89,033
2032	113	2,576,438	57,090	29,108	3,220	600	90,018
2033	115	2,622,848	57,488	29,624	3,281	600	90,992
2034	117	2,667,816	58,327	30,149	3,343	600	92,418
2035	119	2,711,393	59,145	30,683	3,406	600	93,835
2036	121	2,753,696	59,933	31,227	3,471	600	95,231
2037	124	2,794,755	60,696	31,780	3,537	600	96,613
2038	126	2,834,623	61,430	32,344	3,604	600	97,978
AAGR 2018-2038	**1.8%**	**2.1%**	**1.1%**	**1.8%**	**1.9%**	**0.0%**	**1.4%**
Growth 2018-2038	**42.1%**	**52.6%**	**25.4%**	**42.1%**	**45.6%**	**0.0%**	**30.9%**

Source: FAA Aerospace Forecast FY 2018-2038, FAA 2018 TAF, NAA, CHA, 2019.

Table 3-32 – Recommended Forecast vs. FAA TAF

Fiscal Year	Enplanements			Operations		
	ORF TAF	Recommended Forecast	Recommended Forecast vs. TAF	ORF TAF	Recommended Forecast	Recommended Forecast vs. TAF
2017	1,652,323	1,672,024	1.2%	72,785	72,588	-0.3%
2018	1,815,241	1,857,487	2.3%	72,073	74,821	3.8%
2023	2,147,644	2,115,424	-1.5%	77,872	80,058	2.8%
2028	2,294,704	2,376,990	3.6%	81,749	85,896	5.1%
2033	2,458,050	2,622,848	6.7%	86,330	90,992	5.4%
2038	2,627,295	2,834,623	7.9%	91,083	97,978	7.6%
AAGR 2018-2038	**1.9%**	**2.1%**	**-**	**1.2%**	**1.4%**	**-**
Growth 2018-2038	**44.7%**	**52.6%**	**-**	**26.4%**	**30.9%**	**-**

Source: FAA Aerospace Forecast FY 2018-2038, FAA 2018 TAF, NAA, CHA, 2019.

3.10 PEAK ACTIVITY FORECAST

Commercial service airports experience peaks in enplanements, commercial air carrier operations, and total airport operations that drive demand for various areas of airport infrastructure. To properly plan, size, and design passenger terminal facilities, an understanding of peak month-average day (PMAD) and peak hour enplanement demand is necessary. The peak month, PMAD, and peak hour forecasts are key elements in defining the future facility requirements needed to accommodate above average levels of utilization (i.e., peak activity).

The peak month is the calendar month of the year when the highest level of enplanements and commercial aircraft operations typically occur. Peak month-average day is simply the total commercial operations, or total enplanements, divided by the number of days in the peak month. To provide the necessary metrics for the demand/capacity analysis, PMAD is forecast for the following:

- Enplanements, Deplanements, and Total Passengers
- Commercial Air Carrier Aircraft Operations
- Total Aircraft Operations

Each element at an airport must be presented separately:

- Peak enplanements, deplanements, and total passengers - direct impact on terminal (e.g., ticketing and baggage claim) and landside (e.g., access roads and parking) facilities
- Peak commercial air carrier operations- define the demand for airside facilities (gates and ramp)
- Peak hour airport operations- determine runway capacity and airfield needs

Terminal facilities are generally designed to accommodate enplanements on the average day during the peak month, rather than the absolute peak level of activity.

3.10.1 Peak Enplanements

Historical Peak Enplanements

A review of historical enplanements at ORF was performed to identify the peak month for commercial activity.

Table 3-33 – Historical Peak Enplanements

Fiscal Year	Annual Enplanements	Peak Month	Peak Month Enplanements	PMAD Enplanements	Peak Hour	Peak Hour Enplanements
2008	1,841,881	July	179,500	5,998	6:00 am - 7:30 am	1,524
2009	1,740,349	July	173,362	5,888	5:45 am - 7:15 am	1,456
2010	1,697,663	July	172,674	5,933	5:45 am - 7:15 am	1,487
2011	1,658,696	July	168,082	5,629	5:50 am -7:20 am	1,096
2012	1,669,997	August	169,004	5,842	5:35 am -7:05 am	1,160
2013	1,615,283	July	155,669	5,129	5:45 am - 7:15 am	1,000
2014	1,534,316	June	143,278	5,187	5:45 am - 7:15 am	1,091
2015	1,499,400	August	148,257	5,019	5:40 am -7:10 am	1,277
2016	1,603,159	July	157,018	5,385	5:35 am -7:05 am	1,140
2017	1,672,024	July	164,495	5,306	6:00 am - 7:30 am	1,215

Note: Airline schedules for FY 2008- FY 2017 can be found in **Appendix I**.
Source: Data Miner, US DOT T-100, NAA, CHA, 2018.

When developing the forecast, July was determined to be the peak month in 2017.

Peak Month – Average Day Enplanements

During the month of July in FY 2017, ORF experienced approximately 164,495 enplanements, or approximately 9.8 percent of the total annual passengers. To calculate the PMAD, the peak month enplanements (164,495) were divided by the number of days in the peak month of July (31) to define the PMAD.

The PMAD enplanements make up approximately 3.2 percent of the enplanements in the peak month.

Peak Hour Enplanements

Peak hour passenger enplanements in July were calculated by using the following methodology:

- Analyze ORF commercial air carrier schedule data to determine the average air carrier departures.
- Apply average load factors per route destination to peak hour enplanements, then divide peak hour enplanements by the PMAD enplanements to determine the peak hour percentage of enplanements.

It was determined that the peak hour for enplanements was between 6:00 am and 7:30 am, with approximately 22.9 percent of enplanements occurring during this time frame. To generate a forecast of peak hour enplanements, the percentage was applied to the PMAD enplanements.

Table 3-34 – Peak Month Average Day Enplanements

Fiscal Year	Enplanements	Peak Month Percent	Peak Month Enplanements	PMAD Percent	PMAD
2017	1,672,024	9.8%	164,495	3.2%	5,306
2018	1,857,487	9.8%	183,359	3.2%	5,915
2023	2,115,424	9.8%	208,117	3.2%	6,713
2028	2,376,990	9.8%	233,850	3.2%	7,544
2033	2,622,848	9.8%	258,038	3.2%	8,324
2038	2,834,623	9.8%	278,872	3.2%	8,996

Source: NAA, CHA, 2018.

Table 3-35 – Peak Hour Enplanements

Fiscal Year	PMAD	Peak Hour Percent	Peak Hour Enplanements
2017	5,306	22.9%	1,215
2018	5,915	22.9%	1,354
2023	6,713	22.9%	1,537
2028	7,544	22.9%	1,727
2033	8,324	22.9%	1,906
2038	8,996	22.9%	2,060

Source: NAA, CHA, 2018.

3.10.2 Peak Deplanements

Although not as impactful as peak hour enplanements, it was still necessary to evaluate and identify the peak hour passengers for deplanements. The purpose of determining the peak hour deplanement projections was the future impact deplanements have on passengers exiting the airport, passenger circulation, baggage claim demand, and parking facility needs.

Using the same methodology and assumptions provided in the peak hour evaluation for enplanements, the peak deplanements were analyzed and the peak hour was determined to be between 4:30 pm and 6:00 pm (16:30 and 18:00); however, due to runway construction being conducted from approximately midnight to 5:00 am, the short-term peak operating hour is between 10:30 pm and midnight (22:30 and 00:00). For the purpose of this forecast, the peak hour between 4:30 pm and 6:00 pm (16:30 and 18:00) was used. This resuled in approximately 17.1 percent of deplanements occurring during this time frame. To generate a forecast of peak hour deplanements, the percentage was applied to the PMAD enplanements.

Table 3-36 – Peak Hour Deplanements

Fiscal Year	PMAD	Peak Hour Percent	Peak Hour Deplanements
2017	5,371	17.1%	921
2018	5,964	17.1%	1,022
2023	6,769	17.1%	1,160
2028	7,606	17.1%	1,304
2033	8,393	17.1%	1,438
2038	9,070	17.1%	1,555

Source: NAA, CHA, 2018.

3.10.3 Peak Passengers

Peak Month – Average Day Passengers

During the month of July in FY 2017, ORF had approximately 330,982 passengers, or approximately 9.9 percent of the total annual passengers. To calculate the PMAD, the peak month passengers (330,982) were divided by the number of days in the peak month of July (31) to define the PMAD.

The PMAD passengers make up approximately 3.2 percent of the enplanements in the peak month.

Peak Hour Passengers

Total peak hour passengers in July was calculated by using a methodology similar to as when calculating peak passenger enplanements, except that data for enplanements and deplanements were compiled. It was determined that the peak hour for passengers was between 4:45 pm and 6:15 pm (16:45 and 18:15), with approximately 15.2 percent of total passengers occurring during this time frame. To generate a forecast of peak hour passengers, the percentage was applied to the PMAD passengers.

Table 3-37 – Peak Month Average Day Passengers

Fiscal Year	Passengers	Peak Month Percent	Peak Month Passengers	PMAD Percent	PMAD
2017	3,350,421	9.9%	330,982	3.2%	10,677
2018	3,727,532	9.9%	368,236	3.2%	11,879
2023	4,230,848	9.9%	417,958	3.2%	13,483
2028	4,753,980	9.9%	469,637	3.2%	15,150
2033	5,245,696	9.9%	518,213	3.2%	16,717
2038	5,669,246	9.9%	560,054	3.2%	18,066

Source: NAA, CHA, 2018.

Table 3-38 – Peak Hour Passengers

Fiscal Year	PMAD	Peak Hour Percent	Peak Hour Passengers
2017	10,677	15.2%	1,625
2018	11,879	15.2%	1,808
2023	13,483	15.2%	2,052
2028	15,150	15.2%	2,306
2033	16,717	15.2%	2,544
2038	18,066	15.2%	2,750

Source: NAA, CHA, 2018.

3.10.4 Peak Operations

Peak Month – Average Day Commercial Operations

The PMAD for commercial air carrier operations was calculated in the same manner as PMAD for enplanements. For the purposes of this forecast, the month of July was used for commercial operations at ORF, yielding approximately 4,245 commercial operations, or 9.0 percent of the total annual operations. To compute PMAD, the peak month operations (4,245) were divided by the number of days in the peak month (31) to represent the PMAD for the forecast period.

The PMAD operations make up approximately 3.2 percent of operations in the peak month.

Peak Hour Commercial Operations

As discussed previously, it was assumed the month of July averaged the greatest number of total Airport and commercial carrier operations in FY 2017. Before calculating the peak hour for commercial operations, it was first necessary to analyze the Authority-provided commercial carrier schedule data for arrivals and departures during the peak month of July. This analysis determined, based on a 90-minute rolling basis, the peak hour for operations was 4:45 pm to 6:15 pm (16:45 to 18:15), with 20 operations, or 14.6 percent of the PMAD commercial operations. This percentage was then applied to the PMAD operations, as depicted in **Table 3-40**.

Table 3-39 – Peak Month Average Day Commercial Operations

Fiscal Year	Annual Commercial Operations	Peak Month Percent	Peak Month Operations	PMAD Percent	PMAD
2017	47,195	9.0%	4,245	3.2%	137
2018	48,986	9.0%	4,406	3.2%	142
2023	51,889	9.0%	4,667	3.2%	151
2028	55,177	9.0%	4,963	3.2%	160
2033	57,488	9.0%	5,171	3.2%	167
2038	61,430	9.0%	5,525	3.2%	178

Source: NAA, CHA, 2018.

Table 3-40 – Peak Hour Operations

Fiscal Year	PMAD	Peak Hour Percent	Peak Hour Operations
2017	137	14.6%	20
2018	142	14.6%	21
2023	151	14.6%	22
2028	160	14.6%	23
2033	167	14.6%	24
2038	178	14.6%	26

Source: NAA, CHA, 2018.

Peak Month – Average Day All Airport Operations

The PMAD for total annual airport operations was calculated in the same manner as PMAD for commercial air carrier. For the purposes of this forecast, the month of July was used for operations at ORF, yielding approximately 6,272 operations, or 8.6 percent of the total annual operations. To compute PMAD, the peak month operations (6,272) were divided by the number of days in the peak month (31) to represent the PMAD for the forecast period.

The PMAD operations make up approximately 3.2 percent of operations in the peak month.

Table 3-41 – Peak Month Average Day Total Airport Operations

Fiscal Year	Annual Airport Operations	Peak Month Percent	Peak Month Operations	PMAD Percent	PMAD
2017	72,588	11.9%	8,658	3.2%	279
2018	74,821	11.9%	8,924	3.2%	288
2023	80,058	11.9%	9,549	3.2%	308
2028	85,896	11.9%	10,245	3.2%	330
2033	90,992	11.9%	10,853	3.2%	350
2038	97,978	11.9%	11,686	3.2%	377

Note: Total Airport Operations accounts for Commercial, GA, Military, and Cargo operations.
Source: Signature, NAA, CHA, 2018.

3.10.5 ORF Peak Activity Forecast Summary

Table 3-42 provides a summary of PMAD enplanements, passengers, commercial operations, and annual airport operations, as well as a summary of peak hour enplanements, total passengers, and commercial operations.

Table 3-42 – Projected Activity Forecast Summary

Fiscal Year	Enplanements		Total Passengers		Commercial Operations		Annual Airport Operations
	PMAD	Peak Hour	PMAD	Peak Hour	PMAD	Peak Hour	PMAD
2018	5,915	1,354	11,879	1,808	142	21	288
2023	6,713	1,537	13,483	2,052	151	22	308
2028	7,544	1,727	15,150	2,306	160	23	330
2033	8,324	1,906	16,717	2,544	167	24	350
2038	8,996	2,060	18,066	2,750	178	26	377

Source: NAA, CHA 2018.

3.11 CURRENT AND PROJECTED CRITICAL AIRCRAFT

Evaluating the Airport's current fleet mix and determining the current design aircraft, as well as the projected design aircraft, were important aspects of the Master Plan Study. The design aircraft (commonly referred to as the "critical aircraft") determination is a key consideration in FAA decision making on project justification. The "design aircraft" or "design aircraft family" represent the most demanding aircraft or grouping of aircraft with similar characteristics (relative to AAC, ADG, TDG)[18], that are currently using or are anticipated to use an airport on a regular[19] basis.

Upon review of the FAA's ETMSC data, OAG data, T100 and forecast fleet mix assumptions described in this chapter, the design aircraft family identified for ORF is presented in **Table 3-43**. This grouping represents the typical commercial aircraft and cargo aircraft anticipated to operate at ORF over the planning horizon. These aircraft generally have higher AAC, ADG, and TDG classifications than the other regularly scheduled commercial aircraft. While the Study was not limited to planning for the design aircraft, they were still considered when planning airfield and landside facilities as they may require specific facility design accommodations within their designated areas of operation.

The Airport's previous 2008 Airport Layout Plan (ALP) identified the Boeing 757-200 (ARC C-IV, TDG 4) as the critical aircraft for airfield and pavement design. As shown in **Table 3-43**, the Boeing 737-900 (ARC D-III) and the Airbus A-300 (ARC C-IV, TDG 5) are the current critical aircraft, resulting in an ARC of D-IV; however, due to increasing airframe size resulting from fleet mix transitions and the projected increase of B767-300ER operations from FedEx, the future critical aircraft for airfield and pavement design is the B767-300ER (ARC D-IV, TDG 5). Based on the previous ALP, the Airport Reference Code (ARC) at ORF was C-IV; however, based on current operations (i.e., operations from the B737-900 and A-300), the existing and future ARC remain D-IV. Although the ARC is expected to increase from the previous ALP, the TDG, which was 5, is expected to remain the same throughout the forecast period.

[18] AAC (Aircraft Approach Category), ADG (Airplane Design Group), TDG (Taxiway Design Group).

[19] According to FAA AC 150/5000-17, *Critical Aircraft and Regular Use Determination*, the terminology of "regular use" is defined as 500 annual operations, including itinerant and local operations but excluding touch-and-go operations. An operation is either a takeoff or landing.

Table 3-43 – Fleet Mix and Design Aircraft Families

Aircraft		2017	2038	AAC	ADG	TDG	AAC	ADG		TDG	
							Approach Speed (knots)	Wingspan (ft.)	Tail Height (ft.)	CMG (ft.)	MGW (ft.)
B737-7		5,643	8,998	C	III	3	130	117.42	41.58	46.58	22.92
CRJ-700		2,284	8,358	C	II	2	135	76.27	24.83	49.25	16.39
ERJ-175		2,564	8,142	C	III	3	124	85.33	32.33	41.33	20.50
EMB-190/195		2	5,982	C	III	3	124	94.25	126.83	51.95	23.67
A 320		1,132	5,977	C	III	3	136	111.88	39.63	50.20	29.36
A220		0	4,856	C	III	3	130	115.08	38.67	45.43	26.28
A319		3,452	4,493	C	III	3	126	111.88	39.73	44.90	29.36
B737-8		3,219	4,266	D	III	3	142	112.58	41.42	56.42	22.96
EMB E2*		0	3,980	C	III	3	124	101.67	32.67	41.60	20.34
CRJ-900		2,629	3,421	C	III	2	140	81.53	24.12	56.76	16.39
B767-3ER		0	2,819	D	IV	5	140	156.08	52.92	82.17	35.75
B737-9		1,388	1,807	D	III	3	141	112.58	41.41	61.58	22.96
A321		40	1,123	C	III	3	140	117.45	39.70	44.95	29.43
A600ST		60	89	C	IV	5	137	147.14	56.58	80.38	35.76
B767-4		10	22	D	IV	5	150	170.33	55.83	93.33	36.00
MD-80 Series		10,991	0	C	III	4	134	107.80	30.15	70.44	20.42
CRJ-2/4		7,383	0	C	II	1B or 2	140	68.58	20.75	37.42	13.25
EMB-145		2,993	0	C	II	2	124	67.75	22.17	47.42	15.72
B737-3		1,269	0	C	III	3	135	102.08	36.50	46.08	20.92
A300		1,025	0	C	IV	5	137	147.10	54.66	75.03	35.68
B757		876	0	C	IV	4	137	124.83	45.08	72.00	28.00
B757-2		823	0	C	IV	4	137	134.75	45.08	72.00	28.00
B717-2		678	0	C	III	2	139	93.33	29.67	57.75	19.43
B737-4		58	0	C	III	3	139	94.75	36.33	52.08	20.92
A330-3		6	0	C	V	5	137	197.83	56.36	97.28	41.37
TOTAL		48,526	64,333	-	-	-	-	-	-	-	-
Subtotal by AAC	C	43,908	55,419	-	-	-	-	-	-	-	-
	D	4,618	8,914	-	-	-	-	-	-	-	-
Subtotal by ADG	II	12,660	8,358	-	-	-	-	-	-	-	-
	III	33,065	53,045	-	-	-	-	-	-	-	-
	IV	2,794	2,930	-	-	-	-	-	-	-	-
	V	6	0	-	-	-	-	-	-	-	-

Note: N/A refers to aircraft that are at ORF but no in the current or future design aircraft family based on aircraft characteristics.
Source: FAA Database, NAA, CHA, 2018.

Per FAA requirements, an appendix (**Appendix G**) has been included that provides a condensed look at the various forecast levels and growth rates, which include peaks, as well as operational factors at ORF as presented in this chapter.

4 FACILITY REQUIREMENTS

In order to ensure that Norfolk International Airport (ORF) is capable of supporting the forecasted increase in aviation activity, evaluations were conducted to ensure that the recommendations of this Master Plan adequately accommodate existing and anticipated activity levels. The purpose of this chapter is to identify the Airport's facility development needs over the 20-year planning horizon. Using the preferred aviation activity forecast presented in **Chapter 3**, the airport facility needs were determined, which form the basis of the development concepts discussed in **Chapter 5**.

The airport demand, capacity, design standards, and the overall facility requirements at ORF were evaluated using guidance contained in several FAA publications, including:

- Advisory Circular 150/5060-5, *Airport Capacity and Delay*
- AC 150/5300-13A, *Airport Design*
- AC 150/5325-4B*, Runway Length Requirements for Airport Design*
- AC 150/5360-13A, *Airport Terminal Planning*
- Airport Cooperative Research Program, *Report 25: Airport Passenger Terminal Planning and Design*
- Airport Cooperative Research Program, *Report 79: Evaluating Airfield Capacity*
- Federal Aviation Regulation (FAR) Part 77*, Safe, Efficient Use, and Preservation of the Navigable Airspace*
- Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems (NPIAS)*
- Airport Cooperative Research Program (ACRP) *Report 25 – Airport Passenger Terminal Planning and Design, Volume 1: Guidebook*
- Airport Cooperative Research Program (ACRP) *Report 25 – Airport Passenger Terminal Planning and Design, Volume 2: Spreadsheet Models and User's Guide*
- Airport Cooperative Research Program (ACRP) *Report 130 - Guidebook for Airport Terminal Restroom Planning and Design*
- Airport Cooperative Research Program (ACRP) *Report 54 – Resource Manual for In-Terminal Concessions 2011*
- International Air Transportation Association (IATA*), Airport Development Reference Manual (ADRM), 9th Edition*
- U.S. Department of Transportation, Federal Aviation Administration, Systems Research & Development Service *Report No. FAA-RD-75-191 – The Apron & Terminal Building Planning Manual July 1975*
- *US Customs and Border Protection. Airport Technical Design Standard, 2016.*

The following elements of the Airport were addressed in this assessment:

- ✈ Airfield Capacity
- ✈ Airfield Facility Requirements
- ✈ Support Facilities (General Aviation, Cargo, etc.)
- ✈ Passenger Terminal Facilities
- ✈ Surface Transportation & Parking Facilities

4.1 PLANNING FACTORS

Before the facility requirements for ORF could be determined, it was necessary to establish the Planning Activity Levels (PALs) based on the preferred forecasts, the design aircraft family, and the appropriate airport, runway, and taxiway classifications that are associated with FAA design standards. These parameters are discussed in the following subsections.

4.1.1 Planning Activity Levels (PALs)

Since aviation activity is highly susceptible to fluctuations in economic conditions and industry trends, identifying recommended facility improvements based solely on specific years can be a challenge. The timeline associated with the preferred forecast is representative of the anticipated timing of demand (in 5-year increments – 2023, 2028, 2033, and 2038). The actual timing of demand can vary; therefore, Planning Activity Levels (PALs), rather than calendar years, were established to identify significant demand thresholds for facility enhancement projects. Disassociating the predetermined timeline from the recommended facility improvements provides the Norfolk Airport Authority (NAA) with the flexibility to advance or slow the rate of development in response to actualized demand. If the preferred forecast proves conservative (i.e. the high growth forecast scenarios is realized because of successful airport marketing and route development initiatives, etc.), some recommended improvements may be advanced in schedule. In contrast, if demand occurs at a rate that is slower than the preferred forecast projects, the improvements should be deferred accordingly. As actual activity levels approach a PAL and trigger the need for a facility improvement, sufficient lead time for planning, design, and construction must be also given to ensure that the facilities are available for the impending demand.

Table 4-1 identifies the PALs used for this study, which correspond with the preferred aviation activity forecast for the base year of 2018 and the planning horizon years 2023, 2028, 2033, and 2038. **Figure 3-1** presents a graphical representation of how the PALs for passengers were established and relates them to the preferred and alternative forecast scenarios (discussed in **Chapter 3**). The graphic helps to depict the relative time range during which each PAL could be reached if one of these other forecast scenarios are actualized. For example, facilities capable of accommodating PAL 2 demands (i.e. ±2.4 million annual enplanements) could be needed as early as 2028, if the recommended-growth forecast scenario is experienced or as late as 2038 if the low-growth scenario is realized.

Table 4-1 – Planning Activity Levels (PALs)

Passenger Activity							
Enplanements		**2017**	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Annual		1,672,024	1,857,487	2,115,424	2,376,990	2,622,848	2,834,623
Peak Month		164,495	183,359	208,117	233,850	258,038	278,872
Average Day		5,306	5,915	6,713	7,544	8,324	8,996
Peak Hour*		1,215	1,354	1,537	1,727	1,906	2,060
Operations							
Category	**Activity**	**2017**	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Commercial Aviation	Annual	47,195	48,986	51,889	55,177	57,488	61,430
	Peak Month	4,245	4,406	4,667	4,963	5,171	5,525
	Average Day	137	142	151	160	167	178
	Peak Hour	20	21	22	23	24	26
General Aviation	Annual	22,364	22,760	24,850	27,132	29,624	32,344
Military Aviation	Annual	600	600	600	600	600	600
Cargo Operations	Annual	2,429	2,475	2,719	2,987	3,281	3,604
Total Operations	**Annual**	**72,588**	**74,821**	**80,058**	**85,896**	**90,992**	**97,978**
	Peak Month	**8,658**	**8,924**	**9,549**	**10,245**	**10,853**	**11,686**
	Average Day	**279**	**288**	**308**	**330**	**350**	**377**
	Peak Hour*	**33**	**34**	**37**	**39**	**42**	**45**

*Note: The peak hour for enplanements was determined to be between 6:00 am and 7:30 am on weekdays. When determining total operations occurring in a peak hour, the percent of peak month operations (11.9 percent) was applied to the peak month-average day operations, remaining static throughout the forecast period.

Source: CHA, 2018.

Figure 4-1 – Enplanement Planning Activity Levels (PALs)

Source: CHA, 2018.

4.1.2 Aircraft Classification

The FAA has established aircraft classification systems that group aircraft types based on their performance and geometric characteristics. These classification systems were used to determine the appropriate airport design standards for specific runway, taxiway, taxilane, apron, or other facilities at ORF, as described in FAA AC 150/5300-13A, *Airport Design*.

As discussed in **Chapter 3**, the standard classifications are the Aircraft Approach Category (AAC), the Airplane Design Group (ADG), and Taxiway Design Group (TDG). **Table 4-2** presents the applicability of these classification systems to the FAA airport design standards for individual airport components (such as runways, taxiways, or aprons).

Table 4-2 – Applicability of Aircraft Classifications

Aircraft Classification	Related Design Components
Aircraft Approach Category (AAC)	Runway Safety Area (RSA), Runway Object Free Area (ROFA), Runway Protection Zone (RPZ), runway width, runway-to-taxiway separation, runway-to-fixed object
Airplane Design Group (ADG)	Runway, Taxiway, and apron Object Free Areas (OFAs), parking configuration, taxiway-to-taxiway separation, runway-to-taxiway separation
Taxiway Design Group (TDG)	Taxiway width, radius, fillet design, apron area, parking layout

Source: FAA AC 150/5300-13A, CHA, 2018.

4.1.3 Design Aircraft Family

The "critical aircraft" or "design aircraft family" represent the most demanding aircraft or grouping of aircraft with similar characteristics (relative to AAC, ADG, TDG) that are currently using or are anticipated to use an airport on a regular basis. The design aircraft family was identified for ORF (see **Table 4-3**) after review of the FAA's Traffic Flow Management System Counts (TFMSC) data, T100 data[20], airport-reported data, and forecast fleet mix assumptions (as described in **Chapter 3**). This grouping represents the typical commercial aircraft and cargo aircraft anticipated to operate at ORF over the planning horizon. These aircraft generally have higher AAC, ADG, and TDG classifications than the other regularly scheduled commercial aircraft. Determining the critical aircraft is important when planning airfield and landside facilities as they may require specific facility design accommodations within their designated areas of operation. It is important to note that the CRJ-700 has over 8,000 operations forecasted by PAL 4 and the CRJ-900 with over 3,000 by this period. In mid-2019, Mitsubishi Aircraft acquired the CRJ program from Bombardier and is expected to end all CRJ production in the year 2020. While they will likely implement a comparable aircraft as its replacement, it is important to note that these CRJ forecast numbers are simply representative.

[20] The Bureau of Transportation Statistics (BTS) uses a form (Form T-100) to gather monthly traffic reports from certificated air carriers in the United States. These traffic reports provide information regarding domestic and international markets, as well as domestic and international segments. The data collected is then made available to the public via BTS's Air Carrier Statistics Database, also known as the T-100 data bank.

Table 4-3 – Fleet Mix and Design Aircraft Family

Aircraft	2017	PAL 4	AAC	ADG	TDG	AAC	ADG		TDG	
						Approach Speed (knots)	Wingspan (ft.)	Tail Height (ft.)	CMG (ft.)	MGW (ft.)
B737-7	5,643	8,998	C	III	3	130	117.42	41.58	46.58	22.92
CRJ-700	2,284	8,358	C	II	2	135	76.27	24.83	49.25	16.39
ERJ-175	2,564	8,142	C	III	3	124	85.33	32.33	41.33	20.50
EMB-190/195	2	5,982	C	III	3	124	94.25	126.83	51.95	23.67
A 320	1,132	5,977	C	III	3	136	111.88	39.63	50.20	29.36
A220	0	4,856	C	III	3	130	115.08	38.67	45.43	26.28
A319	3,452	4,493	C	III	3	126	111.88	39.73	44.90	29.36
B737-8	3,219	4,266	D	III	3	142	112.58	41.42	56.42	22.96
EMB E2*	0	3,980	C	III	3	124	101.67	32.67	41.60	20.34
CRJ-900	2,629	3,421	C	III	2	140	81.53	24.12	56.76	16.39
B767-3ER	0	2,819	D	IV	5	140	156.08	52.92	82.17	35.75
B737-9	1,388	1,807	D	III	3	141	112.58	41.41	61.58	22.96
A321	40	1,123	C	III	3	140	117.45	39.70	44.95	29.43
A600ST	60	89	C	IV	5	137	147.14	56.58	80.38	35.76
B767-4	10	22	D	IV	5	150	170.33	55.83	93.33	36.00
MD-80 Series	10,991	0	C	III	4	134	107.80	30.15	70.44	20.42
CRJ-2/4	7,383	0	C	II	1B or 2	140	68.58	20.75	37.42	13.25
EMB-145	2,993	0	C	II	2	124	67.75	22.17	47.42	15.72
B737-3	1,269	0	C	III	3	135	102.08	36.50	46.08	20.92
A300	1,025	0	C	IV	5	137	147.10	54.66	75.03	35.68
B757	876	0	C	IV	4	137	124.83	45.08	72.00	28.00
B757-2	823	0	C	IV	4	137	134.75	45.08	72.00	28.00
B717-2	678	0	C	III	2	139	93.33	29.67	57.75	19.43
B737-4	58	0	C	III	3	139	94.75	36.33	52.08	20.92
A330-3	6	0	C	V	5	137	197.83	56.36	97.28	41.37
TOTAL	**48,526**	**64,333**	-	-	-	-	-	-	-	-
Subtotal by AAC	**C**	43,908	55,419	-	-	-	-	-	-	-
	D	4,618	8,914	-	-	-	-	-	-	-
Subtotal by ADG	**II**	12,660	8,358	-	-	-	-	-	-	-
	III	33,065	53,045	-	-	-	-	-	-	-
	IV	2,794	2,930	-	-	-	-	-	-	-
	V	6	0	-	-	-	-	-	-	-

Source: NAA, CHA, 2018.

4.1.4 Airport & Runway Classification

The FAA classifies airports and runways based on their current and planned operational capabilities. These classifications (described below), along with the aircraft classifications defined previously, were used to determine the appropriate FAA standards (as per AC 150/5300-13A) for airfield facilities.

Airport Reference Code (ARC)

ARC is an airport designation that represents the AAC and ADG of the aircraft that the airfield is intended to accommodate on a regular basis. The ARC is used for planning and design only and does not limit the aircraft that may be able to operate safely on the airport. The Airport's previous 2008 Airport Layout Plan (ALP) identified the Boeing 757-200 (which at the time the previous master plan was completed was categorized as D-IV) as the critical aircraft for airfield and pavement design. It is important to note that new FAA guidance categorizes the B757-200 as C-IV; however, recent activity has shown the Airbus A300 and Boeing 737-900 to be the current critical aircraft, which are categorized as C-IV and D-III, respectively. As such, the current ARC remains D-IV.

Due to increasing airframe size resulting from fleet mix transitions and the projected increase of Boeing 767-300ER operations from FedEx, the future critical aircraft[21] for airfield and pavement design is the B767-300ER, maintaining the ARC of ORF as D-IV. The current taxiway design aircraft (A300) is in the same TDG category as the B767-300ER; therefore, the TDG for the Airport's airfield also remains TDG 5.

Table 4-4 – Fleet Mix and Design Aircraft Family by AAC and ADG

AAC/ADG		2017	PAL 4
Operations by AAC	C	43,908	55,419
	D	4,618	8,914
Operations by ADG	II	12,660	8,358
	III	33,065	53,045
	IV	2,794	2,930
	V	6	0

Source: NAA, CHA, 2018.

4.2 AIRFIELD CAPACITY REQUIREMENTS

Airfield capacity refers to the maximum number of aircraft operations (takeoffs or landings) an airfield can accommodate in a specified amount of time. Assessments of the airfield's current and future capacity were performed using common methods described in FAA AC 150/5060-5, *Airport Capacity and Delay*, as well as in Airport Cooperative Research Program (ACRP), *Report 79*: *Evaluating Airfield Capacity*.

4.2.1 FAA AC 150/5060-5, *Airport Capacity and Delay*

FAA AC 150/5060-5, *Airport Capacity and Delay*, explains how to compute airfield capacity for the purposes of airport planning and design. This evaluation helped to determine any capacity-related improvements or expansions that may be needed to support flight activity levels. The estimated capacity of the airfield at ORF was expressed in the following three measurements:

- Hourly Capacity – The maximum number of aircraft operations an airfield can safely accommodate under continuous demand in a one-hour period. This expression accounts for Visual Flight Rules (VFR) and Instrument Flight Rules (IFR) conditions and is used to identify any peak-period constraints on a given day.
- Annual Service Volume (ASV) – The maximum number of aircraft operations an airfield can accommodate in a one-year period without excessive delay. This calculation is typically used in long-range planning and referenced for capacity-related improvement.

[21] A list of critical aircraft for existing and future conditions were previously presented in **Chapter 3** and have been approved by the FAA. It is important to note the list is representative of the types of aircraft foreseen to operate at ORF throughout the forecast period, rather than the exact aircraft that will operate at the Airport.

- Aircraft Delay – The average number of minutes an aircraft experiences delay on the airfield and total hours of delay incurred over a one-year period.

The tables and figures from AC 150/5060-5 that were utilized in the following evaluations can be found in **Appendix J**.

Capacity Calculation Factors

To calculate these three measurements of capacity and delay, several key factors and assumptions specific to ORF were defined. Consistent with the guidance provided in AC 150/5060-5, these included:

- Aircraft Fleet Mix Index – a ratio of the various classes of aircraft serving an airport
- Runway-Use Configuration – the number and orientation of the active runways
- Percentage of Aircraft Arrivals – the ratio of landing operations to total operations
- "Touch and Go" Factor – the ratio of landings with a direct takeoff to total operations
- Location of Exit Taxiways – the number of taxiways available to an aircraft within a given distance from the arrival end of a runway
- Meteorological Conditions – the percentages of times an airfield experiences VFR, IFR, and Poor Visibility Conditions (PVC) conditions

Aircraft Fleet Mix Index

An airport's fleet mix index is determined by the size of typical aircraft and the frequency of their operations. To identify the aircraft mix index, AC 150/5060-5, *Airport Capacity and Delay*, has established four categories in classifying an aircraft by its maximum takeoff weight (MTOW), as depicted in **Table 4-5**.

Table 4-5 – Aircraft Capacity Classifications

Aircraft Class	MTOW (lbs)	Number of Engines	Wake Turbulence
A	<12,500	Single	Small (S)
B		Multi	
C	12,500 – 300,000	Multi	Large (L)
D	>300,000	Multi	Heavy (H)

Source: FAA AC 150/5060-5, CHA, 2018.

The aircraft mix index is calculated using the formula *%(C + 3D)*, the letters corresponding with the aircraft class. This product falls into one of the FAA-established mix index ranges listed below and is use in capacity calculations herein:

- 0 to 20
- 21 to 50
- 51 to 80
- 81 to 120
- 121 to 180

The current facilities at the Airport can accommodate all four aircraft classes. The following operations percentages for aircraft categories C and D were gathered from a review of operations that occurred in 2017:

- Class C = 77.3 percent of the Airport's operations
- Class D = 1.5 percent of the Airport's operations

As such, the base year aircraft mix index is 81.7 [77.3 + 3(1.5) = 81.7]. While the actual mix index for the Airport is subject to variations given changes in air traffic operations, the likelihood of the Airport's mix index to grow beyond the mix index grouping of 81-120 over the planning period is low. Based on the fleet mix changes described in **Chapter 3** for commercial, cargo, military, and general aviation operations, the aircraft fleet mix index is anticipated to increase lightly from 81.7 in 2017 to 89.9 in PAL 4. See **Table 4-6** for each planning period's Aircraft Mix Index.

Table 4-6 – Aircraft Mix Index

Year	Aircraft Mix Index
2017	81.7
Base	86.7
PAL 1	87.7
PAL 2	88.6
PAL 3	89.2
PAL 4	89.9

Source: FAA AC 150/5060-5, CHA, 2018.

Runway Use Configuration

The principle determinants of an airfield's layout or configuration are the number and orientation of runways. The efficiency and functionality of the runways used in conjunction with the taxiways and aprons during the various levels of aviation activity directly affects an airport's operational capacity.

If an airfield layout consists of more than one runway, those runways can be termed as either "independent" or "dependent" of each other. An independent runway is one that is not operationally affected by the other runways during normal operations (e.g. parallel runways). A dependent runway is one that is configured in such a way that aircraft must wait for operations to complete on another runway before resuming (e.g. intersecting runways). Due to this wait time, airfields with dependent runway systems are inherently limited compared to independent runways. The intersecting runways at ORF are thus dependent.

Runway 5/23 has a northeast/southwest orientation and serves as the primary runway for all airport operations. In addition to this runway, Runway 14/32, which has a northwest/southeast orientation, serves as the general aviation crosswind runway. Because the Airport primarily utilizes the two-main runway ends for takeoff and landing (arrival and departure) operations, the usage rates of each runway (5 and 23) were evaluated. These conclusions were established considering the combined VFR and IFR conditions and are depicted in **Table 4-7**. It should be noted that Runway 14/32 is a visual runway. Typically, wind is more favorable from the south. Air Traffic Control directs aircraft, including most light aircraft to land Runway 23 during these conditions, resulting in low usage of Runway 14/32. Due to low usage of Runway 14/32, the Airport is essentially operating under a single runway configuration, which is acknowledged by the FAA; therefore, a single runway configuration was assumed to represent the current airfield configuration when using the methodologies presented in AC 150/5060-5.

Table 4-7 – Runway Usage

Runway End	Runway End Utilization	Runway Utilization
5	50%	100%
23	50%	100%
14	>1	>1
32	>1	>1

Source: FAA Windrose File Generator, FAA Wind Analysis, NAA, CHA, 2018.

Percentage of Aircraft Arrivals

The percentage of arrivals is the ratio of landing operations to total operations at an airport during a specified period and is generally assumed to be equal to the percentage of departing operations; therefore, a factor of 50 percent was used for the capacity calculations for the Airport.

Percentage of Touch-and-Go Operations

Because a touch-and-go (T&G) is representative of two operations (i.e. a landing and takeoff performed consecutively during local flight training operations), an airfield with a higher percentage of T&G operations typically has a greater airfield capacity than one with a higher percentage of air carrier operations.

Operational statistics provided by the ORF Air Traffic Control Tower (ATCT) identified very little local or no T&G operations (less than 1 per day) at ORF. With the assumption that these operations are T&Gs and that local operations will not experience a significant growth over the planning horizon, a percentage range of zero to 20 percent was used in the capacity calculations. Based on FAA figures, this percentage equated to a T&G factor of 1.0.

Location of Exit Taxiways

The location and number of exit taxiways affect the capacity of an airport's runway system because they directly relate to an aircraft's runway occupancy time. Runway capacities are highest when they are complimented with full-length, parallel taxiways, ample runway entrance and exit taxiways, and no active runway crossings. These components reduce the amount of time an aircraft remains on the runway. FAA AC 150/5060-5 identifies the criteria for determining taxiway exit factors based on the mix index and the distance the taxiway exits are from the runway threshold and other taxiway connections. As the Airport's existing mix index range was calculated to be 81-120 over the planning period, only exit taxiways that are between 5,000 and 7,000 feet from the threshold and spaced at least 750 feet apart contribute to the taxiway exit factors. By combining the mix index, percent of aircraft arrivals, and the number of exit taxiways within the specified range, a taxiway exit factor was calculated (0.94 during VFR and 0.92 during IFR).

Meteorological Conditions

Meteorological conditions at and around an airport also have significant impacts on the capacity of an airfield. Previously described runway use percentages are a result of prevailing winds dictating which runway an aircraft should use for takeoff and landing operations.

Three measures of cloud ceiling and visibility are recognized by the FAA and were used to calculate capacity. These included:

- Visual Flight Rules (VFR) – Cloud ceiling is greater than 1,000 feet above ground level (AGL) and visibility is at least three statute miles.
- Instrument Flight Rules (IFR) – Cloud ceiling is at least 500 feet AGL but less than 1,000 feet AGL and/or the visibility is at least one statute mile but less than three statute miles.
- Poor Visibility conditions (PVC) – Cloud ceiling is less than 500 feet AGL and/or the visibility is less than one statute mile.

ORF experiences VFR conditions approximately 85.2 percent of the time, IFR conditions 13.5 percent of the time, and PVC conditions 1.3 percent of the time. These are approximate percentages derived from the historical data from the Airport's AWOS (See **Appendix K**).

Summary of Capacity Calculation Factors

Table 4-8 summarizes these parameters calculated for ORF, which were used to define the hourly capacity (in VFR and IFR conditions-See **Appendix K**) and the ASV for the Airport.

Table 4-8 – Calculated Capacity Parameters

Factor	2017
Aircraft Fleet Mix Index	81.7
Runway-Use Configuration	Single Runway
Percentage of Aircraft Arrivals	50%
Touch and Go Factor (VFR / IFR)	1.0/1.0
Taxiway Exit Factor (VFR / IFR)	0.94/0.92
Meteorological Conditions (VFR / IFR)	85.2%/13.5%

Note: VFR/IFR percentages were derived via the Airports AWOS (PVC:1.3%)
Source: FAA Operations Network (OPSNET), FAA AC 150/5060-5, CHA, 2019.

Current Airfield Capacity (Single Runway Assumption)

As previously discussed, it is important to note that a single runway configuration was assumed to represent the current airfield configuration, as a capacity model for a crosswind runway configuration would not reflect the limited usage of the crosswind runway (Runway 14/32) at ORF. Instead, the crosswind runway configuration analysis would assume that Runway 14/32 is available for commercial use, thus assuming both intersecting runways are available for all operations at ORF; however, commercial service operations and larger GA and cargo operations are not currently accommodated by the crosswind runway due to runway length.

The airfield capacity analysis for a single runway configuration was evaluated with the following conditions and assumptions applied:

- Runway 14/32 will no longer be in operation
- The new runway configuration will be a single runway (Runway 5/23)
- Meteorological Conditions (VFR/IFR), shown in **Table 4-8,** will remain constant throughout the forecast period

Hourly Capacity

Hourly capacity for the airfield is a measurement of the maximum number of aircraft operations (VFR and IFR) that an airfield can support in an hour based on the runway configuration. Using graphs provided in AC 150/5060-5, VFR and IFR hourly capacity bases were established by applying the given VFR and IFR operational capacities for the runway use configuration, the aircraft mix index, and the percentage of aircraft arrivals. Once the hourly capacity bases were identified, they were multiplied by the touch-and-go factors and taxiway exit factors to determine the hourly capacities. This equation is expressed as:

$$\text{Hourly Capacity} = C^* \times T \times E$$

C = Hourly Capacity Base*
T = Touch-and-Go Factor
E = Taxiway Exit Factor

Table 4-9 shows the results of the hourly capacity for 2017, the base year, and for PALs 1 through 4. Note that as the mix index increases from 81.7 (2017) to 89.9 (PAL 4), the operational capacities decrease.

Table 4-9 – Calculated Hourly Capacity (Single Runway Configuration)

Factors	2017	Base	PAL 1	PAL 2	PAL 3	PAL 4
	VFR / IFR	VFR / IFR	VFR / IFR	VFR / IFR	VFR / IFR	VFR / IFR
Hourly Capacity Base	58.0/54.5	57.0/54.0	57.0/54.0	57.0/54.0	56.5/53.5	56.5/53.5
Touch-and-Go Factor	1.0/1.0	1.0/1.0	1.0/1.0	1.0/1.0	1.0/1.0	1.0/1.0
Taxiway Exit Factor	0.94/0.92	0.94/0.92	0.94/0.92	0.94/0.92	0.94/0.92	0.94/0.92
Calculated Hourly Capacity	**54.5/50.1**	**53.6/49.7**	**53.6/49.7**	**53.6/49.7**	**53.1/49.2**	**53.1/49.2**

Note: FAA AC 150/5060-5 [VFR (Figure 3-3), IFR (Figure 3-43)]
Source: FAA AC 150/5060-5, CHA, 2019.

Annual Service Volume

Annual Service Volume (ASV) is an expression of the total number of aircraft operations that an airfield can support per annum. The formula for estimating an airport's ASV is based on the ratio of annual operations to average daily operations during the peak month, multiplied by the ratio of average daily operations to average peak hour operations during the peak month. The product of these values is then multiplied by the weighted hourly capacity to determine the ASV.

Weighted hourly capacity accounts for the varying operating conditions at the airport, which are applied to the hourly capacity determined in the previous section. The formula for weighted hourly capacity is expressed as:

$$C_w = \frac{(C_{n1} \times W_{n1} \times P_{n1}) + (C_{n2} \times W_{n2} \times P_{n2})}{((W_{n1} \times P_{n1}) + (W_{n2} \times P_{n2}))}$$

C_w = Airfield weighted hourly capacity
$_n$ = Number of runway-use configurations.
C = Hourly Capacity of each configuration. ***(2017) VFR/IFR = 54.5/50.1***
W = FAA ASV weighting factor, based on mix index & percentage and hourly capacity. ***VFR/IFR = 1/1*** *(See* ***Appendix A****)*
P = Percent of time the Airport operates in each configuration.
VFR/IFR = 85.2%/13.5%

Applying the 2017 ORF data to this equation yielded the following:

$$C_w = \frac{(54.5 \times 1 \times 85.2) + (50.1 \times 1 \times 13.5)}{((1 \times 85.2) + (1 \times 13.5))}$$

$$\mathbf{C_w = 53.9}$$

Based on the formula above, the airfield weighted hourly capacity is approximately 54 operations per hour.

The ASV formula accounts for a variety of conditions that occur at an airport, including low- and high-volume activity periods, and is expressed as:

$$ASV = C_w \times D \times H$$

C_w = Weighted Hourly Capacity.
D = Daily Demand Ratio (ratio of annual operations to average daily operations during peak month).
H = Hourly Demand Ratio (ratio of average daily operations to average peak hour operations during peak month)

Based on the Airfield Capacity Model (ACM), only certain criteria apply when determining the demand ratios. It is important to recognize that ACM demand ratios were solely based on average daily demand and average hourly demand as they relate to operations; thus, they were not based on peak daily or peak hourly activity at the Airport and do not correspond with the peak activity levels presented in **Chapter 3**. The peak activity demand forecasts in **Chapter 3** were derived based on peak enplanement data and peak operating periods as they related to the enplanements, whereas the activity demand presented herein is based on aircraft operations and not enplanements. Data derived via FAA TFMSC and Distributed OPSNET was used when determining the month with the most operations, the average daily operations during the peak month, and the average hourly operations during the peak month. Reference **Appendix L**.

Table 4-10 identifies the daily and hourly demand ratios throughout the planning period.

Table 4-10 – Demand Ratios

Factor	2017	Base	PAL 1	PAL 2	PAL 3	PAL 4
Annual Operations	72,588	74,821	80,058	85,896	90,992	97,978
Av. Daily Operations (in Peak Month)	220.0	226.8	242.6	260.3	275.8	297.0
Av. Peak Hour (in Peak Month)	15.0	15.0	16.5	17.8	18.8	20.2
Daily Demand Ratio (D)	**329.9**	**329.9**	**329.9**	**329.9**	**329.9**	**329.9**
Hourly Demand Ratio (H)	**14.7**	**14.7**	**14.7**	**14.7**	**14.7**	**14.7**

Note: Data used for determining daily and hourly demand ratios can be found in **Appendix L**.
Source: FAA AC 150/5060-5, CHA, 2019.

The ASV equation for 2017 was as follows:

$$ASV^* = 53.9 \times 329.9 \times 14.7$$

$$\mathbf{ASV = 260{,}936}$$

Note: The numbers presented in this formula have been rounded; however, the results of the formula are based on actual, un-rounded numbers. Again, it is important to reiterate that average daily demand and average hourly demand are independent of the activity demand forecasts presented in **Chapter 3.*

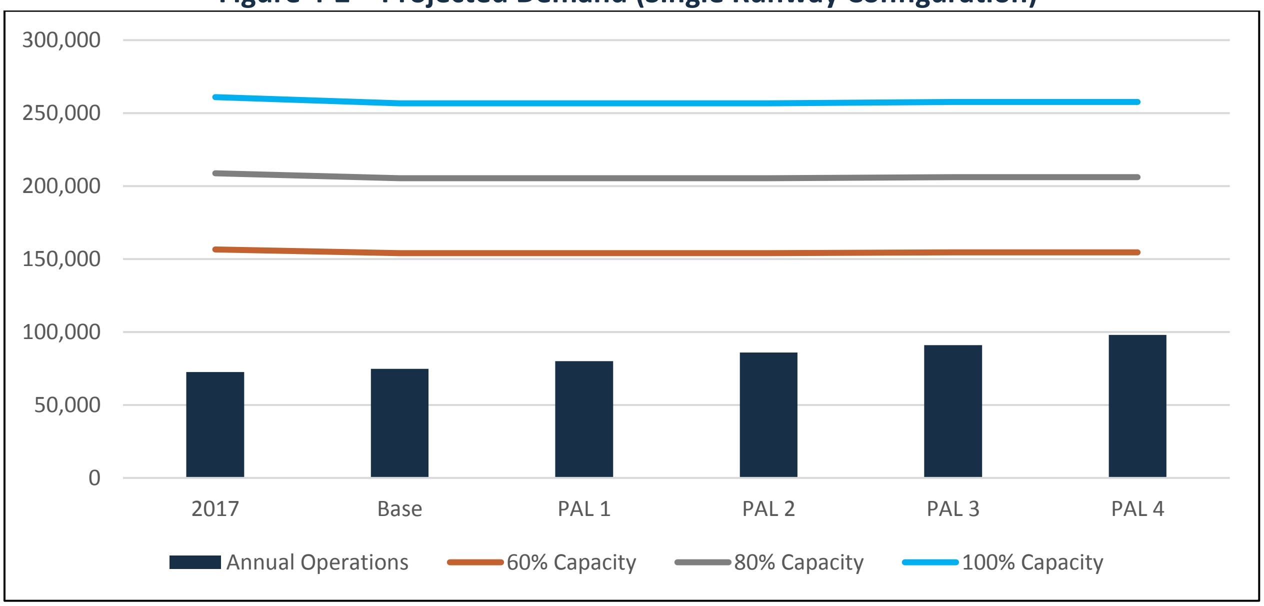
If the annual operations exceed the ASV, the airport is likely to see significant delays. It should be understood that an airport can still experience delays before capacity is reached. Activity levels that may trigger capacity planning and development are discussed in FAA Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems (NPIAS)*, which indicates (via Table 4-4 of Order 5090.3C) that 60 percent ASV is the trigger for planning a new runway or extended runway to increase hourly capacity and that 80 percent is the trigger for development. This allows an airport to make necessary improvements and avoid delays before they are anticipated to occur. The ASV for 2017 showed ORF at approximately 27.8 percent capacity (**Table 4-11**). To better understand ORF's current and projected operational capacity levels, the 2017, base year, and PALs 1 through 4 demands are compared to their respective annual service volumes in **Table 4-11**. The capacity levels are depicted in **Figure 4-2**.

Table 4-11 – Annual Service Volume (Single Runway Configuration)

Factor	2017	Base	PAL 1	PAL 2	PAL 3	PAL 4
Annual Operations	72,588	74,821	80,058	85,896	90,992	97,978
Annual Service Volume	260,936	256,705	256,705	256,705	257,599	257,599
Capacity Level	**27.8%**	**29.1%**	**31.2%**	**33.5%**	**35.3%**	**38.0%**

Note:, ASV was based on average, rather than peak, activity levels.
Source: FAA AC 150/5060-5, CHA, 2019.

Figure 4-2 – Projected Demand (Single Runway Configuration)



Note:, ASV was based on average, rather than peak, activity levels.
Source: NAA, CHA, 2019.

<u>Airfield Capacity Conclusion Using FAA AC/150/5060-5</u>

Based on the airfield capacity calculations for a single runway configuration, the Airport would currently be at approximately 27.8 percent of capacity and would only reach approximately 38.0 percent capacity by PAL 4 if Runway 14/32 is closed; therefore, based on this model, a single runway configuration can adequately accommodate forecasted growth; however, it is important to remember that only certain criteria was considered during the analysis.

Although the ACM depicts that the Airport has adequate capacity, and as previously discussed, the model was based on average daily demand and average hourly demand. As such, during busy hours, ORF sees significantly higher peaks, as shown in the forecasts presented in **Chapter 3**; therefore, during the busiest hours of operation, throughput capacity may be a concern, as commercial, cargo, and general aviation activities are expected to increase throughout the forecast horizon.

For the purposes of this Study, the results using the model herein were used during an in-depth analysis of runway development alternatives, as well as their impact on airfield capacity, which are provided in subsequent chapters.

4.2.2 ACRP, *Report 79: Evaluating Airfield Capacity*

Airport Cooperative Research Program (ACRP), *Report 79: Evaluating Airfield Capacity*, provides a guidebook describing available methods for evaluating existing and future airfield capacity, as well as guidance on selecting an appropriate capacity analysis method. Accompanying the report is a prototype capacity spreadsheet model that has been designed to be a preliminary planning tool. For the purposes of this Study, the Prototype Airfield Capacity Spreadsheet Model was used as a capacity analysis method.

<u>Capacity Calculation Factors</u>

Prior to conducting the analysis, it was necessary to determine the current fleet mix and share allocations, the demand ratios, and the percent of time the airport experienced VFR and IFR conditions. See **Table 4-12** for fleet mix categories and **Table 4-13** for share allocations which used standards set forth in ACRP, *Report 79*. Demand ratios[22] are the same as previously displayed in **Table 4-10**.

According to ACRP, *Report 79*, the basic criteria for determining visual meteorological conditions (VMC) or instrument meteorological conditions (IMC) is a cloud ceiling of at least 1,000 feet above ground level (AGL) and visibility of at least three statute miles. Based on these parameters, ORF experiences VMC conditions 85.2 percent of the time and IMC conditions 14.8 percent of the time. These are approximate percentages derived from the historical data from the Airport's AWOS.

Table 4-12 – Aircraft Classification

Category	Aircraft Classification						
New Category	Small - S	Small - T	Small +	Large-TP	Large-Jet	Large-757	Heavy
Previous FAA Category	A	B	C	C	C	C	D
Maximum Gross Takeoff Weight (MTOW)	< 12,500 lbs (Single Engine)	< 12,500 lbs (Twin Engine)	12,500 lbs - 41,000 lbs	41,000 lbs - 255,000 lbs	41,000 lbs - 300,000 lbs	Boeing 757 Series	> 300,000 lbs

Source: FAA TFMSC Data, NAA, CHA, 2018.

[22] It is important to reiterate that demand ratios are based on average daily demand and average hourly demand during the month that the Airport had the most operations, rather than on peak activity demand as presented within the forecasts developed in **Chapter 3**.

Table 4-13 – Aircraft Classification Share Allocation

Year		Operating Fleet Mix							Total Operations
	New Category	Small - S	Small - T	Small +	Large-TP	Large-Jet	Large-757	Heavy	
	Previous FAA Category	A	B	C	C	C	C	D	
2017	Operations	7,820	6,451	7,381	1,141	48,723	1	1,071	72,588
	Share Allocations	**10.77%**	**8.89%**	**10%**	**1.57%**	**67.12%**	**0.00%**	**1.48%**	
Base	Operations	12,376	2,586	5,997	2,401	48,192	776	2,492	74,821
	Share Allocations	**16.54%**	**3.46%**	**8.02%**	**3.21%**	**64.41%**	**1.04%**	**3.33%**	
PAL 1	Operations	12,633	2,678	7,291	2,848	51,459	411	2,737	80,058
	Share Allocations	**15.78%**	**3.34%**	**9.11%**	**3.56%**	**64.28%**	**0.51%**	**3.42%**	
PAL 2	Operations	12,999	2,792	8,627	3,314	55,158	0	3,006	85,896
	Share Allocations	**15.13%**	**3.25%**	**10.04%**	**3.86%**	**64.21%**	**0.00%**	**3.50%**	
PAL 3	Operations	13,462	2,928	10,027	3,806	57,467	0	3,301	90,992
	Share Allocations	**14.79%**	**3.22%**	**11.02%**	**4.18%**	**63.16%**	**0.00%**	**3.63%**	
PAL 4	Operations	14,019	3,084	11,510	4,331	61,408	0	3,626	97,978
	Share Allocations	**14.31%**	**3.15%**	**11.75%**	**4.42%**	**62.68%**	**0.00%**	**3.70%**	

Source: FAA TFMSC Data, NAA, CHA, 2018.

Hourly Capacity and Air Service Volume Estimations

As previously discussed in **Section 4.2.1** and depicted in **Table 4-7**, a single runway configuration was assumed for the purposes of determining airfield capacity at ORF, as Runway 14/32 usage is low. For the purposes of this Study, it was considered impractical to conduct a crosswind analysis because it would not accurately reflect the limited usage of Runway 14/32. Rather, it would assume that Runway 14/32 is available for commercial use; however, Runway 14/32 does not accommodate commercial service operations and larger GA and Cargo operations due to runway length. A summary of the hourly capacity results (VFR and IFR) and the air service volume estimations are depicted in **Table 4-14**. To determine the percent capacity (also depicted in **Table 4-14**), the forecasted annual operations for each year were divided by the air service volume estimation for the respective year. The full analyses, which included the inputs and results, can be found in **Appendix M**.

Table 4-14 – Hourly Capacity, Air Service Estimations, & Percent Capacity (Single Runway)

Output	2017	Base	PAL 1	PAL 2	PAL 3	PAL 4
Hourly Capacity: VFR	46	46	46	46	46	46
Hourly Capacity: IFR	58	58	59	59	59	59
Forecast	72,588	74,821	80,058	85,896	90,992	97,978
ASV	223,300	222,200	221,800	221,200	221,100	221,100
% Capacity	32.5%	33.7%	36.1%	38.8%	41.2%	44.3%

Source: ACRP Report 79: Spreadsheet Capacity Model Application of Results, CHA, 2018.

Airfield Capacity Conclusion Using ACRP, Report 79

According to the results of the analysis using the methodology presented in ACRP, Report 79, a single runway configuration adequately supports airfield operations now and throughout the forecast period, with the airfield only expected to reach approximately 44.3 percent of maximum capacity.

4.2.3 Airfield Capacity Conclusion

As discussed in **Sections 4.2.1** and **4.2.2**, a single runway configuration was assumed to represent the current airfield layout at ORF due to low usage of Runway 14/32, which is recognized by the FAA. The analyses conducted using methodologies presented in FAA AC 150/5060-5 and ACRP, Report 79 indicated that the airfield will reach approximately 38.0 and 44.3 percent capacity, respectively, by PAL 4. As previously mentioned, FAA Order 5090.3C, *Field Formulation of the National Plan of Integrated Airport Systems (NPIAS)*, indicates that 60 percent ASV is the trigger for planning a new runway or runway extension for the purposes of increasing hourly capacity and that 80 percent is the trigger for development; therefore, all analyses conducted herein indicated that ORF's activity levels can be supported by a single runway configuration throughout the forecast period.

4.3 AIRFIELD FACILITY REQUIREMENTS

Airfield improvements are planned and developed according to the established ARC, ADG, and TDG for an airport. The associated design criteria are applied when planning upgrades or improvements for a runway or taxiway. An airport's ARC is determined by the critical aircraft (aircraft with the longest wingspan, highest tail, and fastest approach speeds) that makes "regular use" of the airport or a specific runway. FAA AC 150/5000-17, defines "regular use" as 500 annual operations, including both itinerant and local operations but excluding touch-and-go operations (an operation is either an arrival or departure). As stated in **Section 4.1.4,** ORF has an existing ARC of D-IV and, based on future projections of aircraft fleet mix transitions, is forecast to become a D-IV airport in the five- to ten-year range; however, this does not affect the Airport's design standards (per FAA AC 150/5300-13A).

4.3.1 Runway Requirements

Airfield Configuration

The general configuration of the airfield, including the number of runways along with their location/orientation, should allow the airport to meet anticipated air traffic demands and maximize wind coverage and operational utility for all types of aircraft. As stated in **Chapter 2**, it is a FAA recommendation that the runway system at an airport be oriented to provide at least 95 percent wind coverage. This means that 95 percent of the time in a given year, the crosswind coverage at an airport is within acceptable limits for the types of aircraft operating on the runways. As shown in **Table 4-15**, the current intersecting runway configuration at ORF provides wind coverage greater than the FAA recommended 95 percent for the design aircraft. Furthermore, Runway 5/23 alone provides over 95 percent wind coverage for all crosswind components, excluding 10.5 knots during IFR conditions.

Table 4-15 – ORF Wind Coverage

	Runway	10.5 Knots	13 Knots	16 Knots	20 Knots
AW	5/23	95.56%	98.14%	99.62%	99.93%
	14/32	80.00%	87.77%	95.89%	98.81%
	All Combined	98.58%	99.64%	99.93%	99.99%
VFR	5/23	95.75%	98.27%	99.70%	99.96%
	14/32	78.79%	87.17%	96.01%	99.04%
	VFR Combined	98.77%	99.72%	99.96%	100%
IFR	5/23	92.05%	96.34%	98.9%	99.75%
	14/32	76.67%	84.58%	92.52%	96.68%
	IFR Combined	96.51%	98.88%	99.75%	99.98%

Source: NOAA, National Climate Center; Station 725080 (2007-2016).

Air traffic records indicate limited use of A-I and B-I aircraft at ORF. Furthermore, the 2010 *General Aviation and Part 135 Activity Survey* indicated that these smaller aircraft do not fly as often during IFR weather conditions. As such, it was concluded that no changes to the runway configuration are recommended during the planning horizon to accommodate wind conditions.

Runway Designations

Due to the changes in the earth's magnetic declination over time, the compass heading of a runway and its associated end number can change. Current magnetic declination information was derived from the National Oceanic and Atmosphere Administration (NOAA). The current headings and declinations of the runway ends at ORF are as follows:

- Runway 5
  - Current headings: 047° magnetic, 038° true
  - Declination: 10° 55' W ± 0° 21' changing by 0° 1' W per year
- Runway 23
  - Current headings: 227° magnetic, 218° true
  - Declination: 10° 56' W ± 0° 21' changing by 0° 1' W per year
- Runway 14
  - Current headings: 137° magnetic, 128° true
  - Declination: 10° 55' W ± 0° 21' changing by 0° 1' W per year
- Runway 32
  - Current headings: 317° magnetic, 308° true
  - Declination: 10° 55' W ± 0° 21' changing by 0° 1' W per year

Currently, no changes in the runway designations are needed; however, since magnetic declination changes slowly over time, the runway numbers may need to be reevaluated by PAL 4, at which time the magnetic declination may have changed more significantly.

Runway Design Standards

During this master planning effort, FAA design and safety standards related to the airfield facilities were identified so that the airport may review and work to achieve compliance where needed. The standards include dimensions, separation distances, protection zones, clearance requirements, etc., which vary according to the design aircraft.

Each runway at the Airport is assigned a Runway Design Code (RDC), which signifies the design standards that the runway is to meet. At ORF, Runway 5/23 is categorized as runway design group D-IV, whereas Runway 14/32 is C-III; however, based on radar data provided by the FAA, current activity levels and fleet mix on this runway no longer justify the increased design standards previously required of Runway 14/32. As such, infrastructure requirements necessary to accommodate C-III operations are no longer necessary and are recommended for further evaluation. Additionally, given the low activity levels and that Runway 5/23 provides adequate wind coverage for all fleet types, further evaluation to the benefits and constraints of Runway 14/32 are examined in subsequent sections.

The key FAA design and safety standards related to the runways at ORF (as defined in AC 150/5300-13A, *Airport Design*) are described below.

<u>Runway Width</u> – Runway width requirements are based on the critical aircraft associated with each runway. For ARC C-III and D-IV, the required runway width is 150 feet. Currently, both Runways 14/32 and 5/23 are 150 feet wide, thereby meeting this design requirement. Another significant design standard for safety is distance of the runway centerline to the parallel taxiway centerline. Currently, both Runways 14/32 and 5/23 are within acceptable range.

<u>Runway Shoulders</u> – Shoulders provide resistance to blast erosion and accommodate the passage of maintenance and emergency equipment and the occasional passage of an airplane veering from the runway. The FAA recommends paved shoulders for runways accommodating Group III aircraft and higher. FAA AC 150/5300-13A indicates the required shoulder width to be 25 feet on either side of a Group III or Group IV runway. Runway 5/23 is equipped with shoulders that vary up to 15 feet in width in some portions, lacking shoulders altogether in other portions. Given it is a D-IV runway, 25-foot shoulders are required per FAA standards. Runway 14/32 has turf shoulders. To comply with the FAA C-III design standards of 25 feet in width, paved shoulders are recommended. For the Airport's runways to no longer be deficient in regard to meeting FAA design requirements, it is recommended that 25-foot shoulders be added to both sides of both runways.

<u>Runway Safety Area (RSA)</u> – The RSA is a rectangular area bordering a runway that is intended to reduce the risk of damage to aircraft in the event of an undershoot, overrun, or excursion from the runway. The RSA is required to be cleared and graded such that it is void of potentially hazardous ruts, depressions, or other surface variations. Additionally, the RSA must be drained by grading or storm sewers to prevent water accumulation, be able to support snow removal and firefighting equipment, and be free of objects except those required because of their function.

The RSA for a Group III or IV runway is required to be 500 feet wide and extend 1,000 feet beyond the runway end. The longitudinal grade from the end of the runway should be between 0.0 percent to -3.0 percent for the first 200 feet and no more than -5.0 percent for the remaining 800 feet of the RSA. Transverse grades should be -1.5 percent to -3.0 percent away from the runway shoulder edge and beyond the runway ends.

The Runway 14/32 RSA meets the length, width, and grading requirements through the application of declared distances. For the Runway 5/23 RSA, its width currently varies between 350 feet and 500 feet, falling short of the 500-foot minimum. This is a result of a drainage structure located near the intersection with Taxiway A and the holding bay adjacent to Taxiway C on the Runway 5 end (the holding bay ROFA non-compliance was corrected via a recent Taxiway Improvement project). Furthermore, portions of the runway do not meet the transverse grading requirements per FAA, as the existing grades are 0.7 percent to 2.0 percent; therefore, it is recommended these areas be graded to meet FAA design criteria.

Runway Object Free Area (ROFA) – The ROFA is a rectangular area bordering a runway intended to provide enhanced safety for aircraft operations by ensuring the area remains clear of parked aircraft or other equipment not required to support air navigation or the ground maneuvering of aircraft. The ROFA design standard for Group III and Group IV runways is 800 feet wide, centered about the runway centerline, and extends 1,000 feet beyond each runway end. At present, both ORF runways fail to adhere to the prescribed ROFA geometry. The ROFA for Runway 5/23 varies between 750 and 800 feet. This noncompliance is a result of the glideslope shelter and antenna located within the Object Free Area. The ROFA for Runway 14/32 varies between 540 and 800 feet as a result of a public road and airport access road within the OFA. In order to ensure these areas are free of potentially hazardous objects non-essential to air navigation or aircraft ground movements, a Modification of Standards (MOS) is required if these objects will not be relocated outside of the OFA.

Runway Object Free Zone (ROFZ) – The ROFZ is a volume of airspace centered above the runway that is required to be clear of all objects, except for frangible navigational aids that need to be in the ROFZ because of their function. The ROFZ provides clearance protection for aircraft landing or taking off from the runway. The ROFZ is the airspace above a surface whose elevation at any point is the same as the elevation of the nearest point on the runway centerline. The ROFZ extends 200 feet beyond each end of the runway, and its width is based on visibility minimums and aircraft size. The ROFZ width for Runways 14/32 and 5/23 is each 400 feet, meeting FAA standards.

The inner-approach OFZ is a volume of airspace and is centered on the approach area that applies only to runway ends equipped with approach lighting systems. At ORF, the inner-approach OFZ applies to Runways 5 and 23. The inner-approach OFZ begins 200 feet from the runway threshold at the same elevation as the runway threshold and extends 200 feet beyond the last unit in the approach lighting system. It has the same width as the Runway OFZ and rises at a slope of 50:1 away from the runway end. It should be noted that the OFZ is penetrated by some trees, as well as by light poles and signs along Miller Store Road and utility poles along Hwy 60 (Shore Drive).

Runway Protection Zone (RPZ) – The RPZ is a trapezoidal area located 200 feet beyond the runway end and centered on the extended runway centerline. The RPZ is primarily a land use control that is meant to enhance the protection of people and property near the airport through airport control. Such control includes clearing of RPZ areas of incompatible objects and activities. Currently, land owned and maintained by the NAA within all four RPZs at ORF comply with FAA design standards; however, there are uncontrolled areas within the RPZ's for Runway 5, Runway 23, and Runway 14 that still have non-compatible land uses within the RPZ (i.e., uncontrolled private/public property, structures, etc.). These properties are currently not owned or controlled by the Authority. It is recommended, when applicable, that the Airport continue to acquire the land within the RPZ's, at minimum for Runways 5 and 23, to maintain operational safety of the airfield and to be in compliance with FAA guidance on RPZ land use combability.

Runway Blast Pads - Similar to runway shoulders, blast pads are intended to provide erosion protection at the runway end. Conformance to FAA design criteria requires that 200-foot wide x 200-foot length blast pads be placed symmetrically at the end of each Group IV runway. At present, Runway 5/23 falls short of the design standards for Group IV runways. The blast pad prior to both ends is approximately 200 feet in length but 150 feet in width, thereby not meeting the 200-foot requirement.

Building Restriction Line (BRL) – Though not a specific FAA design standard, the BRL is a reference line which provides generalized guidance on building location and height restrictions. The BRL is typically established with consideration to OFAs and RPZs as well airspace protection by identifying areas of allowable building heights such as 35 feet above ground level. It should be noted that site-specific terrain considerations (i.e. grade/elevation changes) may allow buildings taller than indicated by the generalized BRL to be developed within the limits of the BRL. These height restrictions are based on FAR Part 77 standards and were evaluated for each specific site development plan.

Table 4-16 and **Figure 4-3** identify the existing conditions at ORF and the geometric requirements of the above standards relative to ARC C-III through D-IV. In addition to the runway design standards evaluated for deficiencies in this Study, an evaluation was conducted in a separate study, *Runway Pavement Rehabilitation and Lighting Improvements – Preliminary Design Report*, released in February of 2018. This study assessed both runways at the Airport for pavement conditions, grading, line of sight, markings, and other potential deficiencies. A summary of the pavement and non-standard conditions assessed in the Study can be found in **Table 4-17**. The following deficits are identified above:

- Runway 5/23
  - Existing paved shoulders do not meet requirements of 25 feet
  - RSA containing a drainage structure and locations with grading steeper than what is allowable
  - ROFA contains non-frangible glideslope shelter and antenna structure
  - Blast pad width is below the requirement of 200 feet
- Runway 14/32
  - Contains turf shoulders; paved shoulders are recommended by the FAA
  - Public road and service road are located within the ROFA

Runway deficiencies were addressed during the development of recommended runway alternatives, as necessary, and will be further addressed through future projects at the Airport.

Table 4-16 – FAA Runway Design Standards

Design Standard	Existing Conditions		Runway Design Code (RDC) (w/visibility minimums ≥ ½-mile)	
	14/32 C-III (1 mi.)	5/23 D-IV (1/2 mi.)	C-III	D-IV
Runway Width	150’	150'	150’	
RSA Width	500’	350' to 500'	500’	
RSA Length Past RW End	1,000' / 0'	1,000’ / 1,000’	1,000’	
ROFA Width	540' to 800'	750' to 800’	800’	
ROFA Length Past RW End	1,000’ / 0'	1,000’ / 1,000’	1,000’	
Runway OFZ Width	400’	400’	400’	
Separation Between:				
Runway Centerline to Parallel Taxiway Centerline	400'	400' to 600'	400’	
Runway Centerline to Edge of Aircraft Parking	515’ to 590’	660’	500’	
Runway Centerline to Hold line	250’	250’	250’	
Runway Protection Zone (RPZ):				
Length	1,700’	2,500’	1,700'	2,500'
Inner Width	500'	1,000’	500'	1,000’
Outer Width	1,010'	1,750’	1,010'	1,750'

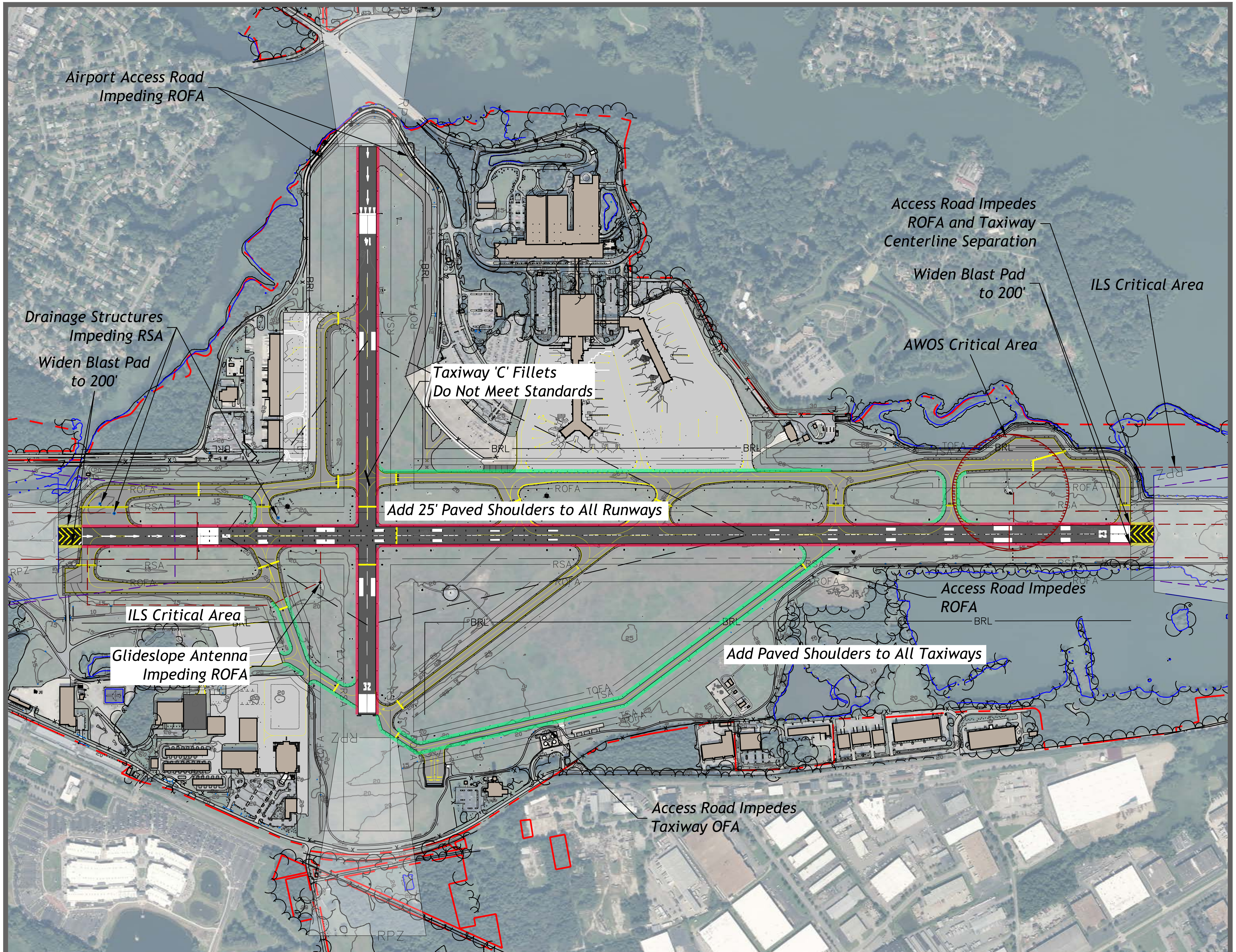
Source: FAA AC 150/5300-13A, NAA, CHA, 2018.

Table 4-17 – Runway Pavement and Non-Standard Conditions

Runway	Runway 5/23				Runway 14/32
Surface ID	5 End	5/23 Center		23 End	
Surface Type	PCC	Asphalt		PCC	Asphalt
Last Major Rehabilitation	38 Years	18 Years		46 Years	28 Years
Geometric Evaluation					
Shoulders	No	N/A		No	N/A
Blast Pads	No	N/A		No	No
Profile Slope and Curve of First 1/4	No	N/A		No	Yes
Profile Slope and Curve of Middle 1/2	N/A	Yes		N/A	Yes
Line of Sight	Yes	Yes	No	Yes	Yes
Transverse Grades	No	No		No	No
Runway Markings	Threshold/Arrows	Yes		Blastpad	Centerline
Taxiway Lead-on/Lead-off Markings	No	No		No	No
Surface Evaluation					
Boeing Bump Index (BBI)	Acceptable	Acceptable	Acceptable	Acceptable	N/A
Aircraft Simulation (CPRMS)	Advisory	Advisory		Advisory	N/A
Groove Condition - Keel	Acceptable	Acceptable		Acceptable	N/A
Groove Condition - Outside Keel	Acceptable	Acceptable		Acceptable	N/A
Severe Distress	ASR	Cracking		Step Faulting	Yes
	Patching	Shoving		Cracking	Cracking
					Exposed Aggregate
Non-Destructive Testing (NFT)					
Load Transfer (Concrete)	Good	N/A		Poor	N/A
ACN/PCN Ratio	> 1.0	< 1.0		< 1.0	< 1.0

COLOR KEY	
Compliant	Not Applicable
Nearing Non-Compliance/Needing Addressed	Not Compliant

Source: Kimley Horn and Associates, 2018.



NORFOLK INTERNATIONAL AIRPORT

MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)

0 400 800

LEGEND

- Proposed Runway Shoulder
- Proposed Taxiway Shoulder
- AWOS Critical Area
- NAVAID Critical Areas
- RPZ — Runway Protection Zone (RPZ)
- RSA — Runway Safety Area (RSA)
- ROFA — Runway Object Free Area (ROFA)
- Runway Obstacle Free Zone (ROFZ)
- Precision Obstacle Free Zone (POFZ)
- BRL — 35' Building Restriction Line (BRL)
- Runway Visibility Zone (RVZ)
- TSA — Ex. Taxiway Safety Area (TSA)
- TOFA — Ex. Taxiway Obstacle Free Area (TOFA)
- Ex. Airport Property Line

Figure 4-3
Design Standard Deficiencies

Runway Length

To ensure that ORF can support existing and anticipated aircraft and airline operational demands, a detailed runway length analysis was performed based on specific aircraft performance characteristics as documented in the manufacturer's Aircraft Planning Manuals (APMs). Inadequate runway length can limit the operational capability of an airport, including the aircraft that can operate and the destinations that the airport serves. Runway lengths can place restrictions on the allowable takeoff weight of the aircraft, which then reduces the amount of fuel, passengers, or cargo that can be carried. Per the guidance provided in AC 150/5325-4B, *Runway Length Requirements for Airport Design*, the following factors were used in the runway length calculations for ORF:

Aircraft Specifics

- Model and Engine Type – the aircraft version and engine type. The most common and demanding aircraft specific to ORF were used.
- Payload – represents the carrying capacity of the aircraft, including passengers, baggage, and cargo. For this analysis, both 90 percent and 100 percent were chosen as the payload for planning purposes.
- Estimated Takeoff Weight – the estimated weight at takeoff, which includes the payload and the fuel required to reach the intended destination (with reserve fuel). The estimated takeoff weight varies by aircraft, payload, and destination.
- Estimated Landing Weight – the estimated weight at landing. For this analysis, maximum landing weight (MLW) was used to determine runway landing requirements.

Airport Specifics

- Temperature – the atmospheric temperature at the airport. Warmer air requires longer runway lengths because the air is less dense, thus generating less lift on the aircraft. The average temperature (87°F) of the hottest month (July) at ORF was used in the calculations.
- Elevation – the elevation above sea level at the airport. As elevation increases, air density decreases, making takeoffs longer and landings faster. The elevation at ORF is established at 27 feet mean sea level (MSL).
- Runway Gradient – the average slope of the runway, expressed as a percentage. The runway gradients at ORF are not significant enough to impact runway length requirements.
- Stage Length (flight distance) – the length in nautical miles (nm) to the intended destination. The stage length determines the amount of fuel an aircraft will require on takeoff to complete its flight, thus impacting aircraft weight and runway length requirements.

Existing Aircraft and Destinations

In order to determine stage lengths for each aircraft, a destination from ORF had to be analyzed for its distance. Unique destinations were used for each aircraft, based on both existing routes and aircraft used, as well as potential routes noted in the air service forecast and potential aircraft in the fleet mix forecast, both found in **Chapter 3 Sections 3.5.1** and **3.5.3**, respectively. The stage length destinations evaluated were Phoenix Sky Harbor International Airport (PHX), London Heathrow Airport (LHR), San Diego International Airport (SAN), Cancun International Airport (CUN), and Los Angeles International Airport (LAX). These length requirements at ORF can be accommodated by Runway 5/23; therefore, the runway system at ORF is considered adequate to accommodate the current traffic. Required landing length was also evaluated and found to be adequate.

Table 4-18 – Existing Takeoff (TO) Length Requirements (90% Payload)

Aircraft Model	Payload	Maximum Range at 90% Payload (nm)	Stage Length (nm)	Estimated Takeoff Weight (lb)	Takeoff Length Req. (ft)	Landing Length Req. (ft)
A320-200	90%	2,200	1,763 (PHX)	152,000	7,750	4,250
A330-300		4,250	3,231 (LHR)	458,000	7,000	6,100
B737-8		2,750	2,025 (SAN)	156,600	6,000	5,250
B767-300ER		4,300	1,101 (CUN)	311,000	6,500	5,100
B767-4		4,300	2,061 (LAX)	373,000	7,000	5,900

Note: Runway lengths were calculated at 59° F – Standard Day + 27° F at sea level. Fuel burn was not accounted for within the evaluations.
Source: AC 150/5325-4B, CHA, 2018.

Table 4-19 – Existing Takeoff (TO) Length Requirements (100% Payload)

Aircraft Model	Payload	Maximum Range at 100% Payload (nm)	Stage Length (nm)	Estimated Takeoff Weight (lb)	Takeoff Length Req. (ft)	Landing Length Req. (ft)
A320-200	100%	1,800	1,763 (PHX)	155,600	7,750	4,250
A330-300		3,750	3,231 (LHR)	472,000	7,000	6,100
B737-8		2,000	2,025 (SAN)	155,000	6,250	5,250
B767-300ER		4,000	1,101 (CUN)	325,500	7,000	5,100
B767-4		3,750	2,061 (LAX)	383,000	7,000	5,900

Note: Runway lengths were calculated at 59° F – Standard Day + 27° F at sea level. Fuel burn was not accounted for within the evaluations.
Source: AC 150/5325-4B, CHA, 2018.

4.3.2 Airfield Lighting and Navigational Systems

Airfield Lighting and Marking

Airfield lighting allows for the safe operation of aircraft during nighttime hours and low visibility conditions. Lighting on the airfield includes runway and taxiway edge lighting, runway centerline lighting, Precision Approach Path Indicator (PAPI) lights, Runway End Identifier Lights (REILs), runway threshold lighting, runway guard lights, runway touchdown zone lighting (TDZL), apron lighting, and the marker beacon.

<u>Runway and Taxiway Edge Lighting</u>

Runway 5/23 is equipped with a High-Intensity Runway Light (HIRL) system, while Runway 14/32 is equipped with a Medium-Intensity Runway Light (MIRL) system. Furthermore, all the Airport's taxiways are equipped with Medium-Intensity Taxiway Lighting (MITL) systems. The systems are up-to-date and meet FAA standards.

Runway Centerline Lighting

Runway 5/23 is the only runway at ORF with centerline lighting; however, the runway centerline lights within the displaced area of Runway 5 are non-compliant with FAA standards, which are addressed later in this section (see Navigational and Landing Air Requirements).

PAPIs

A PAPI system is located at the end of each runway at ORF. Runways 5 and 23 are each equipped with a four-light unit (PAPI-4), whereas Runways 4 and 32 are each equipped with a two-light unit (PAPI-2). All systems meet FAA guidelines.

REILs

At ORF, REILs are positioned at each end of Runway 14/32 to provide rapid and positive identification of the end of the runway. Runway 5/23 does not require REILs, as it is equipped with approach lighting systems.

Threshold Lighting

At ORF, Runways 23 and 32 have standard runway threshold lighting. Runway 5 has a 1,000-foot displaced threshold, and Runway 14 has a 575-foot displaced threshold; therefore, they utilize the displaced threshold lighting system.

Runway Guard Lights

Runway guard lights, also known as wigwags, are not required but, when used, are located on each side of a taxiway and in conjunction with the runway holding position marking. Runway guard lights are not currently utilized at ORF.

Touchdown Zone Lighting

The TDZLs indicate the touchdown zone when landing under adverse visibility conditions. All the runways at ORF have touchdown point markings; however, none of the runways have TDZLs.

Rotating Beacon

The rotating beacon at ORF is located south of the airfield on the south side of Miller Store Road, near the GA facilities and the airfield maintenance facilities. It functions as the indicator for locating the Airport at night and meets FAA standards.

Apron Lighting

Apron floodlight systems illuminate the terminal apron, the general aviation apron, and the air cargo apron.

Based on the above findings, airfield lighting systsems at ORF are adequate.

Navigational and Landing Aid Requirements

Pilots utilize a variety of navigational aids (NAVAIDs) and instrument procedures, including Very High Frequency (VHF) Omni Direction Range (VORs), instrument approach procedures (IAPs) and NAVAIDs, and approach lighting systems (ALS). By providing point-to-point guidance information or position data, NAVAIDs assist pilots to safely and efficiently locate airports, land aircraft, taxi aircraft, and depart from airports during nearly all meteorological conditions.

En-route NAVAIDs

At ORF, Runway 14 and Runway 32 utilize VOR/DME (very high frequency omni-direction range and distance measuring equipment) systems for a published instrument approach, which are a ground-based en-route NAVAID. The VOR/DME systems are owed by the FAA and are included on the FAA VOR Minimum Operating Networks Program's retention list. Runway 5/23 does not require a VOR procedure, as both ILS and RNAV procedures are available to both runway ends. The ILS systems at ORF are also owned and operated by the FAA.

Instrument Approach Procedures and NAVAIDs

At ORF, none of the runways operate strictly as a visual approach category. All of ORF's runways have a non-precision approach (NPA) or a precision approach. Also, all runways at ORF utilize Global Positioning System (GPS) based technology. In addition to the previously described approaches, Runways 5 and 23 also have precision approaches that include an ILS. Instrument approach procedures for each runway are presented in **Table 4-20**. It should be noted that Runway 14/32 does not have precision vertical guidance.

Table 4-20 – NAVAIDs

Runway	Navigational Aids	Instrument Approach Types	Minimum Ceiling (AGL)/ Visibility
5	ILS/DME, RNP, GPS	ILS or LOC, RNAV (RNP), RNAV (GPS)	200 ft. / ½ mile
23	ILS/DME, RNP, GPS	ILS or LOC, RNAV (RNP), RNAV (GPS)	200 ft. / ½ mile
14	GPS, VOR/DME	RNAV (GPS), VOR/DME	500 / 1 mile
32	GPS, VOR/DME	RNAV (GPS), VOR/DME	500 / 1 mile

Source: FAA Airport Master Record (Form 5010), Accessed 2018, CHA, 2018.

Instrument Approach Lighting Systems

As previously mentioned, the Airport operates an ILS for approaches to Runway 5 and Runway 23, which each consist of a localizer (LOC), a glide slope (GS), and the approach lighting system (ALS).

A Medium Intensity Approach Lighting Systems (MALS), along with Runway Alignment Indicator Lights (RAILS), together form Medium Intensity Approach Lighting Systems with Runway Alignment Indicator Lights (MALSR) that are utilized for Runway 5 and Runway 23 at ORF.

The runway centerline lights within the displaced area of Runway 5 are non-compliant with two conditions set-forth in AC 150/5340-30H, *Design and Installation Details for Airport Visual Aids*. According to regulations and standards set forth in paragraph 3.3 (a), for threshold displacements over 700 feet, the centerline lights in the displaced area are to be circuited separately from the centerline lights in the non-displaced runway area and the MALSR lights are to interlock with the runway centerline on the displaced area to ensure that when the approach lights are "on," the displaced area centerline lights are "off," and vice versa. In 2010, as a result of Runway 5 being non-compliant with both the previously mentioned standards, the Norfolk Airport Authority submitted a request to the FAA Washington Airports District Office (WAS-ADO) to re-approve and extend the time of an existing Modification of Standards (MOS) to continue the use of the existing configuration of the runway centerline lights within the displaced area of Runway 5 at ORF. The FAA approved the MOS under the condition that the non-standard conditions will be eliminated when the existing MALSR is replaced with a High Intensity ALS with Sequenced Flashers (ALSF-II) system.

Based on the findings above, the NAVAIDs and landing aids at ORF are adequate.

NextGen

The FAA's Next Generation Air Transportation System (NextGen) is an ongoing and comprehensive transformation of the current National Airspace System. The conversion to NextGen includes a complete overhaul of current and outdated ground-based technology systems associated with air traffic control and navigation technology in an effort to integrate new satellite-based technologies and enhance the airspace system across multiple fronts. The NextGen system will also update and enhance GPS technology, reduce congestion, increase airspace capacity, minimize (or reduce) delays, reduce fuel consumption, and increase the operational safety of flight.

4.3.3 Taxiway Requirements

The overall goal of airfield planning and design is to enhance efficiency and the margin of safety for operational activities. After reviewing FAA guidance, as well as after discussions with the airport operations and air traffic control personnel, the following specific goals were identified for the taxiway system at ORF:

- Accommodate all existing and projected users
    - The existing and forecasted fleet mix (for commercial, cargo, and general aviation activity) should be considered when evaluating the taxiway system
- Reduce runway crossings
    - The opportunity for runway incursions can be reduced by minimizing the number of runway crossings on the primary runway
- Reduce risk of pilot confusion
    - Complexity of the taxiway system can lead to pilot confusion, which can lead to human error and the increased potential for runway incursions. Reducing the risk for pilot confusion includes:
        - Reducing the number of taxiways intersecting at a single location
        - Increasing the pilot's situational awareness (through proper signage and marking)
        - Avoiding wide expanses of pavement
        - Removing "hot spots"
        - Increasing visibility
- Allow for expandability of all Airport facilities
    - The taxiway system should be designed to enable the long-term expansion of other aviation facilities and the ability to provide efficient airside access to developable parcels of the airport.
- Adhere to all FAA design standards (based on ADG and TDG).
    - Taxiways should be developed to the appropriate FAA standards associated with the ADG and TDG of the design aircraft

Many of these objectives are addressed in the development concepts of the Master Plan. The design standards are addressed below.

Taxiway Design Standards

Similar to runways, taxiways are subject to FAA design requirements such as pavement width, edge safety margins, shoulder width, and safety and object free area dimensions. The FAA standards in relation to taxiways (as defined in AC 150/5300-13A, *Airport Design*) are described below.

Table 4-21 – Taxiway Design Standards based on Airplane Design Group (ADG)

Design Standard	ADG		
	III	IV	V
Protection Standards			
Taxiway Safety Area (TSA) Width	118 feet	171 feet	214 feet
Taxiway Object Free Area (TOFA) Width	186 feet	259 feet	320 feet
Wingtip Clearance	34 feet	44 feet	53 feet
Paved Taxiway Shoulders	Recommended	Required	
Separation Standards			
Taxiway Centerline to Parallel Taxiway	152 feet	215 feet	267 feet
Taxiway Centerline to Fixed or Moveable Object	93 feet	129.5 feet	160 feet

Source: FAA AC 150/5300-13A, CHA, 2018.

Table 4-22 – Taxiway Design Standards based on Taxiway Design Group (TDG)

Design Standard	TDG		
	3	4	5
Protection Standards			
Taxiway Width	50 feet		75 feet
Taxiway Edge Safety Margin	10 feet		15 feet
Taxiway Shoulder Width	20 feet		30 feet

Source: FAA AC 150/5300-13A, CHA, 2018

<u>Taxiway Width and Shoulders</u> –Taxiway widths and standards are based on an airport's Taxiway Design Group (TDG), which is currently a 5 for ORF and TDG 3 for Taxiway F. The recommended taxiway width is 75 feet for TDG 5 and 50 feet for TDG 3 taxiways. Presently, all taxiways at ORF meet the required width standards. Similar to runways, shoulders are recommended for taxiways as well. For a TDG 5 airport, this requirement is 30 feet. Only Taxiway V meets the shoulder requirements. Taxiways A and F have no shoulders, while Taxiway C and J shoulders are too narrow and unpaved. Like runways, the distance of taxiway centerlines from fixed and/or movable objects is also critical. Taxiways A, J, and F meet this design standard, while Taxiways C and F do not. These are both as a result of access roads impeding the object free area, by the Runway 23 end and by the fuel farm, respectively.

<u>Taxiway Safety Area (TSA) and Taxiway Object Free Area (TOFA)</u> – Like runway safety area and object free area standards, for taxiways these are based on the prescribed TDG of 5 at ORF. Presently, all taxiways at the Airport follow the proper TSA dimensions. Taxiways A, J, and V meet TOFA dimension standards, but C and F do not. These deficiencies are caused by the same access road impeding the taxiway centerline to fixed/movable object design standard. To ensure these areas are free of potentially hazardous objects non-essential to air navigation or aircraft ground movements, the access road should be realigned. To enhance safety, a Modification of Standards (MOS) is required if these objects will not be relocated outside of the OFA.

Taxiway Fillets – For taxiway turns onto runways, aprons, or additional taxiways, there are FAA design standards for the geometry of the fillets, based on the angle of the turn. Currently, only Taxiway C fails to comply to these fillet dimensions. It is recommended that the additional pavement necessary to bring this fillet up to standard be applied.

The identified taxiway deficiencies can be summarized as follows:

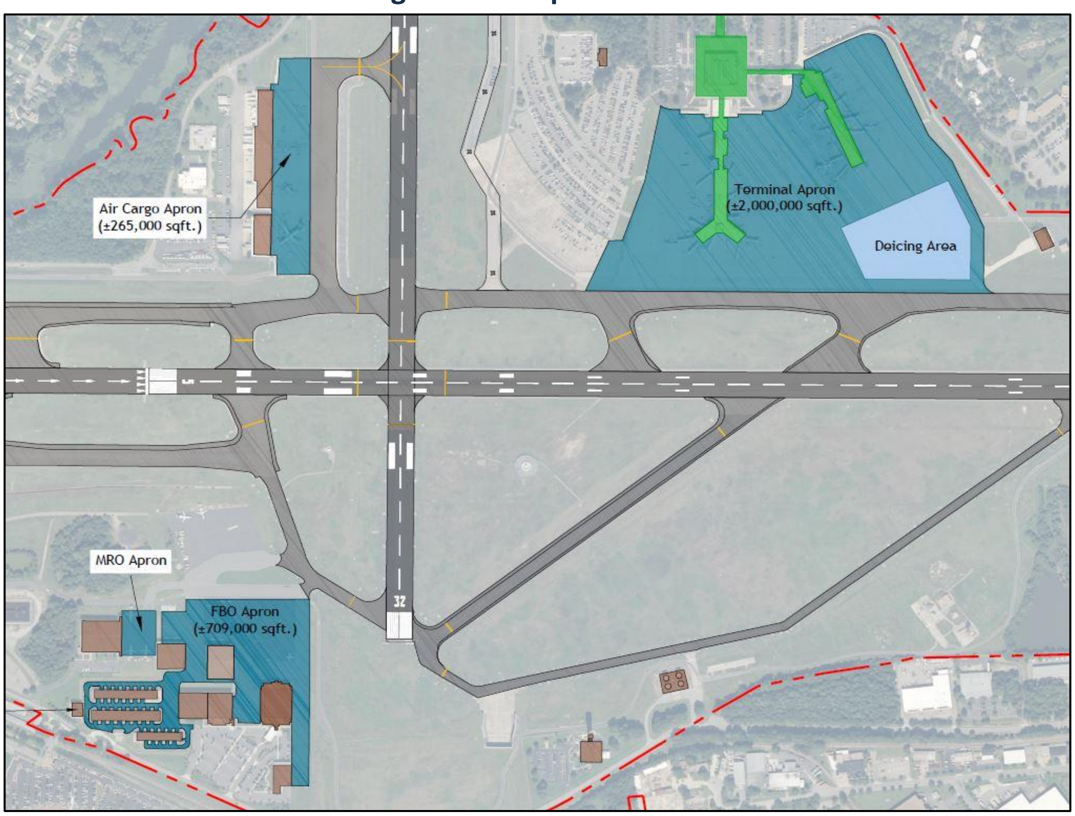
- Paved taxiway shoulders are inadequate on Taxiways A, C, F, and J
- Taxiway C and F do not meet the requirements pertaining to the distance of taxiway centerlines from fixed and/or movable objects
- Taxiways C and F contain portions of the paved service road within the TOFA
- Taxiway C fails to comply with fillet dimensions

Taxiway deficiencies were addressed during the development of recommended taxiways alternatives, as necessary, and will be further addressed through future projects at the Airport.

4.3.4 Aprons

Aircraft parking aprons are intended to accommodate a variety of functions, including the loading and unloading of passengers or cargo, the refueling, servicing, maintenance, and parking of aircraft, and any movements of aircraft, vehicles, and pedestrian's necessary for such purposes. As depicted in **Figure 4-4**, there are three distinct apron types at ORF that serve various functions: terminal apron, general aviation apron, and cargo apron.

Figure 4-4 – Apron Areas



Source: Norfolk International Airport, CHA 2018.

Terminal Apron

The terminal apron is comprised of the facilities used for commercial aircraft gate parking as well as airline support and servicing operations. The terminal apron and its facilities must be able to accommodate the current and future fleet mix of commercial aircraft. Currently, most commercial aircraft operating on the terminal apron consist of Group III aircraft, followed by Group II (with occasional Group IV and Group V operations). ORF has 23 gate positions, 20 of which can accommodate up to Group III aircraft, while the remaining three accommodate Group II aircraft.[23]

The terminal apron is approximately 238,600 square yards, 100,000 square yards of which is designated for aircraft parking at the gates (41,000 square yards and 59,000 square yards for aircraft gate parking at A Concourse and B Concourse, respectively). Approximately 34,300 square yards of the apron is utilized for Remain Overnight (RON) parking, diversion parking, and/or deicing operations. The remaining 10,300 square yards consist of taxilanes and general circulation areas.

Remain Overnight (RON) and Diversion Parking/Commercial Air Carrier Deicing Operations

The northeast side of the terminal apron is currently reserved for remain overnight (RON) aircraft but is also utilized for other activities (see below) when needed.

Typically, there are 14 aircraft that remain overnight at the gates, as well as three on the RON designated ramp, two at hard-stands on the ramp, and four at a hangar in the GA area; however, these numbers are projected to increase (per interviews with airline personnel).

ORF can accommodate diverted aircraft in the RON parking area on a case-by-case basis. This area is also designated for commercial air carrier deicing operations during unfavorable weather conditions, with four deicing positions.

At times, given that this area of the apron is shared between RON and diversion parking, as well as deicing operations, the apron space can become constrained, which in turn can cause delays. Space alternatives for such activities are further evaluated in **Chapter 5**.

General Aviation Parking & Apron Space

GA activity at ORF represents approximately 30.8 percent of total annual airport operations and includes various types of private, corporate, and business aircraft flights. GA aircraft are accommodated by the Fixed Based Operator (FB0), Signature Flight Support. For this analysis, a peak month-average day (PMAD) methodology was used to gauge the approximate number of GA aircraft that park on the FBO aprons during an average day of the peak month. The following is a description of the PMAD aircraft parking evaluation shown in **Table 4-23**.

- GA Itinerant Operations – According to the ORF activity data for 2017 (described in **Section 3.8.3**), itinerant GA operations accounted for approximately 94.8 percent of total GA operations.

[23] Since the analyses conducted herein, Gate 26 has been removed; therefore, the Airport has 22 gate positions, 20 of which can accommodate up to Group III aircraft, while the remaining two accommodate Group II aircraft. It is important to note the calculations herein were based on the initial 23 gate positions.

- GA Peak Month Itinerant Operations – After analyzing data obtained from the Air Traffic Control Tower at ORF, the month of July was determined as the peak month. In July 2017, ORF received approximately 9.9 percent of its total Itinerant GA operations.
- GA PMAD Operations – The GA peak month itinerant operations were divided by the number of days in July (31).
- GA Itinerant Arrivals – The number of PMAD operations was reduced by half to derive the approximate number of GA itinerant arrivals requiring parking.
- GA Itinerant Aircraft Parked on the Apron – According to the FBOs, GA itinerant arrivals typically remain parked on the apron for an extended period during the day; therefore, parking space should be provided for the number of aircraft anticipated to use the apron during an average day of the peak month. For the purposes of this evaluation, it was assumed that 80 percent of itinerant GA operations utilize the FBO aprons and, in turn, was used in the subsequent analysis for apron space.

Table 4-23 – GA Itinerant Aircraft Parked on the Apron

Activity	Base	PAL 1	PAL 2	PAL 3	PAL 4
GA Operations	22,760	24,850	27,132	29,624	32,344
GA Itinerant Operations	21,583	23,565	25,729	28,091	30,670
Peak Month GA Itinerant Operations	2,146	2,343	2,559	2,794	3,050
PMAD Itinerant GA Operations	69	76	83	90	98
GA Itinerant Arrivals	35	38	41	45	49
GA Itinerant Arrivals Parked on Apron	28	30	33	36	39

Source: NAA, CHA, 2018.

FBO Itinerant Operations Apron

The Signature Flight Support facilities at ORF, which include hangars, a terminal building, and apron space, are situated on a 29.5-acre site located on the south side of the airfield. Signature has approximately 66,210 square yards (SY) of apron space; however, 5,670 is reserved for MRO services. Of the 66,210 SY of apron space, there is approximately 60,540 SY that can be utilized solely by general aviation operators. Approximately 14,560 SY is exclusively used for aircraft maneuvering purposes, reducing the total available GA apron parking area to approximately 45,980 SY. Signature also provides multiple tie-down spaces. As of 2017, ORF has approximately 87 based aircraft, as shown in **Table 4-24**.

Table 4-24 – Based Aircraft (As of July 2017)

Fiscal Year	Single Engine	Multi-Engine Piston	Turbo-Prop	Jet	Rotorcraft	Total
2017	46	10	9	20	2	87

Source: Signature, NAA, CHA, 2018.

Signature primarily hosts corporate jets and, on standard to busy days, has 35 to 50 itinerant aircraft, with 50 percent remaining overnight. These aircraft operations are typically comprised of the following breakdown: 52.9 percent single-engine piston, 11.5 percent multi-engine piston, 10.3 percent turboprop, 23.0 percent jet, and 2.3 percent rotorcraft.

Applying these percentages to the number of GA itinerant aircraft parked on the apron at peak periods produced the number of each type of aircraft that will need space for parking. General planning assumptions and professional experience were used to determine the following apron space requirements for the different aircraft types (which included clearance and safety areas):

- Single/Multi-Engine Piston = 400 SY per aircraft
- Turboprop = 800 SY per aircraft
- Jet = 1,600 SY per aircraft
- Rotorcraft = 300 SY per aircraft

As discussed in **Chapter 3**, with anticipated growth in GA, there will be a likelihood of an increased numbers of transient aircraft to require short-term storage space at ORF. Anticipated and recommended apron space is presented in **Table 4-25**.

Table 4-25– Anticipated Apron Space

Activity	Base	PAL 1	PAL 2	PAL 3	PAL 4
Annual Operations	**22,760**	**24,850**	**27,132**	**29,624**	**32,344**
Total Apron Space Parking Requirements (SY)	21,486	23,459	25,613	27,966	30,534
Apron Space Available for Parking (SY)	19,618	19,618	19,618	19,618	19,618
Surplus/(Deficit)	**(1,868)**	**(3,841)**	**(5,995)**	**(8,348)**	**(10,916)**

Source: AC 150/5300-13A: Appendix 5, CHA, 2018.

FBO Facilities Apron Storage Summary

According to the ORF activity data for 2017, and as previously discussed, itinerant GA operations accounted for approximately 94.8 percent of total GA operations at the Airport. Many of these operations utilized itinerant parking aprons and tie-down areas, as well as hangar space in the GA area. Itinerant aprons are typically utilized for transient aircraft that are only visiting or remaining at the airport for a short period of time (i.e., a few hours to overnight). Should an aircraft be at the airport for longer, tie-down parking is typically used to clear the itinerant apron for additional aircraft.

Given the transient nature of the small jets in the forecast period, it is important to note that most of these aircraft will likely utilize itinerant parking aprons, tie-down areas, and apron storage space, opposed to hangar space. Aircraft aprons provide parking and tie-down positions for based and itinerant aircraft, as well as staging areas for aircraft stored in conventional hangars; however, hangar space is typically reserved for aircraft based at the FBO.

In the GA area, there is a large apron area that can provide up to 36 asphalt tie-down positions (depending on aircraft size). These tie-down spaces predominately serve Group I aircraft. Tie-down space requirements differ from itinerant apron parking space due to the clearance requirements per FAA AC 150/5300-13A, *Airport Design*. Essentially, aircraft parked in tie-down spaces must be provided adequate clearance from wing-tip to wing-tip (a minimum of 10 feet) but may park up-to the Object Free Area (OFA) of adjacent movement areas.

Given that the FBO has a limited, fixed number of tie-down points, these aircraft parking spaces are typically reserved for local aircraft with contract leases for those locations; however, apron parking is available. Signature provides both T-hangars and bulk hangar space at a daily rate for itinerant aircraft. In addition to tie-down parking, Signature typically offers hangar storage for itinerant users, should they not want the aircraft parked outside in less than optimal conditions.

As previously mentioned, there are approximately 36 apron tie-downs on the FBO's aprons; however, according to the FBO only eight tie-downs are currently under a lease contract, which leaves up to 28 available tie-downs. If additional tie-down spaces on the itinerant apron are leased, more space will be required to accommodate itinerant aircraft parking at the FBO. A breakdown of aircraft by type leasing tie-down spaces is presented in **Table 4-26**, while available apron and tie-down space is presented in **Table 4-27**.

Table 4-26 – Based Aircraft Leasing Tie-Down Spaces (As of July 2018)

Aircraft Type	Tie Down
Single Engine Piston	6
Multi Engine Piston	-
Single Engine Turbo Prop	0
Multi Engine Turbo Prop	2
Multi Engine Jet	-
HELO Jet	-
TOTAL:	**8**

Source: Signature, NAA, CHA, 2018.

Table 4-27 – Apron and Tie-Down Space

Tie-Downs	Surface Type	Approximate Size per Tie-Down
Up to 36	Asphalt	443 SY

Source: CHA, 2018.

The FBO does not anticipate the number of lease contracts for tie-downs increasing; therefore, for the purposes of this Study, it wasdetermined that ORF has a sufficient number of tie-down spaces to accommodate future based and itinerant aircraft. As previously discussed, if additional spaces on the itinerant apron are leased, additional parking will be needed to accommodate the loss of itinerant parking; however, it is not anticipated that additional apron parking will be needed.

MRO Aprons

Activity is also associated with one maintenance, repair, and overhaul (MRO) facility, which is subleased to PSA Airlines. In addition to the GA aprons utilized by the FBO tenants, this Study also identified apron requirements for the MRO through interviews. Although its needs were included in the GA itinerant apron requirements, they were included in the overall study. The service apron dedicated to MRO activities measures approximately 5,670 SY and accommodates parked aircraft adjacent to the hangar facility. Based on interviews with the FBO, the apron space dedicated for MRO activities is sufficient for current and future activities.

Cargo Apron

In addition to the GA aprons utilized by the FBO tenant (Signature) and the aprons utilized by the MRO tenant (PSA Airlines), this Study identified apron requirements for the major air cargo operators at ORF. The cargo airlines that have regular operation at ORF include: Federal Express (FedEx), Mountain Air Cargo (MAC), and United Parcel Service (UPS). MAC is a contract carrier for FedEx.

The dedicated air cargo area is on the west side of the airfield, south of the terminal. The cargo apron measures approximately 26,430 square yards; however, only 23,050 SY are utilized for aircraft parking. The remaining apron space is used for equipment storage and parking. Annual cargo operations, cargo fleet mix, and peak month average day departures were analyzed to determine if the current cargo apron can support future growth. Based on the cargo forecast identified in **Chapter 3**, **Table 4-28** shows the growth in cargo operations for the forecast period.

Table 4-28 – All-Cargo Annual Operations Forecast (Square Yards)

Operator	2017	Base	PAL 1	PAL 2	PAL 3	PAL 4
Integrator	2,266	2,309	2,536	2,786	3,061	3,362
Other All-Cargo	163	166	182	200	220	242
Total Operations	**2,429**	**2,475**	**2,719**	**2,987**	**3,281**	**3,604**

Note: Excludes Belly Cargo.
Source: NAA, CHA, 2018.

Cargo operations occurring in the month of December were utilized for 2017 because December was the Airport's peak month in 2017 regarding cargo operations, with approximately 196 operations. Based on the information provided in **Table 4-29**, and conversations with cargo representatives and the NAA, the cargo facilities are currently operating at capacity with all four of the current cargo parking positions currently occupied (see base year). The current cargo fleet mix (A300 and B757) requires that aircraft park at angles adjacent to the cargo building to create space for cargo operations associated with unloading and loading of cargo tonnage and not impact the TOFA of Taxiway V. This is expected to continue as the fleet mix continues to increase in size, requiring angled parking. The Airport is expected to need one additional cargo aircraft parking position by PAL 1, with an additional parking space needed in each PAL to follow for the remainder of the forecast period.

Table 4-29 – PMAD Cargo Operations

Activity	2017	Base	PAL 1	PAL 2	PAL 3	PAL 4
Annual Operations	2,429	2,475	2,719	2,987	3,281	3,604
Annual Departures	1,215	1,238	1,359	1,493	1,640	1,802
PMAD Departures	3	4	5	6	7	8

Source: NAA, CHA, 2018.

The apron footprint, or the area of space the aircraft occupies, for the cargo fleet mix operating from ORF was calculated by multiplying the aircraft wingspan by the length of the aircraft. To determine the apron requirement, an aircraft safety area of 25 feet was added to the wingspan and to the length prior to calculating area with adjacent area for the operation of ground support equipment associated with loading and unloading the aircraft. The apron requirements for the cargo fleet mix at ORF are show in **Table 4-30**.

Table 4-30 – Cargo Fleet Mix Apron Sizing

Aircraft Type	Wingspan (Ft.)	Length (Ft.)	Footprint (SF)	Apron Requirement (SF)	Apron Requirement (SY)
Current Aircraft					
Airbus A300	147.10	177.40	26,096	44,823	4,980
Boeing 757	124.8	155.3	19,380	35,890	3,987
Cessna 208 Caravan	52.1	41.66	2,170	5,881	653
Future Cargo Aircraft at ORF					
Boeing 767-300	156.08	177.43	27,693	47,439	5,271
ATR 72	88.9	89.1	7,923	14,147	1,572

Note: During the forecast horizon, it is expected that A300 and Cessna 208 Caravans will cease cargo operations at ORF. The A600 is expected to continue operations.
Source: NAA, CHA, 2018.

Total apron space, as shown in **Table 4-31**, was determined by taking the apron requirement of the most demanding cargo aircraft utilizing the air cargo-dedicated apron and multiplying it by the PMAD departures. Currently, the A300 is the most demanding cargo aircraft; however, for this analysis, the B767-300 aircraft was assumed to be the most demanding cargo aircraft as it is the projected future design aircraft and most demanding.

Table 4-31 – PMAD Air Cargo Apron Space

Activity	2017	Base	PAL 1	PAL 2	PAL 3	PAL 4
B767-300 Apron Requirement (SY)	5,300	5,300	5,300	5,300	5,300	5,300
PMAD Departures	3	4	5	6	7	8
PMAD Aprons Space Requirement (SY)	15,900	21,200	26,500	31,800	37,100	42,400
Supply	23,050	23,050	23,050	23,050	23,050	23,050
Surplus/(Deficit)	**7,150**	**1,850**	**(3,450)**	**(8,750)**	**(14,050)**	**(19,350)**

Source: NAA, CHA, 2018.

Upon evaluation, the cargo apron has capacity in the base year of approximately 1,850 SY, increasing to a deficit of approximately 19,350 SY by PAL 4; however, this may be relatively misleading. As the required apron space in SY required for one additional aircraft is 5,300 SY, the cargo facilities are operating at capacity in the base year. As such, it is recommended that the Airport expand the cargo facilities in the short-term to accommodate operational demand at the cargo facility. Options for apron expansion, as well as the feasibility of expansion, are further evaluated in **Chapter 5**.

Belly cargo operations carried out by the airlines are handled at a cargo building located outside the air cargo area. The belly cargo area does not have a designated apron area. As such, in the future, the Airport should consider the addition of a belly cargo facility located within the cargo operations area of the Airport.

4.4 PASSENGER TERMINAL FACILITY BUILDING AND GATE REQUIREMENTS

Based upon the activity forecasts indicated in **Chapter 3** and correlated to Planning Activity Levels (PALs) indicated in **Table 4-1**, programmatic terminal requirements were determined to accommodate the growing passenger activity and trends at ORF. Specific facility demands, quantified by area square footages and amounts for various components of the terminal, were generated by applying FAA and International Air Transportation Association (IATA) industry standards with other supporting guidelines. Development of the program projections encompassed:

- Annual and peak hour passenger enplanement data
- Peak hour passenger deplanement data
- Peak hour deplanement
- Aircraft operations data
- Fleet mix trends

The industry standards and guidelines requirements were applied in analyses with appropriate modifications to reflect ORF airline tenant needs, passenger processor functions and passenger activities.

Comparing the programmatic spatial requirements of the "base" year (2018), and each "PAL" to the existing terminal facilities (as of 2017) described in **Chapter 3**, the recommended terminal modifications were identified to accommodate projected passenger activity levels. The forecasted passenger demand throughout the planning period shows steady increase. It is important to understand the projected enplanement growth does not predetermine equal or proportional expansion across all passenger processor areas. Decisions pertaining to expanding or decreasing space take several factors into considerations aside from enplanements, such as passengers' behaviors and industry trends. Passengers are becoming more self-reliant and are using self-service functions, such as kiosks, while airlines are transitioning their fleet to include larger aircraft.

In addition, security, passenger screening and check baggage screening requirements as administered by the federally legislated U.S. Department of Homeland Security (DHS) and most commonly known as Transportation Security Administration (TSA) at airports, will often be perceived as growing disproportionally relative to other passenger processor areas. For the purposes of determining spatial needs of the terminal areas throughout the PALs, the analyses were conducted as a "free-body-analysis". This is to say area determinations did not strongly consider the existing layout, size, and configuration as a variable in determining spatial needs; however, it should be noted that the existing terminal was built in a post-generational age before technological advancements in society, enhanced concessions and security affecting passenger behaviors and needs. This reality needed to be addressed in the development of planned alternatives for present and future needs and improvements driven by demand.

4.4.1 Summary Evaluation Conclusions

As a result of the analysis, the following high-level conclusions addressed on a limited basis the significant processor areas that are either deficient or in need of change as a result of passenger safety measures, passenger activity increases, enhanced passenger experience and airport offerings, or where technology has influenced processing methodologies along with passenger behavior patterns. While the conclusions presented are limited in nature and not meant to be conclusive or all encompassing, they represent overarching concerns for ORF to consider moving forward with providing a good level of service and safety for the traveling public.

- Ticket Lobby – Passenger arrival to the terminal complex in the existing parking deck coupled with passenger flow to the ground level ticketing processor area requires redundancy in vertical circulation utilization and is not intuitive for the traveling public not familiar with the airport. Additionally, the split, or non-contiguous ticket lobbies are cumbersome for passengers that are unsure as to which airline resides in what wing of the ticket lobby. The overall "impression" of the Airport is also hampered and compounded by the dark and dated architecture and furnishing. The configurations of the existing ticket lobbies with the proportions of the areas regarding queuing and circulation and the need to locate explosion detection screening equipment in the lobby is problematic for long term operational efficiencies and flexibility.

  Corrective actions were considered in the development of alternatives that address the deficiencies with the ticket lobby to provide enhanced passenger convenience and *service, flexibility in accommodating new air service, and changing passenger behaviors.*

- Outbound Baggage/Checked and Screened Baggage Processes – ORF cannot effectively address passenger growth with the current outbound baggage processing system. The problem is evident with the location of explosion detection checked baggage screening equipment in the ticket lobby and the airline exclusive use of baggage screen arrangements in the outbound baggage area. The configurations of the existing outbound checked screened baggage system(s) without fail safe redundancy and limited physical area for a 100-percent inline check baggage screening array behind the public curtain lobby is untenable.

  Corrective actions were considered in the development of alternatives that address a consolidated checked baggage screen system with outbound baggage make-up carousels, baggage cart storage, circulation and a configuration that is flexible, to enhance security measures and accommodate for growth and new entrant air carriers.

- Concourse and Security Check Point Screening - Out of gauge concourses, along with trending towards a larger fleet mix and accommodating future gates, coupled with the processing of passengers through multiple security checkpoints, poses challenges in regard to meeting air service demands. The existing concourses were originally designed to accommodate a smaller fleet mix than the current conditions and the forecasted changes into a larger fleet mix, which exacerbated the need for the development of alternatives to consider all-inclusive solutions to this problem. Even though the existing security screen checkpoints were enlarged and remodeled not long ago to address future incremental growth, the idea that there may be a third checkpoint and a third concourse to address larger fleet mix and gate demand dilutes any operation efficiencies over a more conventional single source checkpoint and contiguous post-security concourse(s). Adding more building area in the limited aircraft parking and operations areas with the inherent inefficiencies of multiple checkpoint and concourses will diminish the aircraft parking and pushback operations, i.e., more potential for mishap. In addition, the alternatives presented in this Study develop strategic concession (food and beverage/gift and news) offerings for planning considerations to increase revenue for the Airport and concessionaires while providing an enhanced passenger experience and convenience. Notwithstanding, improvements to the operational conditions of the existing FIS and CBP were also factor into any viable alternatives.

  Corrective actions were strongly considered in the development of alternatives that address this very fundamental issue that will very likely impact the long-term viability of the Airport in providing a sustainable good level of service into the future.

4.4.2 Needs Analysis Summary

Table 4-32 provides a summary of the needs for each of the terminal areas analyzed and evaluated. To better understand the needs presented, the table also provides references for additional information within this chapter.

Table 4-32 – Facility Sizing Summary

Needs Analysis and Evaluation Summary								
Areas	**Section**	**Table**	**2017 (Existing)**	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Gate Demand Analysis								
Gate Forecast Demand – *No.*	4.4.4	4-36	(23)	25	26	27	27	29
Narrow-body Equivalent Gates (NBEG) – *No.*	4.4.4	4-37	(23)	25.8	26.8	27.8	27.8	29.8
Equivalent Aircraft Gates (EQA) – No.	4.4.4	4-37	(23)	26.8	26.8	28.8	28.8	30.8
Concourse Processors								
NBEG Hold Room Area Evaluation - *Sq. Ft. Ea.*	4.4.6	4-38	--	2,444	2,480	2,508	2,526	2,561
Inclusive Hold Room Space Requirement - *Sq. Ft.*	4.4.6	4-39	(35,645)	63,055	66,464	69,722	70,223	76,218
Double-loaded Concourse Circulation - *Sq. Ft.*	4.4.7	4-41	(31,419)	55,320	57,280	59,640	59,640	63,930
Check-in Processors								
Check-in Processes (Ticketing) - *Sq. Ft.*	4.4.8	4-46	(18,087)	10,872	10,344	10,934	10,887	11,616
Airline Ticketing Offices (ATO) - *Sq. Ft.*	4.4.9	4-47	(7,170)	4,200	4,200	4,200	4,900	5,600
Concourse Airline Operation Areas - *Sq. Ft.*	4.4.10	4-48	(37,260)	13,540	17,270	17,270	19,060	20,600
Passenger Security Screening Checkpoint (SSCP) Processors								
Divest/Screen/Recompose Area Requirements								
Concourse A - Divest/Screen/Recompose - *Sq. Ft.*	4.4.11	4-51	(8,573)	6,480	8,100	8,100	9,720	9,720
Concourse B - Divest/Screen/Recompose - *Sq. Ft.*	4.4.11	4-51	(7,330)	6,480	8,100	8,100	9,720	9,720
Consolidated - Divest/Screen/Recompose - *Sq. Ft.*	4.4.11	4-51	--	12,960	14,580	16,200	17,820	19,440
Queuing Area Requirements								
Concourse A - Queuing (10 Minute Wait) - *Sq. Ft.*	4.4.11	4-52	(2,305)	1,280	1,600	1,920	1,920	1,920
Concourse B - Queuing (10 Minute Wait) - *Sq. Ft.*	4.4.11	4-52	(2,131)	1,280	1,600	1,920	1,920	1,920
Consolidated - Queuing (10 Minute Wait) - *Sq. Ft.*	4.4.11	4-52	--	2,56d0	2,880	3,200	3,520	3,840
SSCP Divest/Screen/Recompose/Queuing Combined Area Requirements								
Concourse A and B Combined - *Sq. Ft.*	--	--	(20,329)	15,520	19,400	21,040	23,280	23,280
Consolidated SSCP - *Sq. Ft.*	--	--	--	15,520	17,460	19,400	21,340	23,280
SSCP TSA/LEO Office Requirements								
Concourse A - *Sq. Ft.*	4.4.11	4-51	(1,318)	465	582	582	698	698
Concourse B - *Sq. Ft.*	4.4.11	4-51	(722)	465	582	582	698	698
Consolidated - *Sq. Ft.*	4.4.11	4-51	--	931	1,047	1,164	1,280	1,396
SSCP Exit Lane Requirements								
Concourse A - *Sq. Ft.*	4.4.11	4-52	(2,639)	(2,639)	(2,639)	(2,639)	(2,639)	(2,639)
Concourse B - *Sq. Ft.*	4.4.11	4-52	(2,422)	(2,422)	(2,422)	(2,422)	(2,422)	(2,422)
Consolidated - *Sq. Ft.*	4.4.11	4-52	--	2,600	2,600	2,600	2,600	2,600
Baggage Processors								
Outbound Baggage Screening (CBIS) - *Sq. Ft.*	4.4.12	4-55	(5,550)	6,080	6,120	7,020	7,920	8,820
Outbound Baggage Make-up (BHS) - *Sq. Ft.*	4.4.12	4-66	(7,578)	23,000	25,000	26,500	26,500	28,000
Total Outbound CBIS & BHS - *Sq. Ft.*	--	--	(13,128)	29,080	29,120	33,520	34,420	36,820
Inbound Sort Make-up and Feed - *Sq. Ft.*	4.4.14	--	(39,087)	(39,087)	(39,087)	(39,087)	(39,087)	(39,087)
Inbound Baggage Claim Devices Required – *No.*	4.4.13	4-59	(5)	3.08	3.76	3.84	3.86	4.60
Inbound Baggage Claim Area - *Sq. Ft.*	4.4.13	4-57	(42,720)	38,969	39,635	40,337	40,967	41,543
Airline Baggage Service Offices (BSO) - *Sq. Ft.*	4.4.15	4-60	(3,633)	2,172	2,172	2,172	2,534	2,890
U.S. Customs and Border Protection (CBP)/Federal Inspection Service (FIS) Processors								
Customs and Border Protection Area - *Sq. Ft.*	4.4.16	4-61	(13,722)	16,150	16,150	16,150	16,150	16,150
Concessions								
Pre-Security Concessions								
Food and Beverage - *Sq. Ft.*	4.4.17	4-62	(11,940)	3,690	4,189	4,706	5,193	5,612
Gift and News - *Sq. Ft.*	4.4.17	4-62	(4,440)	1,141	1,295	1,455	1,605	1,735

Services - *Sq. Ft.*	4.4.17	4-62	(2,855)	1,879	2,132	2,396	2,644	2,858
Subtotal Pre-Security Concessions- *Sq. Ft.*	4.4.17	4-62	(19,205)	6,710	7,616	8,557	9,442	10,205
Post-Security Concessions								
Food and Beverage - *Sq. Ft.*	4.4.17	4-62	(8,828)	18,250	20,714	23,276	25,683	27,756
Gift and News - *Sq. Ft.*	4.4.17	4-62	(4.240)	8,320	9,443	10,611	11,708	12,654
Services - *Sq. Ft.*	4.4.17	4-62	(0)	268	305	342	378	408
Subtotal Post-Security Concessions - *Sq. Ft.*	4.4.17	4-62	(13,068)	26,838	30,462	34,229	37,769	40,818
Total Pre & Post Security Concessions - *Sq. Ft.*	--	4-62	(32,273)	33,548	38,078	42,786	47,211	51,023
Concession Storage – *Sq. Ft.*	4.4.17	4-62	(2,217)	2,470	2,804	3,151	3,477	3,758
Rental Car Concessionaires and Ground Transportation								
Rental Car Concessionaires - *Sq. Ft.*	4.4.18	4-63	(12,210)	7,400	7,400	7,400	7,400	8,325
Ground Transportation - *Sq. Ft.*	4.4.18	--	(292)	(292)	(292)	(292)	(292)	(292)
Administration Areas								
Airport Administration - *Sq. Ft.*	4.4.19	4-64	(33,145)	20,715	24,168	27,620	29.922	32,224
TSA Administration - *Sq. Ft.*	4.4.19	4-65	(2,828)	2,913	3,000	3,090	3,183	3,278
Public Restroom Facilities								
Airside Post-Security Public Restrooms (Two, Three and Connected Concourse Scenarios)								
Two Concourse Scenario								
Concourse A Restrooms								
Modules – *No.*	4.4.20	4-66	(1)	2	2	2	2	2
Total Restroom Area- *Sq. Ft.*	4.4.20	4-73	(3,745)	3,810	3,980	4,340	4,340	4,530
Total No. of Fixtures Men's – *No.*	4.4.20	4-71	(24)	18	20	22	22	22
Total No. of Fixtures Women's	4.4.20	4-71	(22)	24	24	26	26	28
Mothers Room (Family) - *Sq. Ft.*	4.4.20	4-73	(105)	210	210	210	210	210
Custodial - *Sq. Ft.*	4.4.20	4-73	(156)	312	312	312	312	312
Subtotal M & W Fixtures – *No.*	4.4.20	4-73	(46)	42	44	48	48	50
Subtotal Area - *Sq. Ft.*	4.4.20	4-73	(4,006)	4,322	4,502	4,862	4,862	5,025
Concourse B Restrooms								
Modules – *No.*	4.4.20	4-66	(2)	2	2	2	2	2
Total Restroom Area - *Sq. Ft.*	4.4.20	4-73	(5,718)	3,810	3,980	4,340	4,340	4,530
Total No. of Fixtures Men's – *No.*	4.4.20	4-71	(31)	18	20	22	22	22
Total No. of Fixtures Women's – *No.*	4.4.20	4-71	(30)	24	24	26	26	28
Mothers Room (Family) - *Sq. Ft.*	4.4.20	4-73	(105)	210	210	210	210	210
Custodial - *Sq. Ft.*	4.4.20	4-73	(156)	312	312	312	312	312
Subtotal M & W Fixtures – *No.*	4.4.20	4-71	(61)	42	44	48	48	50
Subtotal Area - *Sq. Ft.*	4.4.20	4-73	(5,979)	4,332	4,502	4,862	4,862	5,052
Total Area Concourse A & B - *Sq. Ft.*	4.4.20	4-73	(9,985)	8,664	9,004	9,724	9,724	10,104
Total Fixtures Concourse A & B – *No.*	4.4.20	4-71	(107)	84	88	96	96	100
Three Concourse Scenario								
Concourse A Restrooms								
Modules – *No.*	4.4.20	4-74	--	1	1	1	1	1
Total Restroom Area - *Sq. Ft.*	4.4.20	4-75	--	2,445	2,625	2,805	2,805	2,985
Total No. of Fixtures Men's – *No.*	4.4.20	4-74	--	12	13	14	14	15
Total No. of Fixtures Women's – *No.*	4.4.20	4-74	--	15	16	17	17	18
Mothers Room (Family) - *Sq. Ft.*	4.4.20	4-75	--	105	105	105	105	105
Custodial - *Sq. Ft.*	4.4.20	4-75	--	156	156	156	156	156
Subtotal M & W Fixtures – *No.*	4.4.20	4-74	--	27	29	31	31	33
Subtotal Area - *Sq. Ft.*	4.4.20	4-75	--	2,706	2,886	3,066	3,066	3,246
Concourse B Restrooms								
Modules – *No.*	4.4.20	4-74	--	1	1	1	1	1

Total Restroom Area - *Sq. Ft.*	4.4.20	4-75	--	2,445	2,625	2,805	2,805	2,985
Total No. of Fixtures Men's – *No.*	4.4.20	4-74	--	12	13	14	14	15
Total No. of Fixtures Women's – *No.*	4.4.20	4-74	--	15	16	17	17	18
Mothers Room (Family) - *Sq. Ft.*	4.4.20	4-75	--	105	105	105	105	105
Custodial – *Sq. Ft.*	4.4.20	4-75	--	156	156	156	156	156
Subtotal M & W Fixtures – *No.*	4.4.20	4-74	---	27	29	31	31	33
Subtotal Area - *Sq. Ft.*	4.4.20	4-75	--	2,706	2,886	3,066	3,066	3,246
Concourse C Restrooms								
Modules – *No.*	4.4.20	4-74	--	1	1	1	1	1
Total Restroom Area - *Sq. Ft.*	4.4.20	4-75	--	2,445	2,625	2,805	2,805	2,985
Total No. of Fixtures Men's – *No.*	4.4.20	4-74	--	12	13	14	14	15
Total No. of Fixtures Women's – *No.*	4.4.20	4-75	--	15	16	17	17	18
Mothers Room (Family) - *Sq. Ft.*	4.4.20	4-75	--	105	105	105	105	105
Custodial – *Sq. Ft.*	4.4.20	4-75	--	156	156	156	156	156
Subtotal M & W Fixtures – *No.*	4.4.20	4-74	--	27	29	31	31	33
Subtotal Area - *Sq. Ft.*	4.4.20	4-75	--	2,706	2,886	3,066	3,066	3,246
Total Fixtures Concourse A, B & C – *No.*	4.4.20	4-74	--	81	87	93	93	99
Total Area Concourse A, B & C - *Sq. Ft.*	4.4.20	4-76	--	8,118	8,658	9,198	9,198	9,738
Connected Concourse Scenario								
Modules – *No.*	4.4.20	4-78	--	3	4	4	4	4
Total Restroom Area - *Sq. Ft.*	4.4.20	4-77	--	7,335	7,620	8,340	8,340	9,060
Total No. of Fixtures Men's – *No.*	4.4.20	--	--	36	39	42	42	45
Total No. of Fixtures Women's – *No.*	4.4.20	-	--	45	48	51	51	54
Mothers Room (Family) - *Sq. Ft.*	4.4.20	4-77	--	315	420	420	420	420
Custodial – *Sq. Ft.*	4.4.20	4-77	--	468	624	624	624	624
Total M & W Fixtures Connected Concourse	4.4.20	--	--	81	87	93	93	99
Total Area Connected Concourse - *Sq. Ft.*	4.4.20	4-78	--	8,118	8,664	9,424	9,424	10,104
Non-Secure Landside Public Restrooms (Check-in Lobby, Baggage Claim, Atrium)								
Check-in Lobby Restrooms								
Modules – *No.*	4.4.20	4-85	(2)	2	2	2	2	2
Total Restroom Area - *Sq. Ft.*	4.4.20	4-84	(924)	2,160	2,520	2,520	2,880	2,880
Total No. of Fixtures Men's – *No.*	4.4.20	4-80	(12)	12	13	14	15	16
Total No. of Fixtures Women's – *No.*	4.4.20	4-80	(10)	12	13	14	15	16
Mothers Room (Family) - *Sq. Ft.*	4.4.20	4-84	--	210	210	210	210	210
Custodial - *Sq. Ft.*	4.4.20	4-84	(400)	312	312	312	312	312
Subtotal M & W Fixtures - *No.*	4.4.20	4-80	(22)	24	26	28	30	32
Subtotal Area - *Sq. Ft.*	4.4.20	4-85	(1,324)	2,682	3,042	3,042	3,402	3,402
Baggage Claim Restrooms								
Modules – *No.*	4.4.20	4-85	(2)	2	2	2	2	2
Total Restroom Area - *Sq. Ft.*	4.4.20	4-84	(1,874)	1,820	2,350	2,350	2,520	2,520
Total No. of Fixtures Men's – *No.*	4.4.20	4-82	(16)	10	11	12	13	14
Total No. of Fixtures Women's – *No.*	4.4.20	4-82	(12)	10	11	12	13	14
Mothers Room (Family) - *Sq. Ft.*	4.4.20	4-84	--	210	210	210	210	210
Custodial - *Sq. Ft.*	4.4.20	4-84	(182)	312	312	312	312	312
Subtotal M & W Fixtures – *No.*	4.4.20	4-88	(28)	20	22	24	26	28
Subtotal Area - *Sq. Ft.*	4.4.20	4-85	(2,056)	2,322	2.682	2,682	3,044	3,044
Atrium Restrooms								
Modules – *No.*	4.4.20	4-85	(2)	2	2	2	2	2
Total Restroom Area - *Sq. Ft.*	4.4.20	4-84	(3,000)	2,350	2,540	2,710	2,900	3,260
Total No. of Fixtures Men's – *No.*	4.4.20	4-83	(32)	11	12	13	14	15

Total No. of Fixtures Women's – *No.*	4.4.20	4-83	(14)	14	15	16	18	19
Mothers Room (Family) - *Sq. Ft.*	4.4.20	4-84	--	210	210	210	210	210
Custodial - *Sq. Ft.*	4.4.20	4-84	(150)	312	312	312	312	312
Subtotal M& W Fixtures – *No.*	4.4.20	4-83	(46)	25	27	29	32	34
Subtotal Area - *Sq. Ft.*	4.4.20	4-85	(3,150)	2,872	3,062	3,232	3,422	3,782
Total M & W Fixtures Non-Secure Landside	4.4.20	4-83	(96)	69	75	81	88	94
Total Area Non-Secure Landside - *Sq. Ft.*	4.4.20	4-85	(6,530)	7,876	8,786	8,956	9,868	10,288
Circulation Considerations								
Meeter and Greeter Area - *Sq. Ft.*	4.4.21	4-86	(9,382)	2,937	3,335	3,749	4,133	4,471
Public Elevators, Escalators and Stairs								
Baggage Claim – *No.*	4.4.21	--	(2)	(2)+1=3	(2)+1=3	(2)+1=3	(2)+1=3	(2)+1=3
Check-in/Atrium – *No.*	4.4.21	--	(4)	(4)+2=6	(4)+2=6	(4)+2=6	(4)+2=6	(4)+2=6
Elevators								
Baggage Claim – *No.*	4.4.21	--	(6)	(6)	(6)	(6)	(6)	(6)
Check-in/Atrium – *No.*	4.4.21	--	(2)	4	4	4	4	4
Stairs								
Baggage Claim – *No.*	4.4.21	--	(2)	(2)	(2)	(2)	(2)	(2)
Check-in/Atrium - *No.*	4.4.21	--	(2)	(2)	(2)	(2)	(2)	(2)
Moving Walkways (People Mover) – *No.*	4.4.21	--	(0)	1	1	1	1	1

Note: The numbers depicted in parentheses indicate existing conditions in the 2017 (Existing) column through PAL 4 column.
Source: CHA, 2019.

4.4.3 Level of Service Standards

Level of Service (LOS) is an accepted value system of space standards and guidelines that are used to assess performance and congestion levels within terminal facilities, as shown **Table 4-33**. The International Air Transport Association (IATA) *Airport Development Reference Manual, 9th Edition*, was used to define the recommended LOS C standards, unless superseded by ORF Authority, airline and/or other stakeholder preferences. LOS C is typically used as a baseline performance criterion target for most airport terminals and is recommended by IATA as the minimum design standard as it denotes “good level of service”.

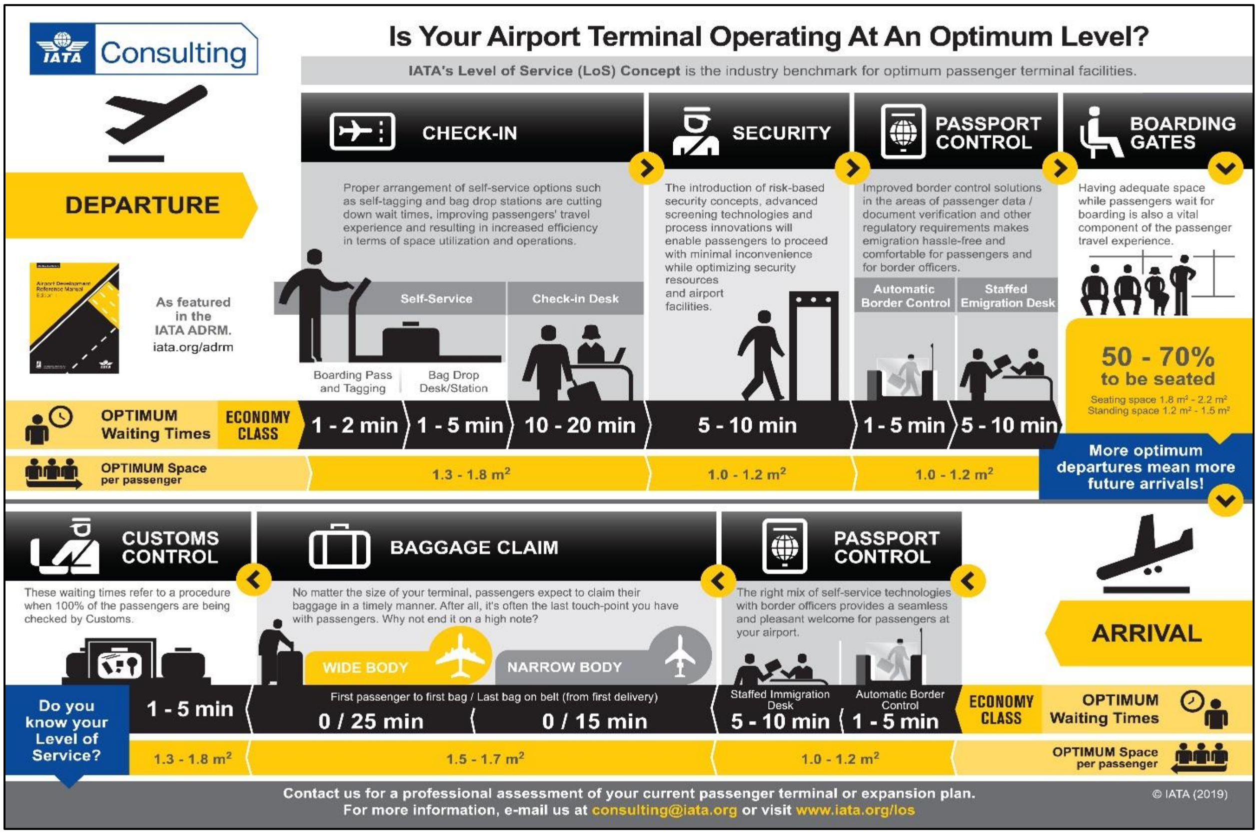
Table 4-33 – IATA Level of Service Grades

Level of Service Grade (LOS)		Level of Service Description
A	Excellent	Excellent level of service; condition of free flow; excellent level of comfort
B	High	High level of service; condition of stable flow; very few delays; high level of comfort
C	Good	Good level of service; condition of stable flow; acceptable good level of comfort
D	Adequate	Adequate level of service; condition of unstable flow; acceptable delays for short period of time; adequate level of comfort
E	Inadequate	Inadequate level of service; conditions of unstable flow; unacceptable delays; inadequate level of comfort
F	System Breakdown	Unacceptable level of service; condition of cross flows; system of breakdown and unacceptable delays; unacceptable level of comfort

Source: International Air Transport Association (IATA), ADRM, 9th Edition, CHA, 2019.

Figure 4-5 is a pictogram from The International Air Transport Association (IATA) *Airport Development Reference Manual, 10th Edition*, depicting graphically, in a summary presentation, optimum wait times associated with certain processor functions within the terminal building.

Figure 4-5 – Passenger Terminal Through Process



Source: International Air Transport Association (IATA), ADRM, 10th Edition, CHA, 2019.

4.4.4 Gate Demand Analysis

The analysis for gate demand, or how many aircraft gates are required, was determined using the "Enplaned Passengers per Gate Approach" and "Departures per Gate Approach" methodologies, as prescribed in Airport Cooperative Research Program (ACRP) *Report 25 – Airport Passenger Terminal Planning and Design Manual.* These analyzes are indicted in **Table 4-34** and **Table 4-35**, respectfully. The averages of the two methodologies are represented in **Table 4-36** and correlate to the PALs.

As of 2017, there were 23 existing contact gates at ORF (one-international swing gate, two gates without jet bridges, and 20 gates with jet bridges). With all 23 gates assumed to be operationally equal, each gate has approximately 2.92 ± departures per day in the "base" analysis. Small hub airports with multiple airline carriers historically have lower departures per gates, per day than medium or large hub airports. For the purposes of determining gate demand using accepted planning guidelines, this analysis did not account for gate demand beyond 3.0 departures per gate, per day. Again, this is consistent with the historic nature and practice of gate utilization at small hub airports. If the airline carriers at ORF could effectively align their schedules and maximize preferential gate usage, the number of departures per gate, per day would increase, resulting in a reduction in gate demand.

Gate demand is driven by gate utilization as mentioned above. Other sub-variables impacting gate utilization are fleet mix and departure load factors. Gate demand is not driven solely by enplanement growth with all the other variables staying constant. The forecast data indicated that as airlines transition their fleet to include larger aircraft with more seats, passengers per departure increase; therefore, the airlines conduct fewer departures. Over the 20-year planning horizon, a lot of variable assumptions were made to come to a forecasted gate demand. The planning analysis used a contingency factor to address any erratic spikes in growth or change to address any uncertainty. The contingency factor addressed these issues in a conservative approach by adding gates to each of the calculated gate totals required for each PAL. The results of this analysis are presented in **Table 4-36.**

Table 4-34 – Enplaned Passenger per Gate Approach (PALs)

Enplaned Passenger per Gate Approach					
Year/Activity Level	**Annual Enplaned PAX**	**Annual Departures**	**# of Gates**	**Annual Enplaned PAX per Gate**	**Enplaned PAX per Departure**
2017 (Existing)	(1,672,024)	(23,598)	(23.00)	(72,697)	(70.8545)
Base	1,857,487	24,493	23.00	80,760	75.8375
PAL 1	2,115,424	25,945	24.37	86,800	81.5349
PAL 2	2,376,990	27,598	25.92	91,690	86.1219
PAL 3	2,622,848	28,744	27.00	97,140	91.2485
PAL 4	2,834,623	30,715	28.85	98,247	92.2879

Note: Those numbers depicted in parentheses indicate existing conditions in thr 2017 (Existing) row.
Source: Airport Cooperative Research Program (ACRP) Report 25 – Airport Passenger Terminal Planning and Design Guidebook, CHA, 2019.

Table 4-35 – Departures per Gate Approach (PALs)

Departures per Gate Approach					
Year/Activity Level	**Annual Enplaned PAX**	**Annual Departures**	**# of Gates**	**Annual Departures per Gate**	**Daily Departures per Gate**
2017 (Existing)	1,672,024	(23,598)	(23)	(1,026)	(2.81)
Base	1,857,487	24,493	23.00	1,065	2.92
PAL 1	2,115,424	25,945	23.69	1,095	3.00
PAL 2	2,376,990	27,598	25.20	1,095	3.00
PAL 3	2,622,848	28,744	26.25	1,095	3.00
PAL 4	2,834,623	30,715	28.05	1,095	3.00

Note: Those numbers depicted in parentheses indicate existing conditions in the 2017 (Existing) row.
Source: Airport Cooperative Research Program (ACRP) *Report 25 – Airport Passenger Terminal Planning and Design Guidebook*, CHA, 2019.

Table 4-36 – Gate Forecast Demand (PALs)

Gate Forecast Demand						
Enplanements	**2017 (Existing)**	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Forecasted Gates = N (Existing)	(23)	23	24	25	26	28
Contingency Factor	NA	2	2	2	1	1
Total Gate Demand = N + Contingency Factor	(23)	25	26	27	27	29

Source: CHA, 2019.

4.4.5 Narrow-body Equivalent Gates and Equivalent Aircraft Gate Analysis

As discussed in **Section 4.1.3**, the "design aircraft" or "design aircraft family" represent the most demanding aircraft or grouping of aircraft with similar characteristics (relative to AAC, ADG, TDG) that are currently using or anticipated to use the airport on a regular basis. Currently, ORF has an ARC of D-IV; however, the Airport's ARC is expected to increase to D-IV over the planning horizon. The current and projected design aircraft family, as presented in **Table 4-3**, was used as the basis for normalizing the terminal gates at the Airport and for conducting the gate equivalencies analyses. Gate equivalency analyses were useful in determining holdroom spatial requirements, as well as in determining other processor evaluations and aircraft ramp frontage requirements at the terminal concourses. The results of the analyses are presented in **Table 4-37**. The results of the analyses represent narrowbody aircraft, along with two ADG IV aircraft.

It is important to note that the definition of the term "gate" varies from airport to airport; therefore, it was important to standardize the definition, as airport comparisons are frequently made on the basis of passengers per gate. To standardize the definition of gates when determining holdroom area requirements, two metrics were developed: Narrowbody Equivalent Gates (NBEG) and Equivalent Aircraft (EQA).

Table 4-37 – Gate Equivalencies (PALs)

Design Group	Class and Aircraft	2017 Gate Equivalencies (Existing)					Base Year Gate Equivalencies				
		# of Gates	NBEG		EQA		# of Gates	NBEG		EQA	
			Maximum Wingspan (Feet)	Index	Typical Seats	Index		Maximum Wingspan (Feet)	Index	Typical Seats	Index
I	Small Regional (Metro, B99, J31)	0	49	0.4	25	0.2	0	49	0.4	25	0.2
II	Medium Regionals (SF340, CRJ)	0	79	0.7	50	0.4	0	79	0.7	50	0.4
III	Large Regionals (DHC8, E175)	0	118	1.0	75	0.5	0	118	1.0	75	0.5
III	Narrow-body (A320, B737, MD80)	(21)	118	1.0	145	1.0	23	118	1.0	145	1.0
IIIa	B757 (B757, B757 w/Winglets)	0	135	1.1	185	1.3	0	135	1.1	185	1.3
IV	Wide-body (MD-11, B767)	(2)	171	1.4	280	1.9	2	171	1.4	280	1.9
V	Jumbo (B747, B777, A330, A340)	0	214	1.8	400	2.8	0	214	1.8	400	2.8
VI	A380 (A380, B747-8)	0	262	2.2	525	3.6	0	262	2.2	525	3.6
	Totals	(23)	**NBEG**	23.8	**EQA**	24.8	27	**NBEG**	25.8	**EQA**	26.8

Design Group	Class and Aircraft	PAL 1 Gate Equivalencies					PAL 2 Gate Equivalencies				
		# of Gates	NBEG		EQA		# of Gates	NBEG		EQA	
			Maximum Wingspan (Feet)	Index	Typical Seats	Index		Maximum Wingspan (Feet)	Index	Typical Seats	Index
I	Small Regional (Metro, B99, J31)	0	49	0.4	25	0.2	0	49	0.4	25	0.2
II	Medium Regionals (SF340, CRJ)	0	79	0.7	50	0.4	0	79	0.7	50	0.4
III	Large Regionals (DHC8, E175)	0	118	1.0	75	0.5	0	118	1.0	75	0.5
III	Narrow-body (A320, B737, MD80)	24	118	1.0	145	1.0	25	118	1.0	145	1.0
IIIa	B757 (B757, B757 w/Winglets)	0	135	1.1	185	1.3	0	135	1.1	185	1.3
IV	Wide-body (MD-11, B767)	2	171	1.4	280	1.9	2	171	1.4	280	1.9
V	Jumbo (B747, B777, A330, A340)	0	214	1.8	400	2.8	0	214	1.8	400	2.8
VI	A380 (A380, B747-8)	0	262	2.2	525	3.6	0	262	2.2	525	3.6
	Totals	26	**NBEG**	26.8	**EQA**	27.8	27	**NBEG**	27.8	**EQA**	28.8

Design Group	Class and Aircraft	PAL 3 Gate Equivalencies					PAL 4 Gate Equivalencies				
		# of Gates	NBEG		EQA		# of Gates	NBEG		EQA	
			Maximum Wingspan (Feet)	Index	Typical Seats	Index		Maximum Wingspan (Feet)	Index	Typical Seats	Index
I	Small Regional (Metro, B99, J31)	0	49	0.4	25	0.2	0	49	0.4	25	0.2
II	Medium Regionals (SF340, CRJ)	0	79	0.7	50	0.4	0	79	0.7	50	0.4
III	Large Regionals (DHC8, E175)	0	118	1.0	75	0.5	0	118	1.0	75	0.5
III	Narrow-body (A320, B737, MD80)	25	118	1.0	145	1.0	27	118	1.0	145	1.0
IIIa	B757 (B757, B757 w/Winglets)	0	135	1.1	185	1.3	0	135	1.1	185	1.3
IV	Wide-body (MD-11, B767)	2	171	1.4	280	1.9	2	171	1.4	280	1.9
V	Jumbo (B747, B777, A330, A340)	0	214	1.8	400	2.8	0	214	1.8	400	2.8
VI	A380 (A380, B747-8)	0	262	2.2	525	3.6	0	262	2.2	525	3.6
	Totals	27	**NBEG**	27.8	**EQA**	28.8	29	**NBEG**	2.8	**EQA**	30.8

Note: Those numbers depicted in parentheses indicate existing conditions.
Source: Airport Cooperative Research Program (ACRP) *Report 25 – Airport Passenger Terminal Planning and Design Guidebook*, CHA, 2019.

4.4.6 Concourse Hold Room Analysis

The analysis for hold rooms assumed all gates are equalized to meet Narrow-Body Aircraft hold room standards. This included those aircraft classified as Aircraft Design Group III (B737, A319, A320, MD80, etc.). Based on these assumptions, it was assumed that ORF should plan two positions for Wide-body Aircraft with corresponding hold room accommodations. This included aircraft classified as Aircraft Design Group IV (B767, MD11, and including B757).

The next evaluation was to determine the optimum NBEG hold room size. For planning purposes, it was assumed that all gates are equalized to accommodate the Design Group III narrow-body fleet mix. The evaluation could have also been conducted to address gate utilization with a specific anticipated Design Group for each individual gate, which may have been appropriate in the short-term; however, long-term needs need to be based on the Design Group III-Narrow-Body Fleet Mix. Again, this approach was consistent with the trend for the fleet mix changing to Design Group III and for preferential lease agreements at the gates, allowing flexibility in gate usage by the Airport Authority. The evaluation assumptions, as indicated in **Table 4-38,** followed the progression of growth throughout the planning horizon. The evaluation was based on a LOS B/C which allots 15-square feet for seated passengers and 10 square feet for standing passengers. As a reference point, LOS A would allot 17-square feet for seated passengers and 12-square feet for standing passengers.

The analysis concluded with calculating the inclusive hold room space requirements through the planning horizon, as indicated in **Table 4-39.**

Table 4-38 – Single NBEG Hold Room Area Evaluation (PALs)

Single NBEG Hold Room Area Evaluation												
	2017 (Existing)		BASE		PAL 1		PAL 2		PAL 3		PAL 4	
	Input	Out	Input	Out	Input	Out	Input	Out	Input	Out	Input	Out
Seats on Design Aircraft – *No.*	145		145		145		145		145		145	
Load Factors (%)[1]	79.0%		79.5%		81.1%		82.2%		83.4%		84.2%	
# of Design Passengers		**115**		**116**		**118**		**120**		**121**		**123**
% PAX Seated	80%	92	80%	93	80%	95	80%	96	80%	97	80%	99
% PAX Standing	20%	23	20%	23	20%	23	20%	24	20%	24	20%	24
Seated PAX Area Requirement - *Sq. Ft.*	15	1,380	15	1,395	15	1,425	15	1,440	15	1,455	15	1,485
Standing PAX Area Requirement - *Sq. Ft.*	10	230	10	230	10	230	10	240	10	240	10	240
Seated & Standing Area - *Sq.Ft.*		1,610		1,625		1,655		1,680		1,695		1,725
% Increase for Amenities	10%	161	10%	163	10%	166	10%	168	10%	170	10%	173
% Increase for High Utilization	5%	81	5%	82	5%	83	5%	84	5%	85	5%	87
Hold Room Share Factor - (Decrease)	-(5%)	-(81)	-(5%)	-(82)	-(5%)	-(83)	-(5%)	-(84)	-(5%)	-(85)	-(5%)	-(87)
Adj. Seated & Standing Area (sq. ft.)		**1,852**		**1,870**		**1,904**		**1932**		**1,950**		**1,985**
Podium Width /Position - *Ft.*	4		4		4		4		4		4	
Depth of Podium to Back Wall - *Ft.*	8		8		8		8		8		8	
Podium Queue Depth - *Ft.*	15		15		15		15		15		15	
Area / Podium Position - *Sq. Ft.*		92		92		92		92		92		92
Podium Positions – *No.*	2		2		2		2		2		2	
Total Podium & Queue Area - *Sq. Ft.*		184		184		184		184		184		184
Boarding/Egress Corridor Width - *Ft.*	6		6		6		6		6		6	
Depth of Hold Room - *Ft.*	25		25		25		25		25		25	
Boarding/Egress per Bridge - *Sq. Ft.*		150		150		150		150		150		150
Bridges/Gate – *No.*	1		1		1		1		1		1	
Boarding Corridor Area - *Sq. Ft.*		150		150		150		150		150		150
Total NBEG Hold Room Area (sq. ft.)		**2,428**		**2,444**		**2,480**		**2,508**		**2,526**		**2,561**

Note: Taking the load factor and multiplying by the number of seats on design aircraft results in the number of design passengers.
[1] as indicated in **Figure 3-10**
Source: Airport Cooperative Research Program (ACRP) *Report 25 – Airport Passenger Terminal Planning and Design Guidebook*, CHA, 2019.

Table 4-39 – Inclusive Hold Room Space Requirements (PALs)

Inclusive Hold Room Space Requirements											
2017 (Existing)		BASE		PAL 1		PAL 2		PAL 3		PAL 4	
Contact Gates	Hold Room (SF)	NBEG	Hold Room (SF)	NBEG	Hold Room (SF)	NBEG	Hold Room (SF)	NBEG	Hold Room (SF)	NBEG	Hold Room (SF)
(23.0)	(35,645)	25.8	63,055	26.8	66,464	27.8	69,722	27.8	70,223	29.8	76,318

Note: Those numbers depicted in parentheses indicate existing conditions
Source: CHA, 2019.

4.4.7 Concourse Circulation

For concourses without moving walkways, a corridor width of 20 feet is acceptable for single-loaded concourses and a 30-foot width for double-loaded concourses. For concourses with moving walkways, 15 feet on both sides of the walkway is recommended to allow uncongested circulation. Other factors also impact corridor width such as use of people mover carts, advertising, vending machines, drinking fountains, etc. For the purposes of this evaluation, double-loaded concourses were assumed throughout the planning horizon.

This analysis took the NBEG aircraft width requirements of 118 feet as indicated in **Table 4-37** and added 25 feet for wingtip clearance between aircraft. The widths were then multiplied by the total number of NBEGs for each activity level, as indicated in **Table 4-40**, to determine single-loaded corridor length (also concourse aircraft frontage) to support the gates; however, in the detailed design of aircraft frontage along the concourse, it may be recommended that a 20-foot wingtip clearance be used in the analysis between a narrow-body fleet mix. This would be an operational consideration for the airport to make with the air carriers, but under no circumstances would a wingtip clearance of less than 25 feet be recommend between a narrow-body aircraft and a Design Group IIIa (B757) aircraft and larger.

Table 4-40 – Single-loaded Concourse Corridor Length (PALs)

Single-loaded Concourse Corridor Length											
2017 (Existing)		BASE		PAL 1		PAL 2		PAL 3		PAL 4	
NBEG[1] (#)	Single-loaded Corridor Length[1] (ft.)	NBEG (#)	Single-loaded Corridor Length (ft.)	NBEG (#)	Single-loaded Corridor Length (ft.)	NBEG (#)	Single-loaded Corridor Length (ft.)	NBEG (#)	Single-loaded Corridor Length (ft.)	NBEG (#)	Single-loaded Corridor Length (ft.)
(23.2)[1]	(3,318 ft.)[1]	25.8	3,689 ft.	26.8	3,832 ft.	27.8	3,975 ft.	27.8	3.975 ft.	29.8	4,261 ft.

Note: Those numbers depicted in parentheses indicate existing conditions.
[1] based on the theoretical NBEG determination the single-loaded corridor length was calculated. This does not reflect the existing conditions, but represents the theoretical lengths required for a single-loaded corridor by normalizing the existing gates to accommodate Aircraft Design Group III - Narrow-body Aircraft.
Source: CHA, 2019.

The calculation could be made to determine the corridor and circulation area requirements for a double-loaded concourse based on the previously mentioned criteria for a single-loaded corridor concourse. The double-loaded corridor to support the gates, along with the fact that the existing concourses are double-loaded, was assumed to be the most practical, efficient, and usable analysis for planning purposes.

The double-loaded concourse area analysis to support the NBEGs was calculated by dividing the single-loaded corridor lengths indicated in **Table 4-41** by two, and then multiplying by 30 feet of width to support the circulation needs for a double-loaded concourse throughout the planning horizon.

Table 4-41 – Double-loaded Concourse Corridor Length and Area (PALs)

Double-loaded Concourse Corridor Length and Area											
2017 (Existing)		BASE		PAL 1		PAL 2		PAL 3		PAL 4	
Length[1] (ft.)	Area[1] (sq. ft.)	Length (ft.)	Area (sq. ft)	Length (ft.)	Area (sq. ft.)	Length (ft.)	Area (sq. ft.)	Length (ft.)	Area (sq. ft.)	Length (ft.)	Area (sq. ft.)
(1,313)	(31,419)	1,844	55,320	1,916	57,480	1,988	59,640	1,988	59,640	2,131	63,930

Note: Those numbers depicted in parentheses indicate existing conditions.
includes both existing Concourse A and B. These figures represent existing conditions.
Source: CHA, 2019.

4.4.8 Check-in Lobby

Passenger check-in trends are heavily reliant on technologies which will continue to drive passenger behavior regarding the check-in process. Prior to technology enhancements, the September 11th attacks in 2001, and checked baggage fees, all passengers checked-in and received boarding passes with the majority of the passengers checking a bag. Despite advancements in technology and airlines providing self-service options, some passengers still prefer checking in with an airline representative; therefore, the need to maintain an acceptable level of service remains in place, despite the airlines best marketing efforts to drive all passengers to use non-airline agent check-in procedures. General preferences and other socioeconomic factors affect this needed level of service.

The emergence of self-service equipment has proven itself beneficial for passengers (and airlines) regarding checking in and printing boarding passes, either on, or off-airport property, and self-bag check. These capabilities have the potential to reduce the demand for ticket lobby space and occupied ticket agent positions. Regardless of technological advances, there will always be a spatial need at airports for passengers to check-in, obtain a boarding pass and check baggage; however, ticketing halls as we know them now may be entirely different as time goes on. In the future the ticketing hall could be repurposed as a passenger baggage drop hall where only those passengers checking through baggage will access the processor area.; however, the need for passengers to obtain paper boarding passes, address oversize or out-of-gauge baggage requirements, and the need for access to customer services will be present throughout the planning horizon. It is not unreasonable to assume these needs may be addressed by self-help, self-service kiosks without airline agent assistance or intervention to the greatest extent possible.

This analysis for the check-in processors addressed and assumed certain passenger trends through the planning horizons (PALs) with a mix of full-service agent positions (where passengers complete their entire transaction with an agent), bag drops (where passengers drop bags after checking-in online or at a kiosk), self-service kiosks, curbside, and an estimate for the number of passengers who complete check-in offsite (i.e. at home, via mobile device, etc.) While this analysis did not consider passenger self-bag tag and drop processes, it should be noted that several large domestic terminals are installing this type of self-serve equipment; however, the current TSA protocols in place require an airline agent to determine identification. Over the planning horizon it was assumed that ORF will not see these technologies sufficiently put into service to affect the spatial needs indicated. Definitions of the types of check-in functions available at an airport are described below.

- Bypass (Internet PC/Mobile Device) Check-in: Passengers who do not check bags and are able to check-in remotely, prior to arriving to the terminal and do not use terminal check-in processors.
- Self-Service Kiosk Check-in: Stand-alone kiosks can be located remote from the ATO counter in the check-in lobby or throughout the terminal. Kiosks print boarding passes but usually do not provide the ability to print bag tags because they are not staffed. When kiosks are located at the ATO ticket counter, they are typically configured in pairs with a bag well, which often includes a baggage scale between pairs. These combined ATO/Kiosk positions provide bag tag printing and bag acceptance by airline or ground handling agents who usually support multiple kiosk positions.
- Baggage Drop Positions: Airline staff or agents accept bags from passengers who check-in via internet PC/mobile device or at a kiosk for a two-step process.
- Full Service (Agent) Check-in: Airline staff or agents may assist passengers with boarding passes, rebooking, and where check-in bags are accepted.
- Curbside Check-in Processors: Typically, curbside check-in facilities are equipped with conveyor belts located at the check-in podiums for direct input of bags into the outbound baggage system. At smaller airports (or for airlines who do not wish to pay for conveyors) checked bags may be placed on carts and taken into the check-in lobby to be transferred to the ATO counter bag conveyor.

The LOS assumptions for passenger check-in behaviors at ORF through the planning horizon are shown in **Table 4-42** and **Table 4-43**.

Table 4-42 – IATA Level of Wait Time Standard for Check-In (Minutes)

Type of Service	Short to Acceptable (min.)	Acceptable to Long (min.)
Full Assist Economy Check-in	0-10	10-20
Kiosk Boarding Pass	1-2	2-5
Agent Assist Bag Drop	1-5	5-10

Source: International Air Transport Association (IATA), ADRM, 10th Edition, CHA, 2019.

Table 4-43 – IATA Level of Service Space Standard for Check-In (sq. ft. per PAX)

Type of Service	A	B	C	D	E	F
Few carts and few PAX with check-in baggage	18.3	15.0	12.9	11.8	9.6	<9.6
Few carts and 1 or 2 pieces of baggage per PAX	19.4	16.1	14.0	12.9	11.8	<11.8
High percentage of PAX using baggage carts	24.8	20.5	18.3	17.2	16.1	<16.1
"Heavy aircraft" flights with 2 or more items per PAX and a high rate of PAX using baggage carts	28.0	24.8	21.5	20.5	19.4	<19.4

Note: Recommended row width between stanchions is 4.0 to 4.5 feet.
Source: International Air Transport Association (IATA), ADRM, 9th Edition, CHA, 2019.

All airlines currently in operation at ORF actively encourage online or mobile check-in before arriving at the terminal. To encourage passengers to use the self-service functions provided, one airline at ORF charges a nominal fee if the boarding pass is printed by an agent at the Airport. Another airline charges for baggage needing to be checked through at the gate to address the phenomenon of passengers by-passing the check-in processor area to avoid the checked baggage fees.

This analysis assumed 40 percent of all enplaned passengers check baggage through at the check-in lobby, with an additional 10 percent checking baggage through at the departure gate. This equated to a total of 50 percent of all passengers checking a bag with an agent. This latter passenger behavior is addressed in **Section 4.4.13** for inbound baggage claim. Without curbside check-in and remote baggage drop locations, it was assumed at ORF that 60-percent of the enplaned passengers drop baggage off in the check-in processor area. This percentage of baggage drop utilization was assumed to remain constant throughout the planning horizon.

The key to the analysis was to determine the effects of technology, passenger demographics, and trust regarding the check-in process. How many passengers (who are not checking baggage) check-in remote online or with mobile devices (digital boarding passes), thus by-passing the check-in processor area? How many passenger's check-in remote-online or with mobile devices (digital boarding passes), but still access the check-in processor area regarding needing to check their luggage? What demographics still rely strongly on expecting full service check-in processors with agent assistance? Survey data suggests that age demographics factor into passengers' level of trust in handling their own technology processes, thus driving the need for full service check-in processors and agent assistance.

The assumptions for passenger check-in behaviors at ORF through the planning horizon are shown in **Table 4-44**.

Table 4-44 – Enplaned Passenger Check-in Utilizations (PALs)

Enplaned Passenger Check-in Utilization							
Check-in / Bag Drop		2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
Passenger Ticketing by Locations							
Traditional Ticketing Counter with Agent Assistance		--	20%	16%	12%	7%	5%
Terminal Kiosk Ticketing Only		--	10%	8%	6%	5%	2%
Terminal Kiosk Ticketing w/Bag Drop Function		--	35%	32%	27%	18%	8%
Remote Check-in w/Bag Drop Function		--	15%	22%	28%	40%	50%
Curbside Check-in Processors		--	0%	0%	0%	0%	0%
By-Pass Check-in Remote		--	20%	22%	27%	30%	35%
Baggage Check or Drop Locations and Utilization							
Terminal Building	Location	(100%)	100%	100%	100%	100%	100%
	PAX Utilization	(40%)	40%	40%	40%	40%	40%
Curbside	Location	(0%)	0%	0%	0%	0%	0%
	PAX Utilization	(0%)	0%	0%	0%	0%	0%
Off-Airport Location	Location	(0%)	0%	0%	0%	0%	0%
	PAX Utilization	(0%)	0%	0%	0%	0%	0%

Note: Those numbers depicted in parentheses indicate existing conditions.
Source: CHA, 2019.

This analysis assumed that curbside services are not going to be factors in addressing passenger check-in or checked baggage/bag drop functions. In addition, remote off-airport baggage drop locations are not foreseeable in the planning horizon. If these two functions were utilized, the demand to provide area within the terminal for these functions may have been reduced.

Assumptions:

- Transaction time for checking in at a kiosk is 2.5 minutes.
- Transaction time for agent assistance is 5.0 minutes.
- Transaction time for checking a bag (baggage drop) is 1.7 minutes.
- Ticketing check-in and bag drop counters area assumes 5.5-linear feet per position (includes baggage scale), 15-foot depth from back wall to face of counter, 8-foot circulation easement form face of counter to queuing line, and 24 feet of queue depth.
- Kiosk area, assuming free standing kiosks not integral to counter, are 9-square feet per kiosk with 25-square feet of circulation space.
- 40-percent of passengers check baggage in the traditional ticket lobby throughout the planning horizon.

Throughout the planning period:

- Curbside positions are not a service provided through the planning horizons.
- The quantity of agent assist positions decreases incrementally.
- The quantity of baggage check and drop positions increases incrementally as passengers arrive at the terminal with checked-in status only needing to check and drop baggage in the check-in hall.
- The quantity of passenger self-service kiosks within the terminal facility decreases incrementally as passenger's check-in remote and/or with mobile devices.

Table 4-45 – Passenger Check-in Requirements (PALs)

Passenger Check-in Requirements						
Check-in Modes	**2017 (Existing)**	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Traditional Agent Assist Positions (Full Service) – *No.*	(44)	12	10	10	8	8
Self-Service Kiosks – *No.*	(10)	17	14	10	9	8
Baggage Check-in and Drops Positions – *No.*	--	14	15	17	19	21

Note: Those numbers depicted in parentheses indicate existing conditions.

Source: Airport Cooperative Research Program (ACRP) *Report 25 – Airport Passenger Terminal Planning and Design Guidebook,* CHA, 2019.

In **Table 4-45**, the traditional agent assisted positions were purposely kept at a higher number than the analytical model would suggest. This accounted for any activities associated with international passengers and check-in protocols with ultra-low-cost carriers.

Table 4-46 – Passenger Check-in Hall Area Requirements (PALs)

Passenger Check-in Hall Area Requirements						
Areas	2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
Base Area - *Sq. Ft.*	--	7,248	6,896	7,289	7,258	7,744
Circulation Factors or 1.50[1] - *Sq. Ft.*	--	3,624	3,448	3,645	3,629	3,872
Total Passenger Check-in Hall Area - *Sq. Ft.*	(18,087)[2]	10,872	10,344	10,934	10,887	11,616

Note: Those numbers depicted in parentheses indicate existing conditions.

[1] the generally acceptable circulation factor is 1.25 times the base area for passenger check-in hall area requirements. This analysis concludesd that an acceptable factor is 1.50 to address any errant airline operational policies and/or procedures, non-common equipment and facilities use participation among the airlines and inherent inefficiencies with the existing structure renovating existing areas into a new or expanded use.

[2] not including area for the outbound baggage screening functions and EDS equipment in the ticketing lobby.

Source: CHA, 2019.

It should be noted that during periods of low demand, the check-in lobby may be perceived as oversized. ORF has migrated towards common-use facilities to address the ultra-low-cost carriers. These efforts should continue when advancing common-use facilities to help balance demand loads between the airlines and achieve a higher level of efficiency in the check-in lobby. Partial or full common-use facilities would allow for the ticketing lobby to adequately serve a demand beyond the planning period and for more flexibility in adjusting to changing conditions, such as the addition of new carriers.

4.4.9 Airline Ticket Offices (ATO)

When calculating ATO requirements for legacy airline carries, 900 square feet of office space per air carrier was assumed for planning purposes. Legacy carriers have begun following market trends similar to those provided by ultra-low-cost carries (Allegiant, Frontier, etc.), offering low-cost services by eliminating many traditional passenger services and reducing many airport-specific overhead costs; therefore, for the purposes of this Study, 700 square feet of office space per air carrier was assumed, along with the assumption that ORF will gain two additional airline carriers during the planning period.

Table 4-47 – Airline Ticketing Offices (PALs)

Airline Ticketing Offices											
2017 (Existing)		Base		PAL 1		PAL 2		PAL 3		PAL 4	
Airlines (#)	ATO (sf)	Airlines (#)	ATO (sf)	Airlines (#)	ATO (sf)	Airlines (#)	ATO (sf)	Airlines (#)	ATO (sf)	Airlines (#)	ATO (sf)
(6)	(7,170)[1]	6	4,200	6	4,200	6	4,200	7	4,900	8	5,600

Note: Those numbers depicted in parentheses indicate existing conditions.

[1] as indicated in **Table 2-10**

Source: CHA, 2019.

4.4.10 Airlines Operations Areas at Gates (Concourse)

Much of the spatial areas beneath the two concourses are built out to support airline and Airport uses, which to some certainty could be summarized as unassigned lease space for airline use. This analysis was based on determining the programmatic area required to support airline activities, specific to ORF. Similar to the trends for ATO space, airlines are looking to reduce overhead costs at airports, as the demand for operational areas has decreased over the years; however, there is still a need for these important activities that require space. To determine the airline operation areas at the concourse locations, a factor of 1,000 square feet for every 100 peak hour enplaned passengers was calculated, as shown in **Table 4-48.**

Table 4-48 – Airline Operation Areas at Gates (PALs)

Airline Operations Areas at Gates						
Function	2017 (Existing)	BASE	PAL 1	PAL 2	PAL 3	PAL 4
Airline Operation Areas at Gates – *Sq. Ft.*	(37,260)[1]	13,540	15,370	17,270	19,060	20,600

Note: Those numbers depicted in parentheses indicate existing conditions.
[1] as indicated in **Table 2-10**
Source: CHA, 2019.

4.4.11 Security Checkpoint Screening

Security screening requirements are subject to regulations set forth by the Transportation Security Administration. The level of security screening and the requirements are subject to change at any time based on the levels of threat and the continued advancement in security screening equipment and requirements.

ORF operates two distinct security check points: one at Concourse A and one at Concourse B. Checkpoints A and B were expanded and remodeled in 2016 and 2014, respectfully. This analysis considered capacity and needs through the planning horizon for both of the existing checkpoints and developed planning data for a single checkpoint, as well as for a consolidated checkpoint.

Checkpoint requirements define the number of TSA document checkers (TDC), the number of checkpoint lanes, and the amount of queue area required to support terminal activity. A checkpoint lane consists of a single or paired advanced imaging technology (AIT) and magnetometer, an x-ray unit with an attached divest and recompose rollers and tables, manual search stations, and benches. A supervisor station is used to monitor each checkpoint area. Demand is affected by airline flight schedules and the upstream flight check-in process. Performance criteria was applied to activity (demand) to determine the number of TDC and screening lanes needed. Dimensional criteria are based on level of service standards and operating requirements. To derive the initial space program, dimensional criteria was applied to the required numbers of TDC and screening lanes, as well as to the number of passengers in the transaction waiting (queues) and recompose areas. For the purpose of detailed planning, separate analyses would have had to be conducted for each checkpoint, taking into consideration the differences in any upstream processes that determine passenger flows into the checkpoint. Determinations for a single checkpoint would be aggregated to formulate the overall program requirement for each of the checkpoint scenarios.

Overall screening lane processing rates, typically stated in terms of passengers per hour per lane, were measured by identifying the total number of passengers passing through the AIT or magnetometer; however, multiple processes within the screening process affect overall throughput. TSA requires that each passenger pass the following screening procedures in sequence to complete the checkpoint screening process: ticketing (boarding pass and passenger identification) document check, divesture of TSA regulated items, AIT or magnetometer scans, recompose, and, if necessary, secondary screening (carry-on baggage and passenger search, or private personal search room screening). Processing rates at checkpoints vary based on the airport, passenger characteristics, and time of year; therefore, these factors were considered when determining the processing rate to be used for calculating the number of checkpoint lanes and the size of the required areas. Divestment and recompose activities are the most time-consuming processes; thus, they were critical determinants of throughput. TSA regulations for divesting personal items requires the use of multiple bins per passenger; similarly, passenger recompose activity - post AIT/magnetometer scanning - can extend the throughput of the x-ray units. Lack of adequate divest and recompose table lengths impede materials reaching the x-ray units, resulting in decreased lane throughput. Extension and/or adding area and table lengths for divesting and recomposing has proven to yield above-average site-specific processing rates.

Checkpoint demand was analyzed against level of service standards that address performance in terms of the time passengers wait for processing, as well as the space allotted for each waiting passenger. The IATA LOS guidelines for checkpoint (same as passport control outbound) wait times are:

- Short to acceptable: 0-5 minutes
- Acceptable to long: 5-10 minutes

Table 4-49 lists the IATA space standards for passengers waiting in a single queue to be screened.

Table 4-49 – IATA Level of Service Standards for Security Screening Checkpoints

Security Screening Checkpoint						
	LOS A	LOS B	LOS C	LOS D	LOS E	LOS F
Checkpoint (IATA Passport Control) per PAX - *Sq. Ft.*	15.0	12.9	10.8	8.6	6.5	<6.5

Source: International Air Transport Association (IATA), ADRM, 9th Edition, CHA, 2019.

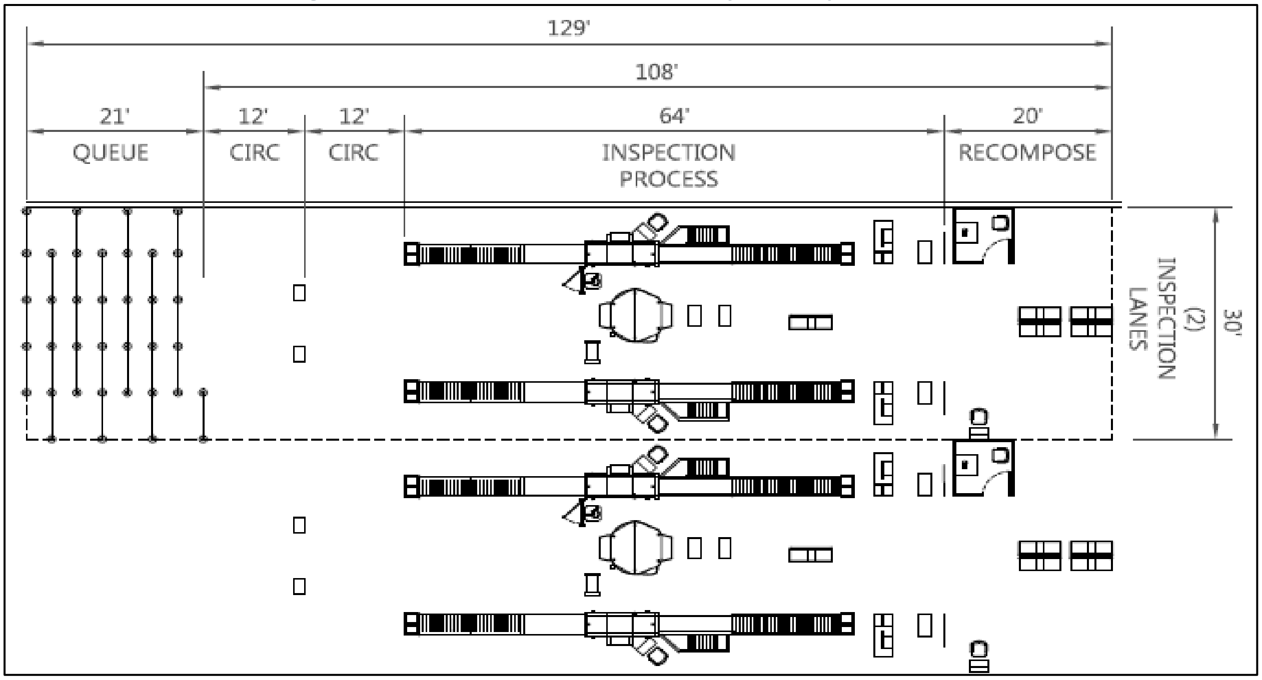
TSA does not provide guidance on level of service duration or spatial guidelines for wait times, or for area per passenger, while in queue; however, it does indicate minimum area allocations for each checkpoint screening lane and its' associated support spaces. The calculations to determine queue areas based on processing rate utilized the longest acceptable IATA standard of 10 minutes with a LOS C; however, queue areas were also calculated to accommodate up to 20 minutes of accumulated passengers waiting for TDC screening to account for fluctuations in staffing. The processing rate per lane in this analysis was 175-passengers per hour, which accounted for a normalized rate of 150 passengers per hour per checkpoint lane, while factoring in TSA Pre✔ TM and airline/airport staff utilization. **Figure 4-6** provides the formula used for calculating queuing area allowances based on wait time. The dimensional effects extended queue depths have on a checkpoint lane pair range from approximately 3,870 square feet to 4,860 square feet, depending on processing rates and wait time variables, to determine queue areas.

Figure 4-6 – Wait Time Calculation

$$\text{Wait Time (min)} = \frac{\text{Total Queue Area (sf)}}{\text{LOS (sf/pax)}} \times \text{Screening Lane Throughput (min/pax)}$$

TSA recommends a minimum of 300 square feet of queuing area per screening lane. This is consistent with the formula as shown in **Figure 4-6**, which assumed a LOS C variable, 150-passenger per hour, per lane processing rate, and a wait time of about 10 minutes. TSA issued *Checkpoint Design Guideline* (CDG), which recommends that airports and local TSA authorities collaborate to establish acceptable goals for airport-terminal-specific wait times and screening lane processing rates for planning purposes. **Figure 4-7** is a generic diagram of a pair of security checkpoint lanes, which is similar to the existing layouts at ORF.

Figure 4-7 – Standard TSA Security Checkpoint Lane



Utilizing the aforementioned assumptions, the dimensional guideline for a checkpoint lane pair with AIT and magnetometer was approximately 3,870-square feet, as depicted in the figure, and consisted of:

- Screening lane pair consisting of the length of each screening lane, including divest tables, x-ray
- machine, agent work area, recompose tables, AIT body scanner, magnetometer, divest bins, and recompose benches
- Private search rooms, manual carry-on baggage search tables, and screening equipment
- Circulation aisle separating the screening lane area from the boarding pass document check agent podium
- Queue stanchions
- Stanchions for ADA-accessible and family queue lanes

The number of security screening lanes was calculated using the peak hour enplanement data indicated in **Table 3-35** (**Chapter 3**). Based on conversations with NAA, it was assumed that enplanement utilization is equally split between the two existing checkpoints. This assumption was applied throughout the planning horizon for determining the number of security screening lanes.

Table 4-50 – No. of Security Screening Lanes at Checkpoints

No. of Security Screening Lanes at Checkpoint											
	2017 (Existing)	Base		PAL 1		PAL 2		PAL 3		PAL 4	
	Nom.	No.	Nom.	No.	Nom.	No.	Nom.	No.	Nom.	No.	Nom.
Concourse A - *No.*	(5.0)	3.87	4.0	4.39	5.0	4.93	5.0	5.45	6.0	5.88	6.0
Concourse B – *No.*	(6.0)	3.87	4.0	4.39	5.0	4.93	5.0	5.45	6.0	5.88	6.0
Consolidated Checkpoint - *No.*	--	7.74	8.0	8.78	9.0	9.86	10.0	10.9	11.0	11.76	12.0

Note: Those numbers depicted in parentheses indicate existing conditions.
Source: CHA, 2019.

The total queue area requirements for all security screening lanes were determined by utilizing the formula in **Figure 4-6**. The results of the calculations, shown in **Table 4-51**, represent the longest acceptable IATA standard of 10-minutes for LOS C; however, to account for delays in TDC screening due to fluctuations in staffing, the total queue area required to accommodate the influx in passengers was determined based on a 20-minute timeframe. To maintain a LOS C, each security lane must be able to process 175 passengers per hour.

Table 4-51 – Security Screening Checkpoint Area Requirements (Not Including Queuing Area)

Security Checkpoint Area Requirements (Not Including Queueing Area)						
	2017 (Existing)	Base[1]	PAL 1[1]	PAL 2[1]	PAL 3[1]	PAL 4[1]
Concourse A - *Sq. Ft.*	(8,573)	6,480	8,100	8,100	9,720	9,720
Concourse B -*Sq. Ft.*	(7,330)	6,480	8,100	8,100	9,720	9,720
Consolidated Checkpoint - *Sq. Ft.*	--	12,960	14,580	16,200	17,820	19,440

Note: Those numbers depicted in parentheses indicate existing conditions.
[1] the area total area requirements for the security checkpoint is the 3,240 square feet as indicated in **Figure 4-7** (not including the queueing area) for every two lanes.
Source: CHA, 2019.

Table 4-52 – Queue Area for All Security Checkpoint Lane (PALs)

Queue Area for All Security Checkpoint Lanes											
	2017 (Existing)	Base		PAL 1		PAL 2		PAL 3		PAL 4	
	Queue Area	10 Min. Wait	20 Min. Wait	10 Min. Wait	20 Min. Wait	10 Min. Wait	20 Min. Wait	10 Min. Wait	20 Min. Wait	10 Min. Wait	20 Min. Wait
Concourse A - *Sq. Ft.*	(2,305)	1,280	2,560	1,600	3,200	1,600	3,200	1,920	3,840	1,920	3,840
Concourse B - *Sq. Ft.*	(2,131)	1,280	2,560	1,600	3,200	1,600	3,200	1,920	3,840	1,920	3,840
Consolidated Checkpoint - *Sq. Ft.*	--	2,560	5,120	2,880	5,760	3,200	6,400	3,520	7,040	3,840	7,320

Note: Those numbers depicted in parentheses indicate existing conditions.
Source: CHA, 2019.

The TSA and LEO office areas, as shown in **Table 4-53,** accounted for three-percent of the queue area for all security checkpoint lanes as indicated in **Table 4-52** and security checkpoint area requirements (not including queuing area) as indicated in **Table 4-51**.

Table 4-53 – Security Screening Checkpoint TSA/LEO Office Requirements (PALs)

Security Checkpoint TSA/LEO Office Requirements						
	2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
Concourse A - *Sq. Ft.*	(1,318)	465	582	582	698	698
Concourse B - *Sq. Ft.*	(722)	465	582	582	698	698
Consolidated Checkpoint - *Sq. Ft.*	--	931	1,047	1,164	1,280	1,396

Note: Those numbers depicted in parentheses indicate existing conditions.
Source: CHA, 2019.

Table 4-54 – Security Screening Checkpoint Exit Lane Requirements (PALs)

Security Checkpoint Exit Lane Requirements						
	2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
Concourse A - *Sq. Ft.*	(2,639)	(2,639)	(2,639)	(2,639)	(2,639)	(2,639)
Concourse B - *Sq. Ft.*	(2,422)	(2,422)	(2,422)	(2,422)	(2,422)	(2,422)
Consolidated Checkpoint - *Sq. Ft.*	--	2,600[1]	2,600[1]	2,600[1]	2,600[1]	2,600[1]

Note: Those numbers depicted in parentheses indicate existing conditions.
[1] the consolidated security checkpoint exit lane is calculated at a width of 15 feet.
Source: CHA, 2019.

4.4.12 Outbound Baggage Facilities

The operational functionality of the outbound baggage system at ORF consists of two components: The Checked Baggage Inspection System (CBIS) and the Baggage Handling System (BHS). The CBIS is utilized by TSA to screen passengers' checked baggage, increasing the safety of the traveling public. After being screened, the baggage is sorted via the airlines' Baggage Handling Systems, where the baggage is then transferred to the appropriate departing aircraft. This analysis looked at both components (CBIS and BHS) separately to determine the final quantities of equipment and the areas required throughout the planning horizon. Each of the six airlines (American, Delta, United, Southwest, Allegiant, Frontier) operating at ORF require baggage make-up facilities. Collectively, these existing facilities are currently housed in the ticketing lobby and behind the ticket lobby in a secure area outbound baggage make-up room. The baggage functions at ORF comprise approximately 30,876 square feet: approximately 4,550 SF in the ticketing lobby and approximately 26,326 SF in the baggage make-up area.

It should be noted that this analysis did not expand on the existing operational functionality of the outbound baggage at ORF. Rather, this analysis aimed to provide planning data for a consolidated and automated Checked Baggage Inspections System (CBIS) with an outbound Baggage Handling System (BHS), which would be located in a non-public area.

Checked Baggage Inspection System Requirements (CBIS)

Table 4-55 depicts the requirements for developing a TSA sponsored and operated Check Baggage Inspection System (CBIS) at ORF.

Table 4-55 – Checked Baggage Inspection System Requirements (CBIS) (PALs)

Checked Baggage Inspection System Requirements (CBIS)						
	2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
Design Hour Baggage Load						
Design Hour PAX Checking In with Surge Factor = 1.25 – *No.*		1,693	1,921	2,159	2,382	2,575
PAX Checking Bags – *No.*		40%	40%	40%	40%	40%
Average # of Bags per PAX – *No.*		1.2	1.2	1.2	1.2	1.2
Bags to Process in Peak Hour – *No.*		813	922	1,036	1,143	1,236
10 Minute Baggage Flow Rate – *No.*		135	154	173	191	206
TSA Surge Factor (Based on a 10 Minute Baggage Flow Rate)		1.17	1.16	1.15	1.14	1.14
Equivalent Baggage Surge Rate		952	1.071	1,194	1,309	1,408
% of Bags That are Over-sized & Too Big For EDS		3%	3%	3%	3%	3%
% of Over-sized Bags Requiring ETD Inspections		29%	32%	36%	39%	42%
Bags to Process Through Level 1 EDS Units – *No.*		924	1,039	1,158	1,270	1,366
EDS/ETD Equipment Requirements						
Level 1 EDS Screening – Process Rate (bags/hour) – *No.*		150	150	150	150	150
Level 1 EDS Units Required – *No.*		7	7	8	9	10
% of Scanned Bags Requiring Level 2 Screen **(Alarm Rate)**		25%	25%	25%	25%	25%
Bags Requiring Level 2 OSR – *No.*		231	260	290	317	341
Level 2 OSR Rate (Bags/Hour per Operator) - *No.*		120	120	120	120	120
Level 2 OSR Stations Required (1 Operator/Station) – *No.*		2	3	3	3	3
% of Resolved OSR Bag reviews **(Clear Rate)**		80%	80%	80%	80%	80%
Bags Needing Level 3 Screening in Peak Hour – *No.*		75	85	94	103	111
Level 3 ETD Screening - Process (Bags/Hour/Screener)		24	24	24	24	24
Level 3 ETD Units Required (2 Screeners/Unit) – *No.*		2	2	2	3	3
Baggage Screening Requirements						
Level 1 Area Per EDS Screening Unit - *Sq. Ft.*		800	800	800	800	800
Required EDS Units – *No.*		7	7	8	9	10
Level 2 Area per OSR Station - *Sq. Ft.*		40	40	40	40	40
OSR Stations Required - *No*		2	3	3	3	3
Area per ETD Screening Units - *Sq. Ft.*		100	100	100	100	100
Required ETD Units – *No.*		2	2	2	3	3
TSA Offices - *Sq. Ft.*		200	200	300	300	400
Total Area Requirements for CBIS - *Sq. Ft.*		6,080	6,120	7,020	7,920	8,820

Source: Airport Cooperative Research Program (ACRP) *Report 25 – Airport Passenger Terminal Planning and Design Guidebook*, CHA, 2019.

Outbound Baggage Handling System Requirements (BHS)

This component of the outbound baggage process consisted of the screened and cleared baggage from the CBIS operation being sorted onto outbound baggage carousels for loading onto tug carts with ultimate delivery to departing aircraft. The analysis took a very conservative approach towards exclusive (individual) use in lieu of preferential (shared or common) use for outbound baggage carousel needs. **Table 4-56** indicates the outbound baggage area requirements, which offer a high degree of exclusive make-up device use, cart stacking, and circulation. It should be noted that the airlines were not actively involved with determining outbound baggage needs.

Table 4-56 – Outbound Baggage System Area Requirements (BHS)

Outbound Baggage System Area Requirements[1]						
	2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
Outbound Baggage System Area Requirements - *Sq. Ft.*	(7,578)[2]	23,000	25,000	26,500	26,500	28,000

Note: Those numbers depicted in parentheses indicate existing conditions.
[1] U.S. Department of Transportation, Federal Aviation Administration, Systems Research & Development Service *Report No. FAA-RD-75-191 – The Apron & Terminal Building Planning Manual, Figure 4-16 dated July 1975*
[2] as indicated **Table 2-10**
Source: CHA, 2019.

4.4.13 Inbound Baggage Claim and Sortation

Inbound Baggage Claim and Claim Devices

The encompassing analysis below addressed both the baggage claim spatial needs for the passenger areas, as well as the capacity and requirements for the baggage claim devises. The first part of the analysis was based on the number of deplaning passengers within a peak 20-minute period to determine the requirements for the active retrieval area and baggage claim frontage, as indicated in **Table 4-57**. The peak hour deplaning data was also used in this analysis [**Table 3-36** (**Chapter 3**)]. For the purpose of this analysis, it was assumed that 50 percent of the deplaning passengers have checked a bag (40 percent at the ticketing counter and 10 percent at the gate). The analysis also assumed a LOS C (18 SF per person) for each individual within the active retrieval area at the baggage carousels. In addition, LOS C for claim frontage per person variable to calculate total claim frontage was required.

It should be noted that, upon observation, not all members of a traveling party (especially families with children) were typically at the claim unit. Rather, one member typically claimed the bags while the remaining members of the traveling party waited in the peripheral area. The number of traveling parties was calculated by taking the one member of the traveling party that actively claimed baggage and then added in the percentage of the additional passengers who may accompany that individual to the claim unit.

The methodology for determining claim device capacities and requirements was further evaluated, beginning with a peak 20-minute arrivals analysis. The forecasted peak hour arrival commercial operations are summarized in **Table 4-58*.***

To determine peak hour arrivals, it was assumed that half the operations are peak hour arrivals. A factor of 50 percent was applied to the peak hour arrivals to produce the 20-minute peak arrivals.

Table 4-57 – Deplaned PAX Baggage Claim Space Requirements (PALs)

Deplaned PAX Baggage Claim Space Requirements											
	2017	BASE		PAL 1		PAL 2		PAL 3		PAL 4	
	(Existing)	Input	Output	Input	Output	Input	Output	Input	Output	Input	Output
Peak Hour Deplaning PAX		1,022		1,160		1,304		1,438		1,555	
% Deplaning in Peak 20 Minutes		50%		50%		50%		50%		50%	
% Terminating PAX		100%		100%		100%		100%		100%	
Peak 20 Min. Terminating PAX – *No.*			511		580		652		719		778
% PAX Checking Bags at TIX		40%	204	40%	232	40%	260	40%	288	40%	311
% PAX Gate Checking Bags		10%	51	10%	58	10%	65	10%	72	10%	78
PAX Checking Bags – *No.*			255		290		325		360		389
Average Travel Party Size – *No.*		1.3		1.3		1.3		1.3		1.3	
Number of Parties – *No.*			196		223		250		278		299
% Additional People at Bag Claim		30%		30%		30%		30%		30%	
Total People at Claim Device – *No.*			273		310		349		384		416
Claim Frontage / Person - LF		1.5		1.5		1.5		1.5		1.5	
Total Claim Frontage Required - *LF*	(841)		410		465		524		576		624
Area/Person in Active Retrieval - *SF*		18		18		18		18		18	
Total Area for Active Retrieval - *SF*	(9,165)[1]		4,914[1]		5,580[1]		6,282[1]		6,912[1]		7,488[1]
Claim Devices Area - *SF*	(6,630)[2]		(6,630)[2]		(6,630)[2]		(6,630)[2]		(6,630)[2]		(6,630)[2]
Baggage Service Offices - *SF*	(2,986)		(2,986)		(2,986)		(2,986)		(2,986)		(2,986)
Circulation - *SF*	(27,425)		(27,425)		(27,425)		(27,425)		(27,425)		(27,425)
Total Baggage Claim - *SF*	(46,206)		41,955		42,621		43,323		43,953		44,529

Note: Those numbers depicted in parentheses indicate existing conditions.
[1] not including area of claim device
[2] each claim device is 1,326 sq. ft x 5
Source: CHA, 2019.

Table 4-58 – Commercial Peak Hour Airline Operations (PALs)

Commercial Peak Hour Airline Operations						
	2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
Operations	(20)	21	22	23	24	26
Peak Hour Arrivals	(10)	10.5	11	11.5	12	13
20-Minute Peak Arrivals	(5)	5	6	6	6	7

Note: Those numbers depicted in parentheses indicate existing conditions
Source: CHA, 2019.

The analysis then normalized the aircraft to Group III Narrow-body aircraft with a 145-seat capacity. Each existing sloped bag claim device is 72 feet by 20 feet, with an effective claim frontage of 168 linear feet. The theoretical baggage storage on each carousel is 336 bags. The calculated practical operational storage was 225 bags. It was assumed that on a flight via a narrowbody aircraft, each passenger checks 1.2 bags. **Table 4-59** below demonstrates that each baggage claim device at ORF can accommodate two narrow-body flight baggage retrieval activities simultaneously. When taking into consideration the data in **Table 4-58** regarding the total number of narrow-body flights, the five existing baggage claim devices are capable of accommodating the 20-minute peak hour demands (depicted in **Table 4-57**) throughout the planning horizon.

Table 4-59 – Baggage Claim Device Capacity (PALs)

Baggage Claim Device Capacity (PALs)	2017 (Existing)		BASE		PAL 1		PAL 2		PAL 3		PAL 4	
	Input	Out	Input	Out	Input	Out	Input	Out	Input	Out	Input	Out
Narrow-body Seating Capacity	145		145		145		145		145		145	
% Load Factor	79%		79.5%		81.1%		82.2%		83.4%		84.2%	
Arriving PAX per Flight – *No.*		115		116		118		120		121		123
Bags per PAX – *No.*	1.2		1.2		1.2		1.2		1.2		1.2	
Bags to Retrieve per Flight – *No.*		138		139		141		144		145		148
of Bag Claim Devices – *No.*	5		5		5		5		5		5	
Baggage Storage per Device – *No.*		225		225		225		225		225		225
NB Flights /Device/20-min – *No.*	1.0		1.0		1.2		1.2		1.2		1.4	
Bags at Each Device/20-min – *No.*		138		139		169		172		174		207

Source: CHA, 2019.

4.4.14 Inbound Baggage Handling Sort Make-up and Feed Belts

The inbound baggage-feeds that connect to the baggage claim devices are located on a lower level under the baggage claim hall. The Airport has five baggage claim devices, with each device having one input belt-feed and the capability of accommodating two baggage tugs with carts; therefore, baggage for two arriving flights can be delivered on the same device simultaneously. This capacity is consistent with the findings from the analysis for the passenger claim devices. This analysis did not calculate the capacities for the inbound baggage handling sort and belt feed areas, but assumed the existing areas and capacities are balanced with the needs to accommodate passenger baggage claim.

4.4.15 Airline Baggage Service Offices (BSO)

Within the terminal and adjacent to the baggage claim devices are the airline baggage service offices, which comprise approximately 3,633 square feet of space. A typical baggage service office module at ORF is approximately 362 square feet and consists of a public service area, as well as a storage room. With all things being equal amongst the airlines in area requirements for their baggage service offices, the total existing area could support approximate 10 typical airline baggage service office modules through the planning horizon. **Table 4-60** summarizes the area needed for airline baggage service offices with the anticipated number of airline carriers in the ORF market.

Table 4-60 – Airline Baggage Service Offices (PALs)

2017 (Existing)		BASE		PAL 1		PAL 2		PAL 3		PAL 4	
No. of Airlines	BSO Area	No. of Airlines	BSO Area	No. of Airlines	BSO Area	No. of Airlines	BSO Area	No, of Airlines	BSO Area	No. of Airlines	BSO Area
(6)	(3,633)	6	2,172	6	2,172	6	2,172	7	2,534	8	2,890

Note: Those numbers depicted in parentheses indicate existing conditions.
Source: CHA, 2019.

4.4.16 U.S. Customs and Border Protection (CBP)/Federal Inspection Services (FIS)

ORF has a fully functioning Federal Inspection Services (FIS) at Concourse A that meets ORF's current needs and demands, with the ability process up to 175 passengers per hour. The facilities are also capable of handling aircraft as large as a Boeing 747, although, apron and terminal constraints are present. ORF does not currently have scheduled international air carrier service; however, on occasion, the Airport will receive a diversion requiring the use of these facilities. U.S. Customs and Border Protection (CBP) will process the passengers. CBP also processes approximately three charter flights per year. This analysis assumed that ORF's current CBP facilities are adequate. Thus, an upgrade is not required to meet the current demand, subject to approval; however, if the Airport desires to provide scheduled international services, improvements and upgrades are warranted. The U.S. Customs and Border Protection's *Airport Technical Design Standards, 2006*, includes programmatic requirements for a CBP facility that can process up to 400 peak-hour arriving international passengers, which is the equivalent of two narrow-body flights, or up to one jumbo aircraft (Boeing 747), within one hour. The required spatial needs are represented in **Table 4-61**.

Table 4-61 – U.S. Customs and Border Protection (CBP)/Federal Inspection Services (FIS)

U.S. Customs and Border Protection (CBP)/Federal Inspection Services (FIS)						
	2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
CBP and International Arrivals – *Sq. Ft.*	(13,722)	16,150	16,150	16,150	16,150	16,150

Note: Those numbers depicted in parentheses indicate existing conditions.
Source: U.S. Customs and Border Protection, Airport Technical Design Standards, 2006, CHA, 2019.

4.4.17 Concessions

Concessions' space requirements represent the areas of the terminal facility directly related to and utilized for concessions, both airside and landside, including storage requirements. Each concession area requirement was divided into specific concession types: food and beverage, gift and news, and services such as advertising, information desks, banking, health counters, ATM, foreign currency exchange, etc.

The overall concession requirements were based on the formula in **Figure 4-8**.

Figure 4-8 – Total Concession Calculation

$$\text{Total Concession Area (SF)} = \frac{\text{Enplaned PAX}}{1{,}000} \times 18 \text{ SF}$$

Industry standard planning guidelines would suggest the pre-security concessions encompass 10 percent of the total concession requirements for O&D airports, while post-security concessions would make up the remaining 90 percent. Given the characteristics of ORF, it was assumed that 20 percent of the total concessions are pre-security concessions; therefore, post-security concessions were calculated at 80 percent of the total concession requirements. The analysis did not strongly consider the validity of the percentage splits between food and beverage, gifts and news, and services; however, the percentage splits indicated for use in the analysis represented industry guidelines that have been generically applied. For this analysis, the splits between food and beverage, gifts and news, and services located pre-security were assumed at 55, 17, and 28 percent, respectively; however, post-security, the splits were assumed at 68, 31, and 1 percent, respectfully. Any significant improvements to the terminal would warrant changes to the Airport's current concessions program; therefore, it is suggested that ORF consider a comprehensive concession plan to address the market-centric variables in further detail to produce the best concessions plan moving forward.

The existing concession storage is shown as the "2017 (Existing)", as indicated in **Table 4-62**. The storage requirements throughout the planning period was calculated based on the percent increase in the projected total concessions space provided.

Table 4-62 – Concession Areas (PALs) [24]

Concession Areas						
	2017 (Existing)	BASE	PAL 1	PAL 2	PAL 3	PAL 4
Pre-Security Concessions						
Food and Beverage - *Sq. Ft.*	(11,940)	3,690	4,189	4,706	5,193	5,612
Gifts and News - *Sq. Ft.*	(4,410)	1,141	1,295	1,455	1,605	1,735
Services - *Sq. Ft.*	(2,855) [1]	1,879	2,132	2,396	2,644	2,858
Subtotal - *Sq. Ft.*	(19,205) [3]	6,710	7,616	8,557	9,442	10,205
Post-Security Concessions						
Food and Beverage - *Sq. Ft.*	(8,828)	18,250	20,714	23,276	25,683	27,756
Gifts and News - *Sq. Ft.*	(4,240)	8,320	9,443	10,611	11,708	12,654
Services - *Sf. Ft.*	(0)	268	305	342	378	408
Subtotal - *Sq. Ft.*	(13,068) [3]	26,838	30,462	34,229	37,769	40,818
Total Retail Concessions (sf. ft.)	**(32,273)**	**33,548**	**38,078**	**42,786**	**47,211**	**51,023**
Concessions Storage - *Sf. Ft.*	(2,217) [2]	2,470	2,804	3,151	3,477	3,758

Note: Those numbers depicted in parentheses indicate existing conditions.
[1] includes ATM/Foreign Currency Exchange/Mailbox Drop and Business Center as a Service concession
[2] as indicated in **Table 2-12**
[3] as indicated in **Table 2-10** or **Table 2-11**
Source: CHA, 2019.

4.4.18 Rental Car Concessions and Ground Transportation

Rental Car Concessions

Currently, eight rental car companies operate in the rental car center within the terminal building. In addition to space within the terminal, each rental car company has return/ready cars in the adjacent parking garage. From a planning perspective, the number of rental car concessionaires on-site is usually pre-determined as part of a Request for Proposal renewal process for rental car concessions, with a mutual understanding between the airport operator and the rental car companies. In the absence of criteria to determine metrics for planning, this analysis assumed a planning factor of 925 square feet per rental car company module. The rental car company module accounted for 20 linear feet of counters, 12-foot deep offices, 10-foot depth from the public face of the transaction counter to the back wall, and 15 feet for queuing with a 1.25 circulation factor.

Through the planning horizons, the current behaviors of how passengers engage the rental car companies and access/return a rental car are not expected to change; however, through the planning horizon, it was assumed that there will be one additional rental car company in the terminal building, bringing the total number of rental car operators from eight to nine.

Table 4-63 – Rental Car Concessions (PALs)

[24] The analysis of concessions does not include the Airport's conference center, the USO Welcome Center, or rental car/transportation functions; however, a separate analysis was conducted for rental car/transportation functions (See **Section 4.4.18**).

Rental Car Concessions																	
2017 (Existing)			BASE			PAL 1			PAL 2			PAL 3			PAL 4		
No.	LF	SF	No.	LF	SF	No.	LF	SF	No.	LF	SF	No.	LF	SF	No.	LF	SF
(8)	(163)	(12,210)[1]	8	160	7,400	8	160	7,400	8	160	7,400	9	180	9,000	9	180	8,325

No. = Number of rental car companies on-site
LF = Linear feet of customer counter frontage
SF = Total square feet required for all rental car companies
Note: Those numbers depicted in parentheses indicate existing conditions.
[1] Includes passenger queuing area, miscellaneous storage area and circulation.
Source: CHA, 2019.

Ground Transportation Services

Ground Transportation Services comprise an area of 292 square feet at ORF. The current space meets the present demand and is expected to adequately support projected demand; therefore, there is not a need for the Airport to allocate additional space for use by ground transportation services during the planning horizon.

4.4.19 Administration Areas

Airport Administration

The Airport Administration areas of the terminal are those used by NAA staff for various Airport operations and include the following areas: administrative offices (14,240 SF), a conference center (2,164 SF), storage (12,075 SF), airport police and security badging offices (2,160 SF), and airport parking offices (2,506 SF), as well as internal circulation. Collectively, there is 33,145 square feet of airport administration space distributed between the different levels of the landside and airside areas of the terminal at different levels. Future needs for administrative office and support space, future staffing levels, and future facility needs correlate to passenger and facility growth, and what staffing levels and facilities are necessary, to support the overall administration needs. The needs were calculated using the formula in **Figure 4-9.**

Figure 4-9 – Administration Demand Calculation

$$FA = EA \times (1.275 \times .5FE) / 1.8$$, where:

- FA is the future program requirement to be calculated, in square feet
- EA is the 2017 (Existing) area, in square feet
- FE is the future enplanement level in Million Annual Enplanements

Table 4-64 presents a summary of the Airport Administration programmatic space requirements throughout the planning horizon.

Table 4-64 – Airport Administration Area (PALs)

Airport Administration Area						
	2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
Airport Administration Area - *Sf. Ft.*	(33,145)	20,715	24,168	27,620	29,922	32,224

Note: Those numbers depicted in parentheses indicate existing conditions.
Source: CHA, 2019.

TSA Administration

Currently, TSA administration offices are located at an office complex near ORF; however, TSA has expressed interest in relocating the offices to the Airport.

The TSA administration category represents areas of the terminal directly related to TSA staff operations, specifically administrative offices and including internal circulation. To account for any staffing fluctuations throughout the planning horizon, the analysis assumed a three percent growth rate from one planning activity level to the next, as indicated in **Table 4-65.**

Table 4-65 – TSA Administration Area (PALs)

TSA Administration Area						
	2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
TSA Administration Area - *Sf. Ft.*	(2,828)[1]	2,913	3,000	3,090	3,183	3,278

Note: Those numbers depicted in parentheses indicate existing conditions.
[1] as indicated in Table 2-12
Source: CHA, 2019.

4.4.20 Restrooms Facilities

The restroom facilities analysis addressed public restroom facilities on both the non-secure (landside) and secure (airside) areas of the terminal buildings. It is important to note that private and non-public restroom facilities were not addressed in the analysis. On the non-secure portions of the airport terminal building (baggage claim, ticketing, etc.), the analysis was conducted as if all the processor areas were contiguously joined as one. The analysis for the secure portions of the airport terminal building (the concourses) was conducted given three separate assumptions:

- Assumption 1 – The Airport will operate two distinct concourses, similar to the existing arrangement.
- Assumption 2 – The Airport will operate three distinct concourses, with two of the three having an equal level of activity. Gate demand and associated needs will be driven by increased activity levels, which are assumed to be shared equally between the three concourses.
- Assumption 3 – The Airport will operate a conjoining concourse that will have a single security screening checkpoint, i.e., the concourse is not physically separated with each concourse requiring a separate security screening checkpoint processing area.

Optimal restroom layout plans provide partitions, giving staff the capability to close-off sections of the restroom for daily maintenance activity and renovations, while leaving other sections open for use. The need for airports to provide additional restroom amenities for passengers, such as nursing-mother rooms, changing rooms, and family rooms, is a growing trend that is not addressed in local or national building codes. The analysis calculated the square footage requirements to support the optimal restroom layout based on the number of fixtures required for each module. The areas calculated included a diaper changing station and the door-less privacy entryway from the concourse circulation. Each restroom module was assumed to have a mother's room (family room), as well as a custodial and service sink room, which were calculated separately.

Equivalent Aircraft (EQA) was the overarching basis of all analyses for restroom facilities. The EQA requirements throughout the planning horizons are indicated in **Table 4-37.** For the purpose of this analysis, a restroom module is defined as having separate men's and women's facilities, mother's room (family room), and a custodial area with a service sink.

Secure Airside Terminal Restroom Facilities - Two Concourse Analysis

The first step of the analysis was to determine the number of restroom modules necessary to service a concourse. **Figure 4-10** describes the methodology used when determining the number of modules.

Figure 4-10 – Restroom Demand

$$\text{No. of Restroom Modules} = \frac{EQA}{8}$$

Figure 4-10 indicated the number of restroom modules required for each concourse throughout the planning horizon. The concourse layout was considered when determining the number of modules, e.g., single- vs. double-loaded concourses. For example, the spacing distance for modules in a double-loaded concourse is less than the required spacing distance for modules in a single-loaded concourse. The results of the analysis are depicted in **Table 4-66.** When reaching these results, the double-loaded corridor length (indicated in **Table 4-41**) was a significant factor to justify rounding up from one to two modules for each concourse.

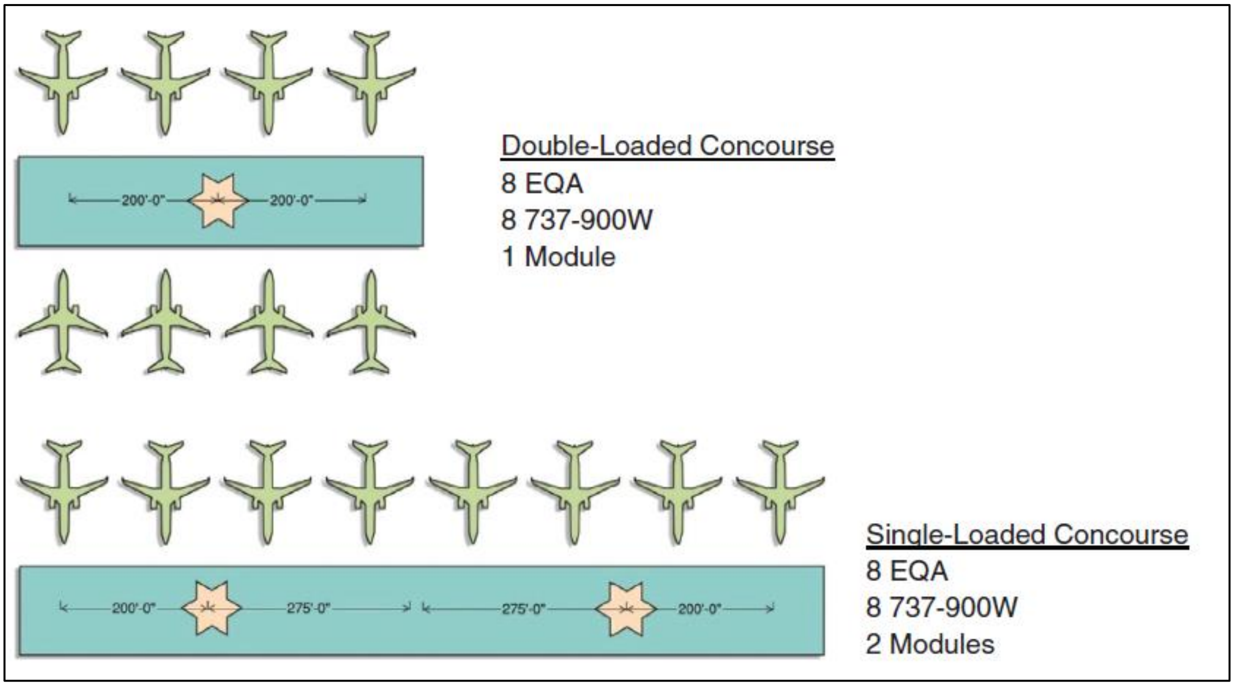
Table 4-66 – Two Concourses: Number of Restroom Modules Required (PALs)

Two Concourses: Number of Restroom Modules Required												
	2017 (Existing)		Base		PAL 1		PAL 2		PAL 3		PAL 4	
	EQA	(#) of Mod.	EQA[1]	(#) of Modules	EQA[1]	(#) of Modules	EQA[1]	(#) of Modules	EQA[1]	(#) of Modules	EQA[1]	(#) of Modules
Concourse A	--	(1)	13.4	1.675[2] (2)[3]	13.7	1.713[2] (2)[3]	14.4	1.800[2] (2)[3]	14.4	1.800[2] (2)[3]	15.4	1.925[2] (2)[3]
Concourse B	--	(2)	13.4	1.675[2] (2)[3]	13.7	1.713[2] (2)[3]	14.4	1.800[2] (2)[3]	14.4	1.800[2] (2)[3]	15.4	1.925[2] (2)[3]

Note: Those numbers depicted in parentheses indicate existing conditions.
[1] the EQA values for each concourse is the activity level EQA value from Table 4-34 ÷ 2
[2] represents calculated theoretical value for number of modules required
[3] the theoretical value is rounded up to the next whole number
Source: Airport Cooperative Research Program (ACRP) *Report 130 - Guidebook for Airport Terminal Restroom Planning and Design*, CHA, 2019.

The spacing of modules for single-loaded concourses and double-loaded concourses are depicted in **Figure 4-11**. The figure represents spacing of restroom modules in each concourse scenario for eight EQA. The frequency and spacing of restroom modules were consistent with the formula in **Figure 4-10**, which determined the number of restroom modules required based on a factor of eight EQA.

Figure 4-11 – Loaded vs. Double-Loaded Concourse Exhibit



From the data in **Table 4-66**, the peak passenger capacity (Design Passengers) was calculated using the formula shown in **Figure 4-12**. The results of the analysis are presented in **Table 4-67.**

Figure 4-12 – Design Passengers Restroom Calculation

Design Passengers = EQA x 145 Seats (1.0 EQA) x Load Factor

Table 4-67 – Two Concourses: Design Passengers (PALs)

Two Concourses: Design Passengers												
	2017 (Existing)		Base		PAL 1		PAL 2		PAL 3		PAL 4	
	Load Factor[1]	Design PAX	Load Factor[1]	Design PAX	Load Factor[1]	Design PAX	Load Factor[1]	Design PAX	Load Factor[1]	Design PAX	Load Factor[1]	Design PAX
Concourse A	(79.0)	--	79.5	1,545	81.1	1,611	82.2	1,716	83.4	1,741	84.2	1,880
Concourse B	(79.0)	--	79.5	1,545	81.1	1,611	82.2	1,716	83.4	1,741	84.2	1,880

Note: Those numbers depicted in parentheses indicate existing conditions.

[1] as indicated in Figure 3-10

Source: Airport Cooperative Research Program (ACRP) *Report 130 - Guidebook for Airport Terminal Restroom Planning and Design*, CHA, 2019.

The next step in the analysis was determining the Peak 20-minute Passenger Demand for restroom facilities, using the formula in **Figure 4-13**.

Figure 4-13 – Restroom Demand (20-min Peak)

Peak 20-Minute Passenger Demand = Design Passenger x Peak 20-Minute %

For concourse with only origin and destination (O & D) assume the Peak 20-Minute % = 50%

Table 4-68 – Two Concourses: Peak 20-Minute Restroom Demand (PALs)

Two Concourses: Peak 20-Minute Restroom Demand						
	2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
Concourse A	--	773	806	858	871	940
Concourse B	--	773	806	858	871	940

Source: Airport Cooperative Research Program (ACRP) *Report 130 - Guidebook for Airport Terminal Restroom Planning and Design,* CHA, 2019.

The Design Factor calculated using the formula in **Figure 4-14** was the variable that allowed us to calculate the fixtures required. These factors are tabulated in **Table 4-69.**

Figure 4-14 – Restroom Demand (Two Concourses)

Design Factor = Peak 20-Minute Passenger Demand x % Using Restroom *(utilization)*

Note: The general utilization rate planning standard = 50% to 60%. For this analysis, 60% is used

Table 4-69 – Two Concourses: Design Factor (PALs)

Two Concourses: Design Factor						
	2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
Concourse A	--	464	484	515	523	564
Concourse B	--	464	484	515	523	564

Source: Airport Cooperative Research Program (ACRP) *Report 130 - Guidebook for Airport Terminal Restroom Planning and Design,* CHA, 2019.

The formulas represented in **Figure 4-15** and **Figure 4-16** was used to determine the total number of men's and women's fixtures respectfully. A fixture is defined as a toilet or urinal. These fixture requirements are tabulated in **Table 4-70.**

Figure 4-15 – Men's Fixtures Calculation (Separate Concourses)

Men's Fixtures = Design Factor x Male % ÷ 13

Note: The passenger gender mix ratio is assumed to be a 50%/50% ratio

Figure 4-16 – Women's Fixtures Calculation (Separate Concourses)

Women's Fixtures = Male Fixtures x Female Increase Factor

Note: The Female Increase Factor = 1.25

Table 4-70 – Two Concourses: Required Fixtures (PALs)

Two Concourses: Required Fixtures						
	2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
Concourse A Men's	(24)[1]	17.84	18.61	19.80	20.11	21.69
Concourse A Women's	(22)	22.30	23.27	24.75	25.14	27.11
Concourse B Men's	(31)[2]	17.84	18.61	19.80	20.11	21.69
Concourse B Women's	(30)	22.30	23.27	24.75	25.14	27.11

Note: Those numbers depicted in parentheses indicate existing conditions

[1] 12 water closets/12 urinals

[2] 13 water closets/18 urinals

Source: Airport Cooperative Research Program (ACRP) *Report 130 - Guidebook for Airport Terminal Restroom Planning and Design,* CHA, 2019.

Fixtures required for each module was then calculated with the formula in **Figure 4-17** and fixtures tabulated in **Table 4-71.**

Figure 4-17 – Restroom Fixture Calculation (Two Concourse)

Fixtures Required for Each Modules = Required Fixtures ÷ No. Modules Required

Table 4-71 – Two Concourses: Fixtures Required per Module (PALs)

Two Concourses: Fixtures Required per Module[1]						
	2017 (Existing)		Base		PAL 1	
	No. of Modules	Fixture No.	# of Modules[1]	Fixture No.	# of Modules[1]	Fixture No.
Concourse A Men's	(1)	(24)[2]	2	9	2	10
Concourse A Women's	(1)	(22)[2]	2	12	2	12
Concourse B Men's	(2)	(31)[2]	2	9	2	10
Concourse B Women's	(2)	(30)[2]	2	12	2	12

Two Concourses: Fixtures Required per Module[1]						
	PAL 2		PAL 3		PAL 4	
	No. of Modules	Fixture No.	# of Modules[1]	Fixture No.	# of Modules[1]	Fixture No.
Concourse A Men's	2	11	2	11	2	11
Concourse A Women's	2	13	2	13	2	14
Concourse B Men's	2	11	2	11	2	11
Concourse B Women's	2	13	2	13	2	14

Note: Those numbers depicted in parentheses indicate existing conditions.
[1] number of restroom modules required is shown in Table 4-35
[2] two modules per existing concourse
Source: Airport Cooperative Research Program (ACRP) *Report 130 - Guidebook for Airport Terminal Restroom Planning and Design,* CHA, 2019.

The formulas used for calculating Concourse Men's and Women's Room area is shown in **Figure 4-18** and **Figure 4-19** respectfully and the areas are tabulated in **Table 4-72** and **Table 4-73** respectfully.

Figure 4-18 – Men's Rest Area Calculation

Men's Room Area = Required Fixtures x 85 SF per Fixture Required

Figure 4-19 – Women's Rest Area Fixture Calculations

Women's Room Area = Required Fixtures x 95 SF per Fixture Required

Table 4-72 – Two Concourses: Single Module Area Requirements (PALs)

Two Concourses: Single Module Area Requirements						
	2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
Men's - *Sq. Ft.*	--	765	850	935	935	935
Women's - *Sq. Ft.*	--	1,140	1,140	1,235	1,235	1,330
Mother's Room (Family)- *Sq. Ft.*	(105)	105	105	105	105	105
Custodial - *Sq. Ft.*	(156)	156	156	156	156	156
Module Total - *Sq. Ft.*	--	2,166	2,251	2,431	2,431	2,526

Note: Those numbers depicted in parentheses indicate existing condition.
Source: CHA, 2019.

Table 4-73 – Two Concourses: Total Restroom Module Area Requirements (PALs)

Two Concourses: Total Restroom Module Area Requirements												
	2017 (Existing)		Base		PAL 1		PAL 2		PAL 3		PAL 4	
	Modules	Area	Modules	Area	Modules	Area	Modules	Area	Modules	Area	Modules	Area
Concourse A - *Sq. Ft.*	(1)	(3,745)	2	4,332	2	4,502	2	4,862	2	4,862	2	5,052
Concourse B - *Sq. Ft.*	(2)	(7,718)	2	4,332	2	4,502	2	4,862	2	4,862	2	5,052
Totals	(3)	(9,463)	4	8,664	4	9,004	4	9,724	4	9,724	4	10,104

Note: Those numbers depicted in parentheses indicate existing conditions.
Source: CHA, 2019.

Secure Airside Terminal Restroom Facilities – Three Concourse Analysis

This analysis assumed that the Airport will operate three separate concourses in a similar fashion to ORF's current situation with two separate concourses. The analysis was similar to the *Two-Concourse Analysis* and assumed all three concourses are equal. **Table 4-74** indicates the number of restroom modules required for each separate concourse, as well as the number of toilet fixtures necessary to service each module. The analysis concluded with *Single Module Area Requirements*, depicted in **Table 4-75**, and *Total Restroom Module Area Requirements,* depicted in **Table 4-76.**

Table 4-74 – Three Concourses: Fixtures Required per Module (PALs)

Three Concourses: Fixtures Required per Module						
	2017 (Existing)		Base		PAL 1	
	No. of Modules	Fixture No.	# of Modules[1]	Fixture No.	# of Modules[1]	Fixture No.
Concourse A Men's	(1)	(24)[1]	1	12	1	13
Concourse A Women's	(1)	(22)[1]	1	15	1	16
Concourse B Men's	(2)	(30)[1]	1	12	1	13
Concourse B Women's	(2)	(31)[1]	1	15	1	16
Concourse C Men's	NA	NA	1	12	1	13
Concourse C Women's	NA	NA	1	15	1	16

Three Concourses: Fixtures Required per Module						
	PAL 2		PAL 3		PAL 4	
	# of Modules[1]	Fixture No.	# of Modules[1]	Fixture No.	# of Modules[1]	Fixture No.
Concourse A Men's	1	14	1	14	1	15
Concourse A Women's	1	17	1	17	1	18
Concourse B Men's	1	14	1	14	1	15
Concourse B Women's	1	17	1	17	1	18
Concourse C Men's	1	14	1	14	1	15
Concourse C Women's	1	17	1	17	1	18

Note: Those numbers depicted in parentheses indicate existing conditions.
[1] two modules per existing concourse.
Source: Airport Cooperative Research Program (ACRP) *Report 130 - Guidebook for Airport Terminal Restroom Planning and Design,* CHA, 2019.

Table 4-75 – Three Concourses: Single Module Area Requirements (PALs)

Two Concourses: Single Module Area Requirements						
	2017 (Existing)	Base	PAL 1	PAL 2	PAL 3	PAL 4
Men's - *Sq. Ft.*	--	1,020	1,105	1,190	1,190	1,275
Women's - *Sq. Ft.*	--	1,425	1,520	1,615	1,615	1,710
Mother's Room (Family) - *Sq. Ft.*	(105)	105	105	105	105	105
Custodial - *Sq. Ft.*	(156)	156	156	156	156	156
Module Total - *Sq. Ft.*	--	2,706	2,886	3,066	3,066	3,246

Note: Those numbers depicted in parentheses indicate existing conditions
Source: CHA, 2019.

Table 4-76 – Three Concourse: Total Restroom Module Area Requirements (PALs)

Three Concourse: Total Restroom Module Area Requirements										
	Base		PAL 1		PAL 2		PAL 3		PAL 4	
	No. Of Modules	Total Area	No. of Modules	Total Area	No. of Modules	Total Area	No. of Modules	Total Area	No. of Modules	Total Area
Totals	3	8,118	3	8,658	3	9,198	3	9,198	3	9,738

Source: CHA, 2019.

Secure Airside Terminal Restroom Facilities - Connected Concourse Analysis

This analysis assumed that the Airport will operate a concourse that is contiguous with a single security screening checkpoint (i.e., the concourse is not physically separated with each concourse requiring its own separate security screening checkpoint processing areas). The analysis was similar to the *Two-Concourse Analysis*; therefore, this analysis concluded with *Single Module Area Requirements,* depicted in **Table 4-77,** and *Total Restroom Module Area Requirements*, depicted in **Table 4-78.**

Table 4-77 – Connected Concourse: Single Module Area Requirements (PALs)

Connected Concourse: Single Module Area Requirements					
	Base	PAL 1	PAL 2	PAL 3	PAL 4
Men's - *Sq. Ft.*	1,020	765	850	850	935
Women's - *Sq. Ft.*	1,425	1,140	1,235	1,235	1,330
Mother's Room (Family) - *Sq. Ft.*	105	105	105	105	105
Custodial - *Sq. Ft.*	156	156	156	156	156
Module Total - *Sq. Ft.*	2,706	2,166	2,346	2,346	2,526

Source: CHA, 2019.

Table 4-78 – Connected Concourse: Total Restroom Module Area Requirements (PALs)

Connected Concourse: Total Restroom Module Area Requirements										
	Base		PAL 1		PAL 2		PAL 3		PAL 4	
	No. of Modules	Total Area	No. of Modules	Total Area	No. of Modules	Total Area	No, of Modules	Total Area	No. of Modules	Total Area
Totals	3	8,118	4	8,664	4	9,424	4	9,424	4	10,104

Source: CHA, 2019.

Non-Secure Landside Terminal Restroom Facilities – Baggage Claim, Ticketing, Concessions, Pre-Security

Landside restrooms are typically located within the major terminal areas such as the check-in lobby, baggage claim, and concessions areas. Calculations were based on the total peak-hour O&D passenger demand (PHP) and the visitors of those passengers. Visitor ratios were assumed to increase the demand by a factor of 20 percent for well-wishers (WW) and 30 percent for meeters and greeters (M&G). Since enplaning and deplaning passenger processing functions (such as check-in/baggage claim, respectively) are on separate levels at ORF, the analysis utilized the associated visitor ratios with their respective passenger processing functions as shown in **Figure 4-20**.

Figure 4-20 – Restroom Facility Calculation

WW + *enplaning passengers*

and

M&G + *deplaning passengers*

The analysis assumed evaluation methodologies associated with a multi-level terminal building. Similar to the airside analysis, the scenario began by determining the landside Design Passenger Demand for each of the functional areas.

Check-in Restroom Facilities Determinations: The Check-in Design Demand was calculated with the formula in **Figure 4-21.** The design demands are shown in **Table 4-79.**

Figure 4-21 – Check-In Fixtures Calculation

Check-in Design Demand = Enplaning Peak-Hour Passengers x WW Ratio

Note: WW Ratio = 1.20

Table 4-79 – Non-Secure Landside: Check-in Restroom Design Demand (PALs)

Non-Secure Landside: Check-in Restroom Design Demand									
Base		PAL 1		PAL 2		PAL 3		PAL 4	
Enplane PHP	Design Demand	Enplane PHP	Design Demand	Enplane PHP	Design Demand	Enplane PHP	Design Demand	Enplane PHP	Design Demand
1,354	1,625	1,537	1,844	1,727	2,072	1,906	2,287	2,060	2,472

Source: Airport Cooperative Research Program (ACRP) *Report 130 - Guidebook for Airport Terminal Restroom Planning and Design,* CHA, 2019.

The quantity of fixtures were determined from the Design Demand for Men's and Women's restroom facilities as shown by the formulas in **Figure 4-22** and **Figure 4-23,** respectfully, and the number of fixtures required was based on gender as indicated in **Table 4-80**.

Figure 4-22 – Check-In Male Fixtures Calculation

Check-in Total Male Fixtures = Design Demand ÷ Ratio

Note: Ratio = 1 fixture per 70 enplaning PHP for first 400 enplaning PHP + 1 fixture per 200 enplaning PHP in excess of 400 enplaning PHP

Figure 4-23 – Check-In Female Fixtures Calculation

Check-in Total Female Fixtures = Total Male Fixtures x Female Increase Factor

Note: Female Increase Factor = 1.00

Table 4-80 – Non-Secure Landside: Check-in Men's and Women's Fixture Requirements (PALs)

Non-Secure Landside Check-in: Men's and Women's Fixture Requirements											
2017 (Existing)		Base		PAL 1		PAL 2		PAL 3		PAL 4	
M	W	M	W	M	W	M	W	M	W	M	W
(12)[1]	(10)[1]	12	12	13	13	14	14	15	15	16	16

M = Men's
W = Women's
Note: Those numbers depicted in parentheses indicate existing conditions.
[1] number of fixtures in the Check-in level and area only
Source: Airport Cooperative Research Program (ACRP) *Report 130 - Guidebook for Airport Terminal Restroom Planning and Design,* CHA, 2019.

Baggage Claim Facilities Determinations: The terminal Design Demand was calculated with the formula in **Figure 4-24** and the Design Demands are indicated in **Table 4-81**.

Figure 4-24 – Baggage Claim Demand

Baggage Claim Design Demand = Deplaning Peak-Hour Passengers x M & G Ratio

Note: M & G Ratio = 1.30

Table 4-81 – Non-Secure Landside: Baggage Claim Restroom Design Demand (PALs)

Non-Secure Landside: Baggage Claim Restroom Design Demand									
Base		PAL 1		PAL 2		PAL 3		PAL 4	
Deplane PHP	Design Demand	Deplane PHP	Design Demand	Deplane PHP	Design Demand	Deplane PHP	Design Demand	Deplane PHP	Design Demand
1,022	1,329	1,160	1,508	1,304	1,695	1,438	1,869	1,555	2,022

Source: Airport Cooperative Research Program (ACRP) *Report 130 - Guidebook for Airport Terminal Restroom Planning and Design,* CHA, 2019.

The quantity of fixtures could be determined from the Design Demand for Men's and Women's restroom facilities as indicated in **Figure 4-25** and **Figure 4-26,** respectfully, and the fixture requirements are depicted in **Table 4-82.**

Figure 4-25 – Baggage Claim Male Fixtures Calculation

Baggage Claim Total Male Fixtures = Design Demand ÷ Ratio

Note: Ratio = 1 fixture per 70 deplaning PHP for first 400 deplaning PHP + 1 fixture per 200 deplaning PHP in excess of 400 deplaning PHP

Figure 4-26 – Baggage Claim Female Fixtures Calculation

Baggage Claim Total Female Fixtures = Total Male Fixtures x Female Increase Factor

Note: Female Increase Factor = 1.00

Table 4-82 – Non-Secure Landside: Baggage Claim Men's and Women's Fixture Requirements (PALs)

Non-Secure Landside: Baggage Claim Men's and Women's Fixture Requirements											
2017 (Existing)		Base		PAL 1		PAL 2		PAL 3		PAL 4	
M	W	M	W	M	W	M	W	M	W	M	W
(16)[1]	(12)[1]	10	10	11	11	12	12	13	13	14	14

M = Men's / W = Women's
Note: Those numbers depicted in parentheses indicate existing conditions.
[1] number of fixtures in the Baggage Claim level and area only
Source: Airport Cooperative Research Program (ACRP) *Report 130 - Guidebook for Airport Terminal Restroom Planning and Design,* CHA, 2019.

The methodology for calculating the required toilet fixture was determined using the analytics for a multi-level terminal and addressed toilet fixture requirements for only the check-in lobby and baggage claim. For multi-level terminals, restrooms should be located in proximity to the major passenger processing functions such as check-in, baggage claim, security screening, meeter and greeter areas, and major landside concession nodes. The atrium area, unique to ORF, provides concession opportunities and a large concentration of public restrooms, as it is often used as a circulation hub that is heavily populated with well-wishers and meter/greeter personnel. All passengers, whether enplaning or deplaning, must pass through the atrium with area specific restrooms before accessing the check-in or baggage claim areas. Given ORF's physical configuration, locations of functional areas, and passenger flow, it may be acceptable to assume that the atrium restrooms also help satisfy the restroom requirements for the check-in lobby and baggage claim, as indicated in **Table 4-79** and **Table 4-81**, respectfully.

The following analysis took the physical configuration, locations of the functional areas, and passenger flow for the Airport's terminal into consideration. Again, the unique characteristics of this terminal is the Atrium space, which the analytics did not directly address; therefore, to normalize the fixture requirements with the existing check-in lobby, baggage claim, and atrium, the atrium analysis assumed similar logic to determine the fixtures required for the check-in lobby and baggage claim. The requirements for men's and women's restrooms were determined using the following formulas, as shown in **Figure 4-27** and **Figure 4-28**, respectfully.

Figure 4-27 – Male Fixtures Calculation

Atrium Male Fixtures = (Enplaning Design Demand + Deplaning Design Demand) x 0.50 ÷ Ratio

Note: Ratio = 1 fixture per 70 deplaning PHP for first 400 deplaning PHP + 1 fixture per 200 deplaning PHP in excess of 400 deplaning PHP

Figure 4-28 – Female Fixtures Calculation

Atrium Total Female Fixtures = Total Male Fixtures x Female Increase Factor

Note: Female Increase Factor = 1.25

Summarized below is in **Table 4-83** are total fixture requirements, while comparing the existing fixtures to the required fixtures through the planning horizon.

Table 4-83 – Non-Secure Landside: Total Fixtures Requirements (PALs)

Non-Secure Landside: Total Fixture Requirements												
Processor Area	2017 (Existing)		Base		PAL 1		PAL 2		PAL 3		PAL 4	
	M	W	M	W	M	W	M	W	M	W	M	W
Check-in Lobby – *No.*	(12)	(10)	12	12	13	13	14	14	15	15	16	16
Baggage Claim – *No.*	(16)	(12)	10	10	11	11	12	12	13	13	14	14
Atrium – *No.*	(32)	(14)	11	14	12	15	13	16	14	18	15	19
Totals	(60)	(36)	33	36	36	39	39	42	42	46	45	49

M = Men's
W = Women's
Note: Those numbers depicted in parentheses indicate existing conditions.
Source: CHA, 2019.

The restroom area calculations assumed that each processor area (check-in lobby, baggage claim, and atrium) will each have two restroom modules; therefore, the total fixture requirements for each processor area (indicated in **Table 4-83**) were divided by a factor of two, thus, representing a single restroom module. In addition, each module included a diaper changing station, as well as door-less privacy entryway from the public circulation area. Each restroom module was assumed to have a mother's room (family room), as well as a custodial and service sink room, which were calculated separately. The single restroom module areas are indicated in **Table 4-84**.

The formulas used for calculating landside Men's and Women's Room area are shown in **Figure 4-29** and **Figure 4-30,** respectfully, and the requirements are shown in **Table 4-84** and **Table 4-85**, respectfully.

Figure 4-29 – Men's Rest Area Calculation

Men's Room Area = Required Fixtures x 85 SF per Fixture Required

Figure 4-30 – Women's Rest Area Calculation

Women's Room Area = Required Fixtures x 95 SF per Fixture Required

Table 4-84 – Non-Secure Airside: Single Restroom Module Area Requirements (PALs)

Non-Secure Airside: Single Restroom Module Area Requirements						
Functional Areas	**2017 (Existing)**	**Base**	**PAL 1**	**PAL 2**	**PAL 3**	**PAL 4**
Check-in Men's (sq. ft.)	(231)	510	595	595	680	680
Check-in Women's (sq. ft.)	(231)	570	665	665	760	760
Mother's/Family Room (sq. ft.)	--	105	105	105	105	105
Custodial (sq. ft.)	(200)	156	156	156	156	156
Check-in Single Module Total (sq. ft.)	**(662)**	**1,341**	**1,521**	**1,521**	**1,701**	**1,701**
Baggage Claim Men's (sq. ft.)	(480)	425	510	510	595	595
Baggage Claim Women's (sq. ft.)	(457)	475	570	570	665	665
Mother's/Family Room (sq. ft.)	--	105	105	105	105	105
Custodial (sq. ft.)	(91)	156	156	156	156	156
Baggage Claim Module Single Total (sq. ft.)	**1,028**	**1,161**	**1,341**	**1,341**	**1,522**	**1,522**
Atrium Men's (sq. ft.)	(710)	510	510	595	595	680
Atrium Women's (sq. ft.)	(790)	665	760	760	855	950
Mother's/Family Room (sq. ft.)	--	105	105	105	105	105
Custodial (sq. ft.)	(75)	156	156	156	156	156
Atrium Single Module Total (sq. ft.)	**1,575**	**1,436**	**1,531**	**1,616**	**1,711**	**1,891**

Note: Those numbers depicted in parentheses indicate existing conditions.
Source: CHA, 2019.

Table 4-85 – Non-Secure Airside: Total Restroom Module Area Requirements (PALs)

Non-Secure Airside: Total Restroom Module Area Requirements						
Processor Area	**2017 (Existing)**		**Base**		**PAL 1**	
	No. of Modules	**Total Area**	**No. of Modules**	**Total Area**	**No. of Modules**	**Total Area**
Check-in (sq. ft.)	(2)	(1,324)	2	2,682	2	3,042
Bag Claim (sq. ft.)	(2)	(2,056)	2	2,322	2	2,682
Atrium (sq. ft.)	(2)	(3,150)	2	2,872	2	3,062
Totals	(6)	(6,530)	6	7,876	6	8,786

Non-Secure Airside: Total Restroom Module Area Requirements						
Processor Area	PAL 2		PAL 3		PAL 4	
	No. of Modules	Total Area	No. of Modules	Total Area	No. of Modules	Total Area
Check-in (sq. ft.)	2	3,042	2	3,402	2	3,402
Bag Claim (sq. ft.)	2	2,682	2	3,044	2	3,044
Atrium (sq. ft.)	2	3,232	2	3,422	2	3,782
Totals	6	8,956	6	9,868	6	10,228

Note: Those numbers depicted in parentheses indicate existing conditions
Source: CHA, 2019.

4.4.21 Terminal Circulation

Meeter and Greeter Lobby (Well-Wishers)

ORF has a larger demand for meeter and greeter area than other airports, as there is a larger presence of regional military passengers. The atrium space serves as an area where these passengers can congregate with well-wishers and meters/greeters. The existing atrium meeter and greeter area is approximately 9,382 square feet. In interviews with ORF, it was confirmed yhat this area, at certain times, can reach capacity with meeter and greeters.

This analysis assumed a generic factor of 10 percent for the peak hour deplaning passengers, along with a 1.25 surge factor, to determine number of meeter and greeters. The result was then multiplied by 23 square feet, per the IATA LOS standard, to determine the overall meeter and greeter area requirements. The areas calculated through the planning horizon are substantially less than the existing area. To reduce this area for future terminal uses could cause an unacceptable LOS to the meeter and greeter area regardless of what the analytics indicate as acceptable to meet the theoretical need.

Table 4-86 – Meeter and Greeter Area (PALs)

Meeter and Greeter Area											
2017 (Existing)		Base		PAL 1		PAL 2		PAL 3		PAL 4	
Deplane PAX Factor	Area (sf)	Deplane Pax Factor	Area (sf)	Deplane PAX Factor	Area (sf)	Deplane PAX Factor	Area (sf)	Deplan e PAX Factor	Area (sf)	Deplan e PAX Factor	Area (sf)
(1,151)[1]	(9,382)	1,277[1]	2,937	1,450[1]	3,335	1,630[1]	3,749	1,797[1]	4,133	1,944[1]	4,471

Note: Those numbers depicted in parentheses indicate existing conditions.
[1] with 1.25 surge factor
Source: CHA, 2019.

Horizontal Circulation Area

An overall circulation value for the terminal was not computed for this analysis, as the horizontal circulation area needs for each of the processor areas within the terminal were indicated within each processor area analyses. It should be noted; the analysis did not compute an overall inclusive circulation value for the terminal building. The processor areas with horizontal circulation values calculated and indicated separately in a tabular format are as follows:

- Re: Section 4.4.7– Concourse Circulation
- Re: Section 4.4.8 – Check-in Circulation
- Re: Section 4.4.11 – SSCP Exit Lane

- Re: Section 4.4.13 – Inbound Baggage Claim
- Re: Section 4.4.18 – Rental Car Concessionaires
- Re: Section 4.4.21 – Meeter and Greeter Lobby

The area determinations calculated for functional areas within the terminal (i.e., administration areas, outbound baggage facilities, etc.) included considerations for internal circulation.

Public Elevators, Escalators and Stairs

A review of the public escalators and stairs within the terminal build was conducted. Through the process, comments were not received in regard to inadequate public escalators and stairs. While the following analysis did not attempt to quantify public escalator and stair requirements in terms of "square feet", the following comments were offered during the review:

- **Baggage Claim Facilities:** Currently, the Airport has one vertical circulation module within the bag claim area that consists of a stair system and two escalators (up/down). The module serves the passenger foot traffic from the parking areas, as well as the vertical movement to access the walkway leading to the check-in, atrium, security checkpoint, and gate areas. A bank of three elevators is located nearby for easy access. Located further to the southwest is another vertical circulation module consisting of a stair system, along with a bank of three elevators located nearby for easy access. During the planning period, NAA may want to consider redundant escalator capacity with the existing escalators by adding additional escalators, more heavily weighted with a "down" escalator at the northwest vertical circulation core as a minimum.
- **Check-in Hall/Atrium:** The Airport has two vertical circulation modules within the check-in hall/atrium that consist of a stair system and two escalators (up/down). These modules serve the passenger foot traffic between the two separate check-in wings, atrium, security checkpoint, and gate level. The two vertical circulation modules also offer the public an inherent redundant to the existing escalators for automated vertical people movers; however, the two check-in halls are physically separated by the outbound baggage functional areas and not clear and intuitive, thus diminishing any valued redundancy characteristics with the overall systems. Two public elevators are located in a hall connecting the two check-in wings.[25] The hall and the location of the public elevators are unintuitive for use from a passenger perceptive. Without addressing the separation issue between the two check-in wings, ORF may want to consider redundancy in regard to escalator capacity with the existing escalators by adding additional escalators, more heavily weighted with "up" escalators. At a minimum, it is suggested that ORF abandon the existing elevators in the connecting hall for public use and add two elevators in plain sight, thus improving the intuitive passenger flow pattern near each existing vertical circulation module.

[25] The elevators co-located with the escalators in the check-in halls are currently under construction, with the project concluding prior to the completion of the Master Plan Update.

Moving Walkway

Moving walkways are often considered for use in airports when walking distances between major terminal functions within the terminal complex area exceed 1,000 feet. The Airport's connecting elevated walkway is 360-feet long and allows passengers to travel safely between the parking and baggage claim areas to the check-in hall, atrium, security checkpoint, and gates without crossing the terminal road curb front complex at grade. The furthest available parking space in the parking garage is approximately 2,225 feet from the end of Concourse B; therefore, the need for a moving walkway can be justified.

It should be noted that, in the past, ORF had a moving walkway in the elevated connecting walkway between the baggage claim building and the check-in/atrium building. The moving walkway has since been removed without providing a replacement for passenger convenience. To add valued passenger convenience, it is recommended that the Airport reinstall a two-directional moving walkway in the elevated connecting walkway between the baggage claim building and the check-in/atrium building.

4.4.22 Service Animal Relief Areas

Per Title 49 Code of Federal Regulations (CFR) Part 27.71 (h)[26], *Service Animal Relief Areas*, "each airport with 10,000 or more annual enplanements shall provide wheelchair-accessible Service Animal Relief Areas (SARAs) for service animals that accompany passengers departing, connecting, or arriving at airports." Furthermore, per AC 150/5360-14A (Appendix A), *Guidelines for Service Animal Relief Areas*[27], "at least one SARA must be located in each public sterile area of each terminal." Since ORF only has one terminal, one security checkpoint, and one sterile area, only one SARA is required. Currently, the Airport provides one service animal relief area; however, the designated area is located in the non-sterile area outside and to the south of the departures building. Service animal relief areas are further addressed in **Chapter 5**.

4.5 SUPPORT FACILITY REQUIREMENTS

A review of existing and future support facilities was necessary to identify additional facilities needed over the 20-year planning horizon.

4.5.1 General Aviation and MRO Facilities

Hangar requirements are generally a function of the number and type of based aircraft, owner preferences, hangar rental costs, and area climate.

Due to weather conditions, hangars are highly desirable in the Norfolk, Virginia region as snow storms, frost, ice, and intense wind can cause damage to parked aircraft. Additionally, during warmer months, heat and sun exposure can damage avionics and fade paint. Thunderstorms and hailstorms also occur, with the potential to cause considerable amounts of damage.

At ORF, available Airport property and future expansion space for the GA area is limited. Taxiway 'A' to the north, Taxiway 'J' and the ILS critical area to the northwest, the safety areas for the departure end of Runway 32 to the north, and Miller Store Road to the south of the GA area

[26] Title 49 CFR Part 27.71, *Airport Facilities.*

[27] AC 150/5360-14A, *Access to Airports by Individuals with Disabilities*

impede future growth. Based on the needs identified in this section, alternatives for additional hangar placement within Airport property is discussed in **Chapter 5**.

General Aviation Aircraft Storage Requirements

Locally based operators at ORF employ use of hangar space. The hangar storage areas, which are leased to the various aircraft owners, consist of six bulk-hangars (i.e., corporate hangars) and three T-hangar buildings (one building containing 11 stalls and two that each contain 16 stalls each). **Table 4-87** identifies the breakdown of aircraft based at ORF, while **Table 4-88** depicts each type of storage hangar at the airport, its approximate size, and the amount of storage provided for based aircraft at ORF (excluding tie-down spaces).

Table 4-87 – Based Aircraft Leasing Hangar Spaces (As of July 2018)

Aircraft Type	Corporate Hangars	T-Hangars
Single Engine Piston	8	32
Multi Engine Piston	7	3
Single Engine Turbo Prop	1	-
Multi Engine Turbo Prop	6	-
Multi Engine Jet	20	-
Helicopter	2	-
TOTAL:	**44**	**35**

Source: Signature, NAA, CHA, 2018.

Table 4-88– Aircraft Hangar Units

Hangar Type	Approximate Size (Sq. Ft.)	Aircraft Storage Capability (Typical – Types Assumed) *
Bulk Hangar #1 (MRO)	41,400	8 Jet, 1 Turbo, 1 Single/Multi
Bulk Hangar #2	23,806	4 Jet, 5 Single/Multi
Bulk Hangar #3	30,000	1 Jet, 10 Turbo, 1 Single/Multi
Bulk Hangar #4	46,771	9 Jet, 1 Turbo, 2 Single/Multi
Bulk Hangar #5	30,613	6 Jet, 1 Turbo
Bulk Hangar #6	12,316	2 Jet, 1 Turbo
T-Hangars (Section 1) - 16 stalls	17,600	16 Single/Multi
T-Hangars (Section 2) - 16 stalls	21,600	16 Single/Multi
T-Hangars (Section 3) - 11 stalls	11,440	11 Single/Multi

Note: Due to projected growth in jet aircraft and turboprop aircraft at ORF, capacity was calculated by giving priority to jet aircraft, followed by turbo prop aircraft, and lastly, by multi/single engine aircraft.
*Types of aircraft in each hangar was estimated based on sizing requirements
Source: Signature, CHA 2018.

According to Signature, 32 of the 35 T-hangar stalls are currently under lease contracts, with no waiting list; however, all bulk hangars have current lease contracts and are at or nearing capacity. With hangars at and nearing maximum capacities, along with increasing itinerant traffic and average aircraft size per tenant, the Airport is constrained to accommodate additional aircraft in bulk hangars. Signature believes that an additional 40,000 square feet of hangar space is currently needed, with a second hangar of the same size needed in the next five to ten years. Signature further advised that no additional T-hangars are needed during the forecast horizon.

Further, the fleet mix at the Airport is anticipated to change with based aircraft growth, adding jets. As such, it is likely that additional larger hangar space is warranted at ORF to accommodate demand. To develop a projection of required hangar space, assumptions were made based on average square feet of space required to store each type of aircraft and the forecasted fleet mix in the planning period, which were then compared to the projections made by the Airport's FBO. **Table 4-89** provides anticipated hangar space requirements based on these assumptions.

Table 4-89– Hangar Space (Stalls) Requirements

Aircraft Type	Existing Capacity (2017)	Planning Period (Recommended Number of Hangar Stalls)				
		Base	PAL 1	PAL 2	PAL 3	PAL 4
Single-Engine Piston	**Aircraft Capacity: 86**	46	47	48	49	51
Multi-Engine Piston		10	10	11	11	12
Turbo-Prop		10	11	13	15	17
Jet		21	26	31	37	42
Rotorcraft		2	3	3	3	4
Total Hangar Stalls		89	97	106	115	126
Total Aircraft Not Stored	-	**(3)**	**(12)**	**(21)**	**(31)**	**(40)**

Source: CHA, 2018.

As discussed, there is an immediate demand for additional hangar space at ORF. **Table 4-90** shows the current useable hangar space, the future hangar space requirements, and the forecasted deficit of stall space by fleet mix.

Table 4-90 – Hangar Space Requirements (Sq. Ft.)

Aircraft Type	Base	PAL 1	PAL 2	PAL 3	PAL 4
Hangar Storage Capacity (Usable Hangar Space)					
Single-Engine/Multi-Engine/Rotorcraft	51,000	51,000	51,000	51,000	51,000
Turbo-Prop	50,000	50,000	50,000	50,000	50,000
Jet	84,600	84,600	84,600	84,600	84,600
Total	**185,600**	**185,600**	**185,600**	**185,600**	**185,600**
Aircraft Hangar Space Required					
Single-Engine Piston	46,229	47,372	48,516	49,659	50,803
Multi-Engine Piston	10,095	10,571	11,046	11,522	11,997
Turbo-Prop	22,497	26,981	31,465	35,949	40,434
Jet	99,023	124,139	149,254	174,370	199,486
Rotorcraft	2,082	2,495	2,907	3,319	3,732
Total	179,926	211,557	243,189	274,820	306,451
Surplus/(Deficit)					
Single/Multi//Rotorcraft	(7,406)	(9,438)	(11,469)	(13,500)	(15,532)
Turbo-Prop	27,503	23,019	18,535	14,051	9,566
Jet	(14,423)	(39,539)	(64,654)	(89,770)	(114,886)
Total	**5,674**	**(25,957)**	**(57,589)**	**(89,220)**	**(120,851)**

Source: CHA, 2018.

This hangar deficit estimate is similar to that expressed by the FBO. Based on the forecasted growth of aircraft, hangar demand may increase from the current space of approximately 170,000 SF to approximately 300,000 SF by the end of the planning period. Current FBO plans are discussed further as alternative development plans in **Chapter 5**.

MRO Facilities

MRO activities take place in a bulk hangar in the GA area. The hangar space is approximately 41,400 square feet. The maintenance hangar space is sufficient and is not expected to need expansion during the forecast period.

4.5.2 Air Cargo Facilities

ORF has processing facilities for air cargo arriving and departing via cargo carriers. As mentioned in **Section 4.3.4**, the dedicated air cargo area is on the west side of the airfield, south of the terminal and is comprised of two multipurpose processing buildings (measuring approximately 64,720 square feet and 23,420 square feet). The smallest of the two buildings is occupied by FedEx and FedEx's contract carrier, Mountain Air Cargo (MAC). The larger building is shared between FedEx, Mountain Air Cargo, and UPS. UPS desires a consolidated facility in the future, as operations and functions are broken into four separate areas: front office space, UPS maintenance space, generalized space, and customs.

As discussed in **Chapter 3**, air cargo operators are expected to transition to new and converted B767-300 aircraft. As these new freighters are added, it is expected that ORF will also see less cargo operations via A300s and B757s. Transitioning to larger freighters, along with the projected increases in cargo operations, will result in higher volumes of cargo being brought into the Airport's cargo facilities. **Table 4-91** shows the forecast of cargo operations and volume.

Table 4-91 – All-Cargo Annual Forecasts

Factor	2017	Base	PAL 1	PAL 2	PAL 3	PAL 4
Total Operations	2,429	2,475	2,719	2,987	3,281	3,604
Total Volume (tons)	119,634	121,903	133,910	147,101	161,590	177,506

Source: NAA, CHA, 2018.

Available cargo processing space and cargo volume, observations of the facilities, and conversations with personnel were factors considered when determining the projected building space required for cargo operations. Based on observations of the cargo multipurpose buildings and conversations with the Airport and tenants, the cargo facilities currently exceed maximum capacity by approximately 10 percent. It was determined that the utilization rate for the cargo facilities at ORF is approximately 1.23 tons/SF. As shown in **Table 4-92**, the cargo facilities are expected to exceed capacity by approximately 63 percent in PAL 4.

Table 4-92 – All-Cargo Building Space Requirements

Activity	2017	Base	PAL 1	PAL 2	PAL 3	PAL 4
Air Cargo Building Space Required	96,953	98,792	108,523	119,212	130,954	143,853
Available Space	88,139	88,139	88,139	88,139	88,139	88,139
Surplus/(Deficit)	**8,814**	**10,653**	**20,384**	**31,073**	**42,815**	**55,714**

Source: CHA, 2019.

NAA should plan to reserve land, or plan for land acquisition, for future expansion of existing cargo facilities and/or the building of additional cargo facilities. If the buildings' spaces reach or exceed capacity prior to new or expanded facilities being available, current sort facility equipment can be updated to more modernized equipment (such as automated machinery), allowing for quicker processing and higher throughput.

4.5.3 TSA Cargo Facilities

In the past, TSA had an office in the cargo area; however, TSA no longer has a cargo-dedicated zone. Rather, TSA officers only respond to the cargo facilities when necessary.

4.5.4 Aviation Fueling Facilities

Signature Flight Support is responsible for operating the commercial fuel farm, the GA fuel farm, and the fuel dispensing area at ORF. The Airport's fuel farm for commercial aircraft operators, located north of the Air Traffic Control Tower (ATCT), consists of four above-ground fuel tanks with fuel storage capacities of 210,000-gallons per tank (Jet-A).

Fuel is transported from the fuel farm via underground pipes to a dispensing area located north of the Aircraft Rescue and Firefighting (ARFF) facility. Fuel is then transported from the dispensing area to aircraft via specialized fuel trucks, which make approximately 13 to 15 deliveries per day. The types of trucks and their carrying capacities are as follows:

- One 750-gallon truck (Avgas)
- One 1,000-gallon truck (Avgas)
- Ten 5,000-gallon trucks (Jet-A)
- One 10,000-gallon truck (Jet-A)

The general aviation fuel farm is located in the GA area, south of the T-hangars, and includes three underground 10,000-gallon tanks (two containing Jet-A and one containing AvGas). Signature receives approximately 100,000 to 160,000 gallons of fuel five days per week. Based on 2017 fuel consumption data provided by Signature and the Airport, growth in fuel consumption was assumed for the 20-year forecast period by determining a ratio of the fuel delivered in 2017 to the commercial and GA operations in 2017. The ratio was then applied to each projected year's operations to determine approximate fuel consumption, assuming the ratio remains static. The results were then split by the PMAD factors identified in **Chapter 3** to estimate an average daily usage of fuel throughout the forecast period. Finally, the daily usage was applied to the actual reserve availability at the Airport.

After evaluating the Airport's fuel storage needs, it was determined that the Airport has sufficient fuel storage capacity. The reserves currently provide up to a five-day availability (the desired amount for an airport such as ORF) but can reach as many as a seven-day availability, depending on the amount of fuel delivered. **Table 4-93** depicts the forecast of air carrier and GA operations at ORF. The required fuel reserve to meet three-and-one-half-, five-, and seven-days reserves is shown in **Table 4-94**.

Table 4-93 – Air Carrier and GA Operations

Year	Air Carrier	GA	Total Air Carrier and GA
2017	47,195	22,364	69,559
Base	48,986	22,760	71,746
PAL 1	51,889	24,850	76,739
PAL 2	55,177	27,132	82,310
PAL 3	57,488	29,624	87,111
PAL 4	61,430	32,344	93,773

Source: Signature, NAA, CHA, 2018.

Table 4-94 – Fueling Storage Requirements (Gallons)

Year	Fuel Volume (gallons)	PMAD Fuel	Reserve		
			3.5	5	7
Assuming 100,000 gallons Per Daily Delivery					
2017	26,000,000	100,038	350,133	500,189	700,265
Base	26,817,616	103,184	361,143	515,919	722,286
PAL 1	28,683,910	110,365	386,276	551,823	772,552
PAL 2	30,765,927	118,375	414,314	591,876	828,627
PAL 3	32,560,746	125,281	438,484	626,405	876,967
PAL 4	35,050,974	134,862	472,019	674,312	944,037
Assuming 160,000 gallons Per Delivery					
2017	41,600,000	160,061	560,212	800,303	1,120,424
Base	42,908,185	165,094	577,829	825,470	1,155,658
PAL 1	45,894,255	176,583	618,041	882,916	1,236,082
PAL 2	49,225,484	189,400	662,902	947,002	1,325,803
PAL 3	52,097,194	200,450	701,574	1,002,248	1,403,148
PAL 4	56,081,559	215,780	755,230	1,078,900	1,510,460
Assuming 130,000 gallons Per Delivery (Average of 100,000 and 160,000 gallons)					
2017	33,800,000	130,049	455,172	650,246	910,345
Base	34,862,901	134,139	469,486	670,694	938,972
PAL 1	37,289,082	143,474	502,158	717,369	1,004,317
PAL 2	39,995,705	153,888	538,608	769,439	1,077,215
PAL 3	42,328,970	162,865	570,029	814,327	1,140,058
PAL 4	45,566,267	175,321	613,624	876,606	1,227,249

Source: CHA, 2018.

The Airport's demand will not exceed its current 870,000-gallon capacity during the planning horizon if only up to 100,000 gallons of fuel are delivered per delivery; however, if the Airport wishes to achieve a 7-day reserve capability, it will need to expand to 880,000 gallons by PAL 3 and 945,000 gallons by PAL 4. Fuel storage facilities will near capacity quicker if receiving 160,000 gallons or approximately 130,000 gallons. The Airport has space available to accommodate additional fuel tanks if necessary.

4.5.5 Aircraft Deicing Facilities

Currently, the deicing area, located on the terminal apron, does not have a built-in collection system; rather, sweeper trucks are utilized to collect glycol from the pavement after application, which is then transferred to glycol storage tanks located near the fuel dispensing area. After deicing services have ceased for the season, the glycol tanks are taken to an off-site facility where the recovered fluid is analyzed and disposed of accordingly. Each airline is responsible for its own glycol storage units.

4.5.6 Aircraft Rescue and Firefighting Facilities (ARFF)

ORF currently has one ARFF facility, which is located on the north side of the airfield, northeast of the terminal building. This facility was constructed prior to the new FAA guidance associated with ARFF building design; however, the existing ARFF building currently meets most of the building design requirements found in AC 150/5210-15A, *Aircraft Rescue and Firefighting (ARFF) Station Building Design*. As aircraft operations increase, it may be necessary to revisit the new FAA guidance for ARFF requirements, as new construction may be necessary to accommodate increased demand for facility sizing as operations increase in the future. The ARFF index (Index C) is expected to remain unchanged over the forecast period.

4.5.7 NAA Maintenance Facilities

The NAA operates maintenance and equipment storage facilities, located on the southeast end of the airfield. The northern building is approximately 40,000 square feet and houses the Airport's snow removal equipment (SRE). The southeastern building is approximately 6,000 square feet and serves as the sand storage facility, as well as a storage unit for the Airport's maintenance and utility vehicles. The facilities as currently constructed are inadequate in size via operational function and sizing and amenities. The SRE building is currently at capacity with the amount of snow removal vehicles necessary to accommodate the demand on the airfield. Additionally, the SRE and maintenance buildings were designed and constructed prior to the update of the most recent FAA guidance FAA AC 150/5220/18A, *Buildings for Storage and maintenance of Airport Snow and Ice Control Equipment and Materials*. As such, several changes were made in the AC associated with facility sizing, sleeping quarters, wash bays, etc., all of which the current facility is lacking; therefore, for the purposes of this Study, it is recommended that the Airport consider expanding the SRE and NAA Maintenance Facility to accommodate design changes within the newest FAA guidance.

4.5.8 Ground Support Equipment Facilities and Fuel Truck Storage

At ORF, the airlines (or in some cases, ground handling companies contracted out by the airlines) at ORF own and operate the ground service equipment (GSE), including a variety of aircraft tugs, cabin service vehicles, deicers, ground power units (GPUs), belt-loaders, and waste disposal vehicles. This equipment is stored outside where space is available around the terminal gates (with respect to aircraft parking safety areas) and on the south side of the cargo apron adjacent to the belly cargo buildings. Signature also has 13 fuel trucks, which are parked at fuel loading islands in the fueling areas.

A storage shelter to protect equipment from harsh weather conditions would increase the service life of the equipment. Review of the airlines' GSE inventory indicates that significant storage space would be required to house all airline GSE equipment indoors. Further evaluation is necessary to determine the amount of space required to house GSE equipment and fueling equipment.

4.5.9 Air Traffic Facilities

The Airport Traffic Control Tower (ATCT) is located at 1245 Miller Store Road. Constructed in 1995, the building is used for Air Traffic Control and contains administrative support offices, as well as the Terminal Radar Approach Control (TRACON) facility. The land is leased from the NAA, but the FAA owns the 134-foot tall (above ground level or AGL) building. Approximately 85 automobile parking spaces are available that serve the ATCT. The tower is attended 24 hours a day throughout the year, during which time its staff controls air traffic in accordance with federal regulations. It is anticipated that the ORF ATCT will sufficiently serve the Airport throughout the forecast horizon.

4.6 SURFACE TRANSPORTATION AND PARKING REQUIREMENTS

This section presents the projections of future airline passenger, car rental, and ORF employee parking needs, based on the forecast presented in **Chapter 3 (Forecasts of Aviation Activity)**, as well as a summary of the anticipated future changes in the ORF parking inventory. Projected enplanement growth by year (base year to PAL 4) was applied to existing (2017) peak on-airport public and employee parking accumulations to project future parking need. Information provided by ORF was used to determine the magnitude and timing of changes to the existing parking inventory.

4.6.1 Passenger Parking Demand Projections

Beginning with the Master Plan enplanement projections from the base year to PAL 4, existing peak parking utilization was increased in line with enplanement growth; however, a five percent reduction in parking demand in the base year was assumed, based on an increase in the use of ride-sharing services such as Uber, Lyft and other car services. **Table 4-95** presents the results of the parking projections from the base year through PAL 4. At the current enplanement level of about 1.8 million passengers, the parking system requires a total capacity of approximately 5,400 parking spaces. At 2.8 million enplanements, the demand for parking is projected to reach almost 8,000 spaces.

4.6.2 Parking Supply Changes

While parking demand is projected to increase in the future as enplanements grow, several projects will also impact the supply of parking owned and controlled by ORF. These known projects will ultimately increase the total supply of parking from 8,598 to 8,976 spaces.

The proposed projects include the removal of Lot D for construction of a new garage. That new garage will be completed in 2021, providing 2,612 public parking and 596 employee spaces. Once the employees are transferred to Garage D, the Employee lot will be eliminated, and Garages B and C will be closed for rehabilitation. In 2022, the rehabilitation will be completed, and the garages will reopen with the loss of 100 total spaces. Once Garages B and C reopen, the Long-term lot will be permanently closed with a loss of 2,052 spaces. **Table 4-97** summarizes the changes in parking inventory by user group and year.

Table 4-95 – Projected Parking Needs

Year	Master Plan Enplanement Projections	Peak Utilization of NAA Public Parking	Peak Utilization of Rental Car Parking	Peak Utilization of CAA Employee Parking	Total Peak Utilization of ORF Parking
2017 (actual)	1,672,024	3,999	636	258	4,893
Base	1,857,487	4,443	707	287	5,436
PAL 1	2,115,424	4,807	805	326	5,938
PAL 2	2,376,990	5,401	904	367	6,672
PAL 3	2,622,848	5,959	998	405	7,362
PAL 4	2,834,623	6,441	1,078	437	7,956

Source: DESMAN.

Table 4-96 – Projected Parking Inventory

Year	Location	Spaces Lost	Spaces Gained	User Group
2019	Loss of Lot D for Construction	82	0	Public Parking
2021	Garage D	0	2,612	Public Parking
		0	596	Employee Parking
2021	Loss of Employee Lot	596	0	Employee Parking
2021	Rehab Garages B and C	2,223	0	Public Parking
2022	Finish Garages B and C	0	2,123	Public Parking
2022	Loss of Long-Term Lot	2,052	0	Public Parking
Total		4,953	5,331	Net +378

Source: DESMAN.

Table 4-97 – Projected Parking Inventory by Type of User

	Location	Regular	Disabled	Authorized	Rental Car	Total by Year				
						2018	2019	2020	2021	2022
A	Garage A	2,535	37	0	636	3,208	3,208	3,208	3,208	3,208
	**Short-Term*	275	7	0	0	282	*282*	282	282	282
	**Long-Term*	2,260	30	0	0	2,290	2,290	2,290	2,290	2,290
	**Rental Cars*	0	0	0	636	636	636	636	636	636
B	Garage B	1,090	21	2	0	1,113	1,113	1,113	0	1,063
C	Garage C	1,089	21	0	0	1,110	1,110	1,110	0	1,060
D	Lot/Garage D	72	4	6	0	82	0	0	3,208	3,208
E	Long-Term Lot	1,999	42	11	0	2,052	2,052	2,052	2,052	0
F	Departures North	146	6	0	0	152	152	152	152	152
G	Departures South	171	6	0	0	177	177	177	177	177
H	North-Permit Only	103	5	0	0	108	108	108	108	108
I	Employee Lot	580	12	4	0	596	596	596	0	0
Total		7,785	154	23	636	8,598	8,516	8,516	8,905	8,976

Source: DESMAN.

4.6.3 Future Adequacy of the ORF Parking Inventory

The projected growth of parking demand was overlaid onto the projected parking supply by user group from the base year through PAL 4. For planning purposes, our target occupancy was 90 percent of available spaces. This accounted for the practical capacity of a parking system such as unused ADA spaces, vehicles parking over the lines, and the last few spaces in a parking facility which may be hard to find. Only when enplanements exceed 2.75 million assuming no further increase in non-drive mode split would public parking demand exceed the target of 90 percent peak occupancy.

As shown in **Table 4-98,** based on observed peak utilization of current parking demand, the public parking demand in the base year of 4,442 spaces will increase to 6,441 in PAL 4. Similarly, rental car space demand will increase from 707 to 1,078 spaces and employee demand will increase from 287 vehicles to 437. It has been noted that during certain employee shift changes, peaks may reach 596 spaces.

This analysis demonstrated that, in total, there will be an adequate number of parking spaces available to accommodate the projected enplanements; however, there may be a need to convert excess long-term spaces to car rental spaces if growth occurs as expected.

Table 4-99 provides a further breakdown of supply and distribution of demand over the 20-year period. For each user group, the existing supply and demand were identified. The planned changes, both additions and subtractions, were added to the existing supply and the projected demand was calculated based on the growth of enplanements. The reserved spaces were assumed to remain constant at 110 and were considered 100 percent occupied throughout the 20-year study period. For each of the user groups shown in the table, the supply of parking in the base year and PAL 4 was identified, the demand was projected, and the surplus/deficit was calculated. As discussed previously, based on the current parking plans and the projected enplanements, there will be adequate parking available to accommodate the demand. As discussed previously, based on the current parking plans and the projected enplanements, there will be adequate public parking available to accommodate the demand; however, during the course of the planning period, rental car demand will exceed capacity.

Table 4-98 – Projected Adequacy of the ORF Parking Inventory

Year	Passenger Projections	Peak Util. of ORF Public Parking	Projected ORF Public Parking Inventory	Anticipated Peak Public Surplus/(Deficit)	Peak Util. of Rental Car Parking	Projected ORF Rental Car Inventory	Anticipated Peak Rental Car Parking Surplus/(Deficit)
2017 (actual)	1,672,024	3,999	7,366	3,367	636	636	0
Base	1,857,487	4,442	7,366	2,924	707	636	(71)
PAL 1	2,115,424	4,807	7,491	2,684	805	636	(169)
PAL 2	2,376,990	5,401	7,491	2,090	904	636	(268)
PAL 3	2,622,848	5,959	7,491	1,532	998	636	(362)
PAL 4	2,834,623	6,441	7,491	1,050	1,078	636	(442)

Year	Passenger Projections	Projected ORF Employee Parking Inventory	Peak Util. of ORF Employee Parking	Anticipated Peak Employee Parking Surplus/(Deficit)
2017 (actual)	1,672,024	596	258	338
Base	1,857,487	596	287	309
PAL 1	2,115,424	596	326	270
PAL 2	2,376,990	596	367	229
PAL 3	2,622,848	596	405	191
PAL 4	2,834,623	596	437	159

Year	Passenger Projections	Projected ORF Total Parking Inventory	Anticipated Total Peak Surplus/(Deficit)	Net Change in ORF Inventory vs. 2017	Total Peak Utilization of ORF Parking
2017 (actual)	1,672,024	8,598	3,705	0	4,893
Base	1,857,487	8,598	3,162	0	5,436
PAL 1	2,115,424	8,723	2,785	125	5,938
PAL 2	2,376,990	8,723	2,051	0	6,672
PAL 3	2,622,848	8,723	1,361	0	7,362
PAL 4	2,834,623	8,723	768	0	7,956

Source: DESMAN.

Table 4-99 – Summary of Projected Parking Needs by User Group

User Group	Base Year Supply	Base Year Demand	Base Year Surplus	PAL 4 Supply	PAL 4 Demand	PAL 4 Surplus
Short Term	592	190	402	592	290	302
Long Term	6,510	4,055	2,455	6,635	5,906	729
ADA	154	88	66	154	134	20
Reserved	110	110	0	110	110	0
Rental Car	636	707	(71)	636	1078	(442)
Employee	596	287	309	596	437	159
Total	**8,598**	**5,436**	**3,162**	**8,723**	**7,956**	**768**

Source: DESMAN

4.6.4 Future Capacity of ORF Curb front

The projected growth of curb front activity for both passenger cars and bus/rideshare vehicles were overlaid onto the existing curb front dimensions by location and user group from the base year through PAL 4. The current useable curb front lengths are shown in **Table 4-100** and are illustrated in **Figure 4-31**. The table summarizes separately the existing curb fronts on the departure and arrivals buildings and separately for cars and bus/rideshare. It should be noted that there are small variations in length due to the locations of cross walk and turning radii. The table also acknowledges that in the three-lane roadway configuration, the curb lane is the primary drop-off lane, the middle lane is the overflow lane, and the outside lane is reserved for through traffic. The current curb front occupancy ranges from 20 percent to 45 percent.

Table 4-100 – Current Useable Curb Front Length

Curb front	Cars & Shuttles	Usable Curb front Length (ft.)		Total Usable Length	Second Lane Length	Total Usable Length
		North	South			
Departures	Cars	377	288	665	500	1,165
	Shuttles	266	244	510	400	910
Arrivals	Cars	688	0	688	500	1,188
	Shuttles	688	0	688	0	688

Curb front	Cars & Shuttles	Current Curb Front Occupancy	Occupancy Incl. Second Lane	Occupancy with 5% shift in rideshare	Base Year Curb Front Occupancy (Base Year)	Peak Design Condition 2x Avg.
Departures	Cars	40%	23%	22%	22%	43%
	Shuttles	20%	11%	13%	13%	25%
Arrivals	Cars	45%	26%	25%	25%	50%
	Shuttles	20%	20%	22%	22%	45%

Source: DESMAN.

The observed occupancies are also summarized for each curb front. It is reported that there are short periods of time during peak departure periods when the immediate curb front, generally immediately in front of the entrance doors, when cars are stacked up or double parked. Based on the existing configuration of the separated departures curbside lanes on each side of the Departures building, individual airline peaking characteristics often cause off-peak period congestion on the curbside based on the fleet mix of the aircraft and the airlines operating the flight during these times. For example, should Delta, Frontier, and Allegiant have flights during the same period, with the make-up of the passengers on Frontier and Allegiant commonly having a higher number of leisure passengers on larger planes (i.e., +/- 177 seats), and the tickets counters on the south departure curbside, congestion is common during these periods. This results in drivers dwelling at the curb front for longer than necessary.

Based on the infrastructure and operational characteristics of the Departures curbside (i.e., passengers can utilize north and south curbsides, curb lane length is constrained, etc.) for the purposes of this Study, the curbside lane was shown and calculated as total length. Additionally, since there was no use of the overflow lane during the field observations conducted for this Study, the current occupancy was factored to include the use of the overflow lane. As such, it is recommended that the departure lanes be actively managed during peak times. Ambassadors, attendants, or police point control should be used to direct drivers to spread out over the length of the curb front and, when necessary, direct them to the overflow lanes.

Factoring the overflow lane, which would be used during busy times, has typical occupancy ranges that are between 11 percent and 26 percent. As with the parking projection, it was assumed that rideshare would increase 5 percent over the near future (see **Table 4-100**). The base year occupancy in the automobile lanes decreases slightly, while the occupancy in the rideshare lanes increases. Recognizing the seasonality of airport enplanements, the base year (2018) occupancy was adjusted to reflect that the peak design condition generally is twice the typical or average condition (see **Table 4-100**). Even during peak times, the occupancy of the lanes is a maximum of 50 percent or less at current enplanements.

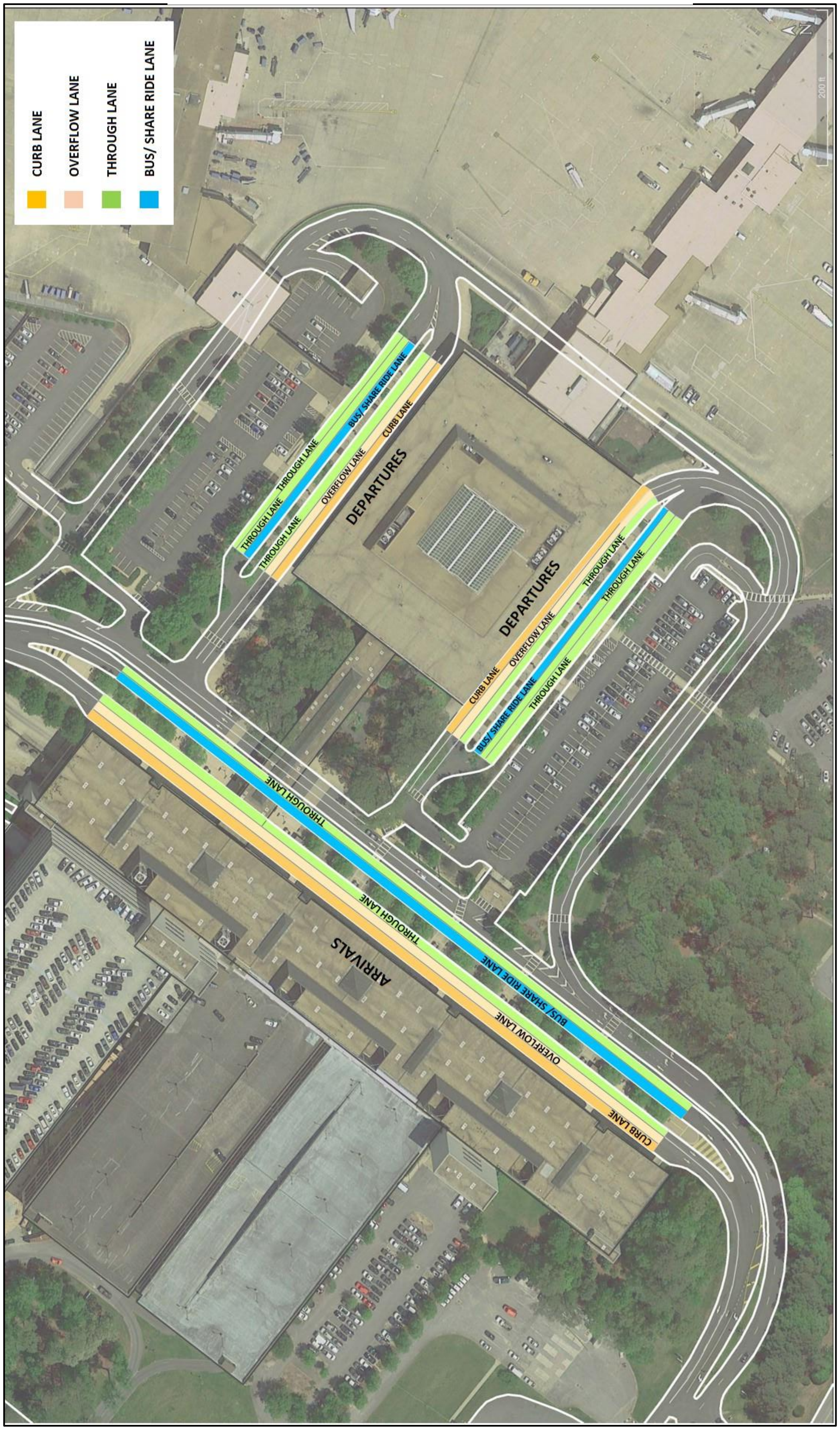
The current design day conditions for each category were projected based on the Master Plan enplanement projections. As shown in **Table 4-101**, the existing curb front occupancy would increase from existing levels to no more than 61 percent for bus/rideshare lanes and to no more than 72 percent for auto lanes. Based on the existing curb front lengths, there will be adequate capacity to accommodate projected enplanements through PAL 4. As new flights are added, some departures may conflict and create a “microburst” of activity. During the short periods when drop-off for several departing flights overlap, point control, either by attendants or police, can direct traffic on the curb front. The point control staff will help to spread the concentration of drop-off motorists along the curb front and will be able to encourage drivers to move along and not dwell unnecessarily at the curb front. If the problem persists or the flight schedules become more heavily concentrated, the outer curb front could be utilized during peak periods. It is not believed that a physical solution, such as adding additional curb length, will be necessary.

Table 4-101 – Projected Curb Needs

Year	Enplanement Projections	Peak Utilization of Departures Curb Front		Peak Utilization of Arrivals Curb Front	
		Private Cars	Bus/Rideshare	Private Cars	Bus/Rideshare
2017 (actual)	1,672,024	43%	25%	50%	45%
Base	1,857,487	48%	28%	55%	49%
PAL 1	2,115,424	52%	29%	54%	46%
PAL 2	2,376,990	59%	33%	60%	52%
PAL 3	2,622,848	65%	36%	67%	57%
PAL 4	2,834,623	70%	39%	72%	61%

Source: DESMAN.

Figure 4-31 – Existing Curb Front Layout



Source: DESMAN

4.6.5 Curbside Management Plan

Based on the projection of curbside activity, the existing curb front will be adequate to accommodate the projected needs; however, as enplanements increase, there may be short “microbursts” of activity when several planes land or take off in a short period of time. During these peak activity periods, it may be desirable to have a curbside management plan ready. At many airports this includes a combination of ambassadors to help direct patrons to and from the curb and the terminal, as well as traffic directors to insure smooth traffic flow for both passenger cars and taxi/transportation network companies (TNCs). The need for this service should be monitored over time.

4.6.6 Rental Car Ready/Return Parking

As previously discussed, current rental car operations consist of two separate facilities; a ready and return area in Garage A and an off-site QTA maintenance facility located west of Airport property on Military Highway. The rental car companies’ return lot was previously located on Airport Road, adjacent to the long-term lot; however, the Airport recently completed the process of converting the second floor of Garage A to a return facility where passengers drop-off vehicles. The current drop-off lot has been eliminated. As discussed previously, the combined rental car facility will be adequate to accommodate the projected enplanements.

4.6.7 Rental Car Vehicle Storage and Maintenance Facilities

Rental car vehicle storage and maintenance is situated off airport property on Military Highway. Currently, there are no plans to relocate or expand the facility; however, if the long-term surface lot is displaced for terminal facility needs, there may be a need for additional customer parking in Garage A. If so, consideration should be given to relocating the Rental Car QTA and fueling facilities in an alternate location. Additionally, there are no current plans to relocate or expand the facilities along Military Highway due to capacity or necessary improvements associated with inadequate facility requirements. There has been considerable thought to operational justification of the relocations of all QTA facilities into a consolidated QTA facility in proximity to the terminal. With the rental ready/return and passenger pick-up now located in Garage A, considerable increased trips via the rental car companies to and from the ready/return and QTA has put a strain on the terminal roadway system from a capacity and operational safety perspective. As such, it is recommended, when practical, to consider a consolidated QTA in proximity to the terminal buildings where feasible.

4.6.8 Commercial Vehicles and TNC Staging Area

The current TNC lot is located in the old rental car return lot. The lot contains more than two acres and can accommodate more than 250 vehicles. The taxi waiting area is located on Airport Road adjacent to the existing long-term lot. It can accommodate approximately 25 taxis and provides a small service building. Between 2016 and 2017, total TNC traffic increased 76 percent to an average of just under 50 trips per hour during the peak month (December). Assuming that TNCs grow in proportion to enplanements, TNC traffic would grow to about 70 per hour. This can easily be accommodated in the existing lot. There is continuing discussion regarding when TNCs’ share of the market will level out, and at whose expense; taxis/limos or parkers. Given the distances that passengers and employees are traveling to get to the Airport, it is expected that price will limit the growth of TNCs at the Airport. Given the uncertainties of projected demand, it is recommended that a combined taxi, TNC, limo waiting area be developed at ORF to accommodate 100 to 125 vehicles. As discussed in **Section 4.6.1**, TNC operations are expected to decrease parking demand by approximately five percent in the base year due to an increase in the use of ride-sharing services; however, TNC activity is not expected to impact public parking in the future, as public parking demand is projected to increase and, thus, is being accounted for in future parking considerations.

4.7 ACCESS ROADWAYS AND CIRCULATION

The Airport is served with access roads and connections to regional highways and Interstate 64. The Airport's grounds provide public access to both the arrivals and departures buildings as well as access to parking facilities.

4.7.1 Regional Access

The regional access system based on I-64 via Norview Avenue and Robin Hood Road has substantial capacity to accommodate an increase in enplanements. These roads, together with Route 192 (Azalea Garden Road), will continue to provide easy access to and from the Airport for passengers and employees; however, as enplanements increase and more vehicles are traveling to the Airport from the Interstate system, consideration should be given to improving the access to and from the east on I-64 (this includes the majority of travelers to and from points south, east and west).

4.7.2 Local Access

The primary local access road for most passengers and employees is Norview Avenue which provides four lanes between the Airport and I-64. Traffic on Norview is controlled by traffic signals at Rt. 192, Military Highway, a shopping center, and the Interstate 64 ramps. The existing turn lanes at key intersections provide a good level of service for existing peak hour traffic and enough capacity to accommodate the growth in enplanements at Norfolk International Airport; however, since Norview Avenue passes through a residential neighborhood between Military Highway and Azalea Garden Road, it can be expected that there would be increasing complaints from the neighborhood about airport traffic. If the neighborhood is to remain in place over the long term, consideration should be given to providing more direct access to the Airport from I-64.

In addition, Azalea Garden Road provides a secondary exit from the Airport to the north to Rt. 170 and to the southwest to Military Highway and points beyond. The Robin Hood Road interchange with I-64 provides an alternative entrance to the Airport from the south and via I-264 from Virginia Beach and Portsmouth. As enplanements increase, consideration should be given to improvement of the interchange at Robin Hood Road to provide full access to and from the east with direct access along Robin Hood Road and Airport Road to the terminal.

4.7.3 Circulation

More than 4.5 lane miles of circulation roadways, in addition to the curb front loading lanes, effectively distribute circulating traffic throughout the Airport. The existing configuration can accommodate the projected increase in enplanements. If the terminal buildings are significantly reconstructed or expanded, it will be appropriate to review the resulting configuration to ensure that the circulation roadways will not be reduced to a level that will be unable to accommodate projected traffic flows.

4.7.4 Parking Cashier Plaza Requirements

The existing cashier plaza contains nine exit lanes (four set up for cashiers and five automated pay stations which accept prepayments and pay in lane), which are adequate to accommodate 1,400 vehicle per hour. This represents approximately 18 percent of the parking capacity, which exceeds the target to accommodate 15 percent of long-term capacity and 100 percent of the short-term capacity in the peak hour. Since the automated lanes have almost twice the capacity of the cashiered lanes over time, more of the cashiered lanes can be converted to prepaid/pay in lane (if demand dictates).

4.7.5 High Capacity Transit (BRT or Light Rail) Route

Hampton Roads Transit (HRT) is exploring the options to expand the existing Tides light rail system from downtown to the Naval Station Norfolk. As a part of the environmental review process that began in the summer of 2019, HRT commenced a Draft Environmental Impact Statement (DEIS) on an eastern corridor where a transit technology/mode (BRT or Light Rail) and a locally preferred alternative (LPA) or route will be selected. The Naval Station Norfolk DEIS, also known as the Naval Station Norfolk Transit Corridor Project, is anticipated to conclude by the end of 2021.

The eastern route will likely travel along the Military Highway corridor and stop at intermediary destinations in Norfolk, continuing to the end destination of Naval Station Norfolk. This route could be configured to approach or enter the Airport, depending on the feasibility of a connection and environmental impacts. If an effective connection is provided to the Airport, the high capacity transit system has the potential to provide alternative access for employees and visitors to Norfolk, Virginia.

5 AIRPORT DEVELOPMENT CONCEPTS

To satisfy the facility requirements identified in **Chapter 4**, numerous concepts, site configurations, and development options were created and reviewed for the various components of the Airport. In many circumstances, multiple alternatives were identified, but eliminated early in the planning process from further consideration. The concepts deemed most reasonable to support the long-term operational sustainability of the Airport were identified and carried forward in the evaluation.

This chapter includes separate concepts and configurations for runways, taxiways, passenger terminal facilities, air cargo, general aviation, and support facilities. The number of potential recommendations is substantial; however, it is emphasized that although projects may be desired, they may not necessarily be financially or environmentally feasible. As such, recommendations presented within this chapter were further modified or narrowed during the financial planning components of the Master Plan Study. The overall effort refined the final strategy into actionable recommended projects for implementation in phases.

5.1 CONCEPT EVALUATION

Regardless of timeframe or activity level, the overarching principles guiding facility recommendations are to provide an elevated level of customer service and promote regional economic wellbeing while accommodating the evolving business model of the airlines and airport tenants. For some functional areas, such as the airfield, the logical recommendations were distinctly apparent as they are driven largely by Federal Aviation Administration (FAA) design standards as well as by existing infrastructure and available property. In contrast, improvements related to the passenger terminal buildings and vehicle parking have variability in their configuration. This is due to potential financing and implementation challenges, and their influence on surrounding Airport facilities.

During the identification of facility requirements, it became evident that the Master Plan would not consist of all-encompassing or competing alternatives for development of the Airport. Rather, the concepts and alternatives presented consist of a series of separate improvements that are assembled into the overall strategy. As such, individual components were reviewed and recommended separately to develop the preferred improvements program.

5.2 CURRENT AIRFIELD COMPLIANCES AND DEFICIENCIES

Norfolk International Airport (ORF) currently operates two runways (Runway 5/23 and Runway 14/32), each having unique capabilities and constraints. Each runway was evaluated based on its operational requirements, with the identified improvements provided below. To identify the best methods for improving airfield operations with regard to the runway infrastructure, it was important to evaluate the strengths and weaknesses of closing Runway 14/32 and/or the addition of a secondary runway (i.e., parallel Runway 5R/23L).

To satisfy operational efficiency, access to and from the runways, improvements and expansions to the associated taxiway systems, and FAA design standards were also identified. Concepts relating to runway standards and deficiencies are presented in **Sections 5.2.1** and **5.2.2,** while taxiway standards and deficiencies are discussed in **Section 5.2.3**.

5.2.1 Runway 5/23

Design Standards Satisfied

Based on the demands outlined in **Chapter 4**, the current length, width, Runway Object Free Zone (ROFZ), and Runway Protection Zones (RPZs) of the primary runway (Runway 5/23) are adequate and are anticipated to remain adequate throughout the forecast period; therefore, it is recommended that these fundamentals of Runway 5/23 be maintained throughout the planning period. No development alternatives are needed for these elements.

Design Standards Needing Improvements

Although many attributes of Runway 5/23 meet FAA design criteria, some features do not, including: the runway shoulders, safety areas, object free areas, and the blast pads.

- Runway Shoulders – When evaluating runway designs standards in **Chapter 4**, it was determined that Runway 5/23 does not meet the 25-foot shoulder requirement, with the current shoulders measuring zero to 15 feet. It is recommended that pavement be added to both sides of the runway to meet the 25-foot requirement.
- Runway Safety Area (RSA) – The Runway 5/23 RSA width contains a drainage structure located near the intersection with Taxiway 'A'. Furthermore, portions of the RSA do not meet the transverse grading requirements. Per FAA design criteria, transverse grades should be -1.5 percent to -3.0 percent away from the runway shoulder edge and beyond the runway ends; however, the existing grades are 0.7 percent to 2.0 percent. It is recommended these areas be graded to meet FAA design criteria and that the RSA is widened where necessary.
- Runway Object Free Area (ROFA) – The ROFA design standard for Runway Design Code (RDC) III and IV is 800 feet wide, centered about the runway centerline, and extends 1,000 feet beyond each runway end. Currently, the Runway 5/23 ROFA contains portions of the glideslope shelter and antenna. To address this condition, these facilities could be relocated, or the Airport could seek an FAA Modification of Standards (MOS).
- Runway Blast Pads – Conformance to FAA design criteria requires that 200-foot wide by 200-foot length blast pads be placed symmetrically at the end of each RDC IV runway. At present, the blast pads on each runway end have a deficient width of only 150 feet. The blast pads could be widened, or the Airport could seek an FAA MOS.

Chapter 4 provides additional details regarding FAA design standards.

5.2.2 Runway 14/32

Design Standards Satisfied

Based on the requirements outlined within **Chapter 4**, the current runway width, RSA, ROFZ, and RPZ of the crosswind runway (Runway 14/32) are adequate and are anticipated to remain adequate throughout the forecast period; therefore, it is recommended that these fundamentals of Runway 14/32 be maintained as long as the Runway remains in operation. No development alternatives are needed for these elements.

Design Standards Needing Improvements

Although many attributes of Runway 14/32 meet FAA design criteria, the runway shoulders and ROFA are deficient.

- Runway Shoulders – Runway 14/32 currently lacks the required 25-foot paved shoulders. It is recommended that 25-foot shoulders be added to the runway.
- ROFA – The ROFA design standard for RDC III and IV is 800 feet wide, centered about the runway centerline, and extends 1,000 feet beyond each runway end. Currently, the ROFA contains part of Robin Hood Road and the airport access road. An FAA MOS is recommended for this condition while the runway remains in use.

5.2.3 Taxiways

Design Standards Satisfied

The taxiway system at ORF was evaluated and compared to FAA standards for taxiway designs based on the Airport's Taxiway Design Group (TDG 5). Based on FAA standards, the following items are satisfactory:

- Width: All taxiways
- Shoulders (30 feet): Taxiway 'V'
- Distance of taxiway centerlines from objects: Taxiways 'A', 'J', and 'F'
- Taxiway Safety Area (TSA): All taxiways
- Taxiway Object Free Area (TOFA): Taxiways 'A', 'J', and 'V'
- Taxiway Fillets: All taxiways, except for Taxiway 'C'

Design Standards Needing Improvements

Although many attributes of ORF's taxiway system meet FAA design criteria, some features do not, including the following:

- Shoulders: Neither Taxiway 'A' or 'F' have shoulders, while the shoulders for Taxiways 'C' and 'J' are less than the required width and unpaved.
- Distance of taxiway centerlines from objects: Taxiways 'C' and 'F'
  - Result of access roads impeding the TOFA (near the Runway 23 end)
- TOFA: Taxiways 'C' and 'F'
  - An MOS is required if objects are not be relocated outside the TOFA.
- Taxiway Fillets: Taxiway 'C'
  - Revised pavement geometry is necessary to meet standards.

5.3 AIRFIELD DEVELOPMENT CONCEPTS

This section identifies and evaluates potential runway and taxiway improvements that will enhance the overall safety, efficiency, reliability, and capacity of the airfield at ORF. Aircraft flows between the runway system and various functional areas (e.g., terminal area, air cargo, and general aviation) have been considered. Runway and taxiway concepts were developed through qualitative review of the following considerations:

- Construction and operating costs
- Operational changes and considerations
- Construction impacts, including ease of phasing and construction
- Airfield delays and other operational factors
- Capacity, safety, and reliability considerations
- Airspace considerations
- Environmental considerations
- Community acceptance

As discussed within previous section of the Master Plan, the goal is to plan for a safe and operationally efficient airfield. This can be accomplished by meeting the following objectives:

- Adhere to FAA design standards, reducing/eliminating Modifications of Standards
- Accommodate all existing and projected users
- Provide sufficient airfield capacity to meet demand, while minimizing airfield delays
- Reduce runway crossings (particularly in the middle third of runway) to improve safety
- Reduce risk of pilot confusion
    - Reducing the number of taxiways intersecting at a single location
    - Eliminating acute angle intersections
    - Increasing the pilot's situational awareness (proper signage and marking)
    - Avoiding wide expanses of pavement
    - Increasing visibility
- Determine the ultimate Airport Layout

5.3.1 Initial Runway Alternatives

ORF currently operates a two-runway system, each with unique capabilities and constraints. Both runways were evaluated based on previously outlined criteria. In total, 16 runway alternatives were initially evaluated, as listed in **Table 5-1**. Runway alternatives considered various issues, including displaced threshold locations on the primary runway (Runway 5/23), improvements to or closure of the crosswind runway (Runway 14/32), and various options for a new secondary parallel runway; which would be designated Runway 5R/23L. Previous studies also considered this need at ORF. The following runway alternatives include refinements of past concepts and additional layouts based on present and forecasted needs. It is noted that the justification for a secondary parallel runway has not been accepted by FAA at this time but remains a strong ultimate goal of the Airport.

Table 5-1 – Initial Runway Alternatives

Alternative	Description	Length	Width	ARC	Visibility Minimums	TSS # (FAA EB 99)	Parallel Rwy CL Separation	Parallel Txy CL Separation	TDG
Runway 5/23									
1	Relocate 5 Threshold	9,001'	150'	D-IV	< 3/4 Mile	5 - 34:1	-	-	-
Runway 14/32									
2	Reconfigure 14/32	4,876'	100'	B-II	≥ 1 Mile	4 - 20:1	-	240'	3
3	Close 14/32	-	-	-	-	-	-	-	-
New Parallel Runway (Runway 5R/23L)									
4	9,001' - 400' Offset	9,001'	150'	D-IV	< 3/4 Mile	5 - 34:1	400'	-	-
5	9,001' - 876' Offset	9,001'	150'	D-IV	< 3/4 Mile	5 - 34:1	876'	400'	5
6	7,900'	7,900'	150'	C-III	< 3/4 Mile	5 - 34:1	876'	400'	3
7	7,200'	7,200'	150'	C-III	< 3/4 Mile	5 - 34:1	876'	400'	3
8	6,000', 34:1	6,000'	150'	C-III	< 3/4 Mile	5 - 34:1	876'	400'	3
9	6,000', 20:1	6,000'	150'	C-II	≥ 3/4 Mile	4 - 20:1	876'	300'	3
10	5,500', 34:1	5,500'	150'	C-II	< 3/4 Mile	5 - 34:1	876'	400'	3
11	4,876', 20:1	4,876	100'	B-II	≥ 1 Mile	4 - 20:1	876'	240'	3
Additional Runway Alternatives									
12A	5,500’ with EMAS	5,500’	100’	C-II	≥ 3/4 Mile	4 - 20:1	876'	300’	3
12B	5,500’ with EMAS	5,500’	100’	C-II	≥ 1 Mile	4 - 20:1	876'	300’	3
13A	Runway Realignment	7,500’	100’						
13B	Runway Shift West	7,900’	100’						
14	Rotated Runway	5,500’	100’						

Note: The new runway (5R/23L) would be parallel to the current runway (Runway 5/23), which would become Runway 5L/23R.
Source: CHA, 2019.

5.3.2 Eliminated Runway Alternatives

Through thorough evaluation and multiple work sessions and discussions with the Authority, 16 overall Runway alternatives were evaluated for consideration, based upon extensive planning considerations. These alternatives were subsequently presented to the Airport Board for consideration. Based upon these work sessions and Board review, it was determined that the following 11 alternatives listed within **Table 5-1** are not preferable and do not require further consideration:

- Alternative 1: Relocate Runway 5 Threshold
- Alternative 4: 9,001’, Offset: 400’ (Commercial Operations)
- Alternative 5: 9,001’, Offset: 876’ (Commercial Operations)
- Alternative 6: 7,900’ (Commercial Operations)
- Alternative 7: 7,200’ (Commercial Operations)
- Alternative 9: 6,000’, ARC C-II (20:1)
- Alternative 10: 5,500’, ARC C-II (34:1)
- Alternative 12A: 5,500’, ARC C-II, with EMAS, 3/4-mile visibility minimum
- Alternative 13A: Runway Realignment

- ✈ Alternative 13B: Runway Shift
- ✈ Alternative 14: Rotated Runway

Appendix N contains further detail and illustrations regarding the alternatives not chosen for further consideration.

5.3.3 Runway Alternatives for Further Consideration

Of the initial 16 alternatives, five have been recommended for further consideration, with each briefly discussed and illustrated throughout the subsequent sections.

Runway 14/32 Alternatives

Alternative 2: Reconfigure Runway 14/32

This alternative (**Figure 5-1**) would retain Runway 14/32 throughout the planning period. The runway was reviewed for standards for commercial operations and large jet aircraft (Airport Reference Code [ARC] C-III) and for lighter general aviation activity (ARC B-II). To provide the RSA and ROFA required for ARC C-III, the Accelerate to Stop Distance Available (ASDA) and Landing Distance Available (LDA) would remain below 4,000 feet for Runway 32 due to the limited property available, making this option impractical. If the Runway was designed for lighter (i.e., non-commercial) aircraft with ARC B-II and improved with a full-length parallel taxiway, all declared distances would be over 4,500 feet. This length would satisfy runway requirements for piston and turboprop aircraft, as well as for some small light jets.

However, there are several airspace and facilities to the northwest and southeast of the runway that may hinder further development. Additional improvements on the Runway 32 end impacts potential GA development necessary to accommodate future GA demand. Additionally, development is restricted on the Runway 14 end, which impacts the the expansion of the cargo facilities necessary to accommodate existing and future demand. Finally, based on runway length, and location of runway ends relative to user (GA operators) the runway usage remains very low (less that one percent of Airport operations, as described in **Chapter 4 – Facility Requirements**).

In terms of airspace, there are several non-compatible land uses within the Runway 14 RPZ. Although reducing the Runway ARC to B-II will reduce the RPZ size, some non-compatible uses, including residential owned land, and sections of Norview Ave and Azalea Garden Drive would still remain. **Table 5-2** lists the opportunities and constraints for Runway Alternative 2.

Table 5-2 – Alternative 2: Reconfigure Runway 14/32

Opportunities	Constraints
✈ Retains crosswind coverage for light general aviation aircraft ✈ Provides improved parallel taxiway	✈ Design standards hinders usage by general aviation jets and commercial aircraft ✈ Requires parallel taxiway relocation and extension ✈ Occupies critical airport property that could be used for other facilities ✈ Airspace limitations (north/south traffic) and conflicts with surrounding facilities

Source: CHA, 2019.

<u>Alternative 3: Close Runway 14/32</u>

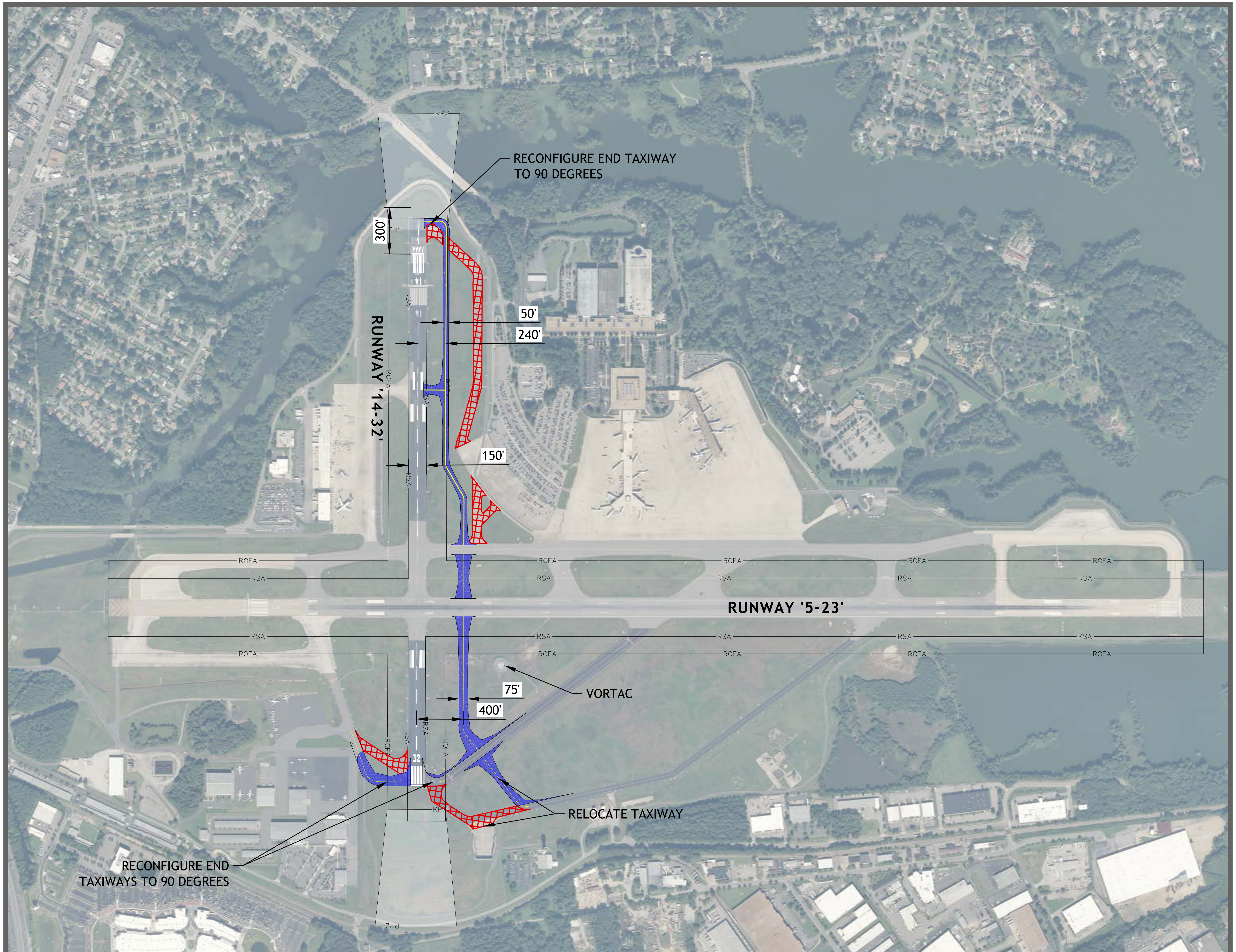
This alternative (**Figure 5-2**) would permanently close Runway 14/32 and enable redevelopment of the property for expanded airport facilities. Runway 14/32 can only effectively serve piston aircraft and is used infrequently. (More detail regarding usage of Runway 14/32 is provided in **Chapter 3, Table 4-7: Runway Usage**). Furthermore, even with a runway extension the surrounding regional airspace would render commercial activity on this orientation difficult. As such, with very limited benefit, there is a strong case for this alternative; therefore, it was also advanced for additional consideration. **Table 5-3** lists the opportunities and constraints for Runway Alternative 3.

Table 5-3 – Alternative 3: Close Runway 14/32

Opportunities	Constraints
✈ Recaptures airport property to expand critical aviation facilities ✈ Avoids airspace conflicts with surrounding facilities ✈ Eliminates some operational conflicts and safety concerns	✈ Reduces crosswind coverage for light General Aviation aircraft

Source: CHA, 2019.

Note: Crosswind coverage is provided in Chapter 2 (Section 2.7.2) and in Chapter 4 (Section 4.3.1).



NORFOLK INTERNATIONAL AIRPORT

MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)
0 400 800

DECLARED DISTANCES RUNWAY 14		
	EXISTING C-III	PROPOSED B-II
TORA	4,876'	4,876'
TODA	4,876'	4,876'
ASDA	4,876'	4,876'
LDA	4,301'	4,576'

DECLARED DISTANCES RUNWAY 32		
	EXISTING C-III	PROPOSED B-II
TORA	4,876'	4,876'
TODA	4,876'	4,876'
ASDA	3,876'	4,576'
LDA	3,876'	4,576'

Figure 5-1
Reconfigure Runway 14-32

20:1 TSS , B-II Runway
Alternative 2

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GRAPHIC SCALE
(FEET)
0 300 600

Figure 5-2
Close Runway 14-32
Alternative 3

Proposed Parallel Runway 5R/23L Alternatives

Each of the following three alternatives proposes a new parallel runway to the existing primary Runway 5/23. As such, the parallel runway's purposes are individually unique to each alternative, and effectively would be designated Runway 5R/23L. Although **Chapter 4** discussed and found airfield capacity and wind coverage on Runway 5/23 to be adequate, it did not address the functionality and operational efficiency of providing an alternative landing service to Runway 5/23 from a general aviation perspective (see **Chapter 1 – Airport Inventory** and **Chapter 4 – Facility Requirements** for discussion regarding operational factors and inefficient impacts of the existing airfield infrastructure).

Currently, smaller general aviation aircraft originating from the FBO and GA area must cross the active primary runway for multiple purposes. In order for GA aircraft to depart Runway 23, they must cross the primary at Taxiway 'A', 'G', or 'F' before entering Taxiway 'C' and taxiing to the Runway 23 end. This may cause operational inefficiencies and safety concerns co-mingling smaller GA piston aircraft with large commercial and cargo service airliners. Similarly, when the airfield is under northerly operations, GA aircraft must exit the runway to the opposite (west side) side of the airfield from the GA area, taxi back and cross the primary runway before taxiing to the FBO and/or GA area. Additionally, in order to deice, GA jets must cross the primary and enter the terminal apron (where the only deicing operations and deicing pad on the airfield is located).

These alternatives seek to identify adequate ways to accommodate all users and future demand in an efficient, safe, and feasible manner. These alternatives pursue economic feasibility, constructability, and sustainability to improve the airfield of ORF into the future. Planning considerations made for these alternatives included limiting environmental impacts, limiting operational impacts to the Little Creek Bay Naval Installation, and preserving future airspace surrounding the Airport for development in the future.

<u>Alternative 8: Runway 5R/23L – 6,000 Feet, ARC C-III</u>

This alternative (**Figure 5-3**) includes building a new parallel runway 876 feet east of the existing Runway 5/23. The new runway would be 6,000 feet in length and 150 feet in width, providing the greatest length without physically impacting adjacent Lake Whitehurst. This runway concept would be capable of serving up to C-III aircraft. Constraints to this alternative include penetration to the Runway 5L glideslope critical area, potentially requiring its relocation[28].

Accompanying the parallel runway would be a full-length parallel taxiway capable of accommodating aircraft up to TDG 3. This taxiway would be 50 feet wide and provide 400 feet of separation from the runway. As shown in **Figure 5-3**, Lake Whitehurst would impede the TOFA, TSA, and RSA. To minimize airspace and obstruction considerations, both runway ends would include displaced thresholds, reducing landing distance to 5,000 or 5,500 feet. The US Navy has

[28] It should be noted that this constraint would be present for the other parallel runway alternatives with the same runway to runway offset.

indicated their concern for impacts to Naval training activity for this and any parallel runway alternative.

This concept warranted further consideration and was used as the foundation for the remaining derivative alternatives of various lengths and approach capabilities. **Table 5-4** lists the opportunities and constraints for Runway Alternative 8.

Table 5-4 – Alternative 8: Runway 5R/23L (6,000', ARC C-III)

Opportunities	Constraints
✈ Provides secondary runway for General Aviation airport users ✈ Avoids impacts to VORTAC ✈ 876' separation enables simultaneous VFR operations ✈ No direct physical impacts to Lake Whitehurst (however some wetland impacts will occur) ✈ Greater height over Little Creek Naval Base	✈ Length limits usage by most commercial operations ✈ Impacts to on-airport facilities (airport maintenance facilities, ARFF training facility, MRO hangar, and General Aviation parking apron) ✈ RPZ impacts to commercial buildings Potential Impact to Naval training activity

Source: CHA, 2019.

Alternative 11: Runway 5R/23L – 4,876 Foot, ARC B-II

This alternative (**Figure 5-4**) illustrates the shortest parallel runway concept, providing the existing length of Runway 14/32 at 4,876 feet. The purpose of this concept is to replace the crosswind runway with a parallel runway. At this length, an ARC of B-II is appropriate with a taxiway offset of only 240 feet. A one-mile visibility minimum results in a steeper 20:1 threshold surface. This minimalist concept would reduce costs and impacts but would not accommodate the full general aviation corporate jet fleet. Larger aircraft would often taxi across the new runway to use the longer length of the primary runway. Nevertheless, with the lowest costs and impacts, this concept was advanced for further consideration. **Table 5-5** lists the opportunities and constraints for Runway Alternative 11.

Table 5-5 – Alternative 11: Runway 5R/23L (Length: 4,876', ARC B-II)

Opportunities	Constraints
✈ Lower cost General Aviation runway for non-jet aircraft ✈ No impacts to airport support facilities ✈ No impacts to Lake Whitehurst ✈ No VOR impacts ✈ Allows for 876-foot simultaneous runway operations	✈ Runway use limited to propeller and light jet aircraft ✈ Potential Impact to Naval training activity

Source: CHA, 2019.

Alternative 12B: Runway 5R/23L – 5,500 Foot, ARC C-II

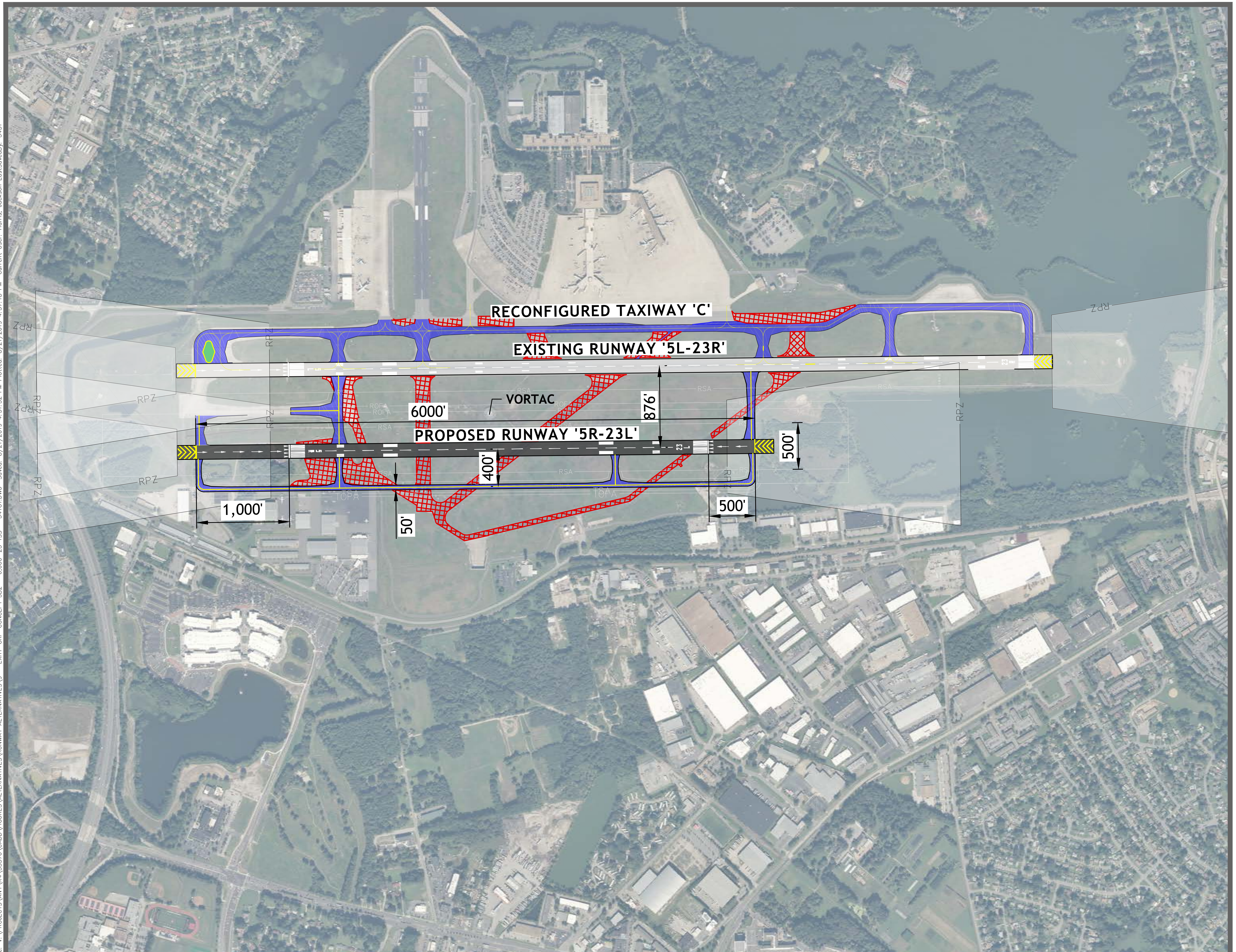
Alternative 12B (**Figure 5-5**) is also intended to be a modest approach to providing a capable parallel runway, and thus, includes a 5,500-foot length and 100-foot width. To keep costs and potential impacts at a minimum, this concept adds an aircraft arresting system, known as an Engineered Materials Arresting System (EMAS), at both ends of the runway. The EMAS beds eliminate the requirement for an RSA beyond the "stop-end" of the runway, with only a 600-foot long RSA on the approach end. As such, the RSA impacts to Lake Whitehurst are avoided, requiring little filling or grading overall. The ARC C-II design includes a 300-foot runway-taxiway offset. A 600-foot runway displacement is included on Runway 5R to avoid building and object obstructions.

Alternative 12B depicts one-mile visibility minimum, which results in a reduced width of the RPZ that is clear of all buildings. It also has a steeper 20:1 threshold surface. Due to its minimum impacts, Alternative 12B was advanced for potential implementation. **Table 5-6** lists the opportunities and constraints for Runway Alternative 12B, and **Appendix N** lists the differences between Alternatives 12A and 12B.

Table 5-6 – Alternative 12B: Runway 5R/23L (Length: 5,500’, ARC C-II)

Opportunities	Constraints
✈ Provides secondary runway for General Aviation airport users ✈ Avoids impacts to VORTAC ✈ 876’ separation enables simultaneous VFR operations ✈ No impacts to Lake Whitehurst ✈ No wetland impacts	✈ Length restricts usage by commercial operations ✈ Potential Impact to Naval training activity

Source: CHA, 2019.



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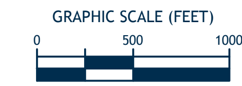

DECLARED DISTANCES PROPOSED RUNWAY 5R-23L		
	RUNWAY 5R	RUNWAY 23L
TORA	6,000'	6,000'
TODA	6,000'	6,000'
ASDA	6,000'	6,000'
LDA	5,000'	5,500'

NOTE: COMMERCIAL TAKEOFFS ARE RESTRICTED ON 5R DUE TO LOCATION OF EXISTING 5L GLIDESLOPE CRITICAL AREA.

EXHIBIT 5-3
PROPOSED 5R-23L - 6,000'
34:1 TSS , C-III Runway
180' SHIP HEIGHTS
Alternative 8

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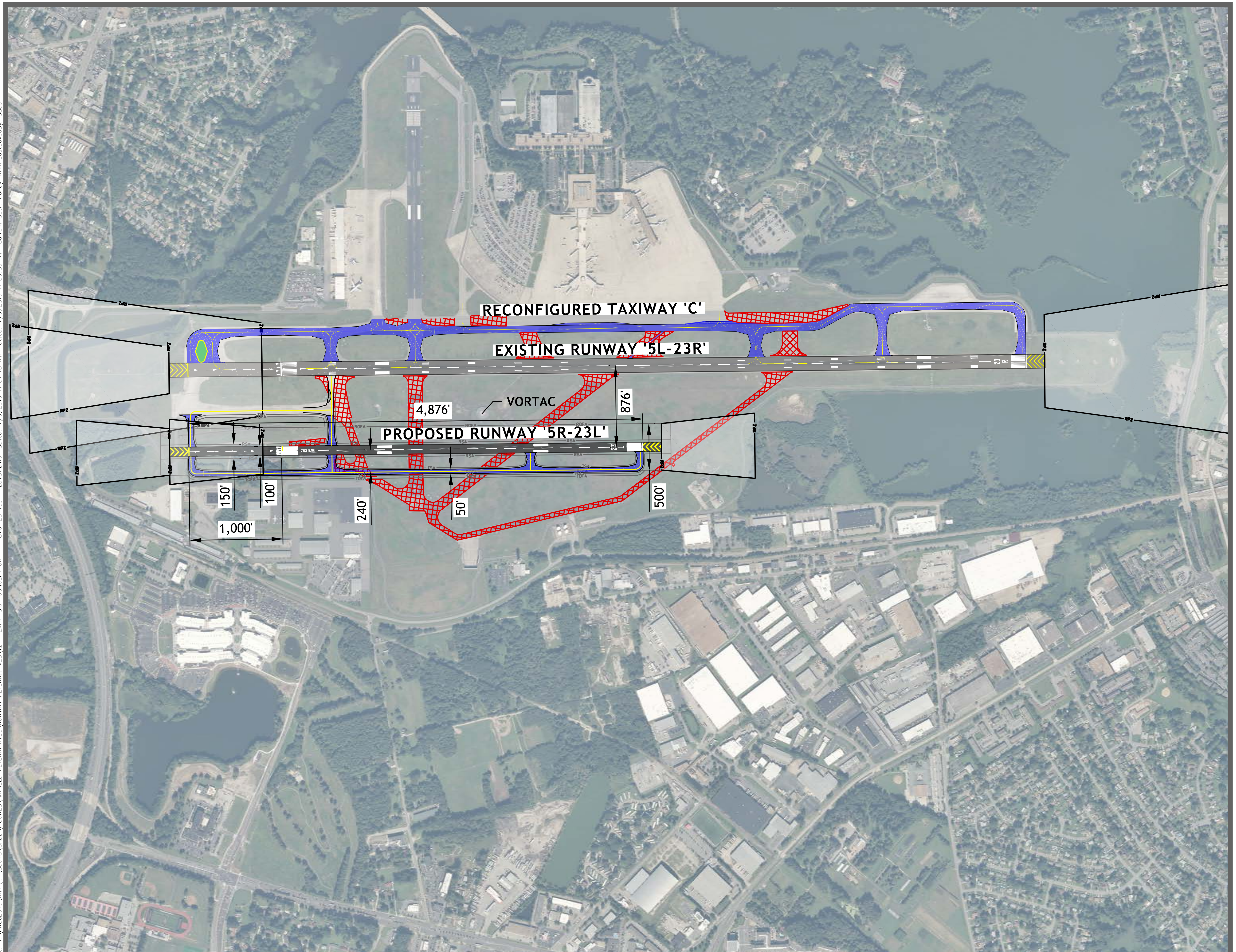


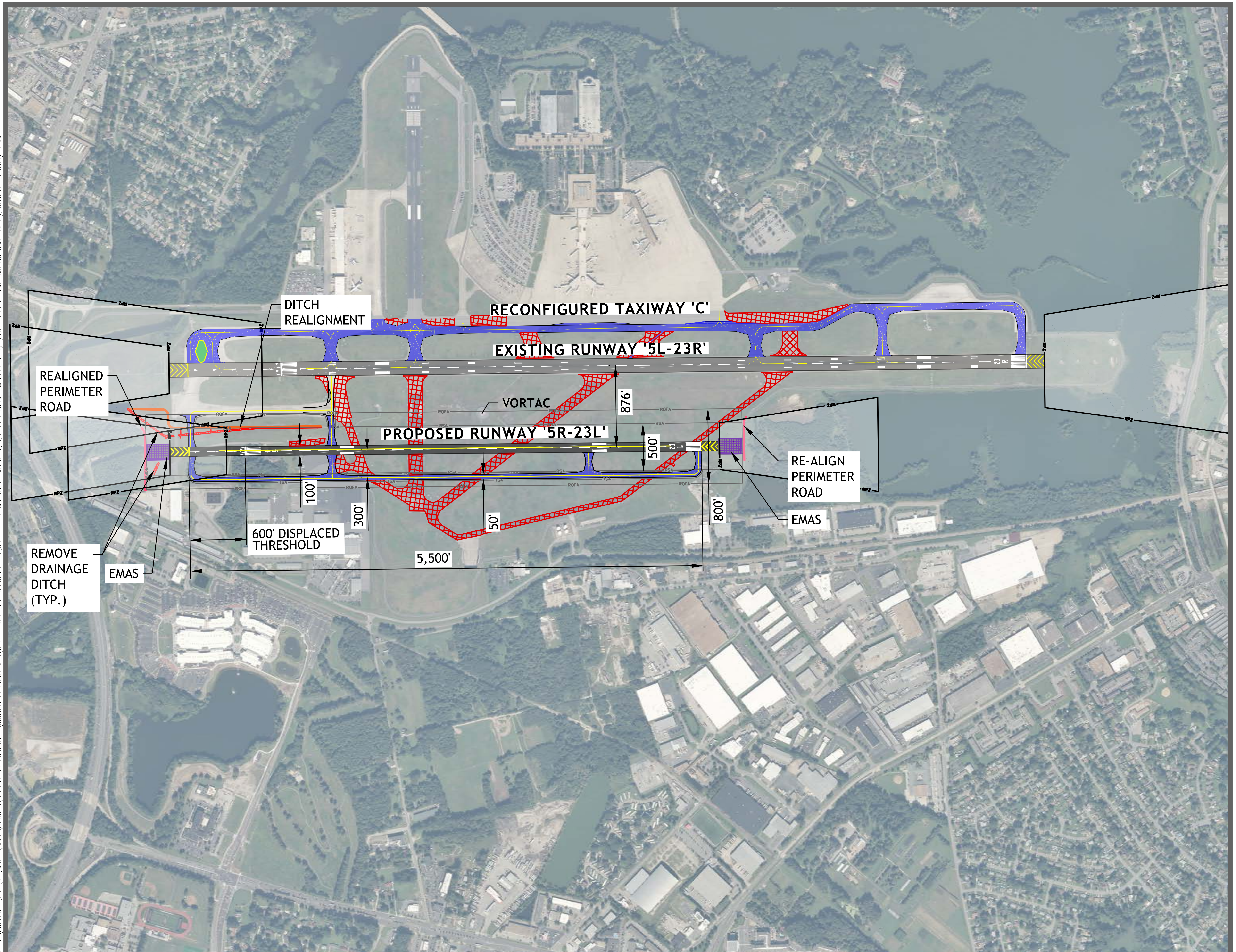
GRAPHIC SCALE (FEET)

0 500 1000

DECLARED DISTANCES PROPOSED RUNWAY 5R-23L		
	RUNWAY 5R	RUNWAY 23L
TORA	4,876'	4,876'
TODA	4,876'	4,876'
ASDA	4,876'	4,876'
LDA	3,876'	4,876'

Figure 5-4
Proposed 5R-23L - 4,876'

20:1 TSS , B-II Runway
180' SHIP HEIGHTS
Alternative 11



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GRAPHIC SCALE (FEET) 0 500 1000

DECLARED DISTANCES PROPOSED RUNWAY 5R-23L		
	RUNWAY 5R	RUNWAY 23L
TORA	5,500'	5,500'
TODA	5,500'	5,500'
ASDA	5,500'	5,500'
LDA	4,900'	5,500'

Figure 5-5
Proposed 5R-23L
5,500' With EMAS At Both Ends

20:1 TSS , C-II Runway
Not Lower than 1 Mile Visibility
Alternative 12B

File: V:\PROJECTS\ANY\K4\33370\CADD\FIGURES\AIRFIELD ALTERNATIVES\RUNWAY ALTERNATIVES\13B – EXHT-ORF-CONCEPT – 5,500 100 FT WIDE.DWG Saved: 7/9/2019 1:20:58 PM Plotted: 7/9/2019 1:22:54 PM Current User: Abney, Nikki LastSavedBy: 5835

5.3.4 Taxiway Alternatives

Aircraft ground movement at ORF is supported by a system of taxiways providing access to all portions of the airfield. Nevertheless, portions of the taxiway system are considered non-standard with regard to current FAA design standards or are such that an improved configuration could reduce the risk of pilot confusion and thus a runway incursion. The following taxiway alternatives were developed with the aforementioned considerations and adherence to all FAA design standards.

It is important to note that with each concept, focus was given to the portions of the taxiway system west of the existing Runway 5/23; therefore, the conceptualized taxiway system supporting the potential parallel Runway 5R/23L remains the same throughout each alternative with a TDG 3 full-length parallel taxiway. **Table 5-6** lists the opportunities and constraints for all taxiway alternatives.

Taxiway Alternative 1

Taxiway Alternative 1 (**Figure 5-6**) addresses the variable separation distance between Taxiway 'C' and Runway 5/23. Taxiway 'C' is currently designated as TDG 5, requiring a minimum taxiway to runway centerline distance of 400 feet; however, the current separation of Taxiway 'C' ranges from 400 feet at the Runway 5 end to over 600 feet at the Runway 23 end. While this distance provides an added separation margin, it also reduces the available non-movement space near the southeasternmost gates of Terminal Concourse B, requiring aircraft push-back into the Taxiway 'C' environment; therefore, Taxiway Alternative 1 illustrates a parallel Taxiway 'C' offset of 400 feet from the Runway 5 end to Taxiway 'H'.

Additionally, Taxiway Alternative 1 illustrates the conversion of the Runway 14/32 pavement (from Runway 5/23 northeastward) into a new TDG 3 taxiway (relocated Taxiway 'D'). This conversion of pavement allows for continued ingress/egress to the cargo area and for potential aeronautical development along the taxiway. If necessary, the taxiway can be shortened to accommodate the realignment of Robin Hood Road and the expansion of the cargo facility.

Lastly, Taxiway Alternative 1 shows the removal and update of taxiways that would be either no longer required or are non-standard. Specifically, this concept shows a realignment of Taxiway 'F' to meet current FAA taxiway design geometry. As a result of this realignment, this concept also shows a relocation of Taxiway 'E' to provide improved access. Although this concept shows the removal of Taxiway 'G', a pavement corridor is reserved for an Aircraft Rescue and Fire Fighting (ARFF) access road between the existing firefighting station and the southern portion of the airfield.

Taxiway Alternative 2

Taxiway Alternative 2 (**Figure 5-7**) shows similar concepts to address non-standard taxiway conditions and improved design geometry. While Taxiway Alternative 1 shows a Taxiway 'C' offset of 400 feet from the Runway 5 end to Taxiway 'H', this concept shows the offset distance throughout the full length of the taxiway. This full-length offset of 400 feet does not require a turn north of Taxiway 'H' and is compliant with current FAA taxiway geometry; however, this configuration impacts the existing Runway 23 glide slope antennae and PAPI, requiring relocation of both NAVAID systems. As a result of these relocations, a portion of Lake Whitehurst east of the Runway 23 end would require filling and grading in order to provide sufficient ground to accommodate reinstallation and operation of both systems, as well as to provide access roads. Significant environmental permitting and coordination would be required prior to moving the NAVAIDs.

Taxiway Alternative 3

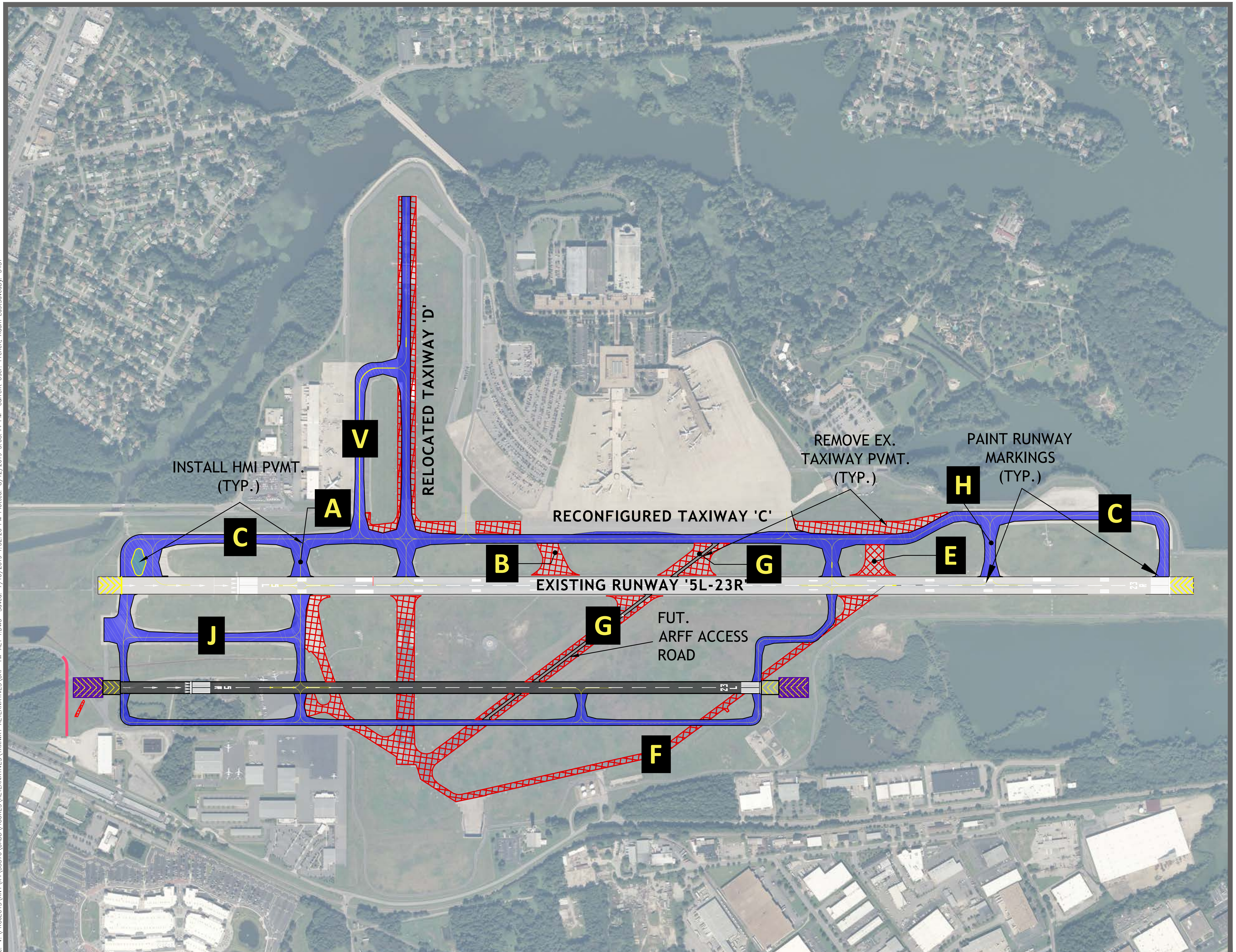
Similar to Taxiway Alternative 1, Taxiway Alternative 3 (**Figure 5-8**) shows a partially realigned offset of Taxiway 'C' from the Runway 5 end to Taxiway 'H', along with the conversion of the Runway 14/32 pavement (from Runway 5/23 northward) into a new TDG 3 taxiway; however, this concept adds a new TDG 5 partial-length parallel taxiway east of Runway 5/23 from the end of Runway 5 to the realigned portion (as discussed in Taxiway Alternative 2) of Taxiway 'E', terminating prior to Lake Whitehurst to avoid filling a portion of the lake.

To accommodate the parallel taxiway, relocation of both the VORTAC and Runway 5 glide slope antenna would be required.

Table 5-7 – Taxiway Alternatives

Alternative	Opportunities	Constraints
Alternative 1: **Partial Realignment of Taxiway C**	✈ Realignment of Taxiway C to 400' offset improves the separation from Concourse B ✈ Partial taxiway realignment avoids impact to Runway 23 Glideslope ✈ Conversion of Runway 14/32 to Taxiway expands area for air cargo apron ✈ Removes non-standard conditions (direct apron to runway access)	✈ Taxiway C retains existing curves near Runway 23 end ✈ Does not provide full-length standard parallel taxiway ✈
Alternative 2: **Full Realignment of Taxiway C**	✈ Full Realignment removes all curves in Taxiway C centerline ✈ Realignment improves separation from Concourse B ✈ Conversion of Runway 14/32 to Taxiway expands area for air cargo apron	✈ Taxiway C realignment near Runway 23 requires relocation of Glideslope and PAPI ✈ Substantial environmental impacts to Lake Whitehurst
Alternative 3: **Extension of Taxiway J**	✈ Improves operational flexibility ✈ Provides additional runway exits	✈ Requires relocation of VORTAC ✈ Taxiway J cannot be extended to full parallel without impacts to Lake Whitehurst

Source: CHA, 2019.



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GRAPHIC SCALE (FEET)
0 400 800

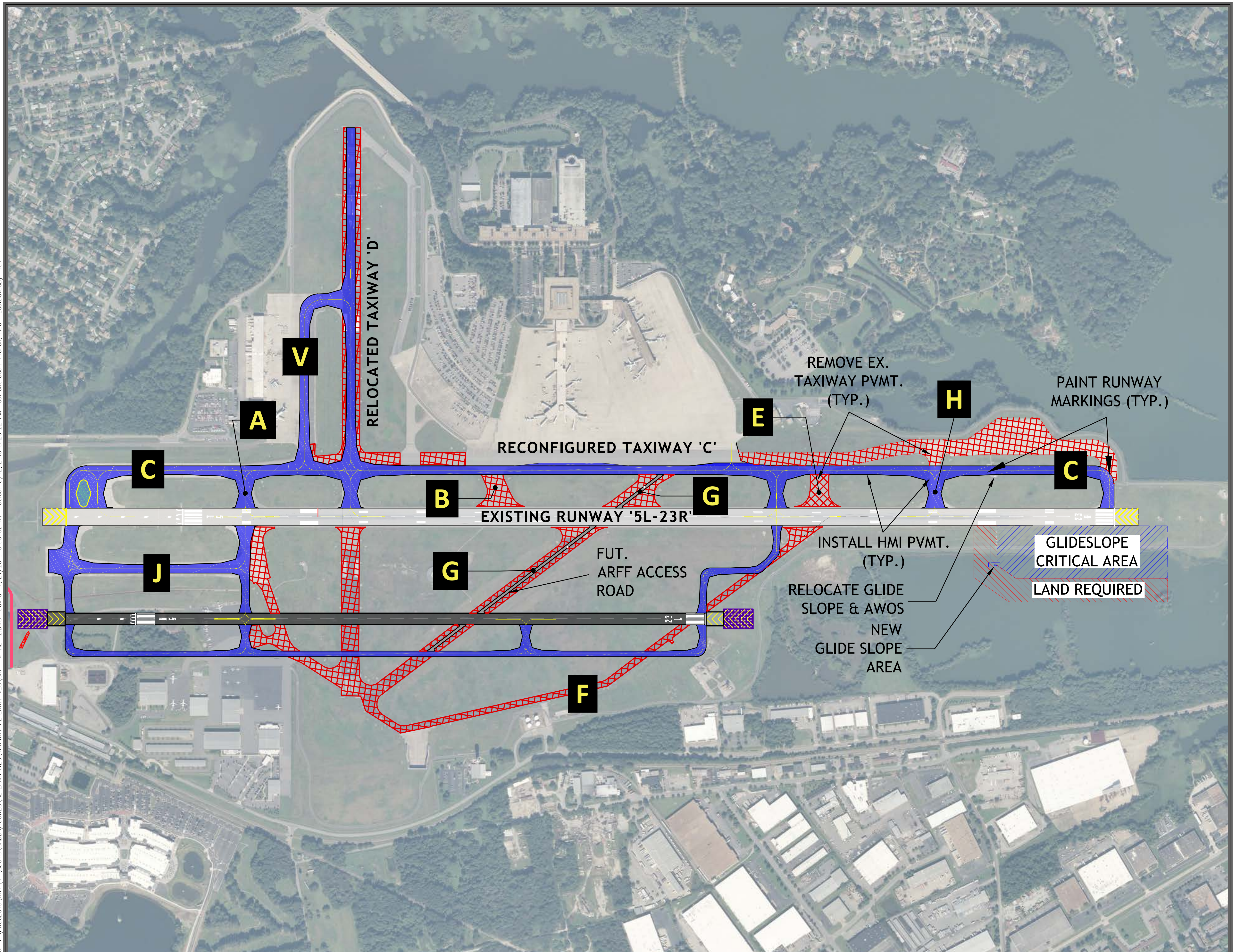
LEGEND

Future Airfield Pavement

Future Parallel Runway

Figure 5-6

Taxiway Alternative 1



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GRAPHIC SCALE (FEET)

0 500 1000

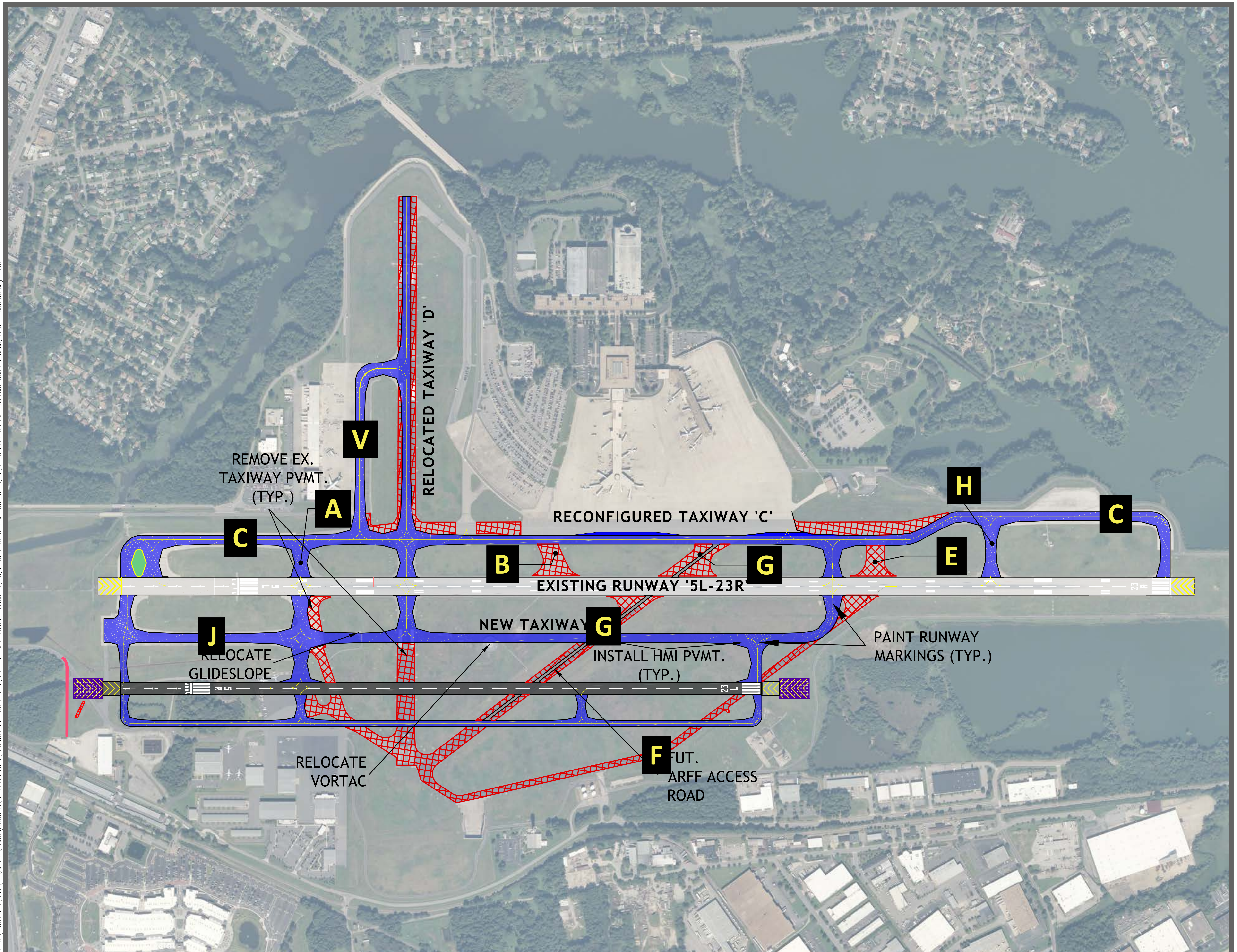
LEGEND

Future Airfield Pavement

Future Parallel Runway

Figure 5-7

Taxiway Alternative 2



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MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)

0 400 800

LEGEND

Future Airfield Pavement

Future Parallel Runway

Figure 5-8

Taxiway Alternative 3

5.4 PASSENGER TERMINAL FACILITY ALTERNATIVES

The preliminary passenger terminal facility concepts for ORF were developed to satisfy the identified facility requirements throughout the 20-year planning period. Each concept incorporates the new or replacement facilities within the footprint of the existing terminal complex. In each alternative, the existing and proposed parking garages are retained, as is the 2002 arrivals building; however, several concepts consider the possibility of developing a two-level terminal facility with upper- and lower-level roadways along with a two-level departures/arrivals building (i.e., headhouse). This two-level concept would have baggage claim functions on the lower level and would call for repurposing the arrivals building as a ground transportation center (GTC) on the lower-level and airport administrative offices on the upper mezzanine level, with the potential for future infrastructure improvements to the second level with renovation as needed for administrative repurposing. Other than the Status Quo Alternative, all of the terminal concepts include substantial changes to the concourses, gates, security screening, ticketing, concessions, access roadways and other facilities, as described below.

Based on discussions with the Norfolk Airport Authority (NAA) management staff and Board Members, the preliminary terminal alternatives were refined, with the selection of a recommended concept. The ultimate plan was organized to include several phases, based on Planning Activity Levels (PALs) following a long-term implementation program.

5.4.1 Status Quo Alternative

The main departure terminal and Concourses A and B were originally constructed in 1974. Over the past 45 years, the NAA has continuously maintained these facilities, including several renovations in the past five years to upgrade the main lobby (i.e., atrium), concourses, airline gate areas, restrooms, concessions, and security checkpoints, and additional renovations are in the design phase. Thus, the Status Quo Alternative includes continuous improvements and renovations of existing facilities, but without any major new or replacement facilities.

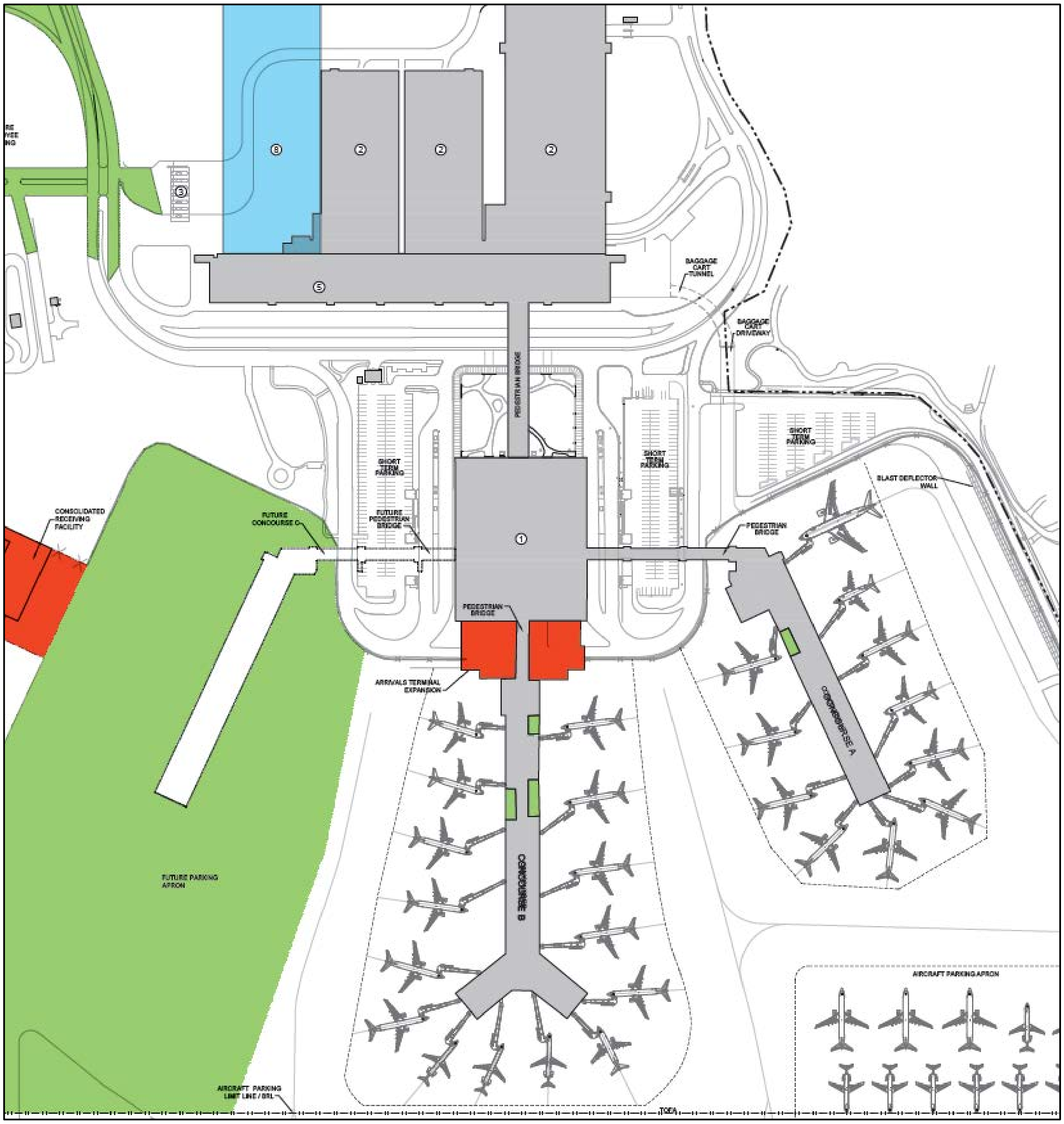
It is noted that without expansion of concourses, gates, post-security concessions, out-bound baggage processors, and other facilities, current problem areas will persist, and the level of passenger service will continually decline as activity grows. At a minimum, with the addition of some airline gates (potentially through an extension of Concourse A), the existing passenger terminal could continue to operate through the planning period, although all of the current shortcomings will become heightened to the detriment of the passenger experience and operational efficiency.

5.4.2 2009 Master Plan Alternative

The previous Airport Master Plan developed an incremental terminal recommendation that retained the existing building layout and internal configuration and included expansion of gates and associated facilities through the addition of a third concourse (Concourse C). This layout utilized the area of the long-term surface parking lot for the location of the additional concourse. This alternative was a simple and low-cost expansion option that maximized use of existing facilities; however, several shortcomings were apparent, including the need for a third security checkpoint and taxilane/push-back conflicts between the concourses. The following exhibit

(**Figure 5-9**) from the 2009 Master Plan provides a graphic depiction of this concept, and **Table 5-8** summarizes the 2009 passenger terminal alternative.

Figure 5-9 – 2009 Passenger Terminal Alternative



Source: CHA, 2019.

Table 5-8 – 2009 Passenger Terminal Facility Summary

General Layout	
Retain the existing terminal layout including the departure and arrivals building, curbside and circulation, but expand the number of gates, hold rooms, and post-security concessions by adding a third concourse.	
Advantages	**Disadvantages**
✈ Low capital costs ✈ Ease of construction phasing; virtually no impact to passenger activity ✈ Provides adequate number of gates and added space for related services.	✈ Requires addition of a third security checkpoint. Issues with TSA staffing and duplication of facilities ✈ Results in separation and some duplication of all post-security facilities, services, and concessions ✈ Reduced flexibility for airline gate utilization and operations ✈ No improvements or expansion of other needed facilities (e.g., out-bound baggage) ✈ Existing deficiencies remain in passenger circulation ✈ Retains split facilities for the ticketing hall and curb side drop-off, with associated passenger confusion ✈ Retains the overly complex roadway layout, see Figure 5-10.

Source: CHA, 2019.

Due to the disadvantages of the 2009 Terminal Alternative, four new concepts were developed as part of this Master Plan and are subsequently discussed and illustrated below.

5.4.3 Passenger Terminal Facility Alternative 1

Passenger Terminal Facility Alternative 1 (**Figure 5-11**) addresses pre-security configuration issues of the current terminal complex. In particular, the split ticketing halls are combined and relocated to the west side of the departure building, facing the arrival building. This enables reconfiguration and shortening of the departure roadways with an efficient parallel alignment with the arrivals building's curbside. The new departure curbside will provide greater overall length, with adjacent short-term parking serving both arrivals and departures.

Relocation of the ticketing halls enable redevelopment of the lower level of the departure building for expansion of the outbound baggage make-up facilities to serve all three concourses. TSA security would be consolidated into a single checkpoint that is located on the eastern half of the atrium area. As is the case with the Status Quo Alternative, the previous Airport Master Plan developed an incremental terminal recommendation that retained the existing building layout and internal configuration, and included gates, and associated facilities through the addition of a third concourse (Concourse C). This layout utilizes the area of the long-term surface parking lot for the location of the additional concourse, with expansion of Terminal Concourse A. This alternative is a simple and low-cost expansion option that maximizes use of existing facilities; however, several shortcomings are apparent, including long walking distances and taxilane/push-back conflicts between the concourses. **Figure 5-11)** provides a graphic depiction of this concept, while **Table 5-9** summarizes Passenger Terminal Alternative 1.

Figure 5-10 – Existing Terminal Curbside Layout

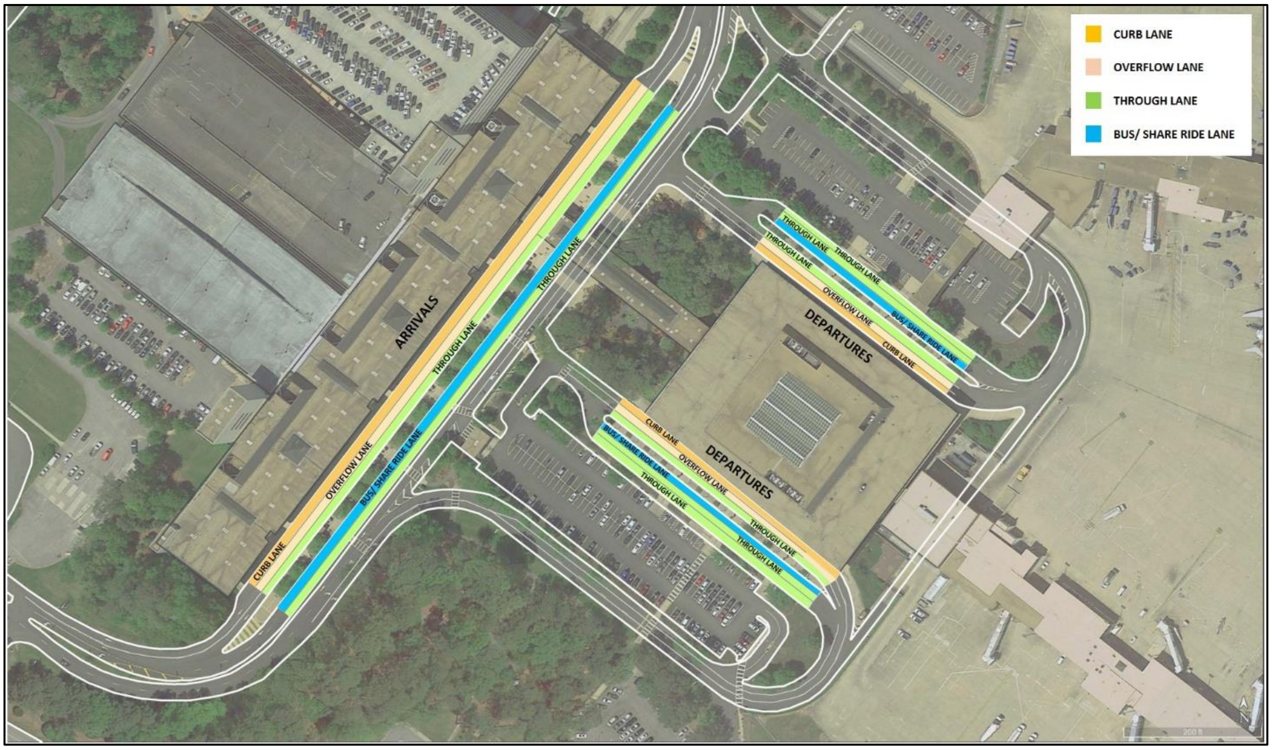


Table 5-9 – Passenger Terminal Facility Alternative 1 Summary

General Layout	
Builds upon the 2009 terminal layout with three concourses, and retention of the arrival building. The departure building is modified to relocate and consolidation of the ticketing halls, security screening checkpoint, and departure curbside, expansion of outbound baggage make-up facilities, and improve vehicular circulation.	
Advantages	**Disadvantages**
✈ Modest capital costs through retention of several existing facilities ✈ Ease of construction phasing with minor impacts to passenger activity ✈ Provides adequate additional facilities for all terminal requirements, including outbound baggage ✈ Removes deficiencies in passenger circulation ✈ Combines split facilities for the ticketing hall and curbside drop-off (reduces passenger confusion) ✈ Eliminates overly complex roadway layout ✈ Eliminates the need for a third security checkpoint.	✈ Results in separation and potential duplication of all post-security facilities, services, and concessions ✈ Reduced flexibility for airline gate utilization and operations ✈ Retains existing long walking distances to baggage claim and parking garages

Source: CHA, 2019.

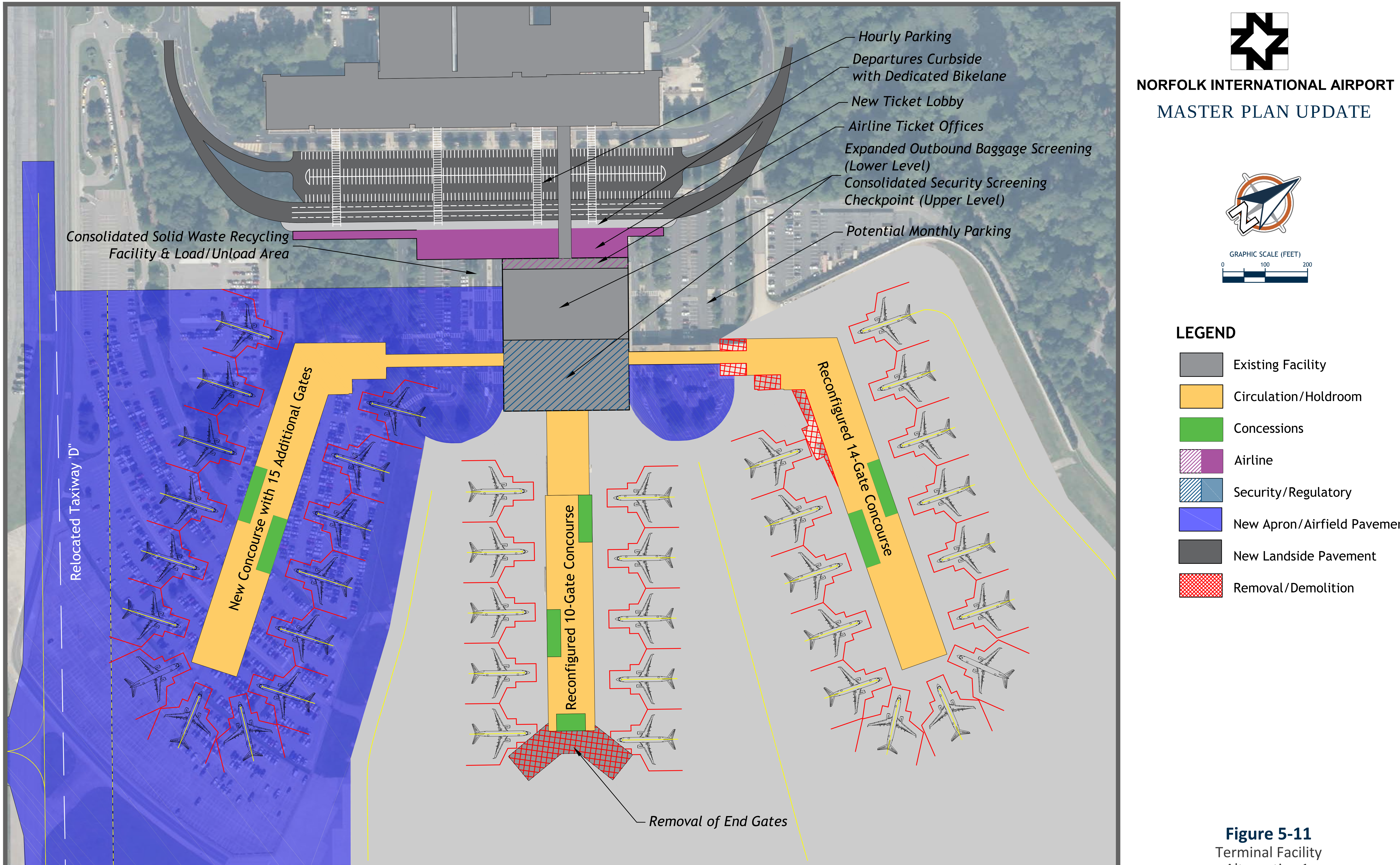


Figure 5-11
Terminal Facility
Alternative 1

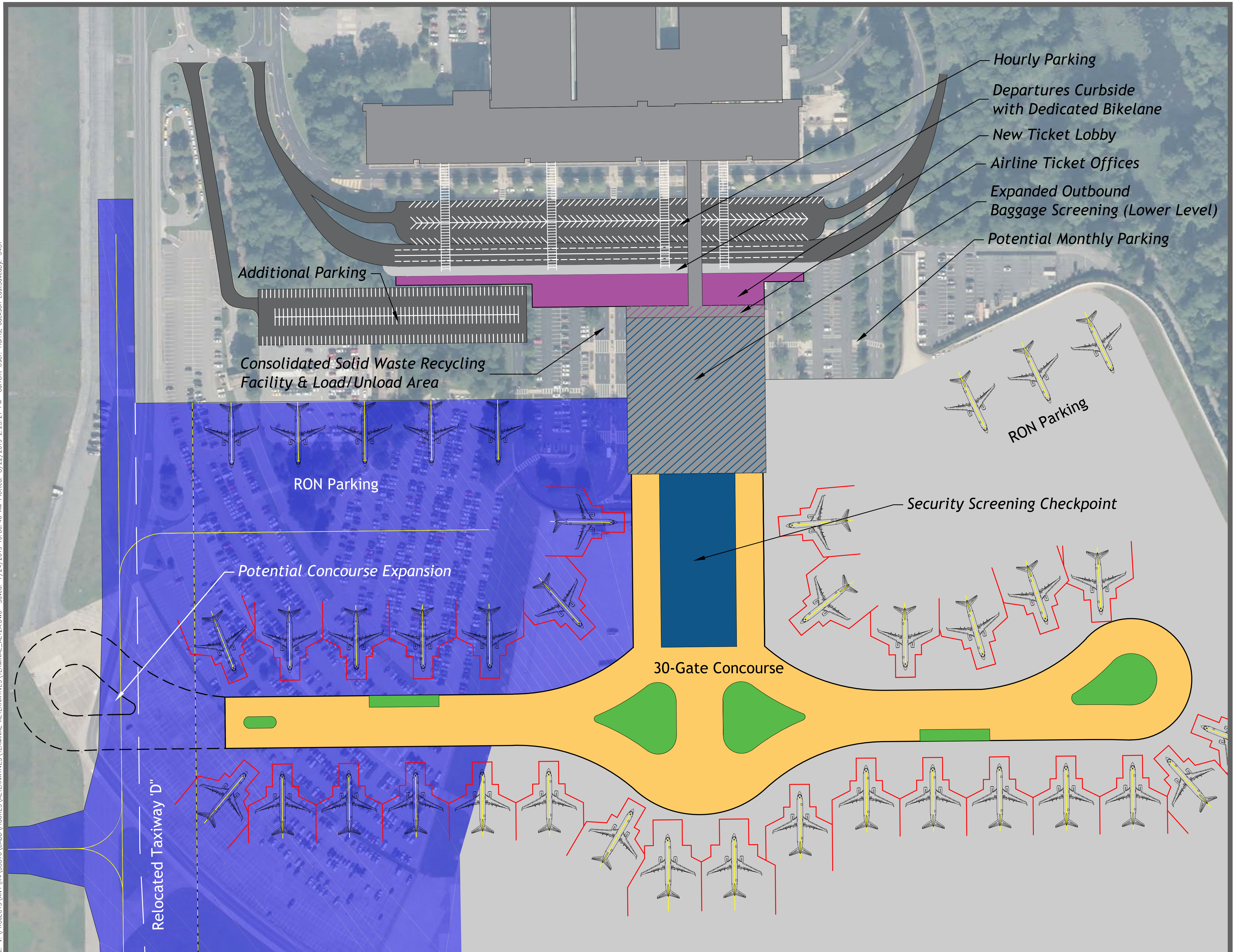
5.4.4 Passenger Terminal Facility Alternative 2A

The goal of Passenger Terminal Facility Alternative 2A (**Figure 5-12**) is to retain the benefits of Alternative 1, while removing its disadvantages. To achieve this goal, Passenger Terminal Facility Alternative 2A includes the same improvements to the departure building's vehicular circulation, and parking as Alternative 1; however, this alternative would completely replace existing Concourses A and B with a new consolidated north-south concourse to house all gates and a centralized security checkpoint and concession core. Alternative 2A assumes that the departures and arrivals function will continue to be separated. As such, the arrivals building is proposed to remain as the baggage claim facility on the lower level; however, in order to provide increased consolidated space for airport administrative functions, the mezzanine level would be used. **Table 5-10** summarizes the Passenger Terminal Facility Alternative 2A.

Table 5-10 – Passenger Terminal Facility Alternative 2A Summary

General Layout	
Includes the development of a new departures building, curbside, and circulation. All existing gates are replaced with a large new contact gate concourse and centralized security checkpoint and concessions core. Arrivals building will continue to function as is with the addition of airport administrative offices on the second level.	
Advantages	**Disadvantages**
✈ Provides adequate additional facilities for all terminal requirements ✈ Consolidates the security checkpoint, improves TSA staffing and eliminates duplicate facilities ✈ Enables a new central FIS facility below an expanded security checkpoint ✈ Provides passenger access to all post-security facilities, services, and concessions ✈ Maximizes flexibility for airline gate utilization and operations ✈ Removes deficiencies in passenger circulation ✈ Combines split facilities for the ticketing halls and curbside drop-off (reduces passenger confusion) ✈ Eliminates the overly complex roadway layout	✈ High capital costs, with substantial new facilities ✈ Moderately difficult construction phasing with impact to passenger activity ✈ Retains long walking distances to baggage claim and parking garages

Source: CHA, 2019.



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MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)

0 100 200

LEGEND

- Existing Facility
- Circulation/Holdroom
- Concessions
- Airline
- Security/Regulatory
- New Apron/Airfield Pavement
- New Landside Pavement
- Removal/Demolition

Figure 5-12

Terminal Facility
Alternative 2A

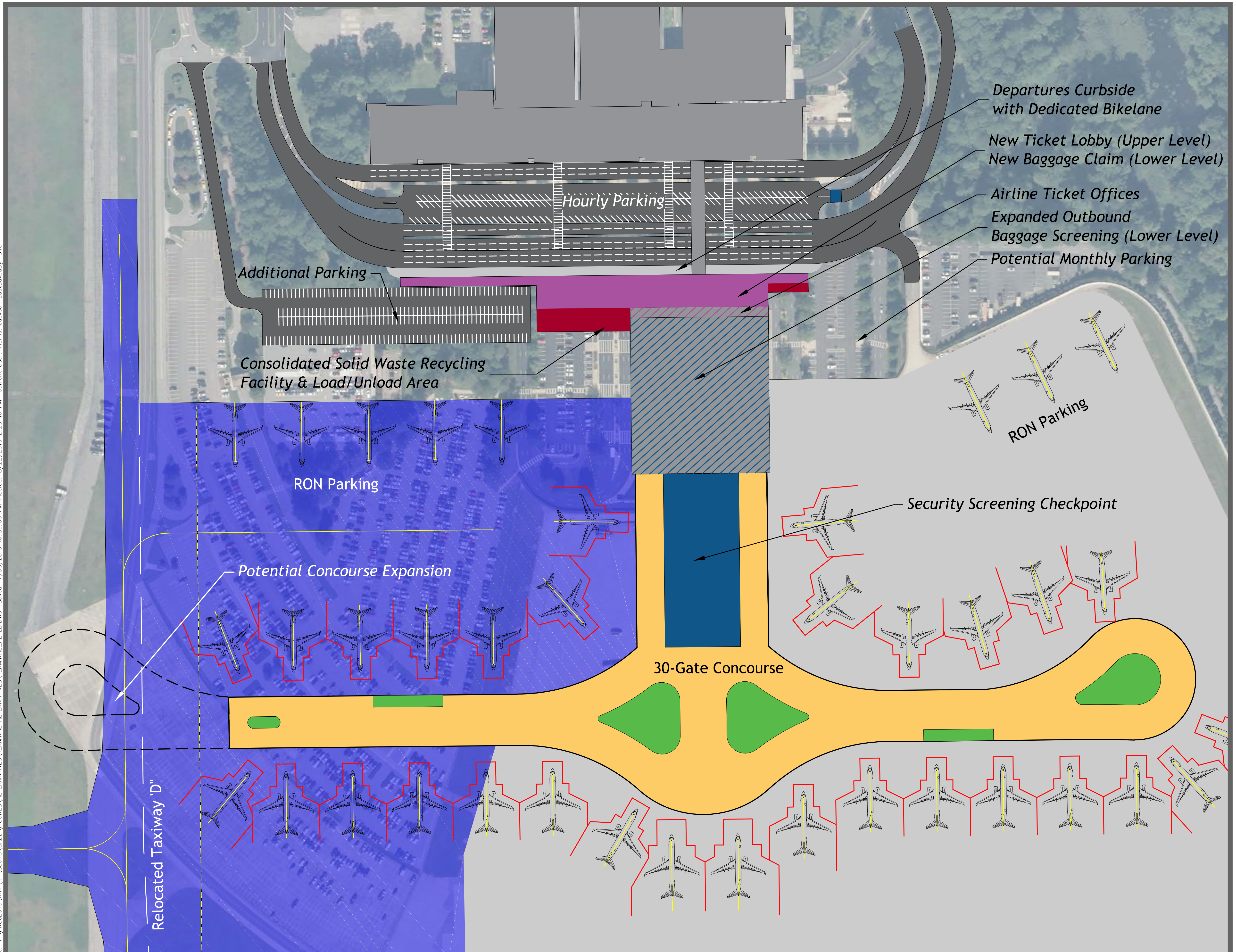
5.4.5 Passenger Terminal Facility Alternative 2B

The goal of Passenger Terminal Facility Alternative 2B (**Figure 5-13**) is to retain the benefits of Alternative 2A, while consolidating passenger and baggage processing functions and roadway/curbside activities into a single consolidated facility. To achieve this goal, Passenger Terminal Facility Alternative 2B includes the same improvements to the concourse and gate area; however, it would completely replace the departures and arrivals buildings and vehicular circulation roadway system. In order to do this, a two-level roadway system would be constructed to serve a new two-level terminal building. The upper level of this building would house the departures and out-bound baggage make-up functions and the lower level will accommodate the in-bound baggage and baggage claim facilities. Alternative 2B calls for repurposing the arrivals building as a new GTC on the lower level, with the second level use to house an expanded airport administrative office area. As in Alternative 2A, this alternative would completely replace existing Concourses A and B with a new consolidated north-south concourse to house all gates, with a centralized security checkpoint and concessions core. **Table 5-11** summarizes the Passenger Terminal Facility Alternative 2B.

Table 5-11 – Passenger Terminal Facility Alternative 2B Summary

General Layout	
Includes the development of a new consolidated passenger and baggage processing facility with a two-level building and support roadway/curbside system. All existing gates are replaced with a large new contact gate concourse and centralized security checkpoint and concessions core. Arrivals building will be repurposed as a ground transportation center and will also provide area for airport administrative offices on the second level.	
Advantages	**Disadvantages**
✈ Provides adequate additional facilities for all terminal requirements ✈ Consolidates the security checkpoint, improves TSA staffing and eliminates duplicate facilities ✈ Enables a new central FIS facility below an expanded security checkpoint ✈ Provides passenger access to all post-security facilities, services, and concessions ✈ Maximizes flexibility for airline gate utilization and operations ✈ Removes deficiencies in passenger circulation ✈ Combines split facilities for the ticketing and arrivals halls (reduces passenger confusion) ✈ Eliminates the overly complex roadway layout ✈ Provides a new GTC to house all ground transportation functions	✈ Higher capital costs, with substantial new facilities and a reconfigured GTC/administrative building ✈ Highly difficult construction phasing with impact to passenger and tenant activity ✈ Retains long walking distance to parking garages

Source: CHA, 2019.



NORFOLK INTERNATIONAL AIRPORT

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GRAPHIC SCALE (FEET)
0 100 200

LEGEND

- Existing Facility
- Circulation/Holdroom
- Concessions
- Airline - Ticketing
- Airline - Baggage Claim
- Ground Transportation
- Security/Regulatory
- New Apron/Airfield Pavement
- New Landside Pavement
- Removal/Demolition

Figure 5-13
Terminal Facility
Alternative 2B

5.4.6 Passenger Terminal Facility Alternative 3A

Passenger Terminal Facility Alternative 3A (**Figure 5-14**) is a derivative of Alternative 2A that provides for additional gate expansion (beyond what is needed during the planning period) in a configuration that may reduce passenger walking distances. The concept includes the centralized security checkpoint and up to four concourses surrounded by a central concessions core. The layout would incorporate development of two double-loaded concourses, with ultimate expansion of two additional single-loaded piers. Alternatively, the concept could include partial development of all four concourses, with expansion as needed. As shown in the figure, up to 42 gates could be accommodated. **Table 5-12** summarizes the Passenger Terminal Facility Alternative 3A.

Table 5-12 – Passenger Terminal Facility Alternative 3A Summary

General Layout	
Includes the development of a new departures building, curbside, and circulation. All existing gates are replaced with a large new contact gate concourse, but with greater expansion capability on four concourses. Includes a centralized security checkpoint and concessions core. Arrivals building will continue to function as is with the addition of airport administrative offices on the second level.	
Advantages	**Disadvantages**
✈ Provides adequate additional facilities for all terminal requirements ✈ Consolidates security checkpoint, improves TSA staffing and eliminates duplicate facilities ✈ Enable central FIS facility below an expanded security checkpoint ✈ Provides passenger access to all post-security facilities, services, and concessions ✈ Maximizes flexibility and expandability for airline gate utilization and operations ✈ Potential to reduce passenger walking distances between the security screening checkpoint and concourse gates/holdroom areas ✈ Removes deficiencies in passenger circulation ✈ Combines split facilities for the ticketing halls and curbside drop-off (reduces passenger confusion) ✈ Eliminates the overly complex roadway layout	✈ High capital costs, with substantial new facilities ✈ Moderately difficult construction phasing with impact to passenger activity ✈ Four concourses will result in duplication of concessions and operational functions ✈ Multiple concourses may result in complex signage and passenger confusion. ✈ Retains long walking distances between the concourse gates/holdrooms/security screening checkpoint and the parking garage/baggage claim areas.

Source: CHA, 2019.

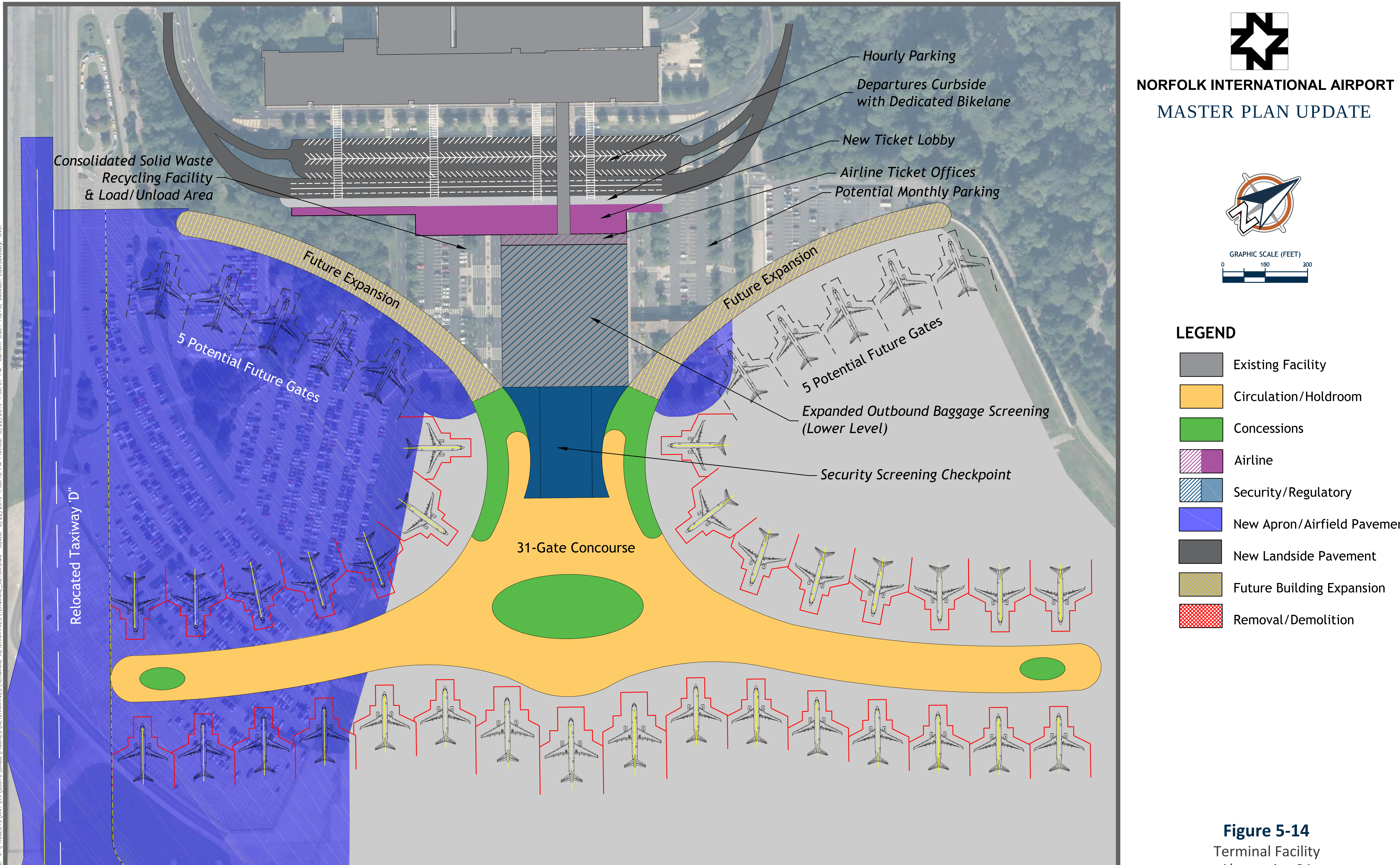


Figure 5-14
Terminal Facility
Alternative 3A

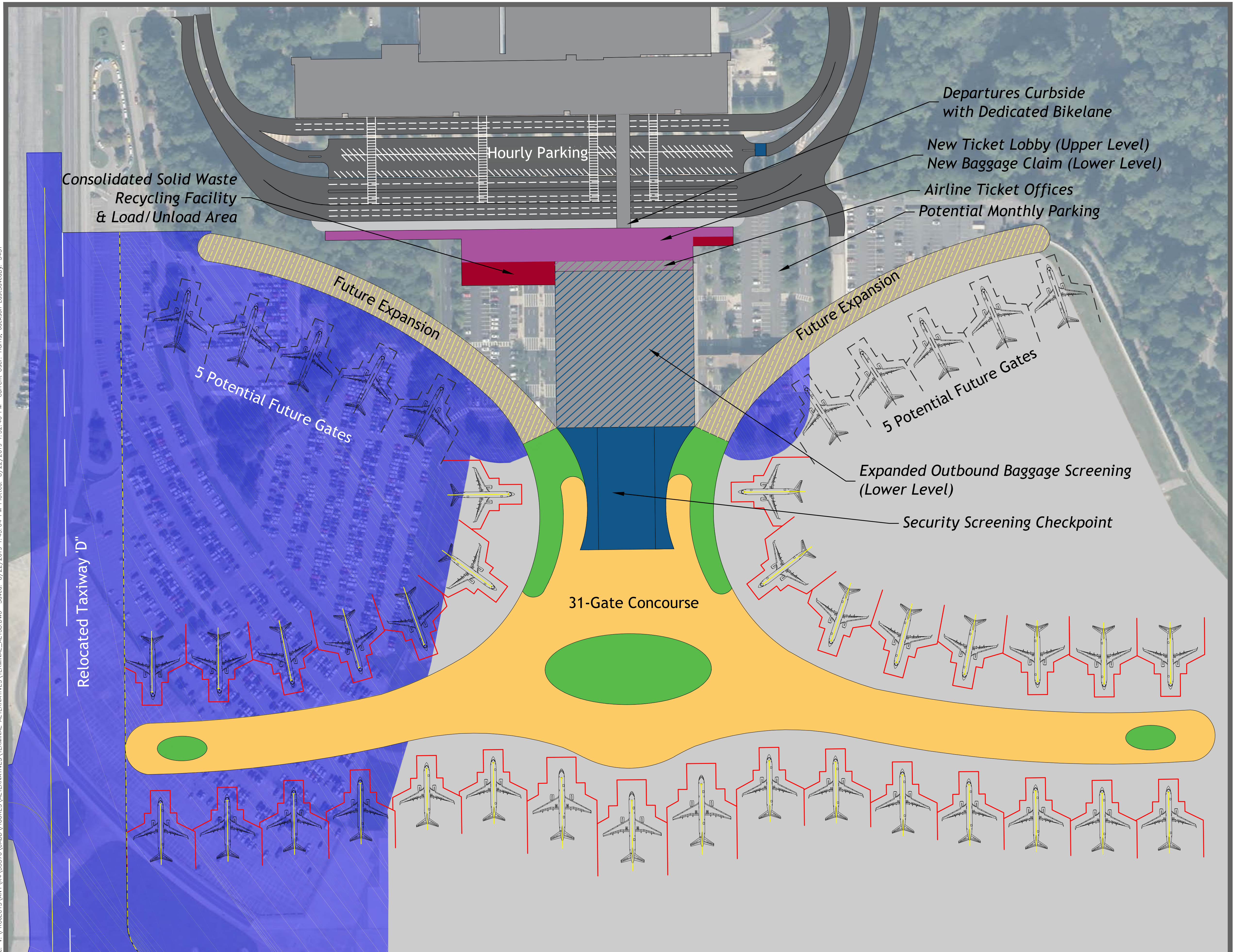
5.4.7 Passenger Terminal Facility Alternative 3B

The goal of Passenger Terminal Facility Alternative (**Figure 5-15**) is to retain the benefits of Alternative 3A, while consolidating passenger and baggage processing functions and roadway/curbside activities into a single consolidated facility. To achieve this goal, Passenger Terminal Facility Alternative 3B includes the same improvements to the concourse and gate area as Alternative 3A; however, it would completely replace the departures and arrivals buildings and vehicular circulation roadway system. In order to do this, a two-level roadway system would be constructed to serve a new two-level terminal building. The upper level of this building would house the departures and out-bound baggage make-up functions and the lower level will accommodate the in-bound baggage and baggage claim facilities. Alternative 3B calls for repurposing the arrivals building as a new GTC on the lower level, with the second level used to house an expanded airport administrative office area. As in Alternative 3A, this alternative would completely replace existing Concourses A and B, with a new consolidated north-south concourse to house all gates and provide additional gates beyond what is needed in the 20-year planning horizon. This concept also incorporates a centralized security checkpoint and concessions core. **Table 5-13** summarizes the Passenger Terminal Facility Alternative 3B.

Table 5-13 – Passenger Terminal Facility Alternative 3B Summary

General Layout	
Includes the development of a new consolidated passenger and baggage processing facility with a two-level building and support roadway/curbside system. All existing gates are replaced with a large new contact gate concourse and centralized security checkpoint and concessions core. Arrivals building will be repurposed as a ground transportation center and will also provide area for airport administrative offices on the second level.	
Advantages	**Disadvantages**
✈ Provides adequate additional facilities for all terminal requirements ✈ Consolidates the security checkpoint, improves TSA staffing and eliminates duplicate facilities ✈ Enables a new central FIS facility below an expanded security checkpoint ✈ Provides passenger access to all post-security facilities, services, and concessions ✈ Maximizes flexibility and future expandability for airline gate utilization and operations ✈ Removes deficiencies in passenger circulation ✈ Combines split facilities for the ticketing and arrivals halls (reduces passenger confusion) ✈ Eliminates the overly complex roadway layout ✈ Provides an expanded area for airport administrative offices ✈ Provides a new GTC to house all ground transportation functions	✈ Higher capital costs, with substantial new facilities and a reconfigured GTC/administrative building ✈ Highly difficult construction phasing with impact to passenger and tenant activity ✈ Four concourses will result in duplication of concessions and operational functions ✈ Multiple concourses may result in complex signage and passenger confusion. ✈ Retains long walking distance to parking garages

Source: CHA, 2019.



NORFOLK INTERNATIONAL AIRPORT

MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)
0 100 200

LEGEND

- Existing Facility
- Circulation/Holdroom
- Concessions
- Airline - Ticketing
- Airline - Baggage Claim
- Ground Transportation
- Security/Regulatory
- New Apron/Airfield Pavement
- New Landside Pavement
- Removal/Demolition

Figure 5-15

Terminal Facility
Alternative 3B

5.4.8 Passenger Terminal Facility Alternative 4A

Passenger Terminal Facility Alternative 4A (**Figure 5-16**) is a derivative of Alternatives 1, 2A, and 3A that provides for additional gate expansion (beyond that needed throughout the planning period); however, due to the split concourse configuration, Alternative 4A increases walking distances between gates and to the headhouse but reduces distances from the headhouse to arrivals and parking This concept includes the centralized security checkpoint and two double-loaded concourses (one to the north and one to the south). It also provides five contact gates at its central core. This central portion of the terminal also serves as a central concessions core area and supports a consolidated security screening checkpoint. The layout would incorporate development of up to 10 remote aircraft parking positions that can support overnight parking and/or four deicing lanes. Alternatively, the concept could include partial development of a third central concourse, with expansion as needed. **Table 5-14** summarizes the Passenger Terminal Facility Alternative 4A.

Table 5-14 – Passenger Terminal Facility Alternative 4A Summary

<table>
<tr><th colspan="2">General Layout</th></tr>
<tr><td colspan="2">Includes a new and improved departure building, curbside, and centralized security checkpoint, but with greater expansion capability on two concourses. The new departures building that will house all ticketing and out-bound baggage functions and is moved closer to the arrivals building, and an overhead canopy is provided.</td></tr>
<tr><th>Advantages</th><th>Disadvantages</th></tr>
<tr><td>✈ Provides adequate additional facilities for all terminal requirements
✈ Consolidates security checkpoint and improves TSA staffing
✈ Enable central FIS facility below an expanded security checkpoint
✈ Provides passenger access to all post-security facilities, services, and concessions
✈ Maximizes flexibility and expandability for airline gate utilization and operations
✈ Combines split facilities for the ticketing halls and curbside drop-off (reduces passenger confusion)
✈ Eliminates the overly complex roadway layout</td><td>✈ High capital costs, with substantial new facilities
✈ Moderately difficult construction phasing with impact to passenger activity
✈ Two concourses will result in duplication of concessions and operational functions
✈ Increases walking distances between gates and to arrivals building and parking given the extension lengths of the concourses</td></tr>
</table>

Source: CHA, 2019.

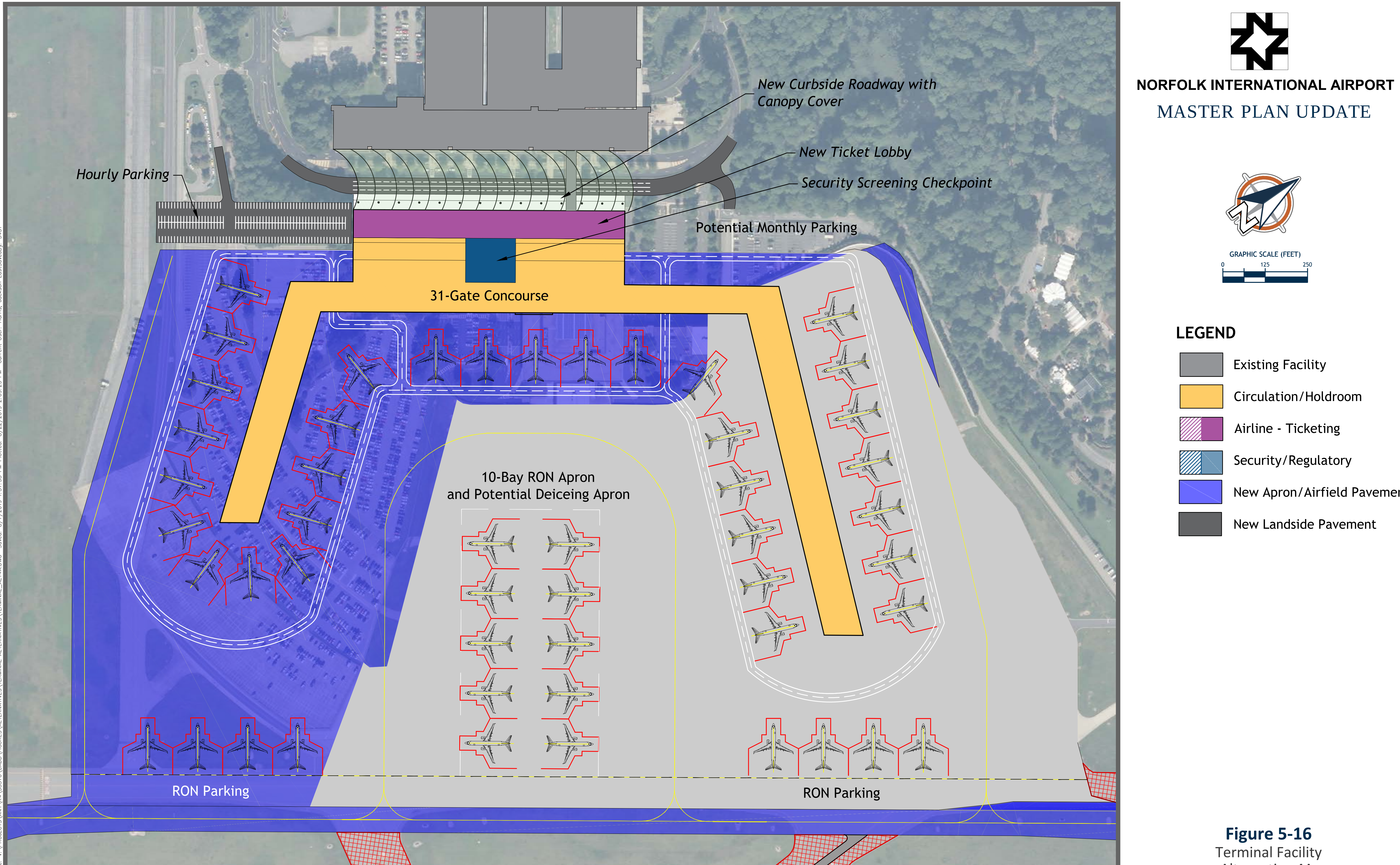


Figure 5-16
Terminal Facility
Alternative 4A

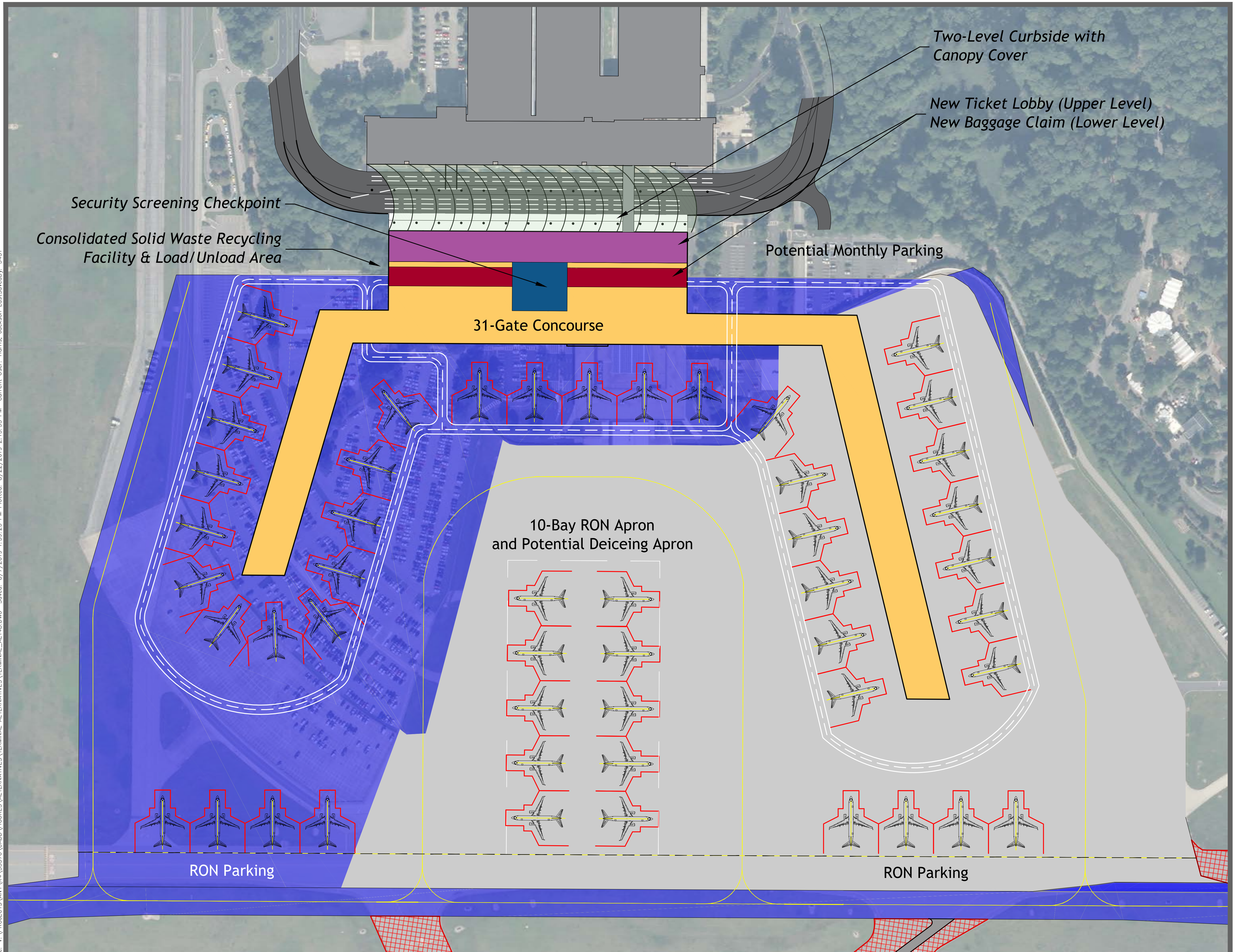
5.4.9 Passenger Terminal Facility Alternative 4B

The goal of Passenger Terminal Facility Alternative (**Figure 5-17**) is to retain the benefits of Alternative 4A, while consolidating passenger and baggage processing functions and roadway/curbside activities into a single consolidated facility. To achieve this goal, Passenger Terminal Facility Alternative 4B includes the same improvements to the concourse and gate area as Alternative 4A; however, it would completely replace the departures and arrivals buildings and vehicular circulation roadway system. In order to do this, a two-level roadway system would be constructed to serve a new two-level terminal building. The upper level of this building would house the departures and out-bound baggage make-up functions and the lower level will accommodate the in-bound baggage and baggage claim facilities. Alternative 4B calls for repurposing the arrivals building as a new GTC on the lower level with the second level to house airport administrative office area. This alternative would completely replace existing Concourses A and B, with two new consolidated double-loaded concourses, one to the north and one to the south of the headhouse, along with a centralized security checkpoint and concessions core. In addition, 5 contact gates are located in the central portion of the terminal facility. Alternative 4B meets the 20-year gate requirements and provides expansion capabilities for a third central concourse beyond what is needed in the 20-year planning horizon. **Table 5-15** summarizes the Passenger Terminal Facility Alternative 4B.

Table 5-15 – Passenger Terminal Facility Alternative 4B Summary

General Layout	
Includes the development of a new consolidated passenger and baggage processing facility with a two-level building and support roadway/curbside system. All existing gates are replaced with two new contact gate concourses and centralized security checkpoint and concessions core. Arrivals building will be repurposed as a ground transportation center and will also provide area for airport administrative offices on the second level.	
Advantages	**Disadvantages**
✈ Provides adequate additional facilities for all terminal requirements ✈ Consolidates the security checkpoint and improves TSA staffing ✈ Enables a new central FIS facility below an expanded security checkpoint ✈ Provides passenger access to all post-security facilities, services, and concessions ✈ Maximizes flexibility and future expandability for airline gate utilization and operations ✈ Combines split facilities for the ticketing and arrivals halls (reduces passenger confusion) ✈ Eliminates the overly complex roadway layout ✈ Provides an expanded area for airport administrative offices ✈ Provides a new GTC to house all ground transportation functions	✈ Higher capital costs, with substantial new facilities and a reconfigured GTC/administrative building ✈ Highly difficult construction phasing with impact to passenger and tenant activity ✈ Two concourses will result in duplication of concessions and operational functions ✈ Increases walking distances between gates and parking garages

Source: CHA, 2019.



NORFOLK INTERNATIONAL AIRPORT

MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)
0 125 250

LEGEND

- Existing Facility
- Circulation/Holdroom
- Airline - Ticketing
- Airline - Baggage Claim
- Security/Regulatory
- New Apron/Airfield Pavement
- New Landside Pavement

Figure 5-17
Terminal Facility
Alternative 4B

5.5 LANDSIDE COMMERCIAL DEVELOPMENT OPTIONS

Should the Airport's parking capacity become constrained, the area southwest of the new Robin Hood Road/Norview Road intersection can be developed for additional long-term parking, along with a new employee parking lot to the southeast of the intersection (as identified in the previous Airport Master Plan). As detailed within **Chapter 3**, even with the loss of the existing long-term parking lot, passenger parking is adequate throughout the forecast period with the development and construction of Garage D. As previously described, with the new Passenger Facility Terminal options presented, additional parking locations become available in proximity to the Terminal front, resulting in additional parking for temporary or emergency purposes in the event construction phasing impacts existing parking capacity; however, should the Airport require additional parking, these two areas are potential locations for a future surface parking lot and are illustrated within **Figure 5-18**. **Table 5-16** summarizes all Landside Commercial Development Options.

Landside Commercial Development

With the potential closure of Runway 14/32 and realignment of Robin Hood Road, considerable land for redevelopment would become available. Several opportunities are presented throughout these alternatives for various options on the land use of these available properties. This alternative presents potential non-aeronautical opportunities within this area.

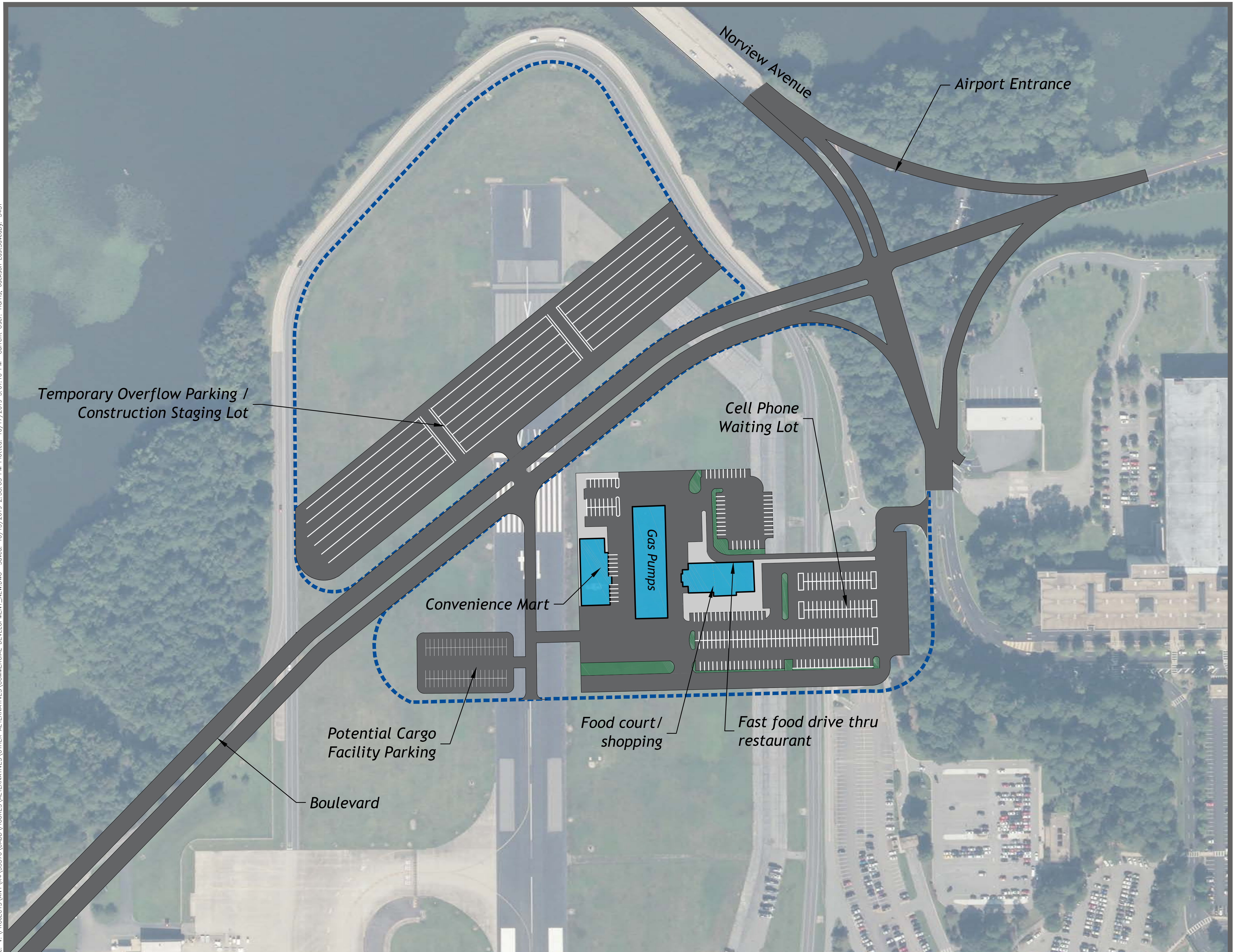
Commercial Retail/Cell Phone Lot/Gas Station

One option is to develop a commercial retail station along the eastern corner of the new Robin Hood Road and Norview Road intersection. This commercial center has the potential to house a consolidated gas station, thus providing a partnership opportunity with terminal concessionaires for an external food court option along with a potential location for a more robust cell phone/passenger wait lot. This concept is a growing trend amongst heavily trafficked airports and provides a potential opportunity for increased revenue generation.

Table 5-16 – Landside Commercial Development Options

General Layout	
Includes commercial retail/concessions, cell phone lot, and gas station	
Opportunities	**Constraints**
✈ Revenue generation ✈ Passenger convenience ✈ Consolidation of new gas station, cell phone lot, "courtyard" ✈ Provides opportunities for new partnership with concessionaires ✈ Potential overflow or emergency parking	✈ Utilizes area with potential for airside connectivity ✈ Potential parking for employees and/or temporary staging lots are pushed further from the Terminal ✈ Requires realignment of Robin Hood Road and Norview Avenue/Airport Road

Source: CHA, 2019.



NORFOLK INTERNATIONAL AIRPORT

MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)

0 100 200

LEGEND

- Future Building
- Future Landside Pavement

Figure 5-18

Landside Commercial Development Options

5.6 SUPPORT FACILITIES DEVELOPMENT CONCEPTS

5.6.1 Rental Car Concessions Alternatives

The Facility Requirements analysis in **Chapter 4** identified sufficient short- and long-term vehicle parking spaces for ORF throughout the planning horizon; however, the analysis further identified a growing deficit of rental car spaces during peak periods, including a need for approximately 450 additional spaces by PAL 4. This additional capacity can be accommodated in various ways including physical capacity increases, consolidation of rental car operations, and relocating off-site rental car activities nearer to the Airport's terminal itself.

As discussed in **Chapter 2** and **Chapter 4**, rental car companies currently have off-site Quick Turnaround (QTA) facilities along Military Highway, resulting in unnecessary rental car throughput (i.e., rental car companies moving overflow and vehicles requiring maintenance) along the terminal curbsides, Norview Ave., and Airport/Robin Hood Road, and expenditures for rental car companies maintaining off-site facilities. As such, there has been a need identified to decrease rental car traffic or separate rental car activity from passenger/pedestrian activity along the Airport's roads and consolidate rental car functions in proximity to the Airport terminal; therefore, concepts have been developed that provide additional rental car space to accommodate growing demand through consolidated QTA facilities or through the development of a Consolidated Rental Car Facility (CONRAC).

It is important to note, that although these alternatives show potential structures to accommodate rental car activity, for planning purposes the overarching goal is the preservation of land to accommodate these activities. As demand changes, the physical structures necessary to accommodate the activity will change; therefore, three potential layouts were developed for a QTA and two potential layouts for a CONRAC facility. All QTA Alternatives are depicted in **Figure 5-19** and all CONRAC alternatives are presented in **Figure 5-20**. **Table 5-17** summarizes both the QTA and CONRAC alternatives.

QTA Alternatives

Alternative 1 - Consolidated QTA

QTA Alternative 1 shows a new rental car QTA facility along the western portion of the airfield nearby the existing Runway 14 end. The construction of a consolidated QTA area/facility provides easy access to all rental car operations for both passengers and rental car employees and reduces the need for vehicle transport to/from airport property. In this concept, Robin Hood Road is realigned (but is not necessary), providing increased connectivity to Military Highway. While this location preserves the area adjacent to the existing long-term and (Transportation Network Company) TNC parking lots (e.g., *Uber*, *Lyft*, etc.), the location of the QTA facility is dependent upon closure of Runway 14/32.

Alternative 2 - Consolidated QTA

Similar to Alternative 1, QTA Alternative 2 shows a new QTA facility at the existing Runway 14 end. The location shown in Alternative 2 allows for development of a new QTA facility without the need for immediate realignment Robin Hood Road. This concept does require some degree of reconstruction of the existing Airport Road and access to/from Robin Hood Road; however, this location limits full aeronautical or non-aeronautical (i.e., parking, retail commercial, etc.)

development potential of the area, as this location east of the Robin Hood Road realignment has access to the airfield.

Alternative 3A – Consolidated QTA

QTA Alternative 3 depicts the repurposing of the existing employee parking lot for a new consolidated QTA facility capable of supporting rental car vehicle parking/storage needs, as well housing for maintenance services. This concept requires a longer shuttle of rental cars to/from the Airport along Robin Hood Road but limits the potential throughput of rental vehicles along the arrivals or departures curbsides and eliminates the use of Norview Avenue as a potential rental car route.

Alternative 3B - Dedicated QTA

QTA Alternative 3 shows the repurposing of the existing employee parking lot into a dedicated QTA facility. For the purposes of the physical make-up of this location, a consolidated single-structure QTA is not feasible; however, this concept allows for a more cost-effective solution by providing a dedicated area for rental car operations without the need for construction of a parking garage. Like Alternative 3A, this concept requires a longer shuttle of rental cars to/from the Airport along Robin Hood Road while limiting the potential throughput of rental vehicles along the arrivals or departures curbsides and eliminating the use of Norview Avenue as a potential rental car route.

CONRAC Alternatives

A need for consolidated rental car facilities has been identified. This need can be met by consolidating the QTA facilities located along Military Highway into a permanent structure, which could possibly be located on the Airport. Typically, a CONRAC provides a full service on-stop location for all rental car activities, including ready return, QTA, overflow storage, and rental pick-up (including rental car counters). Such a facility is most commonly attached to the terminal in some fashion, providing access for arriving passengers.

CONRAC facility sizing varies from airport to airport based upon demand for rental car services, the presence of a GTC, etc.; however, several design considerations exist and, thus, the facility should be sized accordingly to accommodate the existing and future needs of the rental car companies. When developing a CONRAC facility, it is important to account for safety of the employees and the general public, convenience to the rental car agencies and customers, efficient operational capabilities, operational sustainability, and cost efficiency. For the purposes of this Study, two locations for a CONRAC were identified, and the facility sizing of each location were independent of each other.

Alternative 1 – Consolidated CONRAC and QTA

This alternative proposes the construction of a CONRAC and QTA facility west of Airport Road, nearby the taxi queue area. This facility would consolidate all rental car functions and operations, with a pedestrian access bridge that would be constructed across Airport Road to connect the CONRAC facility with the existing Arrivals building. Access into and out of the CONRAC facility would be via Robin Hood Road and Airport Road, thus, preventing interference and congestion of the Terminal Loop. Based on industry standard facility sizing, it is expected that this CONRAC would accommodate all rental car vehicles and operations across five levels, sufficiently accommodating all current and future demand at the Airport; however, it is important to note that facility sizing may change prior to any future planning. Thus, the purpose of this alternative is for the preservation of space sufficient to accommodate such a facility.

This site for the CONRAC has the potential to accommodate the CONRAC itself, additional parking along Robin Hood Road, and space for a potential commercial/retail development at the corner of Robin Hood Road and Norview Ave., as well as potentially housing a gas station/convenience store and food options with a cell phone lot for passengers, visitors and the general public.

Alternative 2 – CONRAC Only

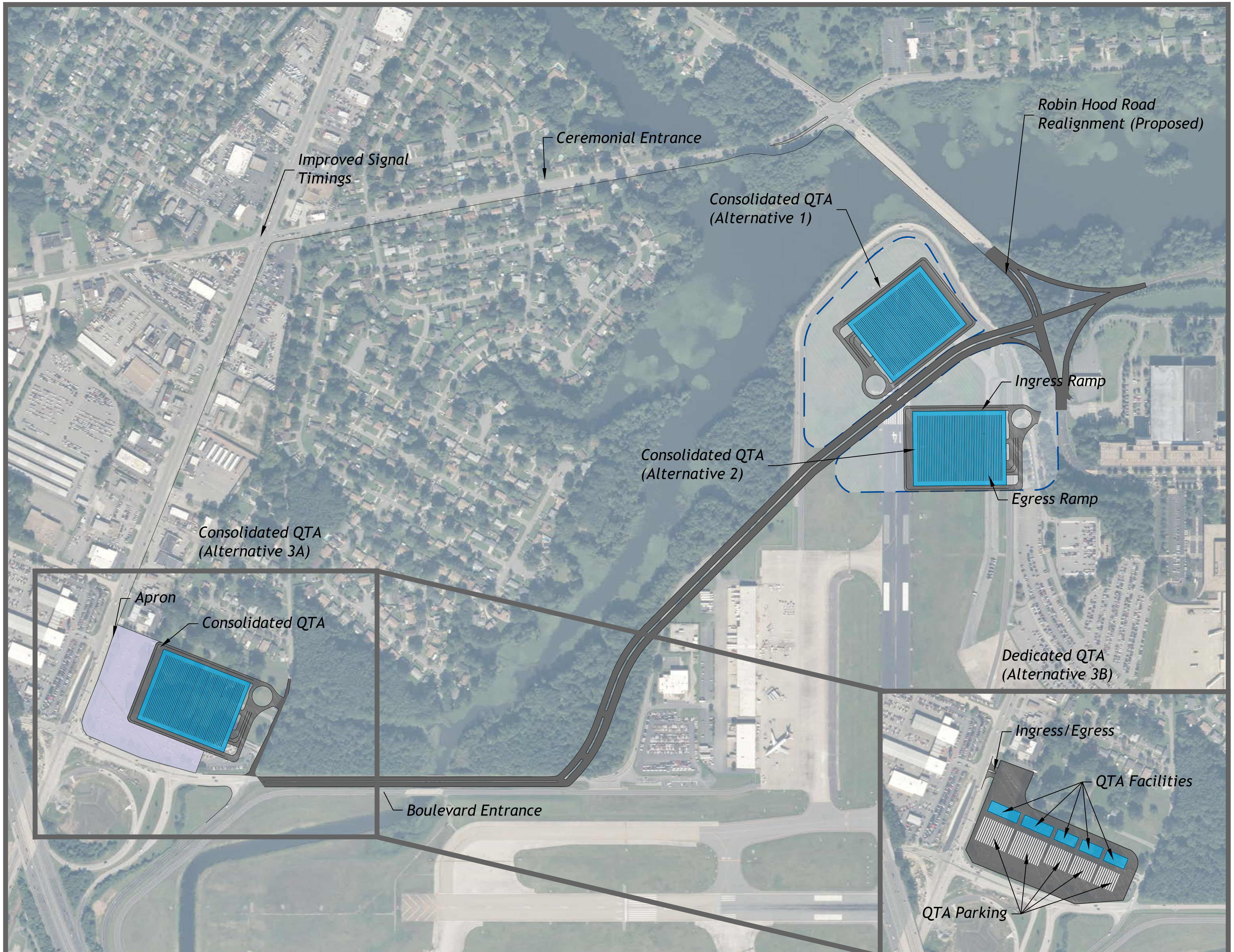
This alternative suggests a replacement of Garages B and C to support a CONRAC facility. For the purposes of the sizing of this facility, the current spacing of Garages B and C provide more than adequate width required for a potential CONRAC, thus decreasing the requirement to accommodate additional floors for rental purposes. As such, an opportunity within this alternative suggests the potential for additional floors within this CONRAC facility for passenger parking, which continues to provide adequate capacity for public parking on the Airport. The lower floors would be dedicated to QTA, rental car ready and return parking; preventing interference with existing public parking within the garages. Customers would be able to access the facility via ingress and egress points currently in place. Although this option would provide the necessary space for CONRAC activity, QTA operations within the lower level of this space would be difficult. In addition, rental car vehicular access would impede the Airport's Terminal Loop, potentially resulting in congestion during peak periods.

The positioning of the facility would also allow space for future commercial development, such as those shown in **Figure 5-18**.

Table 5-17 – Rental Car Alternatives (QTA and/or CONRAC)

Alternative	Opportunities	Constraints
QTA Development	✈ Runway 14/32 end provides sufficient space for either consolidated or dedicated QTA facility ✈ Existing employee lot provides immediate space for consolidation or dedicated QTA facility	✈ QTA development near existing Runway 14 end dependent upon runway closure and realignment of Robin Hood Road ✈ Building within existing long-term lot limits development of future terminal facilities within the existing area
Consolidated CONRAC and QTA	✈ Prevent interference and congestion of the Terminal Loop ✈ Ingress/Egress points in place (Airport Road)	✈ Require relocation of the existing taxi queuing area ✈ Maintenance cost for pedestrian access bridge
CONRAC (Not QTA)	✈ Does not require building an entirely new facility ✈ Avoids interference with existing public parking ✈ Ingress/Egress points in place (to the terminal facilities and by roadway)	✈ No space for QTA activity, thus requiring a QTA elsewhere ✈ Rental car traffic will still impede the Airport's Terminal Loop -

Source: CHA, 2019.



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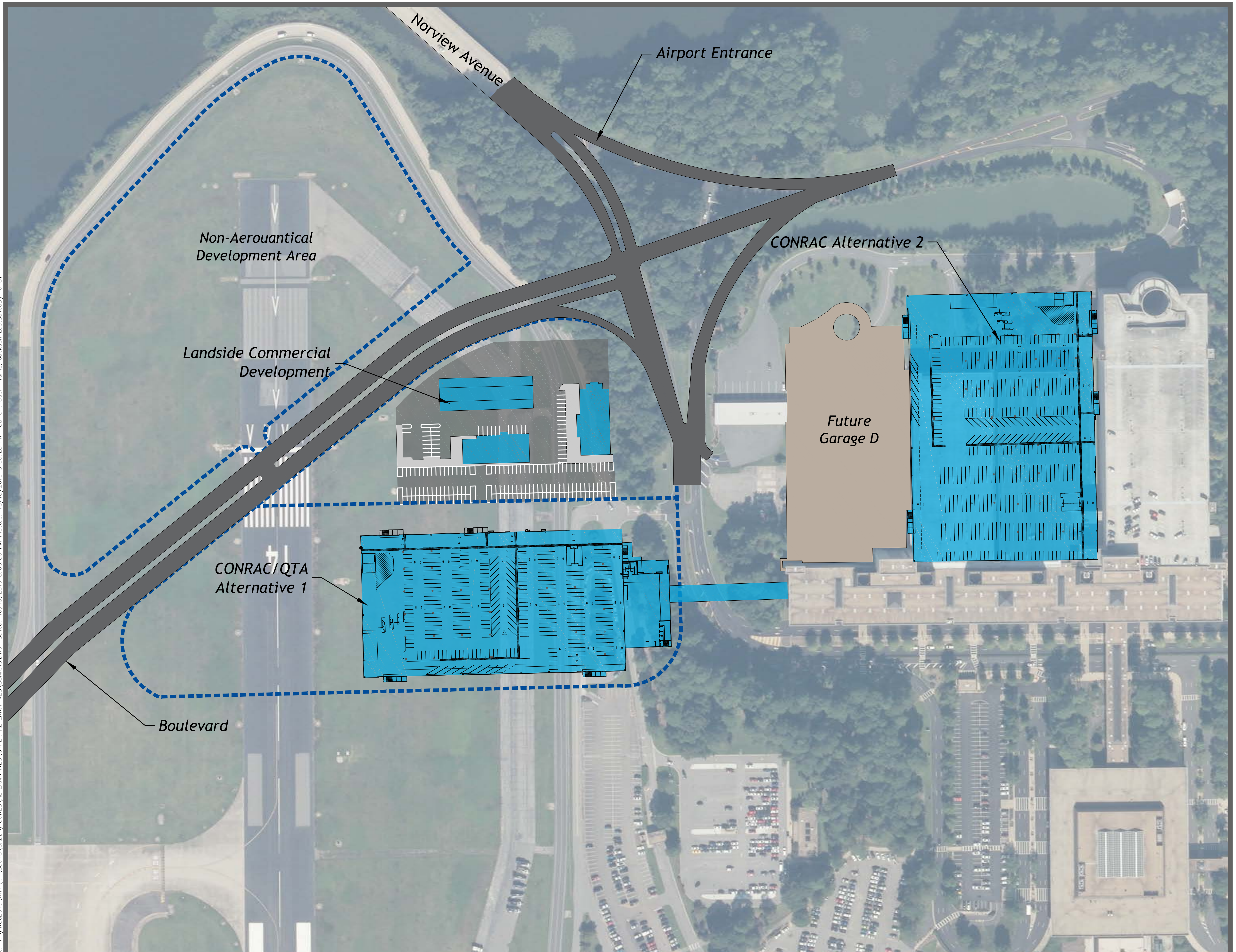
MASTER PLAN UPDATE

Figure 5-19
QTA Alternatives



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MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)
0 100 200

LEGEND

- Future Building
- Future Landside Pavement

Figure 5-20

CONRAC Alternatives

5.6.2 Air Cargo Facilities Alternatives

As described in **Chapter 4**, air cargo facilities at ORF are currently undersized to adequately accommodate the existing level of cargo activity, both by physical footprint and functionality, as leaseholds and processors are separated for each cargo operator. Based on the facility requirements calculations, cargo operations currently exceed maximum capacity by approximately 10 percent during peak periods. The dedicated air cargo apron is currently sufficient in size and capable of supporting up to four widebody aircraft and one single-engine turboprop aircraft with angled parking; however, by PAL 1, it is forecasted that there will be a need for one additional cargo aircraft parking position, with a deficit of approximately 3,450 square yards (SY). This deficit may grow to over 19,000 SY by PAL 4. Furthermore, the existing 88,000 square feet (SF) of cargo processing building space does not meet the current need of approximately 97,000 SF, with demand forecasted to grow to over 143,800 SF by PAL 4.

During the development of the alternatives, future transition of cargo fleet mixes was incorporated as air cargo operators transition to new and converted B767-300 aircraft with decreased operations of A300 and B757 airframes. Based on these observations and the projected growth of cargo operations over the forecast period, three conceptual air cargo facility alternatives were identified for evaluation.

North Cargo/MRO Area Alternative 1

The North Cargo/MRO Area Alternative 1 (**Figure 5-21**) shows an approximate 56,000 SF cargo facility northeast of the current facilities, improving the physical footprint of cargo infrastructure and allowing consolidation of processors. This alternative further depicts area dedicated to loading and unloading activity on the landside of the newly proposed facility, as well as parking for ground-cargo vehicles and cargo operator employee parking.

This concept would shift Taxiway ‘V’ approximately 114 feet northeast, providing additional space for aircraft parking and improved functionality. By shifting the taxiway, cargo operators would have the ability to park widebody aircraft perpendicular to the present facilities rather than the current angled configuration. In addition to parking reorientation, the apron would sufficiently accommodate up to five B767-300 aircraft and two Cessna 208 Caravans.

Additional apron space will be required to accommodate the shifted taxiway, as well as for aircraft parking at the additional processing facility. Apron parking at the depicted cargo facility would accommodate two to three B767-300 aircraft. In addition to cargo activity, MRO activity can also be supported within the development area, with space for two MRO facilities (approximately 85,000 SF each). In total, approximately 74,030 SY of airfield pavement is recommended to support the shifted taxiway, as well as to support parking for aircraft at the newly proposed cargo and Maintenance, Repair, and Overhaul (MRO) facilities. The additional pavement and infrastructure repurposes the pavement currently serving as Runway 14/32, lowering developmental costs. This alternative is cost-effective due to the reuse of existing pavement and retention of existing cargo buildings and apron, rather than razing and replacing current facilities. **Table 5-18** summarizes the North Cargo/MRO Area Alternative 1.

Table 5-18 – North Cargo/MRO Area Alternative 1 Summary

General Layout	
Incremental Expansion of existing Air Cargo facilities.	
Opportunities	**Constraints**
✈ Accommodates relocation of Robin Hood Road. ✈ Provide locations for additional infrastructure needed throughout the planning period ✈ Maintains existing air cargo facilities ✈ Repurposes Runway 14/32 for apron/taxiway ✈ Includes locations for MRO facilities ✈ Does not infringe upon long-term surface parking lot ✈ Lowest cost of the air cargo concepts	✈ Requires closure of Runway 14/32 ✈ Layout is limited to a single taxilane, resulting in potential for some apron congestion/delay

Source: CHA,2019.

North Cargo/MRO Area Alternative 2

North Cargo/MRO Area Alternative 2 (**Figure 5-22**) shows razing of the existing cargo buildings for improved functionality and best-use of the developable area. As such, two new cargo facilities are incorporated, providing a minimum of approximately 56,000 SF of total space. The largest of the two facilities (located northeast of the current building) would serve as a dedicated cargo sort facility, with vehicular parking to the north (landside) and an aircraft parking apron to the south (airside). The aircraft parking apron would utilize the pavement and infrastructure currently used for cargo related vehicular parking, aiding in cost efficiency. The new apron would measure approximately 100,000 SY and could support up to 10 cargo aircraft, allowing cargo operators more options and flexibility when processing freight. The smaller facility shown would also have dedicated apron space capable of supporting up to two B767-300s. To allow for the development of the new cargo buildings and apron space, it is necessary to shift Taxiway ‘V’ approximately 400 feet to the west, converting the pavement currently used for a runway (Runway 14/32) to use as a taxiway, thus lowering costs.

Similar to the first development concept, this alternative also provides the option for the development of two MROs to the east of the shifted taxiway, enabling increased utilization of the available developable area. **Table 5-19** summarizes the North Cargo/MRO Area Alternative 2.

Table 5-19 – North Cargo/MRO Area Alternative 2 Summary

General Layout	
Redevelopment of existing Air Cargo facilities	
Opportunities	**Constraints**
✈ Accommodates relocation of Robin Hood Road. ✈ Provide locations for additional infrastructure beyond that needed during the Planning Period ✈ Repurposes Runway 14/32 for future Taxiway ✈ Includes locations for MRO facilities ✈ Includes separate taxiway access to each component to improve efficiency	✈ Requires closure of Runway 14/32 ✈ Requires replacement of existing air cargo buildings ✈ Highest cost of the alternative concepts

Source: CHA, 2019.

North Cargo/MRO Area Alternative 3

Similar to Alternative 2, North Cargo/MRO Area Alternative 3 (**Figure 5-23**) depicts razing the current cargo facilities and constructing two new facilities to satisfy long-term requirements, with one facility being dedicated to cargo sort activities. A new aircraft parking apron for the sort facility would be necessary, measuring approximately 100,000 SY and capable of supporting up to 10 B767-300 aircraft. The apron would repurpose existing pavement to decrease developmental costs. The smaller cargo facility's apron would also repurpose pavement from Runway 14/32 and would provide parking for up to three B767-300 aircraft. Landside parking and areas for loading and unloading activities would be provided to the west of each newly constructed cargo facility, again repurposing some existing pavement. Roadway access from the proposed Robin Hood Road realignment would serve these new facilities.

In addition, Alternative 3 provides the option of building two new MRO facilities on the southwest side of the developable area, along with a single apron for joint-use operations with the MRO facility operators. An access road is shown to allow for entry from the proposed cargo drive to the proposed Robin Hood Road realignment. The locations of the recommended roadways will maintain the separation of cargo and MRO activities from FAA equipment and non-airport related businesses (i.e., the existing catering company) adjacent to the developable area. The location of the roadways also allows for the repurposing of existing infrastructure (i.e., cargo-related vehicle parking and loading/loading space) used by cargo operators. **Table 5-20** summarizes the North Cargo/MRO Area Alternative 3.

Table 5-20 – North Cargo/MRO Area Alternative 3 Summary

General Layout	
Major Buildout Air Cargo facilities	
Advantages	**Disadvantages**
✈ Accommodates relocation of Robin Hood Road. ✈ Provide locations for additional infrastructure needed throughout the Planning Period ✈ Repurposes Runway 14/32 for future Taxiway ✈ Includes locations for MRO facilities ✈ Does not infringe upon long-term surface parking lot	✈ Requires closure of Runway 14/32 ✈ Requires replacement of existing air cargo buildings ✈ Occupies space of the existing long-term lot the potential future terminal facilities

Source: CHA, 2019.

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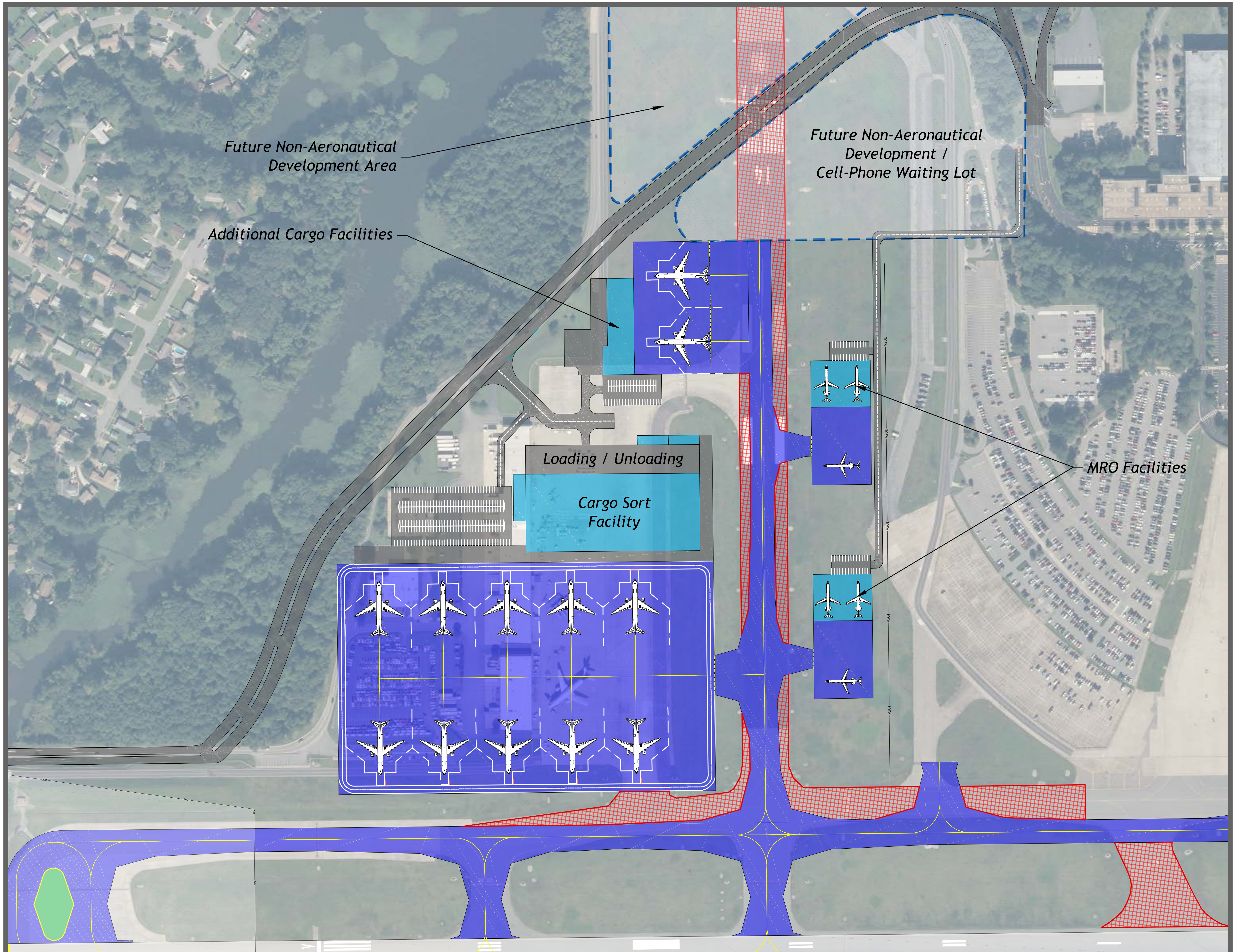
Figure 5-21
North Cargo Area - Alternative 1



NORFOLK INTERNATIONAL AIRPORT

MASTER PLAN UPDATE

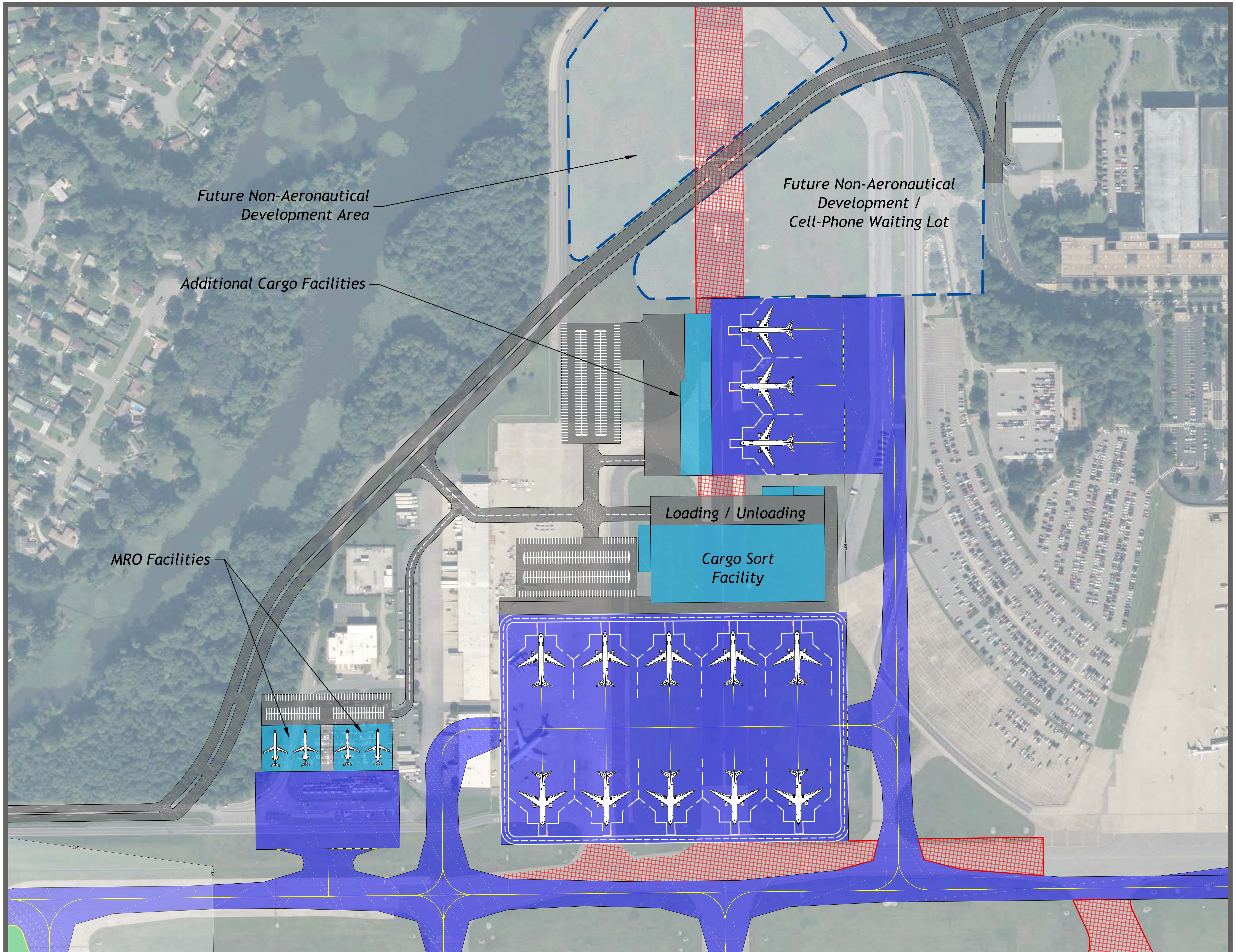
GRAPHIC SCALE (FEET)
0 150 300

LEGEND

- Future Airfield Pavement
- Future Landside Pavement
- Future Building
- Pavement Removal

Exhibit 5-22

North Cargo Area - Alternative 2



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MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)
0 150 300

LEGEND

- Future Airfield Pavement
- Future Landside Pavement
- Future Building
- Pavement Removal

Exhibit 5-23
North Cargo Area - Alternative 3

5.6.3 General Aviation Facilities Alternatives

General Aviation (GA) activity at ORF represents approximately 31 percent of total annual airport operations and includes various types of private, corporate, and business aircraft flights. GA services and facilities are accommodated by Signature Flight Support, which is located along the southern portion of the airport and currently the Airport's only Fixed Based Operator (FBO).

The following discusses the existing GA infrastructure as well as potential concepts to accommodate forecasted demand and future buildout. Note that each concept was developed with the presumed closure of Runway 14/32, although certain portions of each could occur prior.

General Aviation Alternative 1

General Aviation Area Alternative 1 (**Figure 5-24**) depicts an option to accommodate forecasted apron and hangar demand within PAL 1 while requiring minimal construction of additional infrastructure to support future development. This concept depicts a northeasterly expansion of the current GA apron by approximately 29,000 SY. The southern portion of the expansion would support a TDG 2 taxilane to provide access as well as ingress/egress for additional expansion. Although more space than currently forecasted is depicted, the expansion accommodates apron parking for 12 ADG II aircraft and allows for phased development.

Southeast of the GA apron expansion, General Aviation Area Alternative 1 depicts two bulk hangars (150' x 200'), each providing 30,000 SF of aircraft storage. Similar to the GA apron expansion, this concept allows for phased development northeast of the FBO building (Building 20) and along the existing TDG 2 taxilane. Since the development would occur outside of the airside secure limits, vehicle parking/access and associated security measures would likely be required.

This concept also depicts several portions of existing taxiway to be either removed or repurposed. As such, a new taxiway providing TDG 3 access to the Ground Runup Enclosure (GRE) is shown. This taxiway would also provide access to potential corporate hangar development located northwest of the FAA Aircraft Traffic Control facility. Lastly, this concept depicts several areas capable of accommodating future aeronautical and/or non-aeronautical development. As stated, this concept requires closure of Runway 14/32, but other existing facilities (i.e., the GRE, ATCT, fuel farm, ASR, etc.) are all retained. **Table 5-21** summarizes the General Aviation Alternative 1.

Table 5-21 – General Aviation Alternative 1 Summary

General Layout	
Northeasterly expansion of the current GA facilities serviced by existing FBO	
Opportunities	**Constraints**
✈ Minimal additional infrastructure required to accommodate development ✈ Sufficient apron parking and aircraft storage space for short-term demand ✈ Accommodates phased development to accommodate all long-term requirements ✈ Retains existing airport support facilities and access road	✈ Requires closure of Runway 14/32 ✈ Northeasterly apron expansion may be limited by construction of TDG 3 taxiway to GRE

Source: CHA, 2019.

General Aviation Alternative 2

Similar to Alternative 1, General Aviation Alternative 2 (**Figure 5-25**) depicts an option to accommodate forecasted apron and hangar space within PAL 1 with the option for future expansion. Alternative 2, however, assumes the addition of a second FBO servicing additional apron space and aircraft storage located along the proposed Runway 5R/23L eastern corridor.

The GA apron expansion depicted (approximately 36,400 SY) accommodates parking for 16 ADG II aircraft, and a TDG 2 taxilane is shown along the eastern portion of the apron expansion for increased connectivity. Additionally, two bulk hangars (200' x 100') are shown providing a total of 40,000 SF of aircraft storage.

Differing from the first alternative, Alternative 2 depicts a potential second FBO nearby the existing fuel farm, which would be relocated in this concept. As part of this concept, an itinerant apron expansion is shown southeast of the proposed Runway 5R/23L. Although Alterative 2 depicts various bulk hangar sizes, this area provides sufficient space for a variety of hangars and types depending upon demand. This concept also shows preservation of the GRE along with taxiway/runway access. Additionally, the proposed corporate hangar development northeast of the FAA Air Traffic Control facility would likely require access to the apron expansion. Similar to Alternative 1, several areas capable of accommodating future aeronautical and/or non-aeronautical development are shown. Lastly, this concept assumes the redevelopment of Taxiway 'F'. **Table 5-22** summarizes the General Aviation Alternative 2.

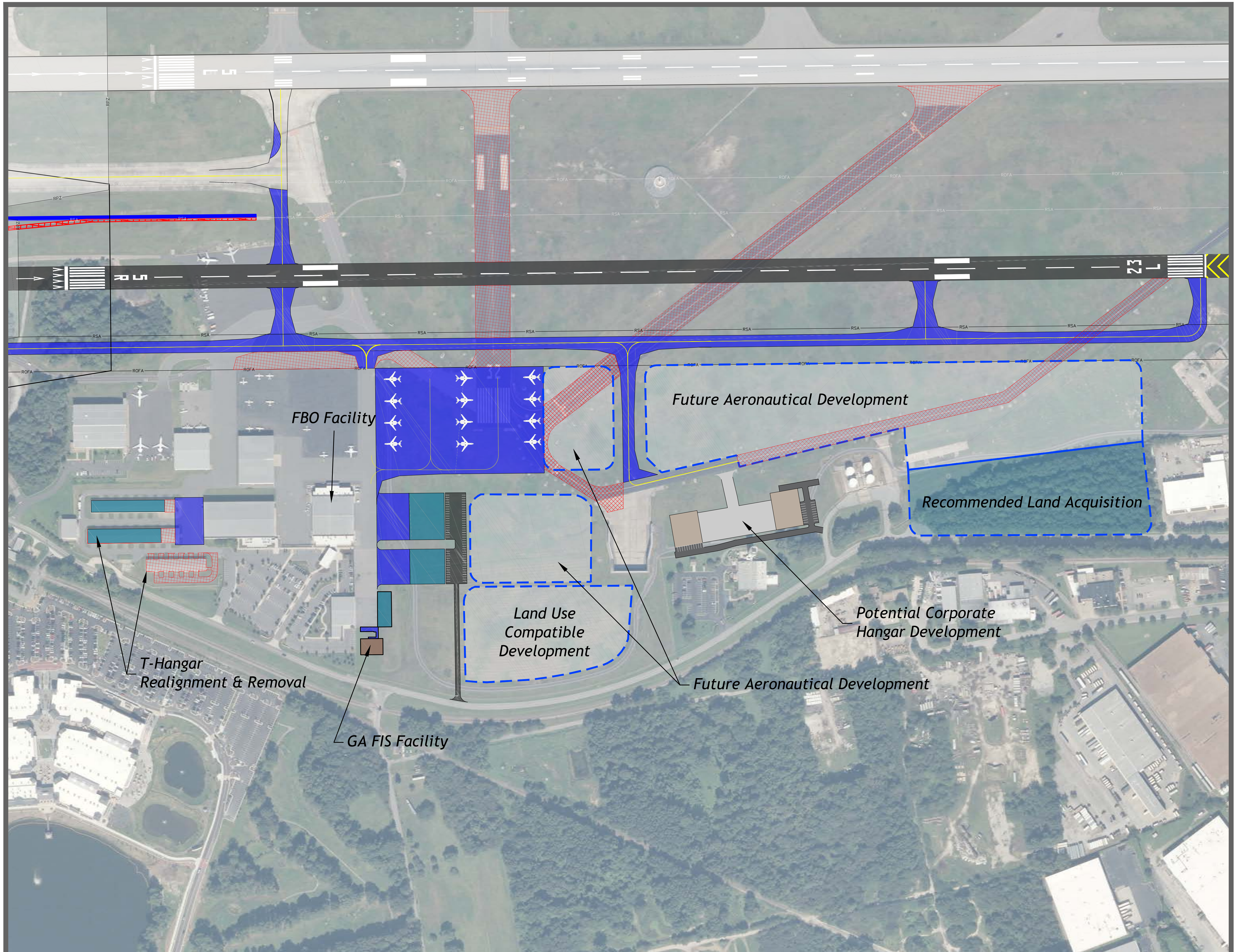
Table 5-22 – General Aviation Alternative 2 Summary

General Layout	
Addition of a second Fixed Base Operator (FBO) servicing additional apron space and aircraft storage located along the proposed Runway 5R/23L eastern corridor	
Opportunities	**Constraints**
✈ Sufficient apron parking and aircraft storage space for short-term demand ✈ Accommodates phased development to accommodate all long-term requirement ✈ Provides frontage and separation between FBOs ✈ Maintains uninterrupted GA layout across proposed Runway 5R/23L eastern corridor ✈ Retains existing airport support facilities and access road	✈ Requires closure of Runway 14/32 ✈ Additional infrastructure required (replaced Taxiway 'F') ✈ Ultimate buildout dependent upon establishment of second FBO ✈ Additional vehicle access to eastern corridor required

Source: CHA, 2019.

Additional Measures for Consideration

Three T-hangar buildings are currently located in the general aviation area at ORF. The buildings are adequate in terms of function; however, spacing between the T-hangar buildings is limited, with some areas only providing approximately 25 feet for maneuverability. Future consideration may be given to the replacement of the existing T-hangars with box hangars, if demand requires; therefore, the need and demand for the T-hangars should be closely monitored for demand throughout the planning horizon.



NORFOLK INTERNATIONAL AIRPORT

MASTER PLAN UPDATE

GRAPHIC SCALE (FEET) 0 400 800

LEGEND

- Future Airfield Pavement
- Future Landside Pavement
- Future Building
- Pavement Removal

Figure 5-24

General Aviation Area Alternative 1

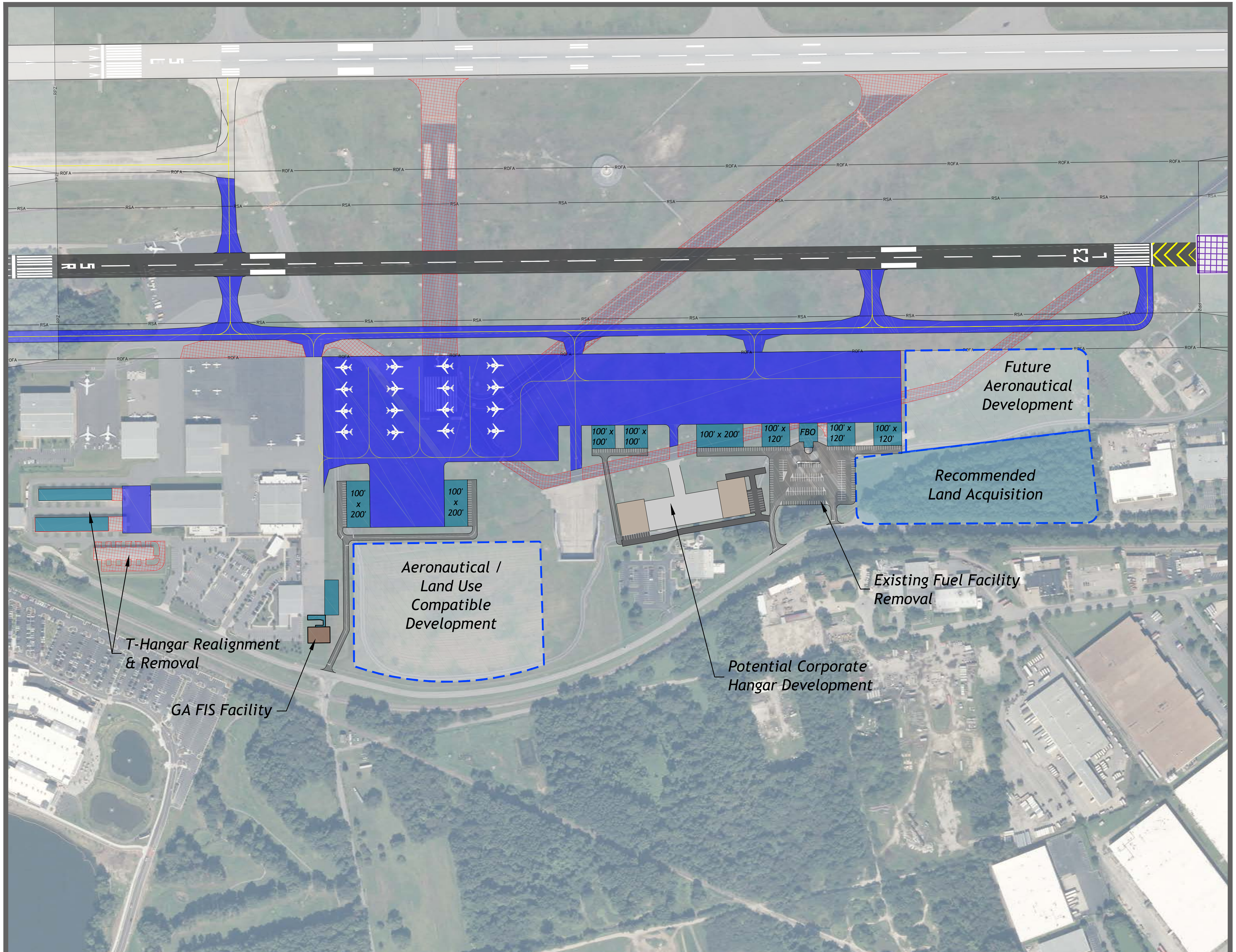


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Figure 5-25
General Aviation Area
Alternative 2

5.6.4 Aviation Fueling Facilities Alternatives

The existing Jet-A fuel farm is located north of the Air Traffic Control Tower and includes four aboveground Jet-A fuel tanks with storage capacities of 210,000-gallons per tank. From the fuel farm, fuel is pumped via underground pipeline to a dispensing location north of the ARFF facility where it is transferred to fuel trucks for dispensing to aircraft.

Source: Google Earth.

The Airport maintains the Jet-A fuel farm, dispensing facility, and underground fuel piping system. Due to the age and condition of the fueling system, it is near the end of its useful life and the Airport is experiencing increasing operations and maintenance costs for upkeep of the system; therefore, in an effort to consolidate the fueling system, **Figure 5-26** depicts two potential locations for a new consolidated Jet-A fuel farm.

Both alternatives assume that the Jet-A fuel storage and upload will be located within a consolidated area, thus eliminating the need for an underground pipeline. With each location, environmental permitting would be required, as well as the decommissioning and demolition of the existing system.

Alterative 1 depicts a location within the existing rental car overflow parking lot. This location allows for quick access of fuel deliveries along with airside connectivity to commercial and cargo aircraft; however, relocation of the rental car overflow parking lot may be required.

Alternative 2 shows expansion of the existing fuel dispensing facility to also include Jet-A storage. This location reuses a portion of the fueling system currently in place and minimizes impacts to existing infrastructure. Access for fuel tanker trucks may be difficult and is shared with the terminal access road. The overall size of this site is limited.

With the potential relocation of Robin Hood road, additional locations are possible that provide both landside and airside access.

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GRAPHIC SCALE (FEET)

0 250 500

Exhibit 5-26

Fuel / Glycol Storage Facility Alternatives

5.6.5 Aircraft Deicing Facilities Alternatives

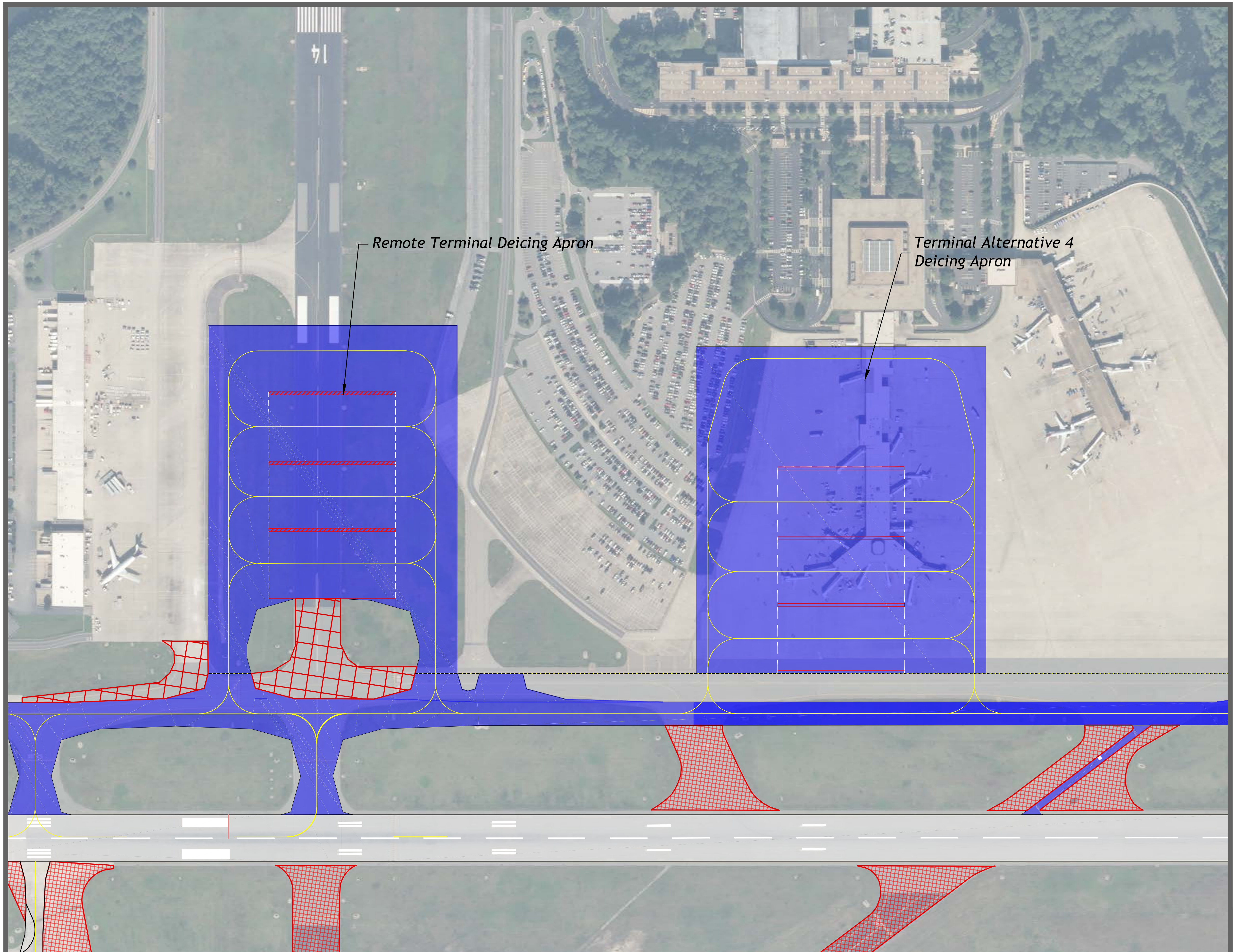
Commercial Aircraft deicing operations at ORF are confined to the main terminal apron, and the cargo apron on the west side of the airfield. The Airport's main deicing facility/pad is located on the northeast side of the main terminal apron and consists of four deicing positions, which are utilized on a first-come-first-serve basis.

Source: Google Earth.

To ensure that deicing operations are accounted for during future terminal development, **Figure 5-27** depicts two deicing alternative locations.

The remote terminal deicing apron location shows an area for four ADG IV deicing positions along the northwestern edge of Taxiway C and on a portion of the current Runway 14/32, which is presumed closed for this alternative. As this location is not a part of the Passenger Terminal apron, a deicing fluid (i.e., glycol) drainage system would be required, however, deicing would be served by mobile trucks and deicing equipment, as impacts to terminal area operations may hinder the likelihood any permanent deicing equipment. This location is respective of Cargo Alternative 1 (**Figure 5-21**), which currently depicts MRO development within the area, and would provide a consolidated commercial/cargo deicing location. Based on ingress and egress requirements for the taxilanes associated with the terminal gates, the overall length of the deicing bays is more than adequate for single use and may be simultaneously occupied with two aircraft. The over space is a dual use with RON capability at night with positions for up to eight RON aircraft.

The Terminal Alterative 4 deicing apron location shows an area southwest of the existing deicing pad. This alternative depicts four ADG IV aircraft deicing positions and is respective of Passenger Terminal Alternative 4 (**Figure 5-16** and **Figure 5-17**). This location allows for utilization of existing apron space and aircraft ingress/egress nearby the terminal gates. Similar to the remote deicing facility, lane length is more than adequate for single aircraft use and may be utilized by up to two aircraft per lane at a time for simultaneous use, therefore increasing the overall deicing capacity at the Airport. Additionally, during non-deicing periods the area can accommodate up to ten remain overnight (RON) aircraft. Single taxilane access as a result of this location may be considered an operational disadvantage.



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GRAPHIC SCALE (FEET)
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Figure 5-27

Deicing Apron Alternatives

5.6.6 Airfield Maintenance Facilities Alternatives

The NAA airfield maintenance facilities are currently located on the southeast end of the airfield and consist of a 40,000 SF facility that houses the snow removal equipment and a 6,000 SF facility for sand storage and airport maintenance and utility vehicles. According to the NAA, these buildings are at capacity and do not account for the most recent FAA guidance within FAA AC 150/5220/18A, *Buildings for Storage and maintenance of Airport Snow and Ice Control Equipment and Materials*; therefore, **Figure 5-28** depicts several alternate locations for additional airfield maintenance facilities. Note that with each location, the potential exists for either complete facility relocation or establishment of a secondary airfield maintenance site, depending on need or location.

Airfield Maintenance Alterative 1

Alternative 1 shows an expanded maintenance facility directly northwest of the existing. This location provides consolidation of all airport maintenance resources within a dedicated area. A disadvantage to this concept is the impact to the existing ARFF training area, which is shown relocated southward.

Airfield Maintenance Alterative 2

Alternative 2 shows an expanded area southeast of the GA apron. This location provides quick access to both the airfield and Miller Store Road with the ability for expansion; however, this area is dependent upon closure of Runway 14/32 and is ideal space for future aeronautical and/or aeronautical-related development. Proximity to the FBO terminal building could be considered an aesthetic disadvantage.

Airfield Maintenance Alterative 3

Alternative 3 is also dependent upon closure of Runway 14/32. Although less of an impact to future aeronautical and/or aeronautical-related development, this location may also be dependent upon potential relocation of the GRE facility.

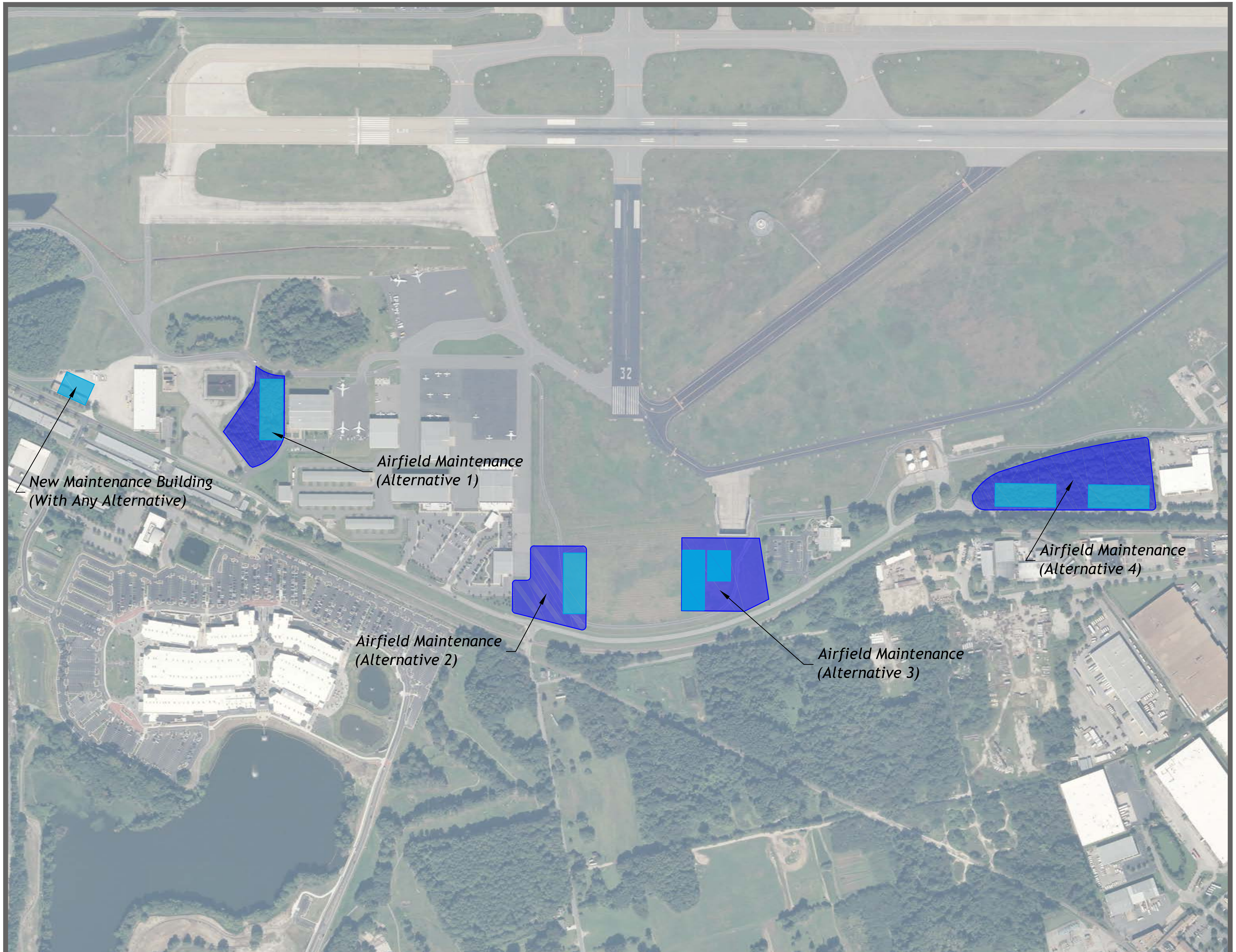
Airfield Maintenance Alterative 4

Alternative 4 takes advantage of the undeveloped wooded area to the north of the existing fuel farm. This area provides connectivity to the airfield and Miller Store Road but would require land acquisition and site clearing prior to development. **Table 5-23** summarizes the Airfield Maintenance Alternatives.

Table 5-23 – Airfield Maintenance Alternatives

Opportunities	Constraints
✈ Existing facility can be retained, allowing for smaller addition(s) to supplement space needs ✈ Sufficient locations throughout airfield allow for total relocation or for a secondary airfield maintenance site	✈ Partial or total relocation within existing Runway 32 approach area limits potential aeronautical and/or aeronautical-related development ✈ Proximity to the FBO terminal building could be considered an aesthetic disadvantage

Source: CHA, 2019.



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GRAPHIC SCALE (FEET)
0 250 500

LEGEND

Future Airfield Pavement

Future Building

Figure 5-28

Airfield Maintenance Alternatives

5.7 RECOMMENDED DEVELOPMENT PLAN SUMMARY

Based on the review of the Airport's goals and objectives, as well as the needs and constraints identified in this Chapter and in previous Chapters, specific alternatives were identified as the most reasonable to form the recommended development plan for ORF. This plan improves the safety, operational efficiency, and functionality of the airfield while incorporating all necessary facilities. This section provides a summary of the major concepts in support of the short- and long-term operation of the Airport.

As mentioned previously, there are a substantial number of areas on the Airport that were evaluated and have recommended improvement concepts. It should be emphasized that this is a long-term plan and that some desired improvements may not be financially or environmentally feasible.

A summary of the advantages and disadvantages of each recommended alternative or concept is presented in **Table 5-24**, while the recommended plan for ORF is illustrated in **Figure 5-29**.

5.7.1 Airside Development

Runway 14/32 Closure

Based on the evaluations of airfield development concepts at the Airport, it was determined that it is in the Airport Authority's best interest to close Runway 14/32 (i.e., removal from the ALP).

Parallel Runway 5R/23L

In the short- to medium-term, a parallel ARC C-II runway (measuring 5,500 feet long and 100 feet wide) is recommended 876 feet south of the existing runway (Runway 5/23), while providing a 300-foot runway-taxiway separation. The existing runway would receive a new designation of Runway 5L/23R and the new parallel runway would be designated as Runway 5R/23L. To eliminate the requirement for an RSA beyond the "stop-end" of the runway (with only a 600-foot long RSA on the approach end) and to lesson environmental impacts, an EMAS would be installed at each runway end. Furthermore, a 600-foot runway displacement avoids building and object obstructions.

In the long-term, it is recommended that the parallel runway be extended an additional 3,501 feet and widened an additional 50 feet, providing an ultimate length and width of 9,001 feet and 150 feet, respectively. The extension would eliminate the need of EMAS beds. The ultimate build-out of the parallel runway would accommodate most aircraft operations at ORF, while also segregating general aviation from commercial activity.

Taxiway 'C' Partial Realignment

The recommended partial realignment of Taxiway 'C' addresses the variable separation distance between the taxiway and Runway 5/23. Taxiway 'C' is currently designated as TDG 5, requiring a minimum taxiway to runway centerline distance of 400 feet; however, the current separation of Taxiway 'C' ranges from 400 feet at the Runway 5 end to over 600 feet at the Runway 23 end. While this distance provides an added separation margin, it also reduces the available non-movement space near the southeasternmost gates of Terminal Concourse B, requiring aircraft push-back into the Taxiway 'C' environment; therefore, this concept recommends a parallel Taxiway 'C' offset of 400 feet from the Runway 5 end to Taxiway 'H'.

Additionally, Taxiway Alternative 1 illustrates the conversion of the Runway 14/32 pavement (from Runway 5/23 northeastward) into a new TDG 3 taxiway (relocated Taxiway 'D'). This conversion of pavement allows for continued ingress/egress to the cargo area and for potential aeronautical development along the taxiway. If necessary, the taxiway can be shortened to accommodate the realignment of Robin Hood Road and the expansion of the cargo facility.

Lastly, this concept recommends the removal and update of taxiways that would be either no longer required or are non-standard. Specifically, this concept shows a realignment of Taxiway 'F' to meet current FAA taxiway design geometry. As a result of this realignment, this concept also shows a relocation of Taxiway 'E' to provide improved access. Although this concept shows the removal of Taxiway 'G', a pavement corridor is reserved for an Aircraft Rescue and Fire Fighting (ARFF) access road between the existing firefighting station and the southern portion of the airfield.

5.7.2 Passenger Terminal Facility Development

Passenger Terminal Facility Alternative 1 addresses pre-security configuration issues of the current terminal complex. In particular, the split ticketing halls are combined and relocated to the west side of the departure building, facing the arrival building. This enables reconfiguration and shortening of the departure roadways with an efficient parallel alignment with the arrivals building's curbside. The new departure curbside will provide greater overall length, with adjacent short-term parking serving both arrivals and departures.

Relocation of the ticketing halls enable redevelopment of the lower level of the departure building for expansion of the outbound baggage make-up facilities to serve all three concourses. TSA security would be consolidated into a single checkpoint that is located on the eastern half of the atrium area. As is the case with the Status Quo Alternative, the previous Airport Master Plan developed an incremental terminal recommendation that retained the existing building layout and internal configuration, and included gates, and associated facilities through the addition of a third concourse (Concourse C). This layout utilizes the area of the long-term surface parking lot for the location of the additional concourse, with expansion of Terminal Concourse A. This alternative is a simple and low-cost expansion option that maximizes use of existing facilities; however, several shortcomings are apparent, including long walking distances and taxilane/push-back conflicts between the concourses.

5.7.3 Landside Commercial Development or Airfield Maintenance Facilities Relocation

The land made available through the closure of Runway 14/32 and the realignment of Robin Hood Road can be developed for either commercial use or for aeronautical use. If reserved for commercial purposes, recommended facilities and uses include commercial retail and concessions, a cell phone lot, and a gas station. If the land is opted for aeronautical uses, it is recommended that the current functions of airfield maintenance be relocated to this site.

5.7.4 Support Facilities Development

Rental Car Facilities

In the short- to medium-term, it is recommended that the existing employee parking lot be repurposed for use as a consolidated QTA facility. The facility should provide enough space to support rental car parking and storage needs, as well as maintenance services, throughout the short- and medium-term.

In the long-term, it is recommended that a CONRAC facility replace the lower level of Parking Garages B and C; however, the facility would still allow for passenger parking on levels not being used for rental car functions.

North Cargo Facility

Development of an additional cargo facility is recommended to the northeast of the current cargo facilities. The new facility would improve the footprint of cargo infrastructure and would allow for consolidation of processors. It is further recommended that an area dedicated to loading and unloading of cargo be provided landside, as well as parking for ground-cargo vehicles and cargo operator employee parking. To accommodate the new facility and to provide adequate apron space, it is recommended that Taxiway 'V' be shifted approximately 114 feet to the northeast; however, repurposing the pavement currently serving as Runway 14/32 will be necessary to support the additional apron space required to accommodate the shifted taxiway.

General Aviation Facilities Expansion

It is recommended that the general aviation apron be expanded approximately 29,000 SY to the northeast (while still retaining existing facilities such as the GRE, ATCT, fuel farm, ASR, etc.), with the southern portion of the expansion supporting a TDG-2 taxilane. The expansion also includes the addition of two bulk hangars, currently shown as 150 feet by 200 feet and each providing 30,000 SF of aircraft storage.

A new taxiway providing TDG 3 access to the GRE is also recommended, requiring the removal or repurposing of existing taxiways. The taxiway would also be capable of providing access to potential corporate hangar development located northwest of the FAA ATC facility.

Aviation Fueling Facilities Relocation

It is recommended that the current fuel farm be decommissioned, followed by demolition, and that a consolidated Jet-A storage and upload facility be constructed in the existing rental car overflow parking lot.

Remote Terminal Deicing Apron

After determining the recommended plan for future cargo development, the deicing apron alternatives were re-evaluated, resulting in a new development concept. It is recommended that a remote terminal deicing apron capable of supporting three ADG IV deicing positions be developed east of the existing cargo area and directly south of the recommended cargo facility, assuming the closure of Runway 14/32 (as recommended in **Section 5.7.1**). The overall length of the deicing bays should be adequate for single use during deicing activities but should be capable of accommodating up to two aircraft per position at night, thus supporting up to six RON aircraft.

Table 5-24 – Recommended Development Plan

Recommended Alternative/Concept	Opportunities	Constraints
Airfield Development		
Runway 14/32 Closure (Alternative 3)	✈ Recaptures airport property to expand critical aviation facilities ✈ Avoids airspace conflicts with surrounding facilities	✈ Reduces crosswind coverage for light General Aviation aircraft
Parallel Runway 5R/23L (Initial Development) (Alternative 12B) 5,500' x 100', ARC C-II EMAS at Both Ends Offset 876' 20:1 TSS, Visibility $\geq$ 1 Mile	✈ Provides secondary runway for GA airport users ✈ Avoids impacts to VORTAC ✈ 876' separation enables simultaneous VFR operations ✈ No impacts to Lake Whitehurst ✈ No wetland impacts	✈ Length restricts usage by commercial operations ✈ Potential Impact to Naval training activity
Parallel Runway 5R/23L (Ultimate Development) (Alternative 5) 9,001' x 150', ARC D-IV Offset 876' 34:1 TSS	✈ Provides secondary runway for operational flexibility ✈ Proposed length accommodates all commercial activity ✈ Avoids impacts to VORTAC ✈ 876' separation enables simultaneous VFR operations	✈ Impacts to Lake Whitehurst ✈ Impacts to on-airport facilities (airport maintenance facilities, ARFF training facility, MRO hangar, and GA parking apron) ✈ Significant construction costs ✈ Approach/departure overfly Little Creek Naval Base
Taxiway 'C' Partial Realignment (Alternative 1)	✈ Realignment of Taxiway C to 400' offset improves the separation from Concourse B ✈ Partial taxiway realignment avoids impact to Runway 23 Glideslope ✈ Conversion of Runway 14/32 to Taxiway expands area for air cargo apron ✈ Removes non-standard conditions (direct apron to runway access)	✈ Taxiway C retains existing curves near Runway 23 end ✈ Does not provide full-length standard parallel taxiway
Terminal Facility Development		
Terminal Expansion (Alternative 1)	✈ Modest capital costs through retention of several existing facilities ✈ Ease of construction phasing with minor impacts to passenger activity ✈ Provides adequate additional facilities for all terminal requirements, including outbound baggage ✈ Removes deficiencies in passenger circulation ✈ Combines split facilities for the ticketing hall and curbside drop-off (reduces passenger confusion) ✈ Eliminates overly complex roadway layout ✈ Eliminates the need for a third security checkpoint	✈ Results in separation and potential duplication of all post-security facilities, services, and concessions ✈ Reduces flexibility for airline gate utilization and operations ✈ Retains existing long walking distances to baggage claim and parking garages

Landside Commercial Development		
Commercial Retail/Cell Phone Lot/Gas Station	✈ Revenue generation ✈ Passenger convenience ✈ Consolidation of new gas station, cell phone lot, "courtyard" ✈ Provides opportunities for new partnership with concessionaires ✈ Potential overflow or emergency parking	✈ Utilizes area with potential for airside connectivity ✈ Potential parking for employees and/or temporary staging lots are pushed farther from the terminal ✈ Requires realignment of Robin Hood Road and Norview Avenue/Airport Road
Support Facilities Development		
Rental Car Consolidated QTA (Alternative 3A)	✈ Consolidates rental car vehicle parking/storage and maintenance services ✈ Limits potential throughput of rental vehicles along the arrivals and departures curbsides ✈ Eliminates use of Norview Avenue as a potential rental car route	✈ Requires longer shuttle of rental cars to/from the Airport along Robin Hood Road
Rental Car CONRAC Facility (Alternative 2, but Excludes QTA)	✈ Does not require building an entirely new facility ✈ Avoids interference with existing public parking ✈ Ingress/Egress points in place (to the terminal facilities and by roadway)	✈ No space for QTA activity, thus requiring a QTA elsewhere ✈ Rental car traffic will still impede the Airport's Terminal Loop
North Cargo Facility (Alternative 1, but Excludes MRO)	✈ Accommodates relocation of Robin Hood Road ✈ Provides locations for additional infrastructure needed throughout the planning period ✈ Maintains existing air cargo facilities ✈ Repurposes Runway 14/32 for apron/taxiway ✈ Does not infringe upon long-term surface parking lot ✈ Lowest cost of the air cargo concepts	✈ Requires closure of Runway 14/32 ✈ Layout is limited to single taxilane, resulting in potential for some apron congestion/delay
GA Facilities Expansion (Alternative 1)	✈ Minimal additional infrastructure required to accommodate development ✈ Sufficient apron parking and aircraft storage space for short-term demand ✈ Accommodates phased development to accommodate all long-term requirements ✈ Retains existing airport support facilities and access road ✈	✈ Requires closure of Runway 14/32 ✈ Northeasterly apron expansion may be limited by construction of TDG 3 taxiway to GRE
Aviation Fueling Facilities Relocation (Alternative 1)	✈ Jet-A storage and upload located in a consolidated location, thus eliminating the need for an unground pipe ✈ Allows for quick access of fuel deliveries ✈ Allows for airside connectivity to commercial and cargo aircraft	✈ Requires environmental permitting ✈ Requires decommissioning and demolition of the existing fueling system ✈ May require relocation of the rental car overflow parking lot

Remote Terminal Deicing Apron (Alternative 1)	✈ Consists of four ADG IV deicing positions ✈ Provides a consolidated commercial/cargo deicing location ✈ Deicing bays may be utilized as single use or may be simultaneously occupied with two aircraft ✈ Over space allows for dual use with RON capability at night (up to eight RON aircraft)	✈ Dependent on closure of Runway 14/32 ✈ Requires installation of a deicing fluid (i.e., glycol) drainage system ✈ Deicing services must be via mobile trucks and mobile equipment, as impacts to terminal area operations hinder the likelihood of permanent deicing equipment
Airfield Maintenance Facilities Relocation	Further Consideration Needed	Further Consideration Needed

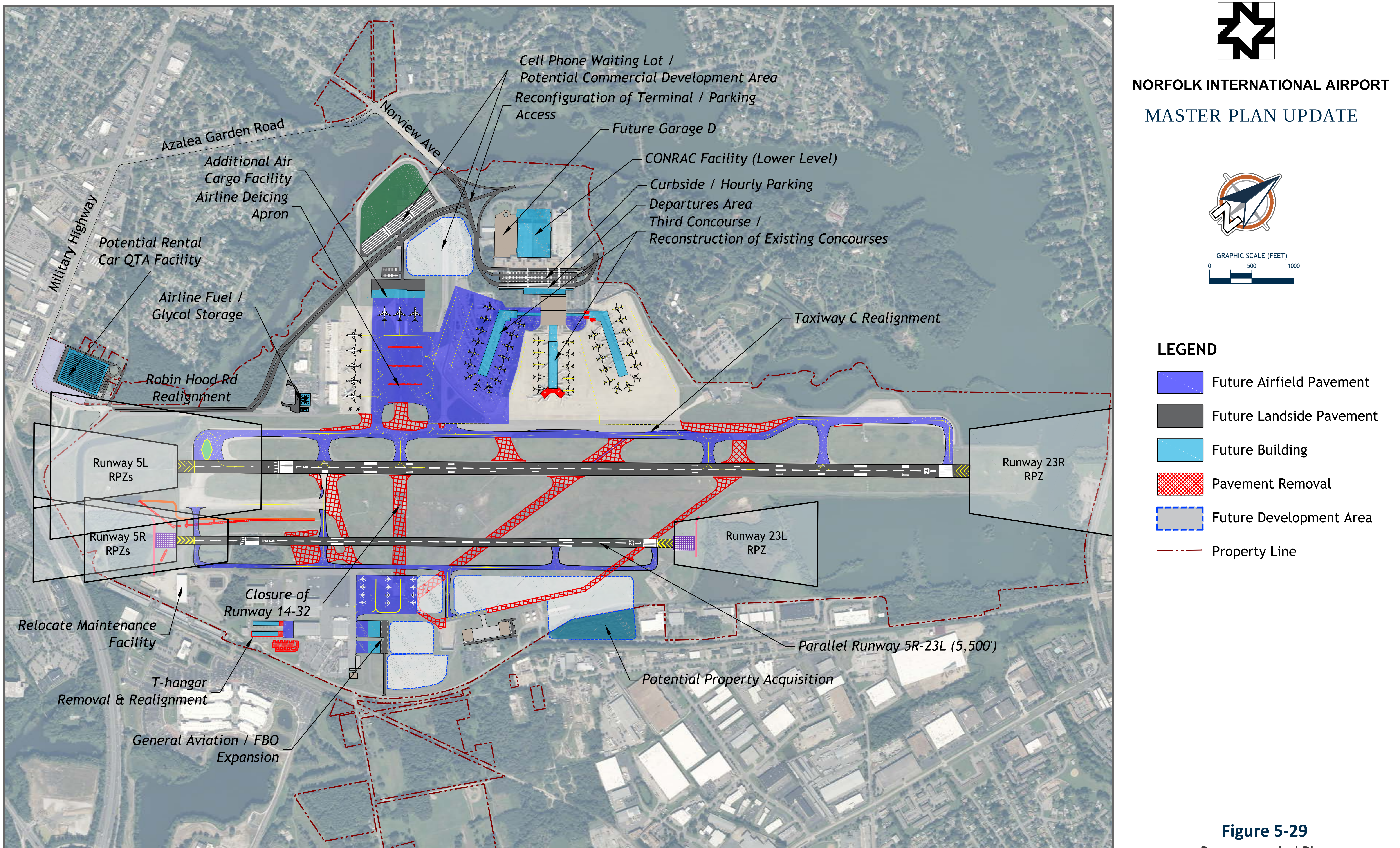

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Figure 5-29
Recommended Plan

6 ENVIRONMENTAL OVERVIEW

This section provides a preliminary assessment of the environmental factors existing on and around the Norfolk International Airport (ORF). This review was conducted in accordance with the FAA Orders 5050.4B, *National Environmental Policy Act (NEPA) Implementing Instructions for Airport Actions* and 1050.1F, *Environmental Impacts: Policies and Procedures*. This review does not provide a complete investigation sufficient for obtaining environmental permits or compliance with environmental documentation as required by the National Environmental Policy Act (NEPA). A review of existing GIS data, coordination with relevant environmental regulatory agencies and a field walk-over were conducted to develop this overview of the environmental resources.

The purpose of this review was to identify the environmental resources that may affect future development at the Airport and to identify those environmental issues that may require additional environmental analysis prior to implementation of future projects. The environmental impact categories discussed in this overview are:

- Air Quality
- Water Quality
- Historic, Architectural, Archaeological, and Cultural Resources
- Biotic Communities
- Threatened and Endangered Species
- Wetlands
- Floodplains
- Coastal Zone Management Program
- Prime and Unique Farmlands
- Wild and Scenic Rivers
- Solid Waste
- Hazardous Waste

Categories discussed elsewhere in this Master Plan are:

- Compatible Land Use and Zoning

6.1 AIR QUALITY

The Clean Air Act Amendments (CAAA) of 1990 required the EPA to set National Ambient Air Quality Standards (NAAQS) for six “criteria” pollutants considered harmful to public health and the environment. The NAAQS identified two types of air quality standards: primary and secondary. Primary standards provide public health protection, including protecting the health of "sensitive" populations, such as asthmatics, children, and the elderly. Secondary standards were established to provide public welfare protection, including protection against impaired visibility and damage to animals, soils, crops, vegetation, and buildings. The six "criteria air pollutants" that were established by EPA to protect public health and welfare include:

- Ozone (O3)
- Carbon monoxide (CO)
- Particulates (PM10 and PM2.5)
- Sulfur dioxide (SO2)
- Nitrogen dioxide (NO2)
- Lead (Pb)

The Commonwealth of Virginia established the Air Pollution Control Board to establish general administrative and air quality program provisions that support the Regulations for the Control and Abatement of Air Pollution and the provisions of the federal Clean Air Act. This program is administered through six regions throughout the Commonwealth of Virginia. Norfolk International Airport lies within the Tidewater Region. As of 2017, the Tidewater Region was in attainment with all six EPA criteria air pollutants, which includes the City of Norfolk. Previously, this area had been in non-attainment with the 1-hour and 8-hour ozone levels. This designation was revoked in 2007, and the City of Norfolk has been re-designated as a maintenance area for these two criteria.

No air quality modeling was conducted as part of this Study. If proposed developments require air quality modeling, it would be conducted during preparation of additional environmental documentation (and before construction). The results of the air quality modeling should be evaluated to determine whether the proposed activity may contribute to significant 1-hour or 8-hour ozone levels.

6.2 WATER QUALITY

Water quality standards applicable to the Airport were established under the federal Clean Water Act (CWA) and the Virginia State Water Control Law and the Groundwater Management Act of 1992. Together, these regulations include requirements for controlling discharges into surface water and groundwater, develop waste treatment management plans and practices, and establish federal permitting requirements for discharges (CWA Section 402) and dredged and fill materials (CWA Section 404). Existing surface water and groundwater quality at the Airport are described below.

6.2.1 Surface Water

Surface water features on and in the immediate vicinity of the Airport include a network of drainage features, wetlands and open water that comprise the Lake Whitehurst Reservoir. Existing wetlands are described in subsequent sections. Surface waters on the airport flow, either through stormwater drainage systems or concentrated drainage channels, into Lake Whitehurst.

Lake Whitehurst is classified as an Impaired (Category 5A) Water by the Virginia DEQ. This designation represents the poor ability of the lake to support aquatic life (due to high levels of chlorophyll-a and phosphorus, and low levels of dissolved oxygen) and a restriction on the consumption of fish removed from the lake (due to the presence of PCBs and mercury in fish tissue). Lake Whitehurst was first listed as an Impaired Water in 2006, with additional listings added in 2008 and 2010.

Any future projects that would potentially add additional impervious surface would increase the potential for runoff from the Airport into nearby surface water. Prior to implementation of these improvements, more detailed documentation would be required to more specifically quantify the additional impervious surface area and assess resulting impacts to surface water. Drainage improvements would be required to minimize stormwater runoff and associated potential for adverse impacts to surface waters. These improvements should be included in the project design and fully evaluated in the project-specific environmental documentation to be conducted closer to the time of construction. If such elements are incorporated, it is not anticipated that the proposed projects would result in adverse impacts to surface water quality.

6.2.2 Groundwater

The Virginia Department of Environmental Quality administers the Groundwater Characterization Program, which assesses groundwater availability and ambient groundwater quality to inform management decisions in legislatively designated Groundwater Management Areas. The Airport lies within the Eastern Virginia Groundwater Management Area.

At the level of effort for this overview, no specific information on groundwater quality in the immediate vicinity of ORF was available. Any proposed projects would be evaluated closer to implementation, when more details are available, in a project-specific environmental document to determine potential impacts.

6.2.3 Stormwater

ORF holds an existing Virginia Pollution Discharge Elimination System (VPDES) permit (permit #VA0089737), which is the state-administered program regulating the discharge of stormwater from an industrial facility. As an airport, ORF is classified as a minor industrial facility and must comply with the Virginia Pollution Discharge Elimination System Permit Regulation (9VAC25-31-190). This includes compliance with all effluent standards mandated by the Clean Water Act through the proper operation and maintenance of all facilities and systems of treatment and control which are installed or used by the permittee to achieve compliance with the conditions of the permit. ORF is also required to monitor the existing stormwater discharges from the Airport for the effluents of concern and report those to the Virginia Department of Environmental Quality (DEQ).

Any modifications to the drainage system or modifications to physical facilities at the Airport which would result in a change to either the quantity or potential quality of stormwater discharge from the airport should be communicated to the Virginia DEQ to determine if the existing permit would require modification or reissue.

In general, new airfield or major terminal projects would trigger the need to address water quality and associated permitting. General maintenance and minor projects typically do not affect water quality.

6.3 DEPARTMENT OF TRANSPORTATION ACT, SECTION 303

Pursuant to Section 303 of the U.S. Department of Transportation (formerly Section 4(f)), programs or projects requiring the use of any publicly-owned land, including public parks, recreation areas, wildlife or waterfowl refuge areas, and historic sites (including traditional cultural properties) of national, state, or local significance shall not be approved by the Secretary of Transportation unless there is no feasible and prudent alternative to the use of such land, and such program includes all possible planning to minimize harm.

Based on a review of the surrounding area, two such facilities exist. Lake Whitehurst, which provides recreational opportunities, surrounds the Airport on three sides. Additionally, the Norfolk Botanical Gardens (also known as Azalea Gardens) lies directly adjacent to the airport property just to the north of the terminal area.

Future projects at ORF should be evaluated for potential impacts to these resources as part of the required environmental documentation under NEPA. Impacts to Lake Whitehurst would require a detailed review under Section 303.

6.4 HISTORIC, ARCHITECTURAL, ARCHAEOLOGICAL, AND CULTURAL RESOURCES

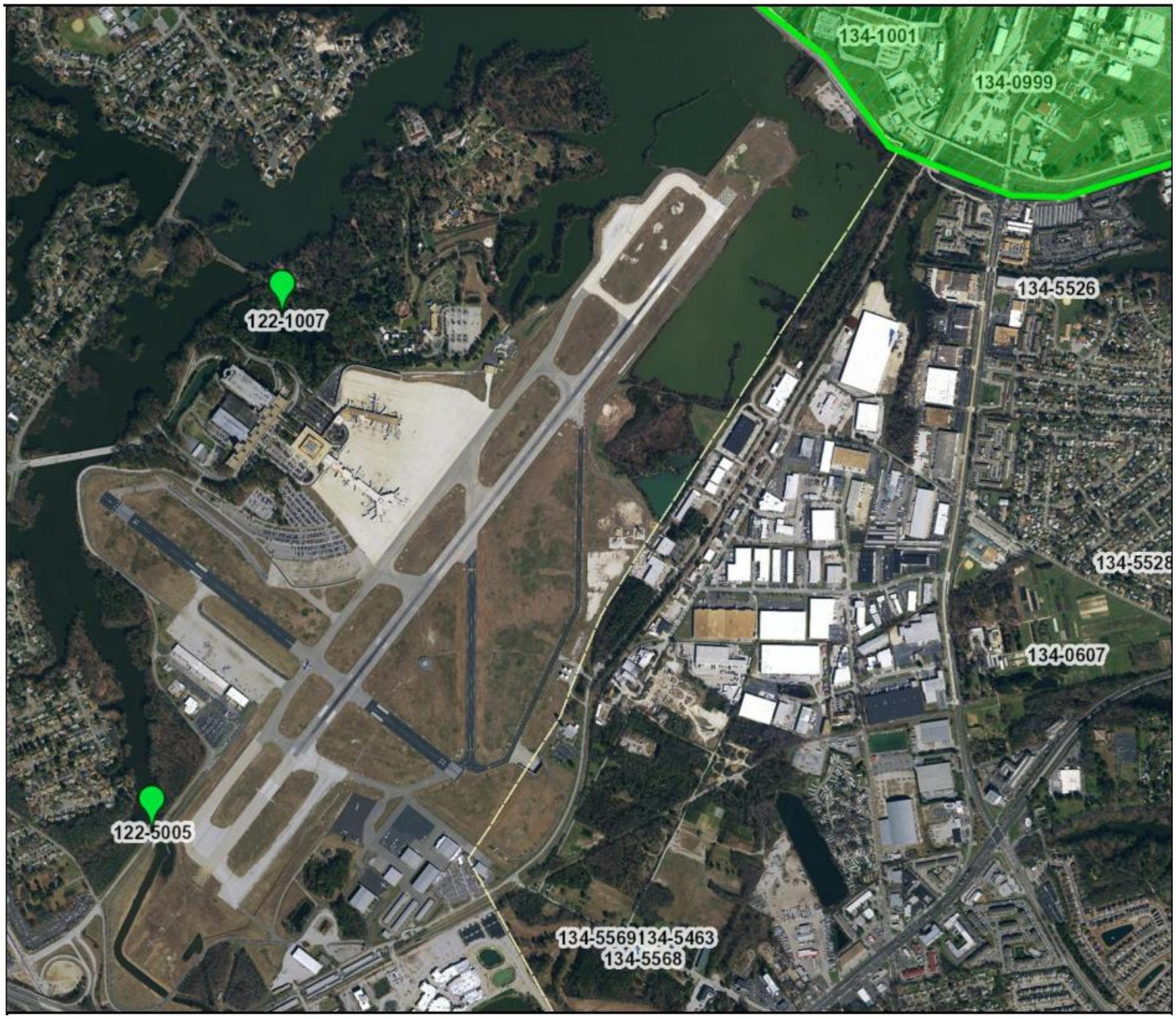
Under the National Historic Preservation Act of 1966 and the Archaeological and Historic Preservation Act of 1974, federal undertakings, such as the actions included in the Master Plan Update, are subject to Section 106 review to ensure that properties or data having historic, scientific, prehistoric, archaeological or paleontological significance are surveyed, recovered or preserved.

The Virginia Cultural Information System (V-CRIS) of the Virginia Department of Historic Resources was queried in order to identify federally and state-listed resources in the project area. The GIS review identified three potentially historic sites near the project area (**Figure 6-1**).

- Robin Hood Road Bridge, DHR ID 122-5005, located along Robin Hood Road along the southwest perimeter of the airport. This bridge was constructed in 1944.

- Norfolk Azalea Garden/Norfolk Botanical Garden, DHR ID 122-1007, located immediately to the north of the existing airport terminal. First established in 1938, this facility lies at 6700 Azalea Garden Road.
- Little Creek Amphibious Naval Base Historic District, DHR ID 134-0999 – approximately 0.35 miles to the northeast of the Airport.

Figure 6-1 – Historical Resources



Of these three resources, only the Norfolk Botanical Garden is listed on both the Virginia Landmarks Register (VLR #06-01-2005) and the National Historic Register of Places (NHRP #08-17-2005).

Prior to implementation of specific airfield recommendations, a more detailed environmental review, including DHR consultation, would be conducted to confirm existing resources and assess any potential effects. The identified resources above are not likely to be impacted by Master Plan recommendations.

6.5 BIOTIC COMMUNITIES

Information regarding biotic communities at the Airport was obtained through a review of the Natural Heritage Data Explorer (NHDE) of the Virginia Department of Conservation and Recreation, screening through the U.S. Fish & Wildlife Service's (USFWS) Information Planning and Conservation (IPaC) System, and a general field walkover.

A large portion of the Airport consists of impervious surfaces such as asphalt, concrete, or buildings. Significant acreage with the Air Operations Area (AOA) is comprised of managed turf adjacent to runways, taxiways and apron areas. These areas provide minimal ecological diversity and show extensive habitat fragmentation.

Intact biotic communities that remain within the Airport include both emergent and forested wetlands (see **Section 6.10**), urban woodlands and open water areas. While no specific critical habitat designations are applicable for the Airport Property (see below), such habitats can support a range of wildlife, including reptiles, amphibians, mammals, song birds and wading birds. For both security purposes and to prevent large mammals, such as deer and coyote, from traversing the runways, the Airport maintains fencing around the airfield.

For implementation of the airfield recommendations, a more detailed environmental analysis would be conducted to assess potential impacts to biotic communities, including quantifying acreages of potential sand barren habitat to be disturbed and identifying mitigation measures to address that loss.

6.6 THREATENED AND ENDANGERED SPECIES

The Endangered Species Act of 1973 (ESA) provides for listing, conservation, and recovery of endangered and threatened species of plants and wildlife. Section 7(a)(2) of the ESA states that federal agencies shall ensure the actions it authorizes, funds, or carries out are not likely to jeopardize the continued existence of a listed species or result in a destruction or adverse modification of designated critical habitat. Section 9 of the ESA prohibits the take of listed species. Take is defined in the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect." The definition of harm also includes adverse habitat modifications. Federal actions that could result in a take must be coordinated under Section 7.

Similar to the biotic communities previously discussed, threatened and endangered species that may or are known to occur within the project area were identified through queries of the Virginia Department of Game and Inland Fisheries Fish and Wildlife Information Service (VaFWIS), screening through the USFWS IPaC system, and a review of the Natural Heritage Data Explorer (NHDE) of the Virginia Department of Conservation and Recreation.

6.6.1 Federally Listed Species

The IPaC report prepared as part of this overview identified only one federally listed species as potentially occurring at the Airport: The Northern Long-eared Bat (*Myotis septentrionalis*); however, the IPaC report indicated that no critical habitat for this species is found at the Airport.

With respect to the Northern Long-eared Bat, the Final 4(d) rule, issued on January 14, 2016, prohibits an incidental take that may occur from tree removal activities within 150 feet of known occupied maternity roost tree(s) during the "pup season" (generally June 1 to July 31). The 4(d) rule also prohibits an incidental take that may occur from tree removal activities within ¼ mile of a hibernation site, year-round. The nearest known maternity roost tree is located 12.8 miles to the southeast of the Airport. The nearest known hibernacula is located over 180 miles to the northwest of the Airport.

The USFWS IPaC report also identified the following 16 migratory birds as having distributional ranges that overlap the project area:

- American Oystercatcher (*Haematopus palliatus*)
- Bald Eagle (*Haliaeetus leucocephalus*)
- Black Skimmer (*Rynchops niger*)
- Clapper Rail (*Rallus crepitans*)
- Dunlin (*Calidris alpine articola*)
- Gull-billed Tern (*Gelochelidon nilotica*)
- Least Tern (*Sterna antillarum*)
- Prairie Warbler (*Dendroica discolor*)
- Prothonotary Warbler (*Protonotaria citrea*)
- Purple Sandpiper (*Calidris maritima*)
- Red-headed Woodpecker (*Melenerpes erythrocephalus*)
- Red-throated Loon (*Gavia stellata*)
- Ruddy Turnstone (*Arenaria interpres morinella*)
- Rusty Blackbird (*Euphagus carolinus*)
- Semipalmated Sandpiper (*Calidris pusilla*)
- Willet (*Tringa semipalmata*)

Closer to implementation of specific airfield recommendations, more detailed environmental analysis would be conducted, including consultation with USFWS, confirmation of existing species within the project area, an evaluation of potential impacts to those species and habitat areas, and, if appropriate, mitigation measures to address adverse impacts.

6.6.2 State-Listed Species

A review of VaFWIS data revealed that fifteen vertebrates, four invertebrates, and four vascular plant species listed as endangered, threatened, and special concern species occur, or formerly within three miles of the Airport. A species-specific evaluation of the available occurrence data indicated that only four state listed avian species and two reptile species of concern occur within the City of Norfolk, and consequently may potentially be found on Airport property. These species are the Eastern Black Rail (*Laterallus jamaicensis jamaicensis*), the Gull-billed Tern (*Gelochelidon nilotica*), the Peregrine Falcon (*Falco peregrinus*), the Loggerhead Shrike (*Lanius ludovicianus*), the Northern Diamond-backed Terrapin (*Malaclemys terrapin terrapin*), and the Spotted Turtle (*Clemmys guttata*).

Of the four state-listed bird species, only the Eastern Black Rail would have specific habitat requirements met within the Airport property. The existing emergent and scrub-shrub wetland habitats could potentially provide this species with both foraging and nesting opportunities. The remaining state listed bird species may potentially be found on or near the Airport but are unlikely to rely upon Airport property for nesting habitat.

The two, state species of concern, the Northern Diamond-backed Terrapin and the Spotted Turtle, are both aquatic turtle species. As Lake Whitehurst is classified as an Impaired Water for aquatic species, the usage of that water body by such species, while possible, is unlikely.

The review of the NHDE indicated no state listed plant species likely to naturally occur within the Airport or adjacent areas. This does not include specimen plants that may exist within the adjacent Norfolk Botanical Garden.

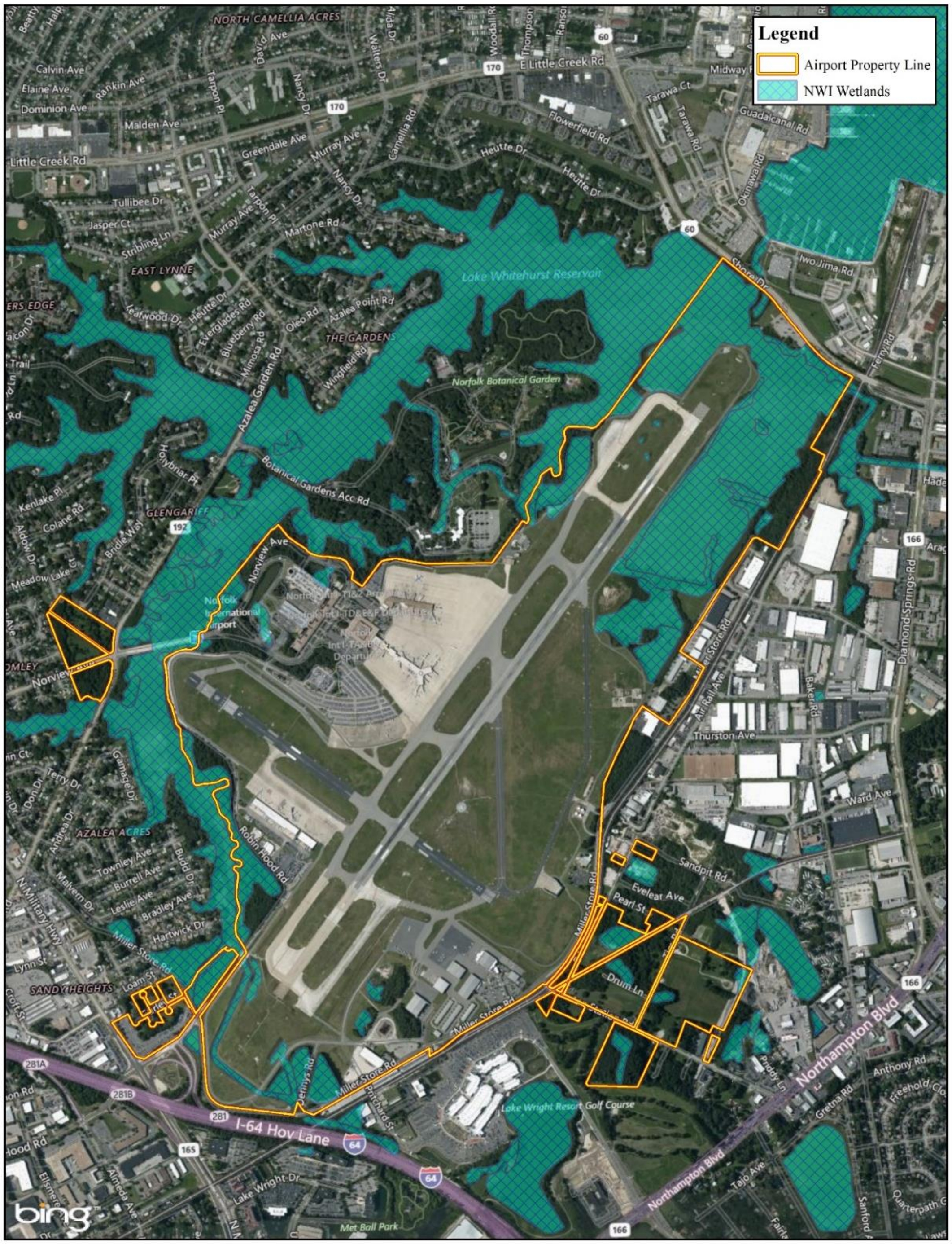
A more detailed environmental analysis would be conducted prior to implementation of the airfield recommendations, including formal consultation with the Virginia Department of Game and Inland Fisheries and Virginia Department of Conservation and Recreation, potential field surveys to determine the presence/absence of any listed species, and an evaluation of potential impacts to those species and habitat areas. If appropriate, mitigation measures to address adverse impacts would be pursued.

6.7 WETLANDS

Wetlands at the Airport are regulated and protected under both federal and state regulatory programs. U.S. Department of Transportation Order 5660.1A, *Preservation of the Nation's Wetlands*, implements Executive Order 11990, *Protection of Wetlands*. The U.S. Army Corps of Engineers (USACE) administers Section 404 of the Clean Water Act (CWA) (33 CFR 320-332) which regulates discharges of fill into wetlands and waters of the United States. Wetlands as defined in 33 CFR Part 328 are *"those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas."* The Virginia Water Protection Permit Program (VWP) of the Virginia Department of Environmental Quality serves as Virginia's Section 401 certification program of federal Section 404 permits issued by the USACE. The VWP regulates activities in both tidal and non-tidal wetlands, including non-tidal wetlands that may not fall under federal jurisdiction but are still considered waters of the state.

In order to identify wetlands occurring within the Airport Property, data available online through the National Wetlands Inventory (NWI) mapper was reviewed. A field walkover of the Airport was also conducted to confirm the potential presence of the wetlands indicated on the NWI. Wetland boundaries were not formally delineated as part of this Study. It is anticipated that prior to initiating specific projects, a current wetland delineation would be required to determine federal and state regulated wetland boundaries.

Figure 6-2 – NWI Wetland Map



A number of wetlands occur on the Airport. Based upon available information, and observations during the field walkover, all of the wetland areas are non-tidal wetlands. Based on information obtained (other than Lake Whitehurst), on-airport wetlands are primarily forested and dominated by red maples and northern spice bush. The largest contiguous wetlands occur at the end of Runway 23 associated with Lake Whitehurst and are comprised of a mosaic of wetland types (**Figure 6-3**). Emergent, scrub/shrub and forested wetland areas were observed, adjacent to and surrounding the open water area of Lake Whitehurst. Additional wetland areas are also present at the end of Runway 5, including emergent and forested wetlands (**Figure 6-4**).

Figure 6-3 – Runway 23 Wetland Detail

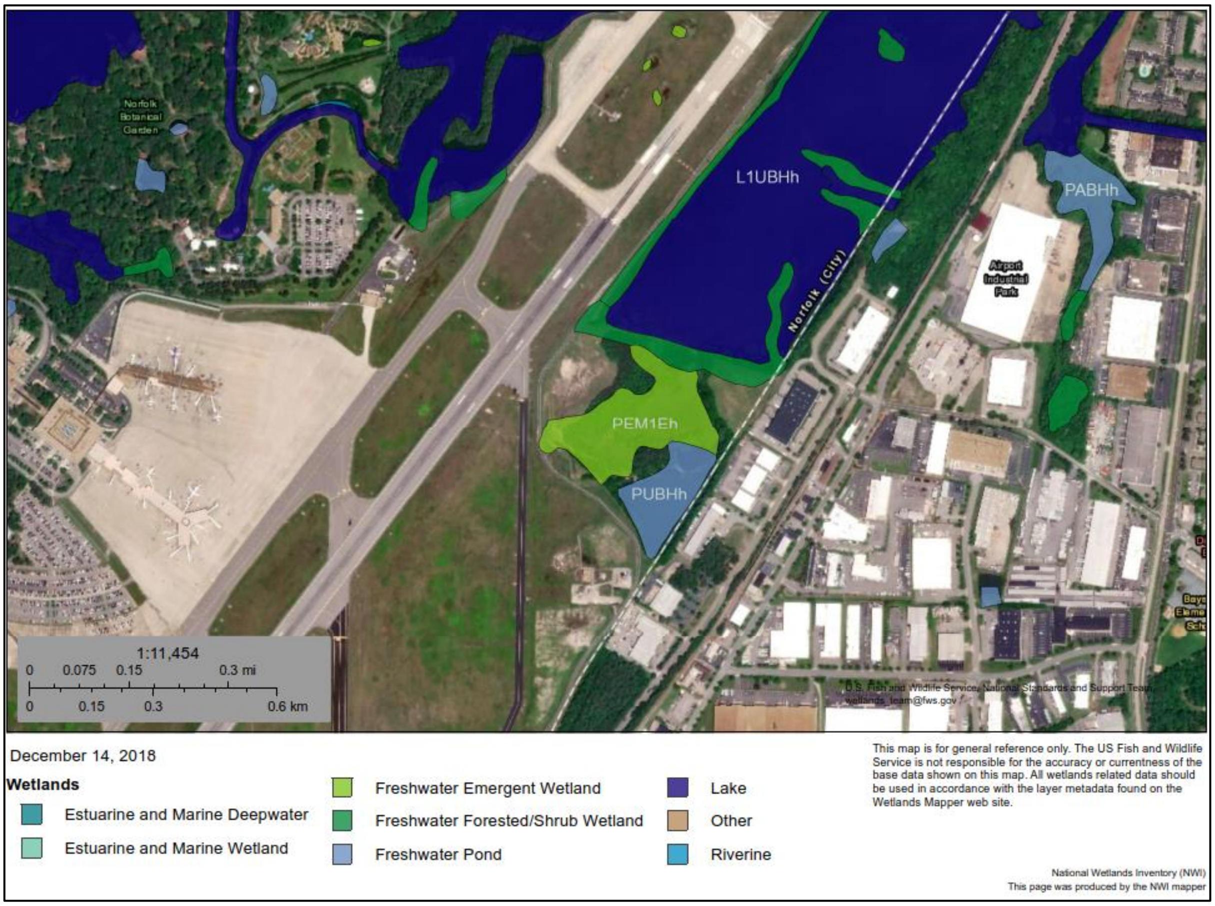
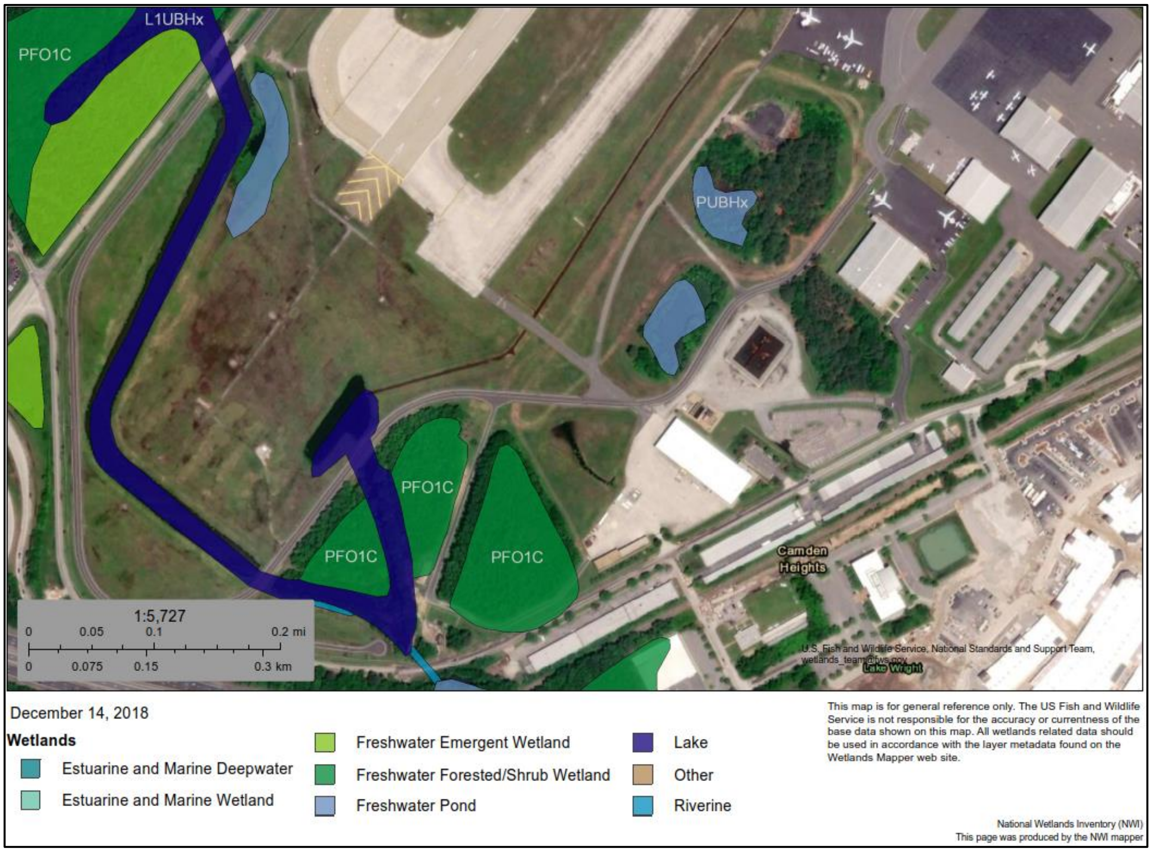


Figure 6-4 – Runway 5 Wetland Detail



6.8 FLOODPLAINS

Executive Order 11988, *Floodplain Management*, defines floodplains as "the lowland and relatively flat areas adjoining inland and coastal waters including flood prone areas of offshore islands", including the area that would be inundated by a 100-year flood. A 100-year floodplain is an area that has a 1 percent chance of being flooded in any given year (Zone AE). A 500-year floodplain is an area that has a 0.2 percent chance of being flooded in any given year.

Figure 6-5 – Floodplain Map

Both 100 and 500-year floodplains are present on the Airport in connection with Lake Whitehurst and the nearby Chesapeake Bay Estuary.

Based on the foregoing, the projects recommended in the master plan are not anticipated to impact floodplains; however, prior to implementation, project-specific environmental documentation would be prepared to document existing floodplains in the area and evaluate potential for impacts. If it is determined that a proposed action would occur within the 100-year floodplain, compliance with applicable state and federal flood and stormwater management standards must be demonstrated.

6.9 COASTAL ZONE MANAGEMENT PROGRAM

The National Oceanic and Atmospheric Administration (NOAA) regulations (15 CFR Part 930) require an analysis of any action affecting the coastal areas along the Atlantic and Gulf Coasts. The Virginia DEQ administers the Virginia Coast Zone Management Program, established in 1986, which administers enforceable laws, regulations and policies that protect the coastal resources of Virginia, foster sustainable use of coastal resources and coordinate the management of coastal lands to ensure sustainable development while minimizing resource use conflicts by promoting informed, science-based decision making. The Airport does lie within the Hampton Roads Planning District of the Virginia Coastal Zone.

This will require that any federal action (including decision making and project funding) that has a reasonably foreseeable effect on any land or water use or natural resource of the coastal zone must be consistent with the enforceable policies of the Virginia Coastal Zone Management Program. This includes both direct and indirect effects. Any proposed project at the Airport will require coordination with the Virginia DEQ to ensure compliance with the enforceable policies (which include Fisheries Management, Subaqueous Lands Management, Wetlands Management, Dunes Management, Non-point Source Pollution Control, Point Source Pollution Control, Shoreline Sanitation, Air Pollution Control, and Coastal Lands Management). Given the location of the Airport and the non-tidal nature of the surrounding aquatic resources (lake and wetlands), some of these policies are not likely to apply.

6.10 PRIME AND UNIQUE FARMLAND

The Farmland Protection Policy Act (FPPA) limits the conversion of significant agricultural lands to non-agricultural uses as a result of federal actions (7 USC § 4201, et seq.). The determination of whether farmlands are subject to FPPA requirements is based on soil type; thus, the land does not have to be actively used for agriculture. Farmland subject to FPPA requirements can be pastureland, forested, or other land types, but not open water or developed urban or transportation areas. The FPPA regulates four types of farmland soils:

- Prime Farmland;
- Unique Farmland;
- Farmland of Statewide Importance; and
- Farmland of Local Importance.

The evaluation is based upon soils identified by the Natural Resources Conservation Services (NRCS). Prime farmland is defined by the NRCS as "land that has the best combination of physical and chemical characteristics" for agriculture. This includes land with these characteristics used for livestock or timber production but not land that is already urbanized or used for water storage. Unique farmland is defined as "land other than prime farmland that is used for production of specific high-value food and fiber crops," with such crops defined by the Secretary of Agriculture. Farmland of statewide or local importance is farmland other than prime or unique farmland that "is used for the production of food, feed, fiber, forage or oilseed crops."

No portion of the Airport is designated prime farmland or the other regulated categories.

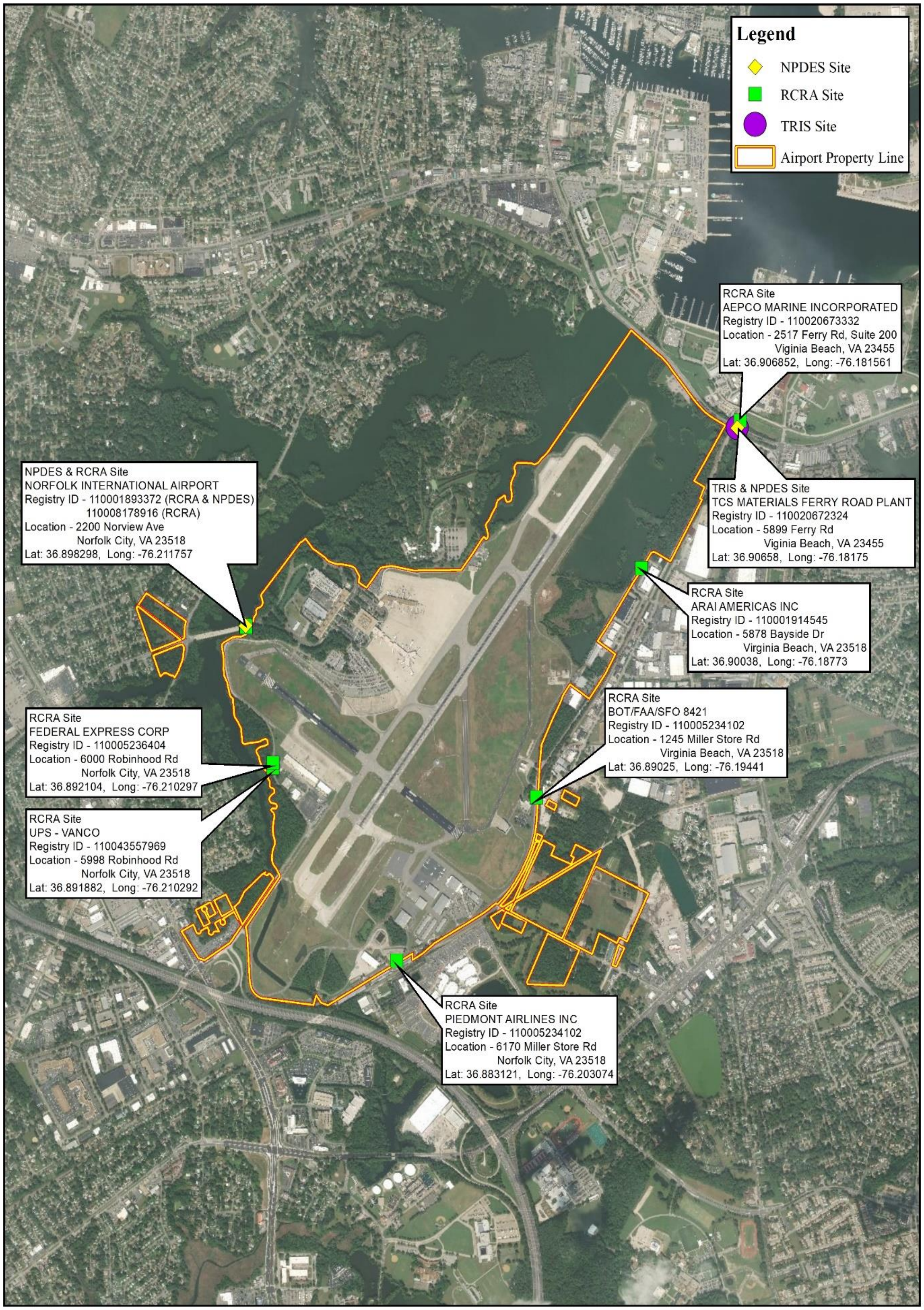
6.11 WILD AND SCENIC RIVERS

Through the National Wild and Scenic Rivers Act of 1968 (16 U.S.C 1271), rivers can be federally designated as wild and scenic if they contain remarkable scenic, recreational, or fish and wildlife related values. Such rivers are granted protection under the Act and must be evaluated as part of the NEPA process. Based upon a review of the National Wild and Scenic Rivers System, Virginia has no designated Wild and Scenic Rivers.

6.12 HAZARDOUS WASTE

The available GIS resources from the EPA were reviewed, indicating a total of eight locations with existing or historic permits under the Resource Conservation and Recovery Act (RCRA). RCRA creates the framework for the proper management of hazardous and non-hazardous solid waste.

Figure 6-6 – Existing or Historical Permits Under the RCRA



Of these eight locations (**Figure** 6-6) five were located on or adjacent to airport property. The first corresponds to Norfolk International Airport itself, classified as a Conditionally Exempt Small Quantity Generator, including both Norfolk Airport Authority (NAA) and the Transportation Security Administration (TSA) activities. Covered activities include the bulb crusher used by the Airport Authority to recycle spent fluorescent bulbs and the generation of potentially ignitable, corrosive, or reactive waste at the TSA checkpoint.

Two of the directly adjacent locations correspond to air cargo operators at ORF (FedEx and UPS), which are classified as Conditionally Exempt Small Quantity Generators. This designation covers the use of solvents and ignitable waste as part of the service and delivery operations. A third location corresponds to Piedmont Airlines, classified as a Small Quantity Generator of similar materials to the shipping companies. The fifth location represents an FAA facility classified as a Conditionally Exempt Small Quantity Generator of ignitable waste.

The remaining three locations correspond to Arai Americans, Inc (a Small Quantity Generator of ignitable waste and solvents associated with automobile parts manufacturing), TCS Materials Ferry Road Plant (a ready-mix concrete manufacturer) and AEPCO Marine Inc. (A Small Quantity Generator of solvents associated with paint manufacturing).

A search of all available EPA compliance databases was conducted, which demonstrated that as of 2018, all identified facilities comply with the applicable environmental regulations.

Typical of airport facilities, ORF does have potential sources of hazardous material that are generated at the Airport. These include:

- Above-ground storage tanks (ASTs)
- Underground storage tanks (USTs)
- Transformers
- Glycol and deicing
- Buckeye jet fuel pipeline
- Sewage pump areas
- Indoor and outdoor floor/ground drains
- Elevators
- Spills on taxiways, roadways, and parking lots
- Waste storage

Modifications to the existing airport facilities should be evaluated for the potential to generate additional hazardous materials; however, it is not expected that any commended projects would produce wastes that could not be properly mitigated and addressed.

6.13 LAND USE AND ZONING

The Norfolk International Airport owns over a thousand acres of property, or approximately two square miles. The Airport is located predominately within the City of Norfolk, with the southeastern portions of the airport in the City of Virginia Beach. While the Airport is predominately surrounded by compatible land use, there are some locations north, west and southwest of the Airport with residential neighborhoods.

6.13.1 General Land Use

As shown in the Land Use illustration (**Figure 6-7**), the property surrounding the Airport is very diverse.

- Immediately north of the Airport is the Norfolk Botanical Garden and portions of Lake Whitehurst
- Northeast of the Airport is the location of the US Navy Joint Expeditionary Base Little Creek, as well as the open water areas of Little Creek Harbor and Lake Whitehurst. This location is beneath the final approach of Runway 23. Avigation easements have been established to accommodate aircraft flyovers of the Little Creek Harbor. The Runway Protection Zone (RPZ) of Runway 23 extends over Route 60 and Amphibious Drive onto the base property. The land use within the RPZ mostly includes open space, storage areas, and parking facilities.
- To the southeast of the Airport is an industrial area within the City of Virginia Beach.
- Directly south is a mixed-use area of Virginia Beach known as Burton Station. This area includes dozens of airport parcels that were acquired to protect the Runway 32 approach. **Figure 6-8** illustrates these parcels in greater detail. **Table 6-1** provides information on the acquisition history. Also, in this location is the new Norfolk Premium Outlets shopping mall, industrial uses, and scattered residential development.
- Southwest of the Airport, across Interstate 64 in the City of Norfolk, the mixed land uses include business/office development, industrial, commercial uses along Military Highway, and some residential areas. This location is beneath the final approach of Runway 5. Due to the displaced threshold on Runway 5, the RPZ extends only up to Interstate 64 and does not contain airport or other buildings. As shown in **Figure 6-10**, the Airport has acquired properties in this location adjacent to Robin Hood Road. These properties are currently used for airport employee parking or remain as open space.
- Lastly, the majority of the area to the west and northwest of the Airport is residential, including areas along Norview Avenue, the primary entrance route to the Airport, and Azalea Garden Road (Route 192). As shown in **Figure 6-7** and **Figure 6-9**, this location includes the final approach to Runway 14. As such, some parcels at the intersection of Norview Avenue and Azalea Garden Road were acquired by the Airport in the past to protect the Runway 14 approach. These parcels remain as undeveloped open space.

As shown, the primary airport property includes a continuous area of over 1,000 acres, and contains the Airport's airfield, terminal area, and other aeronautical facilities. All of this property is critical to the Airport and is retained in the Airport's recommended plan.

As discussed above, there are three additional areas of airport property that were acquired more recently and are located beyond the primary airport boundary for the approaches to Runway 5, 14, and 32. These locations were acquired specifically to protect the critical airspace and the Runway Protection Zones against incompatible land use. These three locations have been referred to as non-aeronautical property because they do not contain airport development, are all located beyond the operational areas, and are outside the airport perimeter fence. These three locations are discussed below.

Table 6-1 – Parcel Acquisition History

Grant Number	Grant Description	Parcel Numbers
Runway 32 (Approach End)		
4	Acquire Land for Noise Compatibility within 75 DNL	78
5	Acquire Land for Approaches	79
6	Acquire Land for Approaches	80, 81, 82, 83, 84, 85, 86, 87, 88, 90
10	Acquire Land for Approaches	89
14	Acquire ARFF Vehicle	57, 61, 62, 63
16	Acquire Land for Approaches	100, 101
19	Acquire Land for Approaches	128
21	Acquire Land for Approaches	108, 110, 111, 114, 121, 122, 123, 124, 143, 144
27	Acquire Land for Noise Compatibility within 75 DNL	116, 117, 118, 119, 120
41	Acquire Land for Approaches	130, 159
N/A	N/A	55, 59, 64, 91, 95, 102, 106, 107, 109, 112, 125, 129, 131, 145
Runway 14 (Approach End)		
5	Acquire Land for Approaches	53, 54

Source: NAA, CHA, 2020.

6.13.2 South Property

The largest of these areas of non-aeronautical property is to the south of the Airport. The Authority owns over 60 parcels totaling over 50 acres beyond the Runway 32 end, generally known as Burton Station within the City of Virginia Beach; and thus, is subject to the City of Virginia Beach zoning regulations. These parcels are primarily zoned for Light Industrial use, with the southern portion adjacent to residential zoning. The area of Burton Station is largely industrial, including an Industrial Park and the recently opened Norfolk Premium Outlets commercial development. Virginia Beach has conducted initial re-development planning for this area that included the parcels owned by the airport. The City views the location as an important growth area for mixed use economic development.

The Airport Master Plan's recommendations include the proposed permanent closure of the infrequently used Runway 14/32. This has a significant positive effect on the potential development of the Burton Station area, which the City considers a strategic growth area with concepts for revitalization. The 50+ acres of non-aeronautical airport property will no longer be required to protect the airspace and RPZ of Runway 32. As such, the Master Plan recommends releasing all of these parcels for compatible development.

The release of airport property that is no longer needed is referred to by the FAA as 'disposal of surplus property.' The Burton Station properties will fall into this category, which requires a formal process to sell the properties to another party. There are many options for the disposal of the various parcels including:

- Individual parcel sale(s) to private parties or developers
- Bundling and consolidating into larger tracks of land for sale

- Property swaps, where the Airport acquires properties that may be contiguous to the airport boundary, in exchange for non-aeronautical parcels of equal value
- Public-private partnerships (P3) for lease or sale, and associated redevelopment
- Working directly with economic development agencies and/or the City of Virginia Beach for the sale of individual or groups of parcels.

The Master Plan recommends that the logical physical division line between the aeronautical and non-aeronautical properties would be Miller Store Road. Parcels to the north of the road would be permanently retained for airport use. Property south of Miller Store Road can be release and resold.

As all of the surplus non-aeronautical properties were acquired with a mixture of FAA, State, and Airport funds, the basic federal requirements for disposal are summarized below:

<u>FAA Land Release</u> – The Airport coordinates with the FAA to prepare a "Land Release" document, which provides the justification and documentation needed for FAA approval to dispose of the properties. The disposal can include a long-term lease or outright sale of the parcels. In this case, it is recommended that sale in fee is appropriate for these parcels.

<u>Environmental Review</u> –The FAA would typically require an environmental review consistent with NEPA practices in order to evaluate the potential impacts of the property redevelopment; however, regulatory changes in 2018 may enable the sale of the properties without environmental study as the parcels are not currently in airport use or directly accessible from the airport. This determination is made by FAA Headquarters, but would be coordinated through the FAA Washington Airports District Office (ADO).

<u>Fair Market Appraisals</u> – The value of the properties must be determined independently by state-licensed land appraisers, and the property sale must be at the determined fair market value. All applicable value considerations, such as property condition, zoning, current use, comparable local sales, etc. are considered in this process. If appropriate, a second appraisal and review appraisal may be conducted to reach a negotiated sale price.

<u>Retention of Avigation Easements</u> – The sale of airport property typically requires the Airport to retain a permanent easement on the property that protects the airport from development of incompatible land use. Examples include permanent height restrictions that prevent development of radio towers that could impact the overlying airspace and use restrictions preventing development of landfills or other facilities that may attract large numbers of birds (i.e., airport wildlife hazards). Note that existing zoning on these properties already include both height and land use restrictions. Thus, such easements may not result in any further restrictions.

<u>Return of Federal & State Funding</u> – Finally, it is noted that as these properties were acquired with public funds, the sales revenue cannot be retained by the Airport. Rather, the FAA and Airport complete a process that requires the airport to return the federal and state portions of the property sales revenue (or apply the revenue to a future FAA funded project). As such, the process may be revenue-neutral to the Airport.

As the overall land release process is detailed, many airport sponsors will hire an agent to assist with the process, similar to hiring consultants to implement other airport programs. Following the approval of the Master Plan, it is recommended that the Airport meet with Virginia Beach to discuss their interest in the Burton Station properties and develop an action plan. Following the disposal of the property, the Airport would update their formal Airport Layout Plan and Property Map on file with the FAA.

6.13.3 North/Northwest Property

The Authority owns a few large parcels totaling approximately 15 acres to the north/northwest of the airfield beyond the Runway 14 end within in the City of Norfolk. These parcels are zoned for Open Space Preservation and single-family residential. The current land use is open space and woods. Although undeveloped, on City mapping this location is listed as Airport Gateway Park. Similar to the non-aeronautical properties to the south, these parcels are no longer needed for airspace protection to Runway 14 as that runway is recommended for permanent closure. Disposal through sale in fee of these 15 acres is recommended; however, based on the City Zoning, these parcels do not have development potential. Airport uses, including for cell phone parking lot, remote parking, or a gas station are not compatible with the zoning or adjacent homes. Nevertheless, the same FAA disposal process is required, with sale at the fair market value; however, based on the limited potential, the appraised value of these parcels would be low.

Upon approval of the Master Plan, it is recommended that the Airport discuss these properties with the City of Norfolk, or perhaps an independent preservation organization, who may be interested in obtaining ownership in fee. In this circumstance, the FAA would be consulted to determine if the property could be donated for long-term preservation as transfer of the property would have a public benefit of open space preservation.

In addition to the potential public benefits of the land releases to the Cities of Norfolk, Virginia Beach, or other parties, the Airport will also benefit as it would no longer have responsibility for property maintenance, security, or insurance. Parcels would be sold "as is", with the forthcoming improvements at the discretion of the new owner(s) and applicable regulations.

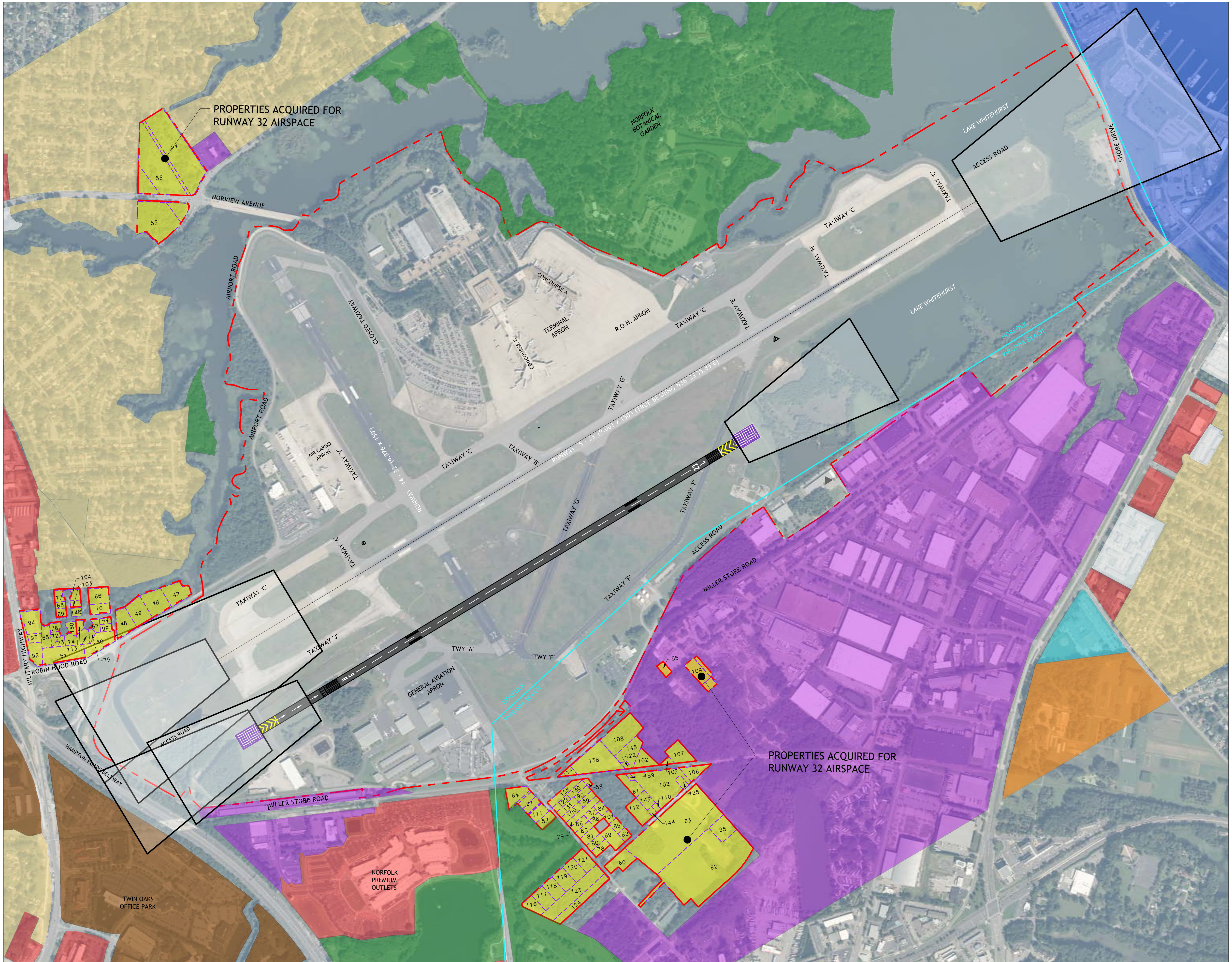
6.13.4 West/Southwest Property

The third area of non-aeronautical property includes five parcels totaling approximately 17 acres west of the airfield near Runway 5, and along Robin Hood Road in the City of Norfolk. This property extends out to Military Highway (Route 165) and included former commercial and residential uses. The property was acquired to protect the approach to Runway 5 and ensure compatibly land use.

In recent years, a portion of these parcels were redeveloped into temporary airport employee parking, which requires the airport to run shuttles to and from the terminal complex. Existing zoning includes a mixture of Open Space Preservation, Corridor Commercial, Single-Family Residential, and General Airport. With exception of the open space, which includes wetlands and environmentally sensitive property, ideally the remainder of the property would be rezoned to General Airport. The Master Plan's recommendations include use of this property for expanded airport landside facilities including parking, rental car facilities, or airport-related commercial use. As such, these properties are recommended for permanent airport property and may be considered as aeronautical property. Thus, the property will be retained by the Authority.

NORFOLK INTERNATIONAL AIRPORT

MASTER PLAN UPDATE



GRAPHIC SCALE (FEET)

0 500 1000

LEGEND

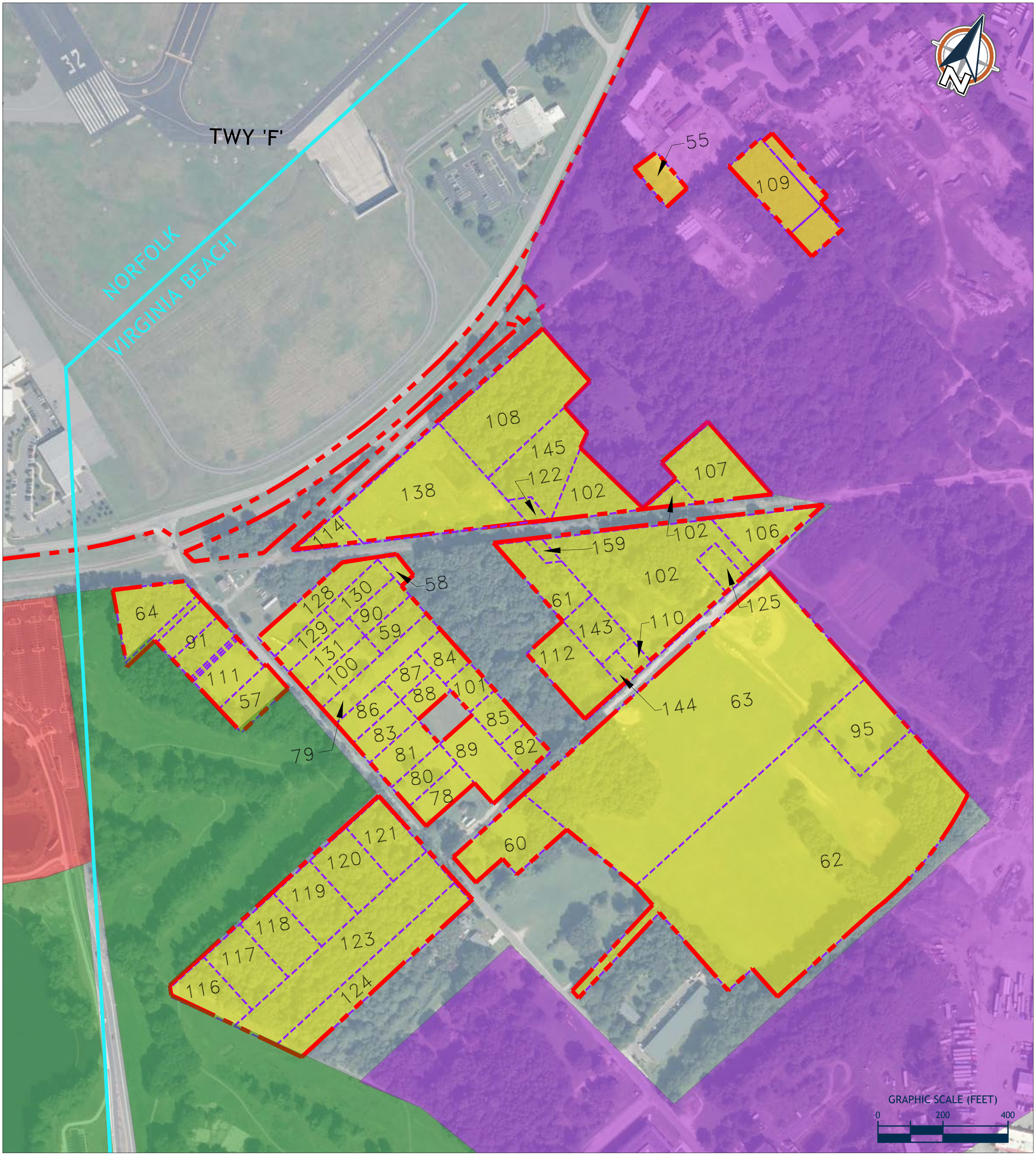
- Airport Property Boundary
- Parcel Delineation
- Non-Aeronautical Airport Property
- Municipal Boundary

LAND USE

- Officespace
- Residential
- Multi-family Residential
- Commercial
- Military Base
- Parks/Recreation/Greenspace
- Industrial
- Agricultural
- Schools & Hospitals

FIGURE 6-X

NON-AERONAUTICAL AIRPORT PROPERTY



LEGEND

Airport Property Boundary

Parcel Delineation

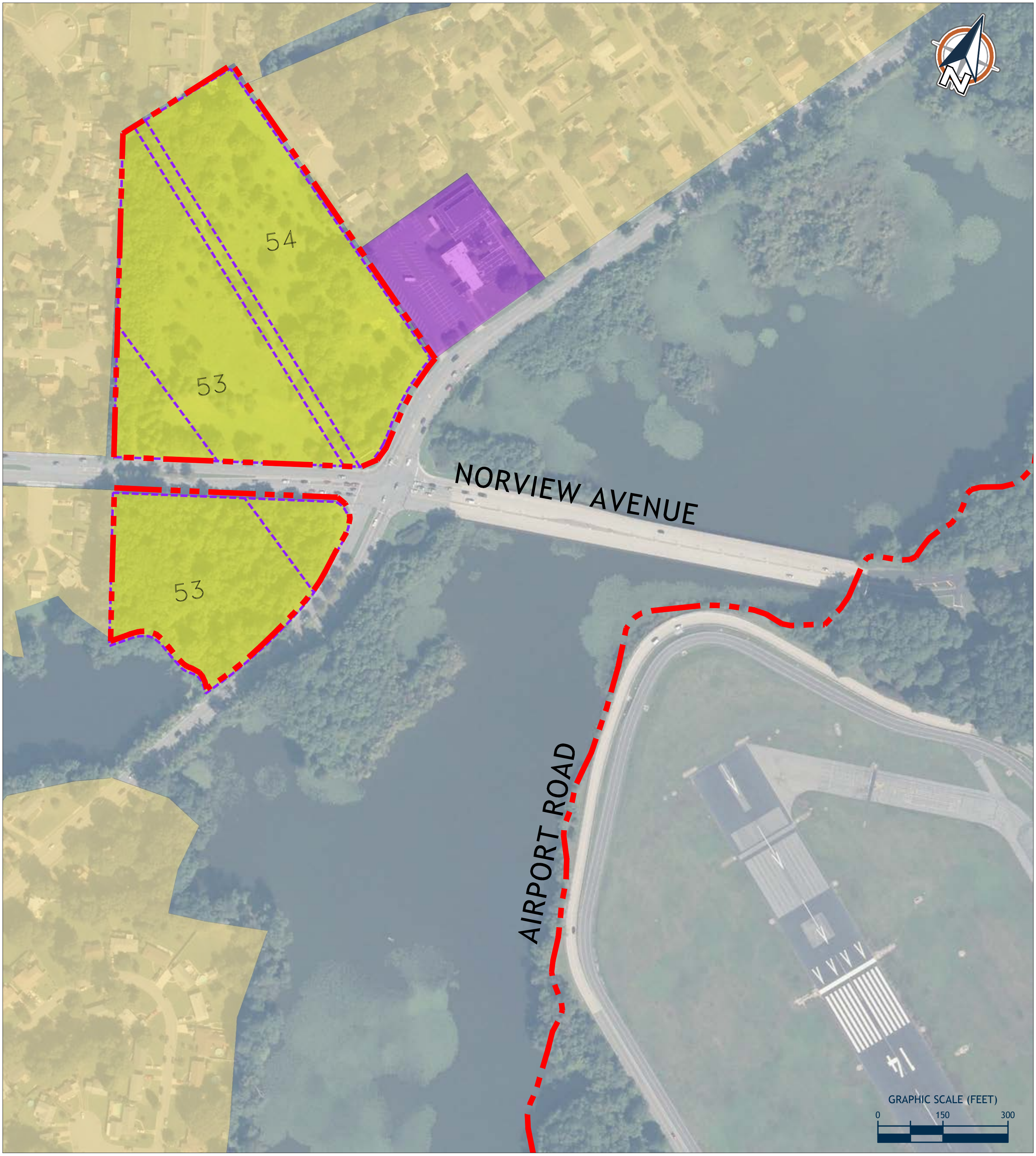
Non Aeronautical Airport Property

FIGURE 6-X

NON-AERONAUTICAL AIRPORT PROPERTY (SOUTH)

NORFOLK INTERNATIONAL AIRPORT

MASTER PLAN UPDATE



NORFOLK INTERNATIONAL AIRPORT

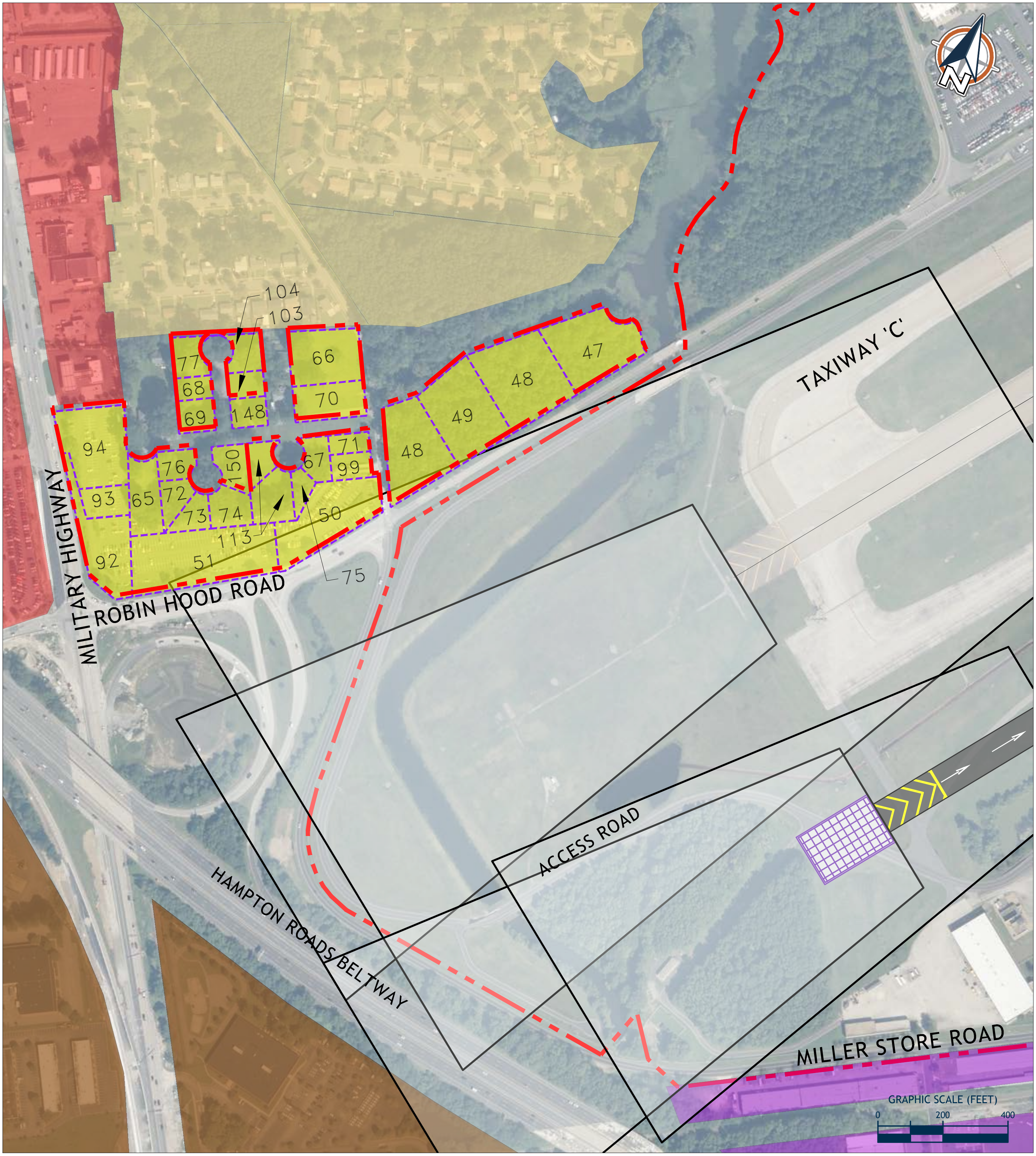
MASTER PLAN UPDATE

LEGEND

- Airport Property Boundary
- Parcel Delineation
- Non Aeronautical Airport Property

FIGURE 6-X

NON-AERONAUTICAL AIRPORT PROPERTY (NORTH)



NORFOLK INTERNATIONAL AIRPORT

MASTER PLAN UPDATE

LEGEND

- Airport Property Boundary
- Parcel Delineation
- Non Aeronautical Airport Property

FIGURE 6-X

NON-AERONAUTICAL AIRPORT PROPERTY (WEST)

6.14 SUMMARY

Projects recommended in the master plan are anticipated to have some impacts on the environment, with concerns generally focused on water quality, biotic communities, threatened and endangered species, and wetlands. As noted under each of the resource-specific sections, before implementation of some of the proposed development projects, further environmental documentation would be required to identify existing conditions at that time, determine impacts on each resource, and if appropriate, identity mitigation measures to address adverse impacts. Once project details are available, if appropriate under NEPA, Categorical Exclusion(s) or Environmental Assessment(s) will be prepared in accordance with FAA guidance. Based on past studies and the types of projects recommended in the master plan, it is anticipated that impacts can be successfully mitigated allowing implementation of the recommended plan.

7 FINANCIAL PLAN

This chapter presents the description of the airport capital improvement program (ACIP) and the resulting financial projections for the Norfolk International Airport (ORF). The ACIP was developed under the assumption that various demand-based indicators, such as annual operations, annual passenger enplanements, and based aircraft grow in-line with the aviation demand forecast presented in the ORF Master Plan **Chapter 3**.

ORF is operated by the Norfolk Airport Authority (Authority). The Authority was established in 1948 as a political subdivision of the Commonwealth of Virginia. The Authority's Fiscal Year (FY) ends June 30. The ACIP was prepared for four planning activity levels (PALs): PAL 1 (FY 2020 through FY 2023), PAL 2 (FY 2024 through FY 2028), PAL 3 (FY 2029 through FY 2033), and PAL 4 (FY 2034 through FY 2038). Due to the uncertainty of capital needs, funding availability, and financial metrics past a 10-year time frame, financial projections were only developed for PAL 1 and PAL 2. Master plans are typically prepared every five to seven years. As a result, an updated master plan would be prepared for ORF during the PAL 2 timeframe, thus producing more accurate project forecasts for the PAL 3 and PAL 4 timeframe.

The FY 2019 numbers included in this Chapter reflect the amounts presented in the Authority's Basic Financial Statements (2019 Financial Statements), and the FY 2020 numbers reflect the Authority's 2020 budget approved by the Board of Commissioners (the Board) in May 2019 (FY 2020 Budget). All financial tables are included at the end of this Chapter.

7.1 ACTIVITY FORECAST

Table 7-1 presents the activity forecast used to develop the financial plan. The enplanement and operation forecast for FY 2020 through FY 2038 reflect the amounts included in ORF's Master Plan **Chapter 3**, **Table 3-31**. Since the forecast was prepared prior to December 2018, the FY 2018 and FY 2019 enplanements and operations in **Table 7-1** reflect actual versus forecast.

As shown in the table, enplanements are forecast to grow at a compound annual growth rate (CAGR) of 2.5 percent from FY 2018 through FY 2038, and operations are forecast to grow at a CAGR of 1.4 percent for the same period. The FY 2020 budgeted landed weight decreases from the FY 2019 actual amount since the budget was prepared prior to actual results. Since landed weight was not forecast in **Table 3-31** but is necessary to calculate the landing fee for the financial forecast, the FY 2021 through FY 2038 landed weights were assumed to grow with the annual percent growth in operations shown in **Table 3-31**.

7.2 CAPITAL PROGRAM AND COST SUMMARIES

All airports receiving federal Airport Improvement Program (AIP) funding are required to maintain a current ACIP with the Federal Aviation Administration (FAA), which identifies projects to be undertaken at an airport over a specified period of time. The Authority's ACIP includes the projects recommended in **Chapter 6** of this Master Plan.

Table 7-2 presents the recommended ACIP and its corresponding cost estimates, which were based on a planning level of detail, for PAL 1 and PAL 2. While accurate for master planning purposes, actual project costs will likely vary from these planning estimates once project design and engineering estimates are developed. The cost estimates presented in the table are presented in 2020 dollars and include contingencies, design costs and construction management costs. As shown in the table, the ACIP for PAL 1 and PAL 2 is estimated at approximately $411.8 million.

7.3 CAPITAL PROGRAM FUNDING SOURCES

Table 7-3 presents the ACIP's estimated funding sources for PAL 1 and PAL 2. The following sections describe the amount of funding available from these sources.

7.3.1 AIP Grants

Grants administered by the FAA through the AIP are a critical capital funding source to implement the projects recommended in the ACIP. Passenger entitlement grants are allocated to airports by a formula based on enplanements, cargo entitlement grants are allocated based on historical landed weight market share, and discretionary grants are allocated in accordance with FAA guidelines. FAA grants are subject to annual Congressional appropriation. The AIP expires periodically and federal reauthorization is required to continue. In October 2018, Congress passed a five-year reauthorization bill for the FAA — the FAA Reauthorization Act of 2018.

The U.S. DOT classifies ORF as a small hub airport; therefore, the AIP formula stipulates that ORF is entitled to receive 90 percent in federal funding for AIP-eligible projects. AIP funds can be used for most improvement needs, but not operating costs; however, AIP funds are typically not available for revenue-generating projects, so for the purpose of this analysis, AIP funds were not assumed for revenue-generating projects.

As shown on **Table 7-3**, AIP grants were estimated to be approximately $86.5 million from FY 2020 through FY 2028. Of this amount, approximately $55.0 millionwas assumed to be funded with passenger entitlement grants, approximately $1.5 million was assumed to be funded with cargo entitlement grants, and $30 million with discretionary grants. The annual application of the AIP grants to the eligible portions of the ACIP is presented in **Table 7-4** and is described in greater detail in the following subsections.

Entitlement Grants

Entitlement funds are distributed through grants by a formula based on the number of enplanements at individual airports and the amount of landed weight of arriving cargo at individual airports for the most recent federal fiscal year. In cases where entitlement funds are not used during the current federal fiscal year, these funds are redistributed to other airport sponsors as discretionary funds in the next federal fiscal year. **Table 7-5** presents ORF's AIP passenger entitlement calculation. As shown in the table, it is estimated that ORF will receive approximately $45.9 million in passenger entitlement AIP grants from FY 2020 through FY 2028.

ORF also receives cargo entitlement grants. In FY 2019, the FAA apportioned total entitlements of $3.2 billion, of which 3.5 percent is allotted for cargo entitlements, or $112 million. This amount is then allocated to airports on a pro-rata basis according to an airport's share of total U.S. cargo landed weight. In FY 2017, ORF's cargo landed weight was 0.15 percent of total U.S.

landed weight; therefore, ORF was apportioned $165,000 in cargo entitlements in FY 2019. This amount is forecast to increase with the growth in landed weight presented in **Table 7-1**. As shown on **Table 7-4**, it is estimated that ORF will receive approximately $1.5 million in cargo entitlement AIP grants from FY 2020 through FY 2028.

Discretionary Grants

At the beginning of each federal fiscal year, the FAA sets aside the amount of discretionary funds to cover the Letter of Intent (LOI) payment schedules. The total discretionary funds in all LOIs subject to future obligation are limited to approximately 50 percent of the forecast discretionary funds available for that purpose. The authorizing statute directs the FAA to allocate certain discretionary funding to specific airport types and set aside categories such as noise, reliever airports, military airport program and projects relating to capacity, safety, security and noise; however, the FAA has some discretion in funding specific projects within these discretionary funding set-aside categories. The FAA approves discretionary funds for use on specific projects, after consideration of project priority and other selection criteria.

As shown on **Table 7-2**, approximately $30 million in discretionary funds are assumed to fund a portion of the $103.0 million design and construction of Runway 5/23. Since the Authority has not yet received FAA approval for these funds, it is possible that it will not receive these funds. If the Authority does not receive this discretionary funding, it will need to identify alternative funding sources, delay the projects until funding sources become available, or cancel the projects. A possible alternative funding source in PAL 1 and PAL 2, if the discretionary funds are not approved, is the Authority's General Reserve Fund balance, which is discussed in greater detail in **Section 7.5.5 Pro Forma Cash Flow.**

As shown on **Table 7-2**, of the $411.8 million total project costs, approximately $255.8 million is eligible for AIP grants; however, as shown in **Table 7-4**, only $77.5 million is available in AIP passenger entitlements, cargo entitlements, and discretionary funds. This shortfall in funding will need to be recovered in other funding sources, which are discussed in greater detail in the remainder of this section.

7.3.2 State Grants

The Code of Virginia §58.1-638 *Disposition of state sales and use tax revenue* created in the Department of the Treasury a special non-reverting fund which is part of the Transportation Trust Fund and is known as the Commonwealth Airport Fund (CAF). The Commonwealth Transportation Board per §58.1-638 annually allocates 2.4 percent of the Transportation Trust Fund for the CAF. These funds are allocated by the Commonwealth Transportation Board to the Virginia Aviation Board (VAB). Funds are then allocated by the VAB to any Virginia airport which is owned by the Commonwealth, a governmental subdivision thereof, or a private entity to which the public has access for the purposes enumerated in Code of Virginia §5.1-2.16 or is owned or leased by the Metropolitan Washington Airports Authority.

The CAF is then used through entitlement and discretionary funds, to provide funding for planning and engineering projects that focus on airport facility development. In general, these projects include master plan and airport layout plan studies, environmental studies, land acquisition, airside facility design and construction, and terminal building design and construction.

The maximum amount an airport can receive from CAF entitlement funds is $2 million annually, which is what ORF has historically received. As shown on **Table 7-4**, this analysis assumed ORF will continue to receive $2 million annually from CAF for a total of $28.7 million in state entitlement grants through PAL 2. FY 2021 state entitlements are greater than the $2 million maximum due to the reimbursement of past state grants with passenger facility charge (PFC) revenue.

In addition to entitlement funds, CAF has approximately $8 million annually that is applied on a discretionary basis. This analysis assumed that ORF will receive discretionary state grants in the amount of $5 million in FY 2022, FY 2023, and FY 2024, for a total of $15 million, to fund the reconstruction of Runway 5/23. If the Authority does not receive approval for this funding, it will need to identify alternative funding sources, delay the projects until funding sources become available, or cancel the projects.

7.3.3 Third Party

Many airports use private third-party investment when the planned improvements will primarily be used by a private business or other organization. Such projects are not ordinarily eligible for federal funding. Projects of this kind typically include cargo facilities, hangars, FBO facilities, fuel storage, exclusive aircraft parking aprons, industrial aviation use facilities, non-aviation office/commercial/industrial developments, and similar projects. Private development proposals are considered by an airport on a case-by-case basis. Often, airport funds for infrastructure, preliminary site work, and site access are required to facilitate privately developed projects on airport property.

This analysis assumed the Authority will fund all projects, and therefore, no third party funding was included; however, certain projects may be considered for third party financing such as the cargo facility expansion totaling $26.5 million in FY 2025, the relocation of the fuel farm totaling $40 million in FY 2026, and the general aviation hangar construction totaling $22 million in FY 2028.

7.3.4 Local Funds

As shown in **Table 7-3**, approximately $137.9 million in PFC revenue (excluding financing costs), $12.2 million in customer facility charge (CFC) revenue, and $131.1 million in ORF revenue (excluding financing costs) is required to fund the remaining costs of the ACIP. These funding sources are described in greater detail in the following sub-sections.

Passenger Facility Charges

PFCs are authorized by Title 14 of the Code of Federal Regulations, Part 158 and are administered by the FAA. PFCs collected from qualified enplaned passengers are used to fund eligible projects. An airport operator can impose a PFC of $1, $2, $3, $4 or $4.50 per eligible, enplaned passenger. Once a PFC is imposed, it is included as part of the ticket price paid by passengers enplaning at the airport, collected by the airlines and remitted to the airport operator, less an allowance for airline processing expenses. The PFC legislation stipulates that if a medium to large hub airport institutes a PFC of $1, $2, or $3, they must forego 50 percent of their AIP entitlement funds. This increases to 75 percent if they charge a $4 or $4.50 PFC. Since ORF is designated by the FAA as a small hub airport, it does not have to forego any of its annual AIP entitlement funds.

Projects that are eligible for PFC funding include those that preserve or enhance the capacity, safety or security of the air transportation system, reduce noise or mitigate noise effects, or furnish opportunities for enhanced competition between or among air carriers. PFCs cannot be used for revenue-generating facilities at airports, such as restaurants and other concession space, rental car facilities, public parking facilities or construction of exclusively leased space or facilities.

The Authority currently has three open PFC applications all having approval to collect a $4.50 per enplaned passenger fee. PFC Application #14-04-C-00-ORF is fully funded but not yet closed out, PFC Application #18-05-C-00-ORF is forecast to be fully funded in FY 2020, and PFC Application #19-06-C-00-ORF expires on April 1, 2023. This expiration date was determined based on ORF's Terminal Area Forecast for enplanements dated February 2019 (TAF). The TAF has a CAGR of 1.8 percent from FY 2019 through FY 2022 compared to the Master Plan enplanement forecast included in **Table 3-31** of 3 percent for the same time period. As a result of the higher enplanement growth rate, PFC revenues are estimated to be available for future eligible projects in FY 2022.

Table 7-6 presents the PFC calculation for ORF, as well as the annual funding plan for these revenues. As shown in the table, approximately $77.8 million in PFCs are estimated to be collected during the projection period. This amount increases to approximately $92.2 million when combined with $14.4 million of PFCs the Authority has in its PFC Fund as of June 30, 2019. Approximately $10 million of this PFC revenue is committed to fund PFC Application #18-05-C-00-ORF and $15.8 million is committed to fund PFC Application #19-06-C-00-ORF, with the $66.4 million remaining being available to fund the ACIP on a pay-go and leveraged basis.

As shown in **Table 7-3**, $137.9 million in PFCs are needed to fund the ACIP, of which $19.4 million is assumed to be funded on a pay-go basis and, due to a difference in the timing of the project spend versus the receipt of PFC revenues, $118.5 million was assumed to be funded with general airport revenue bonds (GARBs). While this analysis did not make any recommendations on the type of debt structure ORF needs to undertake, it did assume the following:

- Thirty-year GARB issuances in 2022 and 2025 to fund the PFC eligible portions of the ACIP.
- Five percent interest rate.
- The funding of a debt service reserve equaling maximum annual debt service.

These assumptions translate into GARB issuances with a total construction fund deposit of $118.5 million, which is all for airfield projects, at a par amount of $128.3 million. **Table 7-7** presents the debt service that results from the future PFC-eligible GARB issuances. As shown in the table, PFC-eligible debt service totals approximately $43.6 million through PAL 2 and approximately $250.4 million through the term of the bonds. These GARB issuances would commit the majority of PFC revenues through FY 2054; however, the Authority's PFC capacity would become available prior to 2054 if actual enplanements are better than forecasted and if the PFC collection rate is increased from the current $4.50 per enplaned passenger fee.

Customer Facility Charges

In September 1999, the Authority approved a CFC to be charged by the rental car companies to their customers. This CFC is collected by the rental car companies to cover the costs of on-airport rental car facilities, including all costs associated with ready/return facilities, parking facilities, and a shuttle bus service (1999 Resolution). According to the 1999 Resolution, the CFC is calculated annually based on the estimated cost of operating the rental car facilities and is collected from rental car customers using the airport facilities and remitted 100 percent to the Authority by the rental car operators. The initial CFC was estimated to be between $0.70 and $1.00 per transaction/rental, increasing to $1.03 in FY 2018. In May 2018, the Board approved a resolution, which authorized the Authority's staff to set a CFC rate to fund future capital projects. As a result, the CFC was increased to $2.00 per transaction day effective July 29, 2018. The rental car companies are obligated to collect the CFC through July 31, 2023, which can be extended by mutual agreement of the Authority and the rental car companies.

Table 7-8 presents the CFC calculation for ORF, as well as the annual funding plan for these revenues. As shown in the table, $28.7 million in CFCs were assumed to be collected through PAL 2, of which $12.2 million is needed to fund the CFC-eligible portions of the ACIP on a pay-go basis, $11.3 million is used to fund rental car operating expenses, and $3.4 million to fund the CFC-eligible debt service related to the Series 2019 Bond.

Authority Funds

ORF generates revenue through parking, rental cars, terminal concessions, land rents, and airline revenues. These revenues are used to cover maintenance and operating expenses and debt service obligations at ORF. As shown on **Table 7-3**, approximately $131.1 in Authority funds (excluding financing costs) are required to fund the remainder of the ACIP. This amount was forecast to be funded through a combination of pay-go funds and GARBs, which are described in greater detail in **Section 7.5 Financial Feasibility**.

7.4 AUTHORITY'S ACCOUNTING STRUCTURE

The Authority was established in 1948 as a political subdivision of the Commonwealth of Virginia and has the full responsibility for ORF's operation, maintenance, and development. The Authority is governed by the Board of at least seven but not more than nine members appointed for four-year terms by the City Council. The Authority has a management staff headed by the Executive Director who is appointed by the Board.

Under Section 601 of the Master Indenture, Rate Covenant, the Authority shall continuously own, control, operate, and maintain ORF in an efficient and economical manner and on a revenue producing basis and shall at all times prescribe, fix, maintain, and collect rates, fees, and other charges for the services and facilities furnished by ORF fully sufficient at all times:

- For 100 percent of the Operating Expenses and for the accumulation in the Revenue Fund of a reasonable reserve therefor; and
- Such Net Revenues for General Revenues in each Fiscal Year:
  - Will equal at least 125 percent of the Debt Service Requirement on all Revenue Obligations secured by General Revenues then Outstanding;
  - Will enable the Authority to make all required payments, if any, into the Debt Service Reserve Account and the Rebate Fund and on any Contract or Other Airport Obligation;

- o Will enable the Authority to accumulate an amount to be held in the Renewal and Extension Fund, which in the judgment of the Authority is adequate to meet the costs of major renewals, replacements, repairs, additions, betterments, and improvements to ORF, necessary to keep the same in good operating condition or as is required by any governmental agency having jurisdiction over the ORF; and
- o Will remedy all deficiencies in required payments into any of the funds and accounts mentioned in the Indenture from prior Fiscal Years.

The Airline Agreements extend through June 30, 2021 and shall be automatically renewed for two additional terms of one year each unless either party gives notice of its intent to terminate 90 days prior to the end of the then current term. The Signatory Airlines include American, Delta, Southwest, and United. FedEx and UPS are not signatory to the Airline Agreement but pay signatory landing fees since they meet the minimum number of flights required to pay the signatory rates. Allegiant and Frontier are the only Non-Signatory Airlines operating at ORF. Article 7 of the Airline Agreements describes the method for the calculation of the rents, fees and charges of the Signatory Airlines for the use of facilities, rights, licenses, and privileges to operate at ORF, which is a compensatory rate-setting methodology with a revenue-sharing mechanism. Non-signatory airlines pay a fee that is 1.25 times higher than the rates paid by the Signatory Airlines. The Airline Agreement also permits the Authority to increase the Landing Fee Rate and Terminal Rental Rate to meet the Rate Covenant. Although the Airline Agreements will expire during the forecast period, the rate-setting methodologies outlined in the current Airline Agreements were assumed to be extended throughout the forecast period.

7.5 FINANCIAL FEASIBILITY

This section of the financial analysis presents the projected operating expenses, debt service, and revenues resulting from the daily operation of the Authority. In addition, the funding of the ACIP was layered into the projections to determine if it is feasible for the Authority to undertake the program in the FY 2020 through FY 2028 planning period.

7.5.1 Operating Expenses

The Authority's financial statements were prepared using the economic resources measurement focus and the accrual basis of accounting. Operating expenses include salaries and fringe benefit costs, maintenance and repairs, security, utilities, professional services, administrative, payments to the City, and other operating expenses. Interest expense and financing costs are reported as non-operating expenses.

The FY 2019 operating expenses reflect the actual expenses presented in the 2019 Financial Statements and the FY 2020 operating expenses reflect the FY 2020 Budget. **Table 7-9** presents operating expenses by line item and cost center for FY 2019 through FY 2028.

As shown in the table, operating expenses were approximately $33.5 million in FY 2019 and are budgeted to increase 8.3 percent, primarily as a result of maintenance and repairs and administrative services, to approximately $36.3 million in FY 2020. Operating expenses are forecast to be approximately $40.0 million in FY 2028, reflecting a CAGR of 1.2 percent from FY 2020 through FY 2028. Operating expenses were projected based on the following:

- A review of historical trends and the anticipated effects of inflation assumed at 1.4 percent annually, reflecting the most recent 10-year average of the South Region Consumer Price Index (CPI).
- A reduction of $600,000 in 2022 to reflect the decommissioning of the employee parking lot shuttle buses since the employees will be parking in the garages upon parking garage D's completion.
- Increases in the City Payment of $150,000 every five years based on the Authority's agreement with the City. This agreement expires in 2024; however, this analysis assumed that the City Payments will continue and increase per the existing agreement.

7.5.2 Debt Service

The Authority currently has two outstanding debt obligations: Series 2011A-C Bonds and Series 2019 Bonds. As shown in **Table 7-10**, annual outstanding debt service is approximately $4.2 million in FY 2020, increasing to a high of $8.5 million in FY 2024.

As shown in **Table 7-3**, $131.1 million in Authority funds is needed to fund the ACIP, of which $31.2 million was assumed to be funded on a pay-go basis and, due to a difference in the timing of the project spend versus the availability of General Reserve funds, $99.9 million was assumed to be funded with GARBs. While this analysis did not make any recommendations on the type of debt structure ORF needs to undertake, it did assume the following:

- Thirty-year GARB issuances in 2021 and 2025 to fund the ACIP.
- Five percent interest rate.
- Two-year capitalized interest period.
- The funding of a debt service reserve equaling maximum annual debt service.

Table 7-11 presents the debt service that results from the future GARB issuances. As shown in the table, the total construction fund deposit of $99.9 million at a par amount of $121.3 million. The resulting debt service totals approximately $20.1 million through PAL 2 and approximately $224.6 million through the term of the bonds. The 2021 GARB issuance were assumed to fund ground transportation and general aviation projects and the 2025 GARB issuance were assumed to fund cargo and general aviation projects; therefore, neither bond issuance is funded through airline rates and charges.

7.5.3 Capital Improvement Amortization

As shown in **Table 7-3**, approximately $31.2 million in Authority funds are required to fund the remainder of the ACIP on a pay-go basis. According to the Airline Agreements, only airfield, terminal, and an allocation of administrative projects can be recovered through airline rates and charges. As a result, approximately $26.6 million of the Authority-funded projects can be recovered through airline rates and charges. **Table 7-12** presents the estimated amortization for these projects, which totals approximately $3.8 million in FY 2028. The projects are amortized over their useful life at 3%, reflecting the Revenue Bond Index as of January 30, 2020 rounded up.

7.5.4 Operating Revenues

Major sources of operating revenue at ORF are derived from non-airline and airline sources. Non-airline revenues accounted for 75.9 percent of ORF's revenues in FY 2019 and include parking, rental car revenues, terminal concessions, FBO fees, land rents, maintenance hangar rentals, cargo rentals, and other operating revenues.

Airline revenues accounted for 24.1 percent of ORF's operating revenue in FY 2019 and included revenues generated primarily from airline landing fees and terminal rentals. As previously discussed, the existing airline agreements expire on June 30, 2021. The methodologies outlined in the current airline agreements were assumed to be in place throughout the forecast period.

Table 7-13 presents the airline rates and charges at ORF for FY 2020 through FY 2028. As shown in the table, the maximum airline cost per enplanement (CPE) in PAL 1 is $5.74 in FY 2023 and in PAL 2 is $6.00 in FY 2024.

Table 7-14 presents operating revenues for FY 2019 through FY 2028. As shown, operating revenues were approximately $41.2 million in FY 2019 and budgeted to be $44.8 million in FY 2020, reflecting an 8.7 percent increase, primarily due to an increase in parking and landing fee revenues due to a rate increase. Operating revenues are forecast to increase to approximately $65.6 million in FY 2028, reflecting a CAGR of 4.9 percent from FY 2020 to FY 2028. FY 2021 through FY 2028 operating revenues are projected based on the following:

- Historical trends, lease provisions, and inflation.
- Revenues from parking, terminal concessions, and rental cars are projected to increase with prospective enplanement growth.
- It was assumed that the Authority would renegotiate concession leases that expire during the planning period with terms and conditions that would implement changes in rate structures and business practices, as necessary, to maintain positive financial performance.
- The employee parking monthly fee is estimated to increase from $20 per month to $30 in FY 2022 since the employees will be parking in a garage instead of the surface lot.
- Once the parking garage D is complete in FY 2022, the Authority intends on instituting premium parking programs that could potentially increase parking revenues. Also, there will be a slight increase in available parking spaces that may increase revenues. After 2022, additional parking revenues are forecasted to grow with enplanements.
- Parking rates were assumed to increase $1.00 in FY 2022 to coincide with the completion of parking garage D and then every five years thereafter.
- Air cargo and general aviation terminal rentals were increased in FY 2027 to reflect additional rent anticipated once the new facilities are complete. The revenue increase is equal to the debt service required to fund those facilities.

7.5.5 Pro Forma Cash Flow

Table 7-15 presents the pro forma cash flow of ORF for the planning period, based on the projection of operating revenues, operating expenses, and debt service discussed previously. As shown in the table, the Authority has sufficient funds for its portion of the ACIP through PAL 2.

As previously discussed, the Authority's Master Indenture requires that net revenues available for debt service be at least 125 percent of debt service. **Table 7-16** presents the debt service coverage calculation. As shown in the table, the Authority satisfies the debt service coverage test in PAL 1 and PAL 2.

Table 7-16 also presents the days cash on hand for ORF. Days cash on hand is the number of days that an organization can continue to pay its operating expenses given the amount of cash available. The Authority's days cash on hand in FY 2019 was 310 days. As shown in the table, the Authority has a minimum of 272 and an average of 300 days cash on hand in PAL 1 and a minimum of 356 and an average of 488 days cash on hand in PAL 2.

This analysis assumed that approximately $30 million in AIP discretionary grants and $15 million in state discretionary grants will fund the ACIP. If the Authority does not receive approval for these funds, it will need to identify alternative funding sources, delay the projects until funding sources become available, or cancel the projects. As shown in **Table 7-15**, the Authority is forecast to have approximately $85.6 million in General Reserve Funds by the end of PAL 2. These funds could be used to bridge any gap that may occur due to the receipt of less discretionary funding.

7.6 SUMMARY

The financial feasibility of future projects will be determined by existing and future leases, funding levels and participation rates of federal grant programs, the availability of PFC and CFC revenues and other funding sources, bonding capacity and the ability to generate internal cash flow from operations at ORF.

The financial projections were prepared on the basis of available information and assumptions set forth in this Chapter. It is believed that such information and assumptions provide a reasonable basis for the projections to the level of detail appropriate for planning purposes. Some of the assumptions used to develop the projections may not be realized, and unanticipated events or circumstances may occur; therefore, the actual results will vary from those projected, and such variations could be material.

If actual results are less favorable than the forecast, the Authority may need additional grants, PFCs, CFCs, and Authority funds to fund the ACIP as it is presented; therefore, as the Authority has done in the past, it should continue to monitor its financial situation to determine which projects should be undertaken and when. In addition, the Authority should review and evaluate current leases and service incentives to enhance revenues and provide financial solvency, while improving the facilities.

The actual need for facilities is most appropriately established by airport activity levels rather than a specified date. For example, projections were made as to when the terminal expansions may be needed at ORF. In reality, the timeframe in which the development is needed may be substantially different. Actual demand may be slower to develop than expected. On the other hand, high levels of demand may establish the need to accelerate the development. Although every effort was made in this planning process to conservatively estimate when facility development may be needed, aviation demand will dictate when facility improvements need to be delayed or accelerated.

Table 7-1 – Activity Forecast (in 000s)

Fiscal Year	Enplanements		Operations		Landed Weight (a)	Change
	Per Table 3-31	% Change	Per Table 3-31	% Change		
2018(b)	1,741.1	--	74.8	--	2,308.8	--
2019(b)	1,927.1	10.7%	78.0	4.3%	2,689.3	16.5%
Forecast						
2020	2,038.2	5.8%	78.7	0.8%	2,551.4	-5.1%
2021	2,072.3	1.7%	79.3	0.8%	2,572.6	0.8%
2022	2,104.7	1.6%	80.0	0.8%	2,594.1	0.8%
2023	2,115.4	0.5%	80.1	0.1%	2,614.2	0.8%
2024	2,168.2	2.5%	81.2	1.5%	2,617.4	0.1%
2025	2,220.8	2.4%	82.4	1.4%	2,656.0	1.5%
2026	2,273.2	2.4%	83.6	1.4%	2,694.4	1.4%
2027	2,325.3	2.3%	84.7	1.4%	2,732.2	1.4%
2028	2,377.0	2.2%	85.9	1.4%	2,770.5	1.4%
2029	2,428.3	2.2%	87.0	1.2%	2,808.3	1.4%
2030	2,479.3	2.1%	88.0	1.2%	2,843.0	1.2%
2031	2,528.7	2.0%	89.0	1.2%	2,877.4	1.2%
2032	2,576.4	1.9%	90.0	1.1%	2,910.8	1.2%
2033	2,622.8	1.8%	91.0	1.1%	2,943.0	1.1%
2034	2,667.8	1.7%	92.4	1.6%	2,974.9	1.1%
2035	2,711.4	1.6%	93.8	1.5%	3,021.5	1.6%
2036	2,753.7	1.6%	95.2	1.5%	3,067.8	1.5%
2037	2,794.8	1.5%	96.6	1.5%	3,113.5	1.5%
2038	2,834.6	1.4%	98.0	1.4%	3,158.6	1.5%
CAGR (2018 - 2038)	**2.5%**		**1.4%**		**1.6%**	

(a) The FY 2020 landed weight amount reflects the amount included in the FY 2020 Budget. Since landed weight is not forecast in Table 3-31, FY 2021 through FY 2038 is forecast to grow based on the growth in operations.
(b) FY 2018 and FY 2019 reflect actual results; and therefore, do not match the amounts in Table 3-31.
Source: DKMG, CHA, 2020.

Table 7-2 – ACIP and Funding Sources
(in 000s)

Project	Fiscal Year	Cost Center	Project Costs	Inflated	90% Eligibility	Funding Sources												
						AIP Grants			State		Third Party	Authority						Total
						Entitlement		Discretionary	Entitlement	Discretionary		PFCs		CFC	General Reserve			
															GARBs	Direct Expense (a)		
						Passenger	Cargo					Pay-Go	GARBs			Amort in Rate Base	Non-rate base	
PAL 1 (2020-2023)																		
Airfield Signage Replacement (Design & Constr)	2020	Airfield	$2,500	$2,500	$2,250	$2,250	$0	$0	$250	$0	$0	$0	$0	$0	$0	$0	$0	$2,500
Txwy 'C' South Reconstruct (Design)	2020	Airfield	1,500	1,500	1,350	1,350	0	0	150	0	0	0	0	0	0	0	0	1,500
Property Purchase - Gurley Street (3 Parcels)	2020	Airfield	525	525	473	473	0	0	53	0	0	0	0	0	0	0	0	525
Property Purchase - Barrs Road	2020	Airfield	750	750	675	675	0	0	75	0	0	0	0	0	0	0	0	750
Pavement Management Plan Update	2020	Airfield	250	250	225	225	0	0	25	0	0	0	0	0	0	0	0	250
Continuous Friction Measuring Equipment (Purchase)	2020	Airfield	70	70	63	0	0	0	56	0	0	0	0	0	0	14	0	70
Intersection Impr- Departures Blvd & LT W Exit (Design)	2020	Grnd Trans	500	500	450	0	0	0	400	0	0	0	0	0	0	100	0	500
Rnwy 5/23 Outer Pavement Mill & Overlay (Design)	2020	Airfield	250	250	225	0	0	0	200	0	0	0	0	0	0	50	0	250
Fire Protection in Departures Basement (Design)	2020	Fire	250	250	0	0	0	0	200	0	0	0	0	0	0	50	0	250
Water Main into Departures Tml (Design & Constr)	2020	Terminal	250	250	225	0	0	0	200	0	0	0	0	0	0	50	0	250
Field Maintenance High Bay Heating	2020	Airfield	150	150	135	0	0	0	120	0	0	0	0	0	0	30	0	150
Departures Terminal Ticket Lobby Seating	2020	Terminal	100	100	0	0	0	0	80	0	0	0	0	0	0	20	0	100
Field Maintenance Mechanic Truck	2020	Airfield	70	70	63	0	0	0	56	0	0	0	0	0	0	14	0	70
Long Term East Repairs- Departures South (Constr)	2020	Grnd Trans	500	500	0	0	0	0	0	0	0	0	0	0	0	500	0	500
Garage B & C Repairs (Design & Constr)	2020	Grnd Trans	300	300	0	0	0	0	0	0	0	0	0	0	0	300	0	300
Fuel Farm Expansion-AvGas for GA, Close old GA Farm	2020	Airfield	750	750	0	0	0	0	0	0	0	0	0	0	0	0	750	750
Concourse Stairwell Refurbishment (Design & Constr)	2020	Terminal	600	600	0	0	0	0	0	0	0	0	0	0	0	0	600	600
Arrivals Terminal & Fire Station Fire Alarm Upgrade	2020	Fire	400	400	360	0	0	0	0	0	0	0	0	0	0	0	400	400

Project	Fiscal Year	Cost Center	Project Costs	Inflated	90% Eligibility	Funding Sources – AIP Grants – Entitlement – Passenger	Funding Sources – AIP Grants – Entitlement – Cargo	Funding Sources – AIP Grants – Discretionary	Funding Sources – State – Entitlement	Funding Sources – State – Discretionary	Funding Sources – Third Party	Funding Sources – Authority – PFCs – Pay-Go	Funding Sources – Authority – PFCs – GARBs	Funding Sources – Authority – CFC	Funding Sources – Authority – General Reserve – GARBs	Funding Sources – Authority – General Reserve – Direct Expense (a) – Amort in Rate Base	Funding Sources – Authority – General Reserve – Direct Expense (a) – Non-rate base	Total
Doors for Departures Main Lobby & Admin Elevator Hall	2020	Terminal	150	150	0	0	0	0	0	0	0	0	0	0	0	0	150	150
Work Station & Server Upgrades/Replacement	2020	Terminal	150	150	0	0	0	0	0	0	0	0	0	0	0	0	150	150
Concourse Digital Message Signs	2020	Terminal	120	120	0	0	0	0	0	0	0	0	0	0	0	0	120	120
Parking Lot South Generator - Replacement	2020	Grnd Trans	80	80	0	0	0	0	0	0	0	0	0	0	0	80	0	80
Conference Room IT Upgrades	2020	Terminal	80	80	0	0	0	0	0	0	0	0	0	0	0	0	80	80
Fire Department & Field Maintenance Bunk Area Study	2020	Fire	60	60	54	0	0	0	0	0	0	0	0	0	0	0	60	60
Human Resources Information System	2020	Admin	130	130	0	0	0	0	0	0	0	0	0	0	0	130	0	130
Janitorial Department Ride On Floor Equipment	2020	Terminal	50	50	0	0	0	0	0	0	0	0	0	0	0	0	50	50
Txwy C South Reconstruct & Txwy V Rehab (Constr)	2021	Airfield	11,000	11,000	9,900	9,900	0	0	1,100	0	0	0	0	0	0	0	0	11,000
Rnwy 5/23 Standardization - Design	2021	Airfield	3,000	3,000	2,700	2,700	0	0	300	0	0	0	0	0	0	0	0	3,000
Closure of Rnwy 14/32- Environ Study & Design	2021	Airfield	300	300	270	270	0	0	30	0	0	0	0	0	0	0	0	300
West Airfield Txwy Impr (North/South)-Prelim P&D	2021	Airfield	1,750	1,750	1,575	1,575	0	0	175	0	0	0	0	0	0	0	0	1,750
Intersection Impr- Departures Blvd & LT W Exit (Constr)	2021	Grnd Trans	6,000	6,000	5,400	0	0	0	4,800	0	0	0	0	0	0	0	1,200	6,000
Rnwy 5/23 Outer Pavement Mill & Overlay (Constr)	2021	Airfield	3,500	3,500	3,150	0	0	0	2,275	383	0	0	0	0	0	842	0	3,500
Fire Protection in Departures Basement (Constr)	2021	Fire	600	600	0	0	0	0	480	0	0	0	0	0	0	0	120	600
Ticket Lobby Improvements (Constr)	2021	Terminal	4,000	4,000	0	0	0	0	0	0	0	0	0	0	0	4,000	0	4,000
Interior Wayfinding Impr (Constr)	2021	Terminal	2,000	2,000	0	0	0	0	1,600	0	0	0	0	0	0	400	0	2,000
ARFF & SRE Sleeping Quarters Impr (Design & Constr)	2021	Fire	1,000	1,000	900	0	0	0	0	0	0	0	0	0	0	0	1,000	1,000
Garage A, B, C Rehabilitation (Design & Constr)	2021	Grnd Trans	10,000	10,000	0	0	0	0	0	0	0	0	0	0	10,000	0	0	10,000
Corporate Hangar (Constr)	2021	Other	3,000	3,000	0	0	0	0	0	0	0	0	0	0	3,000	0	0	3,000

Project	Fiscal Year	Cost Center	Project Costs	Inflated	90% Eligibility	Funding Sources: AIP Grants – Entitlement – Passenger	AIP Grants – Entitlement – Cargo	AIP Grants – Discretionary	State – Entitlement	State – Discretionary	Third Party	Authority – PFCs – Pay-Go	Authority – PFCs – GARBs	Authority – CFC	Authority – General Reserve – GARBs	Authority – General Reserve – Direct Expense (a) – Amort in Rate Base	Authority – General Reserve – Direct Expense (a) – Non-rate base	Total
Design Development for Departures Terminal (Design)	2021	Terminal	1,000	1,000	0	900	0	0	100	0	0	0	0	0	0	0	0	1,000
Arrivals North Stair Tower Elevator (Constr)	2021	Terminal	750	750	0	0	0	0	0	0	0	0	0	167	0	583	0	750
Arrivals Terminal Restrooms (Constr)	2021	Terminal	2,500	2,500	0	0	0	0	2,000	0	0	0	0	0	0	500	0	2,500
Rnwy 5/23 Standardization-Constr Ph 1	2022	Airfield	30,000	30,000	27,000	5,000	0	10,000	2,000	5,000	0	3,400	0	0	0	4,600	0	30,000
Closure of Rnwy 14/32 (Design)	2022	Airfield	1,500	1,500	1,350	0	0	0	0	0	0	0	0	0	0	1,500	0	1,500
Misc Airside & Landside Maintenance & Equipment	2022	Admin	3,000	3,000	2,700	0	0	0	0	0	0	0	0	0	0	3,000	0	3,000
Txwy C Mid-Field South Txwy A to B (Design & Constr)	2022	Airfield	18,000	18,000	16,200	0	0	0	0	0	0	0	18,000	0	0	0	0	18,000
Rnwy 5/23 Standardization-Constr Ph 2	2023	Airfield	40,000	40,000	36,000	5,000	0	10,000	2,000	5,000	0	8,000	10,000	0	0	0	0	40,000
Closure of Rnwy 14/32 (Constr)	2023	Airfield	7,500	7,500	6,750	0	0	0	0	0	0	0	7,500	0	0	0	0	7,500
Txwy C Mid-Field North Txwy B E (Design & Constr)	2023	Airfield	13,000	13,000	11,700	0	0	0	0	0	0	0	13,000	0	0	0	0	13,000
Misc Airside & Landside Maintenance & Equipment	2023	Admin	3,000	3,000	2,700	0	0	0	0	0	0	0	0	0	0	3,000	0	3,000
Total PAL 1 (2020-2023)			**$176,935**	**$176,935**	**$134,843**	**$30,318**	**$0**	**$20,000**	**$18,725**	**$10,383**	**$0**	**$11,400**	**$48,500**	**$167**	**$13,000**	**$19,763**	**$4,680**	**$176,935**
PAL 2 (2024-2028)																		
Txwy C North Rehabilitation (Final Design & Constr)	2024	Airfield	$3,000	$3,000	$2,700	$2,700	$0	$0	$0	$0	$0	$0	$0	$0	$0	$300	$0	$3,000
Rnwy 5/23 Standardization-Constr Ph 3	2024	Airfield	30,000	30,000	27,000	5,000	0	10,000	2,000	5,000	0	8,000	0	0	0	0	0	30,000
Misc Airside & Landside Maintenance & Equipment	2024	Admin	2,500	2,500	2,250	0	0	0	0	0	0	0	0	0	0	2,500	0	2,500
Cargo Apron Improvements	2025	Cargo	31,200	31,200	28,080	0	1,540	0	0	0	0	0	0	0	29,660	0	0	31,200
Cargo Facility Expansion	2025	Cargo	26,500	26,500	0	0	0	0	0	0	0	0	0	0	26,500	0	0	26,500
Misc Airside & Landside Maintenance & Equipment	2025	Admin	2,500	2,500	2,250	0	0	0	2,000	0	0	0	0	0	0	500	0	2,500
Deicing Apron with Glycol Recovery System	2026	Airfield	39,000	39,000	35,100	5,000	0	0	2,000	0	0	0	32,000	0	0	0	0	39,000
Relocated Fuel Facility	2026	Airfield	40,000	40,000	0	2,000	0	0	0	0	0	0	38,000	0	0	0	0	40,000
Misc Airside & Landside Maintenance & Equipment	2026	Admin	2,500	2,500	2,250	0	0	0	0	0	0	0	0	0	0	2,500	0	2,500
QTA Facility (Repurpose Employee Lot)	2027	Grnd Trans	12,000	12,000	0	0	0	0	0	0	0	0	0	12,000	0	0	0	12,000
Misc Airside & Landside Maintenance & Equipment	2027	Admin	2,500	2,500	2,250	0	0	0	2,000	0	0	0	0	0	0	500	0	2,500

Project	Fiscal Year	Cost Center	Project Costs	Inflated	90% Eligibility	Funding Sources												Total
						AIP Grants			State		Third Party	Authority						
						Entitlement		Discretionary	Entitlement	Discretionary		PFCs		CFC	General Reserve			
															GARBs	Direct Expense (a)		
						Passenger	Cargo					Pay-Go	GARBs			Amort in Rate Base	Non-rate base	
General Aviation Apron Improvements	2028	GA	18,700	18,700	16,830	5,000	0	0	0	0	0	0	0	0	13,700	0	0	18,700
General Aviation Hangar Construction	2028	GA	22,000	22,000	0	5,000	0	0	0	0	0	0	0	0	17,000	0	0	22,000
Misc Airside & Landside Maintenance & Equipment	2028	Admin	2,500	2,500	2,250	0	0	0	2,000	0	0	0	0	0	0	500	0	2,500
Total PAL 2 (2024-2028)			**$234,900**	**$234,900**	**$120,960**	**$24,700**	**$1,540**	**$10,000**	**$10,000**	**$5,000**	**$0**	**$8,000**	**$70,000**	**$12,000**	**$86,860**	**$6,800**	**$0**	**$234,900**
Total PAL 1 and PAL 2			$411,835	$411,835	$255,803	$55,018	$1,540	$30,000	$28,725	$15,383	$0	$19,400	$118,500	$12,167	$99,860	$26,563	$4,680	$411,835
						$86,557			$44,108			$137,900			$131,104			

(a) Capital expenditures in the airfield and terminal are included the airline rate base through amortization (see Table 7-12).

Source: DKMG, CHA, project costs

Table 7-3 – ACIP Funding Sources by Year (in 000s)

Year	Project Costs	Funding Sources: AIP Grants – Entitlement – Passenger	AIP Grants – Entitlement – Cargo	AIP Grants – Discretionary	State – Entitlement	State – Discretionary	Third Party	Authority – PFCs – Pay-Go	Authority – PFCs – GARBs	Authority – CFC	Authority – General Reserve – GARBs	General Reserve – Direct Expense (a) – Amort in Rate Base	General Reserve – Direct Expense (a) – Non rate base	Total
2020	$10,535.00	$4,972.50	$0.00	$0.00	$1,864.50	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$1,338.00	$2,360.00	$10,535.00
2021	$50,400.00	$15,345.00	$0.00	$0.00	$12,860.00	$383.00	$0.00	$0.00	$0.00	$166.67	$13,000.00	$6,325.33	$2,320.00	$50,400.00
2022	$52,500.00	$5,000.00	$0.00	$10,000.00	$2,000.00	$5,000.00	$0.00	$3,400.00	$18,000.00	$0.00	$0.00	$9,100.00	$0.00	$52,500.00
2023	$63,500.00	$5,000.00	$0.00	$10,000.00	$2,000.00	$5,000.00	$0.00	$8,000.00	$30,500.00	$0.00	$0.00	$3,000.00	$0.00	$63,500.00
Total PAL 1	**$176,935.00**	**$30,317.50**	**$0.00**	**$20,000.00**	**$18,724.50**	**$10,383.00**	**$0.00**	**$11,400.00**	**$48,500.00**	**$166.67**	**$13,000.00**	**$19,763.33**	**$4,680.00**	**$176,935.00**
2024	$35,500.00	$7,700.00	$0.00	$10,000.00	$2,000.00	$5,000.00	$0.00	$8,000.00	$0.00	$0.00	$0.00	$2,800.00	$0.00	$35,500.00
2025	$60,200.00	$0.00	$1,539.60	$0.00	$2,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$56,160.40	$500.00	$0.00	$60,200.00
2026	$81,500.00	$7,000.00	$0.00	$0.00	$2,000.00	$0.00	$0.00	$0.00	$70,000.00	$0.00	$0.00	$2,500.00	$0.00	$81,500.00
2027	$14,500.00	$0.00	$0.00	$0.00	$2,000.00	$0.00	$0.00	$0.00	$0.00	$12,000.00	$0.00	$500.00	$0.00	$14,500.00
2028	$43,200.00	$10,000.00	$0.00	$0.00	$2,000.00	$0.00	$0.00	$0.00	$0.00	$0.00	$30,700.00	$500.00	$0.00	$43,200.00
Total PAL 2	**$234,900.00**	**$24,700.00**	**$1,539.60**	**$10,000.00**	**$10,000.00**	**$5,000.00**	**$0.00**	**$8,000.00**	**$70,000.00**	**$12,000.00**	**$86,860.40**	**$6,800.00**	**$0.00**	**$234,900.00**
Total	**$411,835.00**	**$55,017.50**	**$1,539.60**	**$30,000.00**	**$28,724.50**	**$15,383.00**	**$0.00**	**$19,400.00**	**$118,500.00**	**$12,166.67**	**$99,860.40**	**$26,563.33**	**$4,680.00**	**$411,835.00**
		$86,557.10			**$44,107.50**			**$137,900.00**			**$99,860.40**	**$31,243.33**		
											$131,103.73			

(a) Capital expenditures in the airfield and terminal are included the airline rate base through amortization (see Table 7-12).
Source: DKMG, CHA, 2020.

Table 7-4 – Application of AIP and State Grants
(in 000s)

	Source Table	Total	PAL 1				PAL 2				
			2020	2021	2022	2023	2024	2025	2026	2027	2028
AIP Grants											
Entitlement (a)	7-5	$45,930.94	$4,771.13	$4,957.08	$5,068.18	$5,102.29	$5,134.68	$5,145.42	$5,198.17	$5,250.80	$5,303.20
Discretionary		$30,000.00	$0.00	$0.00	$10,000.00	$10,000.00	$10,000.00	$0.00	$0.00	$0.00	$0.00
Cargo (b)		$1,539.60	$165.00	$166.40	$167.80	$169.10	$169.30	$171.80	$174.30	$176.70	$179.20
Total AIP grants		**$77,470.54**	**$4,936.13**	**$5,123.48**	**$15,235.98**	**$15,271.39**	**$15,303.98**	**$5,317.22**	**$5,372.47**	**$5,427.50**	**$5,482.40**
State Grants											
Entitlement (c)		$28,724.50	$1,864.50	$12,860.00	$2,000.00	$2,000.00	$2,000.00	$2,000.00	$2,000.00	$2,000.00	$2,000.00
Discretionary		$15,383.00	$0.00	$383.00	$5,000.00	$5,000.00	$5,000.00	$0.00	$0.00	$0.00	$0.00
Total state grants		**$44,107.50**	**$1,864.50**	**$13,243.00**	**$7,000.00**	**$7,000.00**	**$7,000.00**	**$2,000.00**	**$2,000.00**	**$2,000.00**	**$2,000.00**
Total available grants		**$121,578.04**	**$6,800.63**	**$18,366.48**	**$22,235.98**	**$22,271.39**	**$22,303.98**	**$7,317.22**	**$7,372.47**	**$7,427.50**	**$7,482.40**
Cumulative				**$25,167.11**	**$47,403.08**	**$69,674.47**	**$91,978.45**	**$99,295.67**	**$106,668.14**	**$114,095.64**	**$121,578.04**
Beginning balance		**$13,336.95**	**$13,336.95**	**$13,300.58**	**$3,079.06**	**$3,315.03**	**$3,586.42**	**$1,190.40**	**$4,968.02**	**$3,340.49**	**$8,767.99**
Plus: available grants		**$121,578.04**	**$6,800.63**	**$18,366.48**	**$22,235.98**	**$22,271.39**	**$22,303.98**	**$7,317.22**	**$7,372.47**	**$7,427.50**	**$7,482.40**
Less: CIP Funded with AIP grants											
Entitlement-passenger	**7-2**	**(55,017.50)**	**(4,972.50)**	**(15,345.00)**	**(5,000.00)**	**(5,000.00)**	**(7,700.00)**	**0.00**	**(7,000.00)**	**0.00**	**(10,000.00)**
Entitlement-cargo	**7-2**	**(1,539.60)**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**(1,539.60)**	**0.00**	**0.00**	**0.00**
Discretionary	**7-2**	**(30,000.00)**	**0.00**	**0.00**	**(10,000.00)**	**(10,000.00)**	**(10,000.00)**	**0.00**	**0.00**	**0.00**	**0.00**
Less: CIP Funded with state grants											
Entitlement	**7-2**	**(28,724.50)**	**(1,864.50)**	**(12,860.00)**	**(2,000.00)**	**(2,000.00)**	**(2,000.00)**	**(2,000.00)**	**(2,000.00)**	**(2,000.00)**	**(2,000.00)**
Discretionary	**7-2**	**(15,383.00)**	**0.00**	**(383.00)**	**(5,000.00)**	**(5,000.00)**	**(5,000.00)**	**0.00**	**0.00**	**0.00**	**0.00**
Ending balance		**4,250.39**	**13,300.58**	**3,079.06**	**3,315.03**	**3,586.42**	**1,190.40**	**4,968.02**	**3,340.49**	**8,767.99**	**4,250.39**

(a) A two-year lag is assumed to reflect the time needed to compile annual enplanement data and complete the grant application and approval process.
b) In federal fiscal year 2019, the FAA apportioned total entitlements of $3.2 billion, of which 3.5% is allotted for cargo entitlements, or $112 million. This amount is then allocated to airports on a pro-rata basis according to an airport's share of total U.S. cargo landed weight. In federal fiscal year 2017, ORF's cargo landed weight was 0.15% of total U.S. landed weight, therefore, ORF was apportioned $165,000 in cargo entitlements in federal fiscal year 2019. This amount is forecast to increase with the growth in landed weight presented in Table 7-1.
(c) FY 2021 state entitlements are greater than the $2 million maximum due to the reimbursement of past state grants with PFC revenue.
Source: DKMG, CHA, 2020.

Table 7-5 – Calculation of AIP Entitlements
(in 000s)

	Source Table	PAL 1				PAL 2				
		2020	2021	2022	2023	2024	2025	2026	2027	2028
Enplanements	7-1	2,038.2	2,072.3	2,104.7	2,115.4	2,168.2	2,220.8	2,273.2	2,325.3	2,377.0
FAA Formula (a)										
$7.80 for 1st 50,000 Enpl		$390.00	$390.00	$390.00	$390.00	$390.00	$390.00	$390.00	$390.00	$390.00
$5.20 for next 50,000 Enpl		$260.00	$260.00	$260.00	$260.00	$260.00	$260.00	$260.00	$260.00	$260.00
$2.60 for next 400,000 Enpl		$1,040.00	$1,040.00	$1,040.00	$1,040.00	$1,040.00	$1,040.00	$1,040.00	$1,040.00	$1,040.00
$0.65 for next 500,000 Enpl		$325.00	$325.00	$325.00	$325.00	$325.00	$325.00	$325.00	$325.00	$325.00
$0.50 for the remaining Enpl		$519.09	$536.14	$552.34	$557.71	$584.09	$610.40	$636.60	$662.66	$688.50
Total Calculated Entitlements		$2,534.09	$2,551.14	$2,567.34	$2,572.71	$2,599.09	$2,625.40	$2,651.60	$2,677.66	$2,703.50
Calculated Entitlement x 2 (b)		**$5,068.18**	**$5,102.29**	**$5,134.68**	**$5,145.42**	**$5,198.17**	**$5,250.80**	**$5,303.20**	**$5,355.32**	**$5,406.99**
Entitlements (c)		**$4,771.13**	**$4,957.08**	**$5,068.18**	**$5,102.29**	**$5,134.68**	**$5,145.42**	**$5,198.17**	**$5,250.80**	**$5,303.20**
Cumulative					**$19,898.67**	**$25,033.35**	**$30,178.77**	**$35,376.94**	**$40,627.74**	**$45,930.94**

(a) The FAA formula is defined in 49 United States Code § 47114.
(b) In any fiscal year in which the total amount available under 49 United States Code § 48103 is $3.2 billion or more, the amount apportioned to a sponsor shall be increased by doubling the amount that would otherwise be apportioned.
(c) A two-year lag is assumed to reflect the time needed to compile annual enplanement data and complete the grant application and approval process.
Source: DKMG, CHA, 2020.

Table 7-6 – Application of PFCs
(in 000s)

	Source Table	Total	PAL 1				PAL 2				
			2020	2021	2022	2023	2024	2025	2026	2027	2028
Enplanements	7-1		2,038.2	2,072.3	2,104.7	2,115.4	2,168.2	2,220.8	2,273.2	2,325.3	2,377.0
% of enplanements revenue producing			90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%	90.0%
Enplanements for PFC			1,834.4	1,865.1	1,894.2	1,903.9	1,951.4	1,998.7	2,045.9	2,092.8	2,139.3
Net PFC charge (a)			4.39	4.39	4.39	4.39	4.39	4.39	4.39	4.39	4.39
PFC revenue			8,053.00	8,188.00	8,316.00	8,358.00	8,566.00	8,774.00	8,981.00	9,187.00	9,391.00
Cumulative				16,241.00	24,557.00	32,915.00	41,481.00	50,255.00	59,236.00	68,423.00	77,814.00
Balance in PFC Account as of 6/30/18		**$14,359.29**	**$14,359.29**	**$0.00**	**$4,818.11**	**$6,317.41**	**$3,258.72**	**$408.03**	**$834.02**	**$1,467.02**	**$2,306.02**
Plus: PFC revenue		**$77,814.00**	**$8,053.00**	**$8,188.00**	**$8,316.00**	**$8,358.00**	**$8,566.00**	**$8,774.00**	**$8,981.00**	**$9,187.00**	**$9,391.00**
Less: committed PFCs											
PFC App #18-05-C-00-ORF	**7-2**	**($10,000.00)**	**($10,000.00)**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**
PFC App #19-06-C-00-ORF	**7-2**	**($15,782.18)**	**($12,412.29)**	**($3,369.90)**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Less: CIP funded with PFC pay-go	**7-2**	**($19,400.00)**	**$0.00**	**$0.00**	**($3,400.00)**	**($8,000.00)**	**($8,000.00)**	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Less: PFC eligible debt service	**7-7**	**($43,642.09)**	**$0.00**	**$0.00**	**($3,416.69)**	**($3,416.69)**	**($3,416.69)**	**($8,348.00)**	**($8,348.00)**	**($8,348.00)**	**($8,348.00)**
Ending balance		**$3,349.02**	**$0.00**	**$4,818.11**	**$6,317.41**	**$3,258.72**	**$408.03**	**$834.02**	**$1,467.02**	**$2,306.02**	**$3,349.02**

(a) The PFC formula is defined in 49 United States Code § 40117. PFC of $4.50 less airline collection fee of $0.11.
Source: DKMG, CHA, 2020.

Table 7-7 – PFC-Eligible Debt Service
(in 000s)

Fiscal Year	Source Table	Series 2022 Bonds			Series 2025 Bonds			Total			Cumulative
		Principal	Interest	Total	Principal	Interest	Total	Principal	Interest	Total	
2020		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2021		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2022		$790.55	$2,626.15	$3,416.69	$0.00	$0.00	$0.00	$790.55	$2,626.15	$3,416.69	$3,416.69
2023		$830.07	$2,586.62	$3,416.69	$0.00	$0.00	$0.00	$830.07	$2,586.62	$3,416.69	**$6,833.39**
2024		$871.58	$2,545.12	$3,416.69	$0.00	$0.00	$0.00	$871.58	$2,545.12	$3,416.69	$10,250.08
2025		$915.16	$2,501.54	$3,416.69	$1,140.99	$3,790.32	$4,931.31	$2,056.15	$6,291.85	$8,348.00	$18,598.08
2026		$960.91	$2,455.78	$3,416.69	$1,198.04	$3,733.27	$4,931.31	$2,158.96	$6,189.05	$8,348.00	$26,946.08
2027		$1,008.96	$2,407.73	$3,416.69	$1,257.95	$3,673.36	$4,931.31	$2,266.90	$6,081.10	$8,348.00	$35,294.08
2028		$1,059.41	$2,357.29	$3,416.69	$1,320.84	$3,610.47	$4,931.31	$2,380.25	$5,967.75	$8,348.00	**$43,642.09**
Total through PAL 2		**$6,436.63**	**$17,480.22**	**$23,916.85**	**$4,917.83**	**$14,807.41**	**$19,725.24**	**$11,354.46**	**$32,287.63**	**$43,642.09**	
Remaining years		$46,086.31	$32,497.62	$78,583.93	$70,888.48	$57,325.56	$128,214.04	$116,974.80	$89,823.18	$206,797.97	
Total debt service		$52,522.94	$49,977.84	$102,500.78	$75,806.31	$72,132.97	$147,939.28	$128,329.25	$122,110.81	$250,440.06	
Construction fund	7-2	$48,500.00			$70,000.00			$118,500.00			
Par amount		$52,522.94			$75,806.31			$128,329.25			

Source: DKMG, CHA, 2020.

Table 7-8 – Application of CFCs
(in 000s)

	Source Table	Total	PAL 1				PAL 2				
			2020	2021	2022	2023	2024	2025	2026	2027	2028
Enplanements	7-1		2,038.2	2,072.3	2,104.7	2,115.4	2,168.2	2,220.8	2,273.2	2,325.3	2,377.0
% O&D of enplanements			97.0%	97.0%	97.0%	97.0%	97.0%	97.0%	97.0%	97.0%	97.0%
Total O&D enplanements			$1,977.03	$2,010.12	$2,041.54	$2,051.96	$2,103.13	$2,154.18	$2,205.00	$2,255.56	$2,305.68
% visiting passengers (a)			$0.37	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37	$0.37
Total visiting passengers			$731.50	$743.74	$755.37	$759.23	$778.16	$797.05	$815.85	$834.56	$853.10
Total transactions			$384.75	$391.19	$397.30	$399.33	$409.29	$419.22	$429.12	$438.95	$448.71
% of visiting passengers renting cars (b)			$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53	$0.53
Average days per rental			$3.86	$3.86	$3.86	$3.86	$3.86	$3.86	$3.86	$3.86	$3.86
Transaction days (c)			$1,483.30	$1,508.12	$1,531.70	$1,539.52	$1,577.90	$1,616.21	$1,654.34	$1,692.27	$1,729.87
CFC per transaction day			$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00	$2.00
CFC revenue			$2,967.00	$3,016.00	$3,063.00	$3,079.00	$3,156.00	$3,232.00	$3,309.00	$3,384.00	$3,460.00
Cumulative				$5,983.00	$9,046.00	$12,125.00	$15,281.00	$18,513.00	$21,822.00	$25,206.00	$28,666.00
Balance in CFC Account as of 6/30/19		**$187.60**	**$187.60**	**$1,969.81**	**$3,618.14**	**$5,283.14**	**$6,584.66**	**$7,946.51**	**$9,367.51**	**$10,849.16**	**$388.65**
Plus: CFC revenue		**$28,666.00**	**$2,967.00**	**$3,016.00**	**$3,063.00**	**$3,079.00**	**$3,156.00**	**$3,232.00**	**$3,309.00**	**$3,384.00**	**$3,460.00**
Less: CFC eligible debt service											
Series 2019 Bonds	**7-10**	**($3,430.58)**	**$0.00**	**$0.00**	**($180.00)**	**($542.48)**	**($542.15)**	**($542.00)**	**($541.36)**	**($541.50)**	**($541.09)**
Less: CIP funded with CFC pay-go	**7-2**	**($12,166.67)**	**$0.00**	**($166.67)**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**($12,000.00)**	**$0.00**
Less: rental car operating expenses		**($11,268.78)**	**($1,184.78)**	**($1,201.00)**	**($1,218.00)**	**($1,235.00)**	**($1,252.00)**	**($1,269.00)**	**($1,286.00)**	**($1,303.00)**	**($1,320.00)**
Ending balance		**$1,987.56**	**$1,969.81**	**$3,618.14**	**$5,283.14**	**$6,584.66**	**$7,946.51**	**$9,367.51**	**$10,849.16**	**$388.65**	**$1,987.56**

(a) Per Table 3 of Characteristics of Passengers Using Norfolk International Airport 2017, prepared by Bonney & Company.
(b) Based on the average of FY 2016 through FY 2019.
(c) Transaction days are forecasted with enplanement growth.
Source: DKMG, CHA, 2020.

Table 7-9 – Operating Expenses (in 000s)

	Actual	PAL 1				PAL 2				
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Summary by line item										
Salaries and fringe benefits	$17,041.38	$17,791.75	$18,041.00	$18,293.00	$18,549.00	$18,808.00	$19,071.00	$19,338.00	$19,609.00	$19,882.00
Maintenance and repairs	$2,993.53	$3,706.40	$3,758.00	$3,810.00	$3,863.00	$3,917.00	$3,972.00	$4,027.00	$4,083.00	$4,140.00
Payment to City (a)	$2,500.00	$2,500.00	$2,650.00	$2,650.00	$2,650.00	$2,650.00	$2,650.00	$2,800.00	$2,800.00	$2,800.00
Other expenses										
Security and other services	$3,957.95	$4,303.76	$4,363.00	$4,424.00	$4,485.00	$4,547.00	$4,611.00	$4,676.00	$4,742.00	$4,808.00
Utilities	$2,780.34	$2,791.22	$2,829.00	$2,868.00	$2,907.00	$2,947.00	$2,988.00	$3,030.00	$3,073.00	$3,117.00
Professional services, administrative, advertising, insurance, sanitation, etc.	$4,211.60	$5,179.58	$5,251.00	$5,324.00	$5,398.00	$5,472.00	$5,548.00	$5,625.00	$5,705.00	$5,785.00
Increase due to terminal expansion (b)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Decommissioning of shuttle buses (c)	$0.00	$0.00	$0.00	($600.00)	($608.00)	($617.00)	($626.00)	($635.00)	($644.00)	($653.00)
Total Operating Expenses	**$33,484.81**	**$36,272.71**	**$36,892.00**	**$36,769.00**	**$37,244.00**	**$37,724.00**	**$38,214.00**	**$38,861.00**	**$39,368.00**	**$39,879.00**
Summary by cost center										
Airfield	$2,556.22	$2,085.20	$2,114.00	$2,144.00	$2,175.00	$2,206.00	$2,238.00	$2,270.00	$2,302.00	$2,335.00
Terminal	$4,624.57	$4,664.50	$4,730.00	$4,796.00	$4,862.00	$4,930.00	$4,998.00	$5,068.00	$5,139.00	$5,211.00
Ground Transportation	$6,105.38	$6,672.14	$6,765.00	$6,260.00	$6,348.00	$6,436.00	$6,525.00	$6,616.00	$6,710.00	$6,805.00
Other	$0.00	$172.56	$175.00	$178.00	$181.00	$184.00	$187.00	$190.00	$193.00	$196.00
Total direct	$13,286.17	$13,594.40	$13,784.00	$13,378.00	$13,566.00	$13,756.00	$13,948.00	$14,144.00	$14,344.00	$14,547.00
Maintenance - Field	$1,509.72	$1,341.25	$1,360.00	$1,379.00	$1,398.00	$1,417.00	$1,437.00	$1,457.00	$1,477.00	$1,497.00
Maintenance - Building	$1,581.05	$1,584.75	$1,607.00	$1,630.00	$1,653.00	$1,676.00	$1,700.00	$1,724.00	$1,748.00	$1,773.00
Janitorial	$2,239.28	$2,343.60	$2,376.00	$2,408.00	$2,441.00	$2,474.00	$2,508.00	$2,543.00	$2,578.00	$2,613.00
Police	$5,389.47	$5,562.14	$5,640.00	$5,718.00	$5,798.00	$5,880.00	$5,963.00	$6,047.00	$6,132.00	$6,217.00
Fire	$3,168.76	$3,054.20	$3,096.00	$3,138.00	$3,180.00	$3,223.00	$3,267.00	$3,312.00	$3,358.00	$3,404.00
Administrative	$3,810.35	$6,292.37	$6,379.00	$6,468.00	$6,558.00	$6,648.00	$6,741.00	$6,834.00	$6,931.00	$7,028.00
Payment to City	$2,500.00	$2,500.00	$2,650.00	$2,650.00	$2,650.00	$2,650.00	$2,650.00	$2,800.00	$2,800.00	$2,800.00
Total indirect	$20,198.64	$22,678.31	$23,108.00	$23,391.00	$23,678.00	$23,968.00	$24,266.00	$24,717.00	$25,024.00	$25,332.00
Total Operating Expenses	**$33,484.81**	**$36,272.71**	**$36,892.00**	**$36,769.00**	**$37,244.00**	**$37,724.00**	**$38,214.00**	**$38,861.00**	**$39,368.00**	**$39,879.00**
% Change		**8.3%**	**1.7%**	**-0.3%**	**1.3%**	**1.3%**	**1.3%**	**1.7%**	**1.3%**	**1.3%**
CAGR from 2020					**0.9%**					**1.2%**
Allocation of indirect for rates & charges										
Airfield		$5,755.83	$5,852.56	$5,958.68	$6,034.64	$6,111.58	$6,191.03	$6,293.92	$6,375.81	$6,457.97
Terminal		$11,463.85	$11,646.87	$11,865.02	$12,021.96	$12,180.79	$12,343.60	$12,539.18	$12,706.53	$12,874.54
Ground Transportation		$4,855.41	$4,990.51	$4,939.94	$4,987.23	$5,034.55	$5,083.23	$5,220.30	$5,270.86	$5,321.50
Other		$603.22	$618.06	$627.36	$634.17	$641.08	$648.14	$663.60	$670.80	$677.98
Total indirect		**$22,678.31**	**$23,108.00**	**$23,391.00**	**$23,678.00**	**$23,968.00**	**$24,266.00**	**$24,717.00**	**$25,024.00**	**$25,332.00**

(a) Increases in the City Payment of $150,000 every five years based on the Authority's agreement with the City. This agreement expires in 2024; however, this analysis assumes that the City Payments will continue and increase per the existing agreement.

(b) Operating expenses are projected to increase in PAL 3 and PAL 4 to account for the maintenance and operation of the new and expanded terminal facilities.

(c) A reduction of $600,000 in 2022 to reflect the decommissioning of the employee parking lot shuttle buses since the employees will be parking in the garages upon parking garage D's completion.

Sources: Authority's Basic Financial Statements for FY ended June 30, 2019, Authority's budget for FY 2020, DKMG Consulting LLC (FY 2021 - FY 2038), CHA, 2020.

Table 7-10 – Outstanding Debt Service Requirement (in 000s)

	Actual	PAL 1				PAL 2				
	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Series 2011A	$2,120.93	$2,127.85	$2,119.53	$2,117.90	$2,124.20	$0.00	$0.00	$0.00	$0.00	$0.00
Series 2011B (a)	$893.21	$891.28	$891.51	$899.34	$899.51	$876.60	$871.48	$605.49	$0.00	$0.00
Series 2011C	$1,204.59	$1,204.59	$1,204.59	$1,204.59	$1,204.59	$3,520.21	$3,513.59	$3,510.96	$3,506.96	$3,517.03
Series 2019 Bonds (b)	$0.00	$0.00	$0.00	$1,360.88	$4,101.38	$4,098.88	$4,097.75	$4,092.88	$4,094.00	$4,090.88
Total Debt Service	**$4,218.73**	**$4,223.72**	**$4,215.63**	**$5,582.70**	**$8,329.68**	**$8,495.69**	**$8,482.81**	**$8,209.33**	**$7,600.96**	**$7,607.91**
Summary by funding source										
Summary for debt service coverage (c)										
Authority funded	$3,102.49	$4,223.72	$4,215.63	$5,402.70	$7,787.20	$7,953.54	$7,940.81	$7,667.97	$7,059.46	$7,066.82
CFC eligible	$0.00	$0.00	$0.00	$180.00	$542.48	$542.15	$542.00	$541.36	$541.50	$541.09
PFC eligible										
Series 2019 Bonds (d)	$1,116.24	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	**$4,218.73**	**$4,223.72**	**$4,215.63**	**$5,582.70**	**$8,329.68**	**$8,495.69**	**$8,482.81**	**$8,209.33**	**$7,600.96**	**$7,607.91**
Summary for airline rates and charges (c)										
Authority funded										
Airfield	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Terminal	$1,444.42	$1,457.80	$1,489.11	$1,491.21	$1,504.75	$1,499.87	$1,228.95	$607.85	$608.32	$608.72
Ground transportation	$1,713.39	$2,820.59	$2,798.75	$6,756.33	$6,564.58	$6,562.55	$6,560.11	$6,563.38	$6,564.52	$6,566.66
CFC eligible	$0.00	$0.00	$0.00	$180.00	$542.48	$542.15	$542.00	$541.36	$541.50	$541.09
PFC eligible	$1,116.24	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total	**$4,274.05**	**$4,278.39**	**$4,287.86**	**$8,427.54**	**$8,611.81**	**$8,604.56**	**$8,331.06**	**$7,712.59**	**$7,714.34**	**$7,716.48**

(a) A portion of the Series 2011B Bond debt service is PFC eligible and was approved in PFC Application #2.
(b) The Series 2019 Bond Debt Service is shown net of capitalized interest.
(c) For the calculation of debt service coverage, the principal and interest payments are the sum of July of the prior calendar year and January of the current calendar year. For the calculation of airline rate and charges, the principal and interest payments are the sum of January and July of the current year.
(d) The maximum PFC eligibility for PFC Application #2 was reached for the Series 2011B Bonds through the PFC contribution made in FY 2019. Since no PFC contributions were made in FY 2018, the remaining PFC eligibility amount applied in FY 2019 to achieve full eligibility was greater than the Series 2011B Bond debt service payment for that year.
Source: Authority records, DKMG, CHA, 2020.

Table 7-11 – Future Debt Service Requirement (in 000s)

Fiscal Year	Source Table	Series 2021 Bonds			Series 2025 Bonds			Total			Allocation to Cost Centers							Cumulative
		Principal	Interest (a)	Total	Principal	Interest (a)	Total	Principal	Interest (a)	Total	Airfield	Terminal	Ground Trans	Other	Cargo	General Aviation	Total	
2020		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2021		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2022		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
2023		$270.32	$765.02	$1,035.34	$0.00	$0.00	$0.00	$270.32	$765.02	$1,035.34	$0.00	$0.00	$796.42	$238.92	$0.00	$0.00	$1,035.34	$1,035.34
2024		$283.84	$751.92	$1,035.76	$0.00	$0.00	$0.00	$283.84	$751.92	$1,035.76	$0.00	$0.00	$796.74	$239.02	$0.00	$0.00	$1,035.76	$2,071.10
2025		$298.03	$738.17	$1,036.20	$0.00	$0.00	$0.00	$298.03	$738.17	$1,036.20	$0.00	$0.00	$797.07	$239.12	$0.00	$0.00	$1,036.20	$3,107.30
2026		$312.93	$723.72	$1,036.66	$0.00	$0.00	$0.00	$312.93	$723.72	$1,036.66	$0.00	$0.00	$797.43	$239.23	$0.00	$0.00	$1,036.66	$4,143.95
2027		$328.58	$708.56	$1,037.14	$1,806.18	$5,111.53	$6,917.70	$2,134.75	$5,820.09	$7,954.84	$0.00	$0.00	$797.80	$239.34	$4,472.71	$2,445.00	$7,954.84	$12,098.79
2028		$345.01	$692.64	$1,037.65	$1,896.48	$5,024.01	$6,920.49	$2,241.49	$5,716.64	$7,958.14	$0.00	$0.00	$798.19	$239.46	$4,474.51	$2,445.98	$7,958.14	$20,056.93
Total through PAL 2		1,838.71	4,380.03	6,218.74	3,702.66	10,135.53	13,838.19	5,541.37	14,515.56	20,056.93	0.00	0.00	4,783.64	1,435.09	8,947.21	4,890.98	20,056.93	
Remaining years		13,948.80	9,075.60	23,024.40	101,782.68	79,769.16	181,551.85	115,731.49	88,844.76	204,576.25	0.00	0.00	17,711.08	5,313.32	117,384.04	64,167.81	204,576.25	
Total debt service		15,787.51	13,455.63	29,243.14	105,485.34	89,904.70	195,390.04	121,272.85	103,360.32	224,633.18	0.00	0.00	22,494.72	6,748.42	126,331.25	69,058.79	224,633.18	
Construction fund	7-2	13,000.00			86,860.40			99,860.40										
Par amount		15,787.51			105,485.34			121,272.85										

(a) Net of capitalized interest.
Source: DKMG, CHA, 2020.

Table 7-12 – Capital Improvement Amortization (in 000s)

	Source Table	PAL 1				PAL 2				
		2020	2021	2022	2023	2024	2025	2026	2027	2028
CIP to be Amortized										
Project costs	7-2	$1,338.00	$6,325.33	$9,100.00	$3,000.00	$2,800.00	$500.00	$2,500.00	$500.00	$500.00
Cumulative	7-2				$19,763.33					$6,800.00
Amortization										
Prior year amortization		$1,391.39	$1,253.35	$1,129.68	$1,053.94	$1,040.85	$865.80	$817.83	$808.13	$793.85
CIP amortization (a)		$0.00	$0.00	$156.85	$898.38	$1,965.17	$2,316.87	$2,645.11	$2,703.73	$2,996.80
Total amortization		$1,391.39	$1,253.35	$1,286.53	$1,952.32	$3,006.02	$3,182.66	$3,462.94	$3,511.86	$3,790.65
Amortization by cost center										
Direct cost centers										
Airfield		$164.59	$127.66	$148.57	$234.62	$1,060.84	$1,148.20	$1,238.16	$1,249.75	$1,333.16
Terminal		$884.45	$799.95	$814.41	$1,394.15	$1,504.40	$1,492.60	$1,587.76	$1,605.55	$1,703.24
Ground Transportation		$339.55	$322.95	$320.77	$320.77	$438.00	$541.86	$637.02	$656.56	$754.25
Other		$2.79	$2.79	$2.79	$2.79	$2.79	$0.00	$0.00	$0.00	$0.00
Total amortization		$1,391.39	$1,253.35	$1,286.53	$1,952.32	$3,006.02	$3,182.66	$3,462.94	$3,511.86	$3,790.65
% Change			-9.9%	2.6%	51.8%	54.0%	5.9%	8.8%	1.4%	7.9%

(a) Amortization begins when project is placed into service, which is assumed to be two years after the project start date. The projects are amortized over their useful life at 3%, reflecting the Revenue Bond Index as of January 30, 2020 rounded up.
Source: Autohrity's budget for FY 2020

Table 7-13 – Airline Rates and Charges

	Source Table	PAL 1				PAL 2				
		2020	2021	2022	2023	2024	2025	2026	2027	2028
Landing Fee Rate										
Operating Expenses										
Direct	7-9	$2,085.20	$2,114.00	$2,144.00	$2,175.00	$2,206.00	$2,238.00	$2,270.00	$2,302.00	$2,335.00
Indirect	7-9	$5,755.83	$5,852.56	$5,958.68	$6,034.64	$6,111.58	$6,191.03	$6,293.92	$6,375.81	$6,457.97
Debt Service Requirement										
Outstanding	7-10	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Future	7-11	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Amortization	7-12	$164.59	$127.66	$148.57	$234.62	$1,060.84	$1,148.20	$1,238.16	$1,249.75	$1,333.16
Total requirement		$8,005.62	$8,094.22	$8,251.24	$8,444.26	$9,378.42	$9,577.23	$9,802.09	$9,927.57	$10,126.14
Landed weight	7-1	$2,551.35	$2,572.60	$2,594.11	$2,614.22	$2,617.39	$2,656.00	$2,694.35	$2,732.21	$2,770.53
Signatory landing fee rate		**$3.14**	**$3.15**	**$3.18**	**$3.23**	**$3.58**	**$3.61**	**$3.64**	**$3.63**	**$3.65**
Non-signatory landing fee rate		$3.92	$3.93	$3.98	$4.04	$4.48	$4.51	$4.55	$4.54	$4.57
Landing fee revenue										
Signatory		$6,643.03	$6,716.55	$6,846.85	$7,007.01	$7,782.17	$7,947.14	$8,133.73	$8,237.85	$8,402.63
Cargo and non-signatory		$1,061.27	$1,377.67	$1,404.40	$1,437.25	$1,596.25	$1,630.09	$1,668.36	$1,689.72	$1,723.51
Total landing fee revenue		$7,704.30	$8,094.22	$8,251.24	$8,444.26	$9,378.42	$9,577.23	$9,802.09	$9,927.57	$10,126.14
Terminal Rental Rate										
Operating Expenses										
Direct	7-9	$4,664.50	$4,730.00	$4,796.00	$4,862.00	$4,930.00	$4,998.00	$5,068.00	$5,139.00	$5,211.00
Indirect	7-9	$11,463.85	$11,646.87	$11,865.02	$12,021.96	$12,180.79	$12,343.60	$12,539.18	$12,706.53	$12,874.54
Debt Service Requirement										
Outstanding	7-10	$1,457.80	$1,489.11	$1,491.21	$1,504.75	$1,499.87	$1,228.95	$607.85	$608.32	$608.72
Future	7-11	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Amortization		$884.45	$799.95	$814.41	$1,394.15	$1,504.40	$1,492.60	$1,587.76	$1,605.55	$1,703.24
Less telephone reimbursements	7-14	($40.00)	($41.00)	($42.00)	($43.00)	($44.00)	($45.00)	($46.00)	($47.00)	($48.00)
Net requirement		$18,430.60	$18,624.94	$18,924.64	$19,739.86	$20,071.06	$20,018.15	$19,756.79	$20,012.39	$20,349.50
Total useable terminal space		$485.89	$485.89	$485.89	$485.89	$485.89	$485.89	$485.89	$485.89	$485.89
Terminal Rental Rate		**$37.93**	**$38.33**	**$38.95**	**$40.63**	**$41.31**	**$41.20**	**$40.66**	**$41.19**	**$41.88**
Airline leased space		$125.45	$125.45	$125.45	$125.45	$125.45	$125.45	$125.45	$125.45	$125.45
Terminal rental revenue		$4,758.48	$4,808.65	$4,886.03	$5,096.51	$5,182.01	$5,168.36	$5,100.88	$5,166.87	$5,253.90
Airline cost per enplanement										
Landing fee revenue		$6,643.03	$6,716.55	$6,846.85	$7,007.01	$7,782.17	$7,947.14	$8,133.73	$8,237.85	$8,402.63
Terminal rental revenue		$4,758.48	$4,808.65	$4,886.03	$5,096.51	$5,182.01	$5,168.36	$5,100.88	$5,166.87	$5,253.90
Telephone reimbursement	7-14	$40.00	$41.00	$42.00	$43.00	$44.00	$45.00	$46.00	$47.00	$48.00
Less: airline's share of surplus revenue		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total		$11,441.51	$11,566.20	$11,774.87	$12,146.52	$13,008.19	$13,160.50	$13,280.60	$13,451.72	$13,704.53
Enplaned passengers	7-1	$2,038.18	$2,072.29	$2,104.68	$2,115.42	$2,168.17	$2,220.80	$2,273.20	$2,325.32	$2,376.99
Airline cost per enplaned passengers		**$5.61**	**$5.58**	**$5.59**	**$5.74**	**$6.00**	**$5.93**	**$5.84**	**$5.78**	**$5.77**

(a) Reflects the years when future debt service comes on line.
Source: DKMG, CHA, 2020

Table 7-14 – Operating Revenues (in 000s)

	Source Table	Actual	PAL 1				PAL 2				
		2019	2020	2021	2022	2023	2024	2025	2026	2027	2028
Parking											
Public parking		$16,689.3	$17,950.0	$18,250.0	$18,535.0	$18,630.0	$19,095.0	$19,559.0	$20,020.0	$20,479.0	$20,934.0
Employee & limo parking (a)		$237.8	$234.5	$238.0	$361.5	$367.0	$372.0	$377.0	$382.0	$387.0	$392.0
Additional parking revenues											
Due to enhanced parking amenities (b)		$0.0	$0.0	$0.0	$232.8	$234.0	$240.0	$246.0	$252.0	$258.0	$264.0
Due to rate increase (c)		$0.0	$0.0	$0.0	$2,605.0	$2,618.0	$2,683.0	$2,749.0	$2,813.0	$5,755.0	$5,883.0
Total parking		$16,927.1	$18,184.5	$18,488.0	$21,734.3	$21,849.0	$22,390.0	$22,931.0	$23,467.0	$26,879.0	$27,473.0
% Change			7.4%	1.7%	17.6%	0.5%	2.5%	2.4%	2.3%	14.5%	2.2%
Landing fees		$6,175.57	$7,704.30	$8,094.22	$8,251.24	$8,444.26	$9,378.42	$9,577.23	$9,802.09	$9,927.57	$10,126.14
% Change			24.8%	5.1%	1.9%	2.3%	11.1%	2.1%	2.3%	1.3%	2.0%
Rent											
Airline space rent		$3,767.61	$4,758.48	$4,808.65	$4,886.03	$5,096.51	$5,182.01	$5,168.36	$5,100.88	$5,166.87	$5,253.90
Building rent		$1,133.71	$1,165.72	$1,165.72	$1,165.72	$1,165.72	$1,165.72	$1,165.72	$1,165.72	$1,165.72	$1,165.72
Fuel farm rent		$278.28	$300.00	$304.20	$308.50	$312.80	$317.20	$321.60	$326.10	$330.70	$335.30
Air cargo terminal		$232.16	$210.00	$213.00	$216.00	$219.00	$222.00	$225.00	$228.00	$231.00	$234.00
Passenger loading bridge loan		$106.04	$106.04	$106.04	$106.04	$106.04	$106.04	$106.04	$106.04	$106.04	$106.04
Common use gates		$0.00	$100.00	$100.00	$100.00	$100.00	$100.00	$100.00	$100.00	$100.00	$100.00
Other		$859.99	$839.70	$852.00	$863.00	$875.00	$887.00	$899.00	$911.00	$923.00	$935.00
Increase due to new cargo building rentals (d)	7-11	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$4,472.71	$4,474.51
Increase due to new GA hangar rentals (d)	7-11	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$2,445.00	$2,445.98
Total rent		$6,377.79	$7,479.93	$7,549.61	$7,645.29	$7,875.06	$7,979.97	$7,985.71	$7,937.73	$14,941.03	$15,050.45
% Change			17.3%	0.9%	1.3%	3.0%	1.3%	0.1%	-0.6%	88.2%	0.7%
Rental car		$7,246.77	$7,000.00	$7,098.00	$7,197.00	$7,298.00	$7,400.00	$7,504.00	$7,609.00	$7,716.00	$7,824.00
% Change			-3.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%	1.4%
Concessions											
Food services		$1,468.55	$1,800.00	$1,830.00	$1,859.00	$1,868.00	$1,915.00	$1,961.00	$2,007.00	$2,053.00	$2,099.00
Newsstand		$1,107.74	$950.00	$966.00	$981.00	$986.00	$1,011.00	$1,036.00	$1,060.00	$1,084.00	$1,108.00
Fixed base operator		$360.84	$330.00	$335.00	$340.00	$345.00	$350.00	$355.00	$360.00	$365.00	$370.00
Advertising		$233.82	$250.00	$254.00	$258.00	$259.00	$265.00	$271.00	$277.00	$283.00	$289.00
Catering		$103.85	$115.00	$117.00	$119.00	$120.00	$123.00	$126.00	$129.00	$132.00	$135.00
Other		$55.17	$53.00	$54.00	$55.00	$55.00	$56.00	$57.00	$58.00	$59.00	$60.00
Increase due to new concession space (e)		$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Total concessions		$3,329.96	$3,498.00	$3,556.00	$3,612.00	$3,633.00	$3,720.00	$3,806.00	$3,891.00	$3,976.00	$4,061.00
% Change			5.0%	1.7%	1.6%	0.6%	2.4%	2.3%	2.2%	2.2%	2.1%
Other											
Ground transportation revenues		$937.89	$855.00	$868.00	$881.00	$885.00	$906.00	$927.00	$948.00	$968.00	$988.00
Reimbursements - telephones		$38.88	$40.00	$41.00	$42.00	$43.00	$44.00	$45.00	$46.00	$47.00	$48.00
Other		$187.08	$44.00	$45.00	$46.00	$47.00	$48.00	$49.00	$50.00	$51.00	$52.00
Total other		$1,163.85	$939.00	$954.00	$969.00	$975.00	$998.00	$1,021.00	$1,044.00	$1,066.00	$1,088.00
% Change			-19.3%	1.6%	1.6%	0.6%	2.4%	2.3%	2.3%	2.1%	2.1%
Total operating revenue		**$41,221.03**	**$44,805.73**	**$45,739.83**	**$49,408.83**	**$50,074.32**	**$51,866.39**	**$52,824.94**	**$53,750.82**	**$64,505.60**	**$65,622.59**
% Change			**8.7%**	**2.1%**	**8.0%**	**1.3%**	**3.6%**	**1.8%**	**1.8%**	**20.0%**	**1.7%**
CAGR from 2020						**3.8%**					**4.9%**

(a) The employee parking monthly fee is estimated to increase from $20 per month to $30 in FY 2022 since the employees will be parking in a garage instead of the surface lot.
(b) Once the Parking Garage D is complete, the Authority intends on instituting premium parking programs that could potentially increase parking revenues. Also, there will be a slight increase in available parking spaces that may increase revenues. After 2022, additional parking revenues are forecasted to grow with enplanements.
(c) Assumes a $1.00 rate increase in FY 2022 to coincide with the completion of parking garage D and then every five years thereafter.
(d) Air cargo and general aviation terminal rentals are increased in FY 2027 to reflect additional rent anticipated once the new facilities are complete. The revenue increase is equal to the debt service required to fund those facilities.
(e) Increased concession revenues due to the new concession space resulting from the terminal expansion.
Sources: Authority's Basic Financial Statements for FY ended June 30, 2019, Authority's budget for FY 2020, DKMG Consulting LLC (FY 2021 - FY 2038), CHA, 2020.

Table 7-15 – Pro Forma Cash Flow (in 000s)

	Source Table	Total	Actual 2019	PAL 1				PAL 2				
				2020	2021	2022	2023	2024	2025	2026	2027	2028
Operating revenues	7-14		$41,221.03	$44,805.73	$45,739.83	$49,408.83	$50,074.32	$51,866.39	$52,824.94	$53,750.82	$64,505.60	$65,622.59
Non-operating revenues			$6,213.98	$5,753.50	$5,805.00	$5,854.00	$5,872.00	$5,951.00	$6,029.00	$6,108.00	$6,185.00	$6,263.00
General Revenues			$47,435.02	$50,559.23	$51,544.83	$55,262.83	$55,946.32	$57,817.39	$58,853.94	$59,858.82	$70,690.60	$71,885.59
Less: Operating Expenses	7-9		($33,484.81)	($36,272.71)	($36,892.00)	($36,769.00)	($37,244.00)	($37,724.00)	($38,214.00)	($38,861.00)	($39,368.00)	($39,879.00)
Net Revenues			$13,950.21	$14,286.52	$14,652.83	$18,493.83	$18,702.32	$20,093.39	$20,639.94	$20,997.82	$31,322.60	$32,006.59
Less: Debt Service Requirement	7-10											
Outstanding debt service			($4,218.73)	($4,223.72)	($4,215.63)	($5,582.70)	($8,329.68)	($8,495.69)	($8,482.81)	($8,209.33)	($7,600.96)	($7,607.91)
Plus: PFC-eligible debt service			$1,116.24	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Future debt service			$0.00	$0.00	$0.00	$0.00	($1,035.34)	($1,035.76)	($1,036.20)	($1,036.66)	($7,954.84)	($7,958.14)
Total Debt Service Requirement			($3,102.49)	($4,223.72)	($4,215.63)	($5,582.70)	($9,365.02)	($9,531.45)	($9,519.01)	($9,245.98)	($15,555.80)	($15,566.04)
Less: VRA Loan Payments (a)			($92.29)	($92.29)	($15.38)	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00	$0.00
Transfer to the General Reserve Fund			$10,755.43	$9,970.52	$10,421.82	$12,911.13	$9,337.31	$10,561.95	$11,120.93	$11,751.84	$15,766.79	$16,440.55
Cumulative					$20,392.34	$33,303.47	$42,640.77	$53,202.72	$64,323.65	$76,075.49	$91,842.28	$108,282.83
General Reserve Fund												
Beginning balance (balance as of 6/30/19)		**$26,973.42**		**$26,973.42**	**$30,818.50**	**$30,594.98**	**$32,406.11**	**$36,743.42**	**$42,505.37**	**$51,126.30**	**$58,378.14**	**$71,644.93**
Plus: Transfer from the Revenue Fund		**$108,282.83**		**$9,970.52**	**$10,421.82**	**$12,911.13**	**$9,337.31**	**$10,561.95**	**$11,120.93**	**$11,751.84**	**$15,766.79**	**$16,440.55**
Less: Authority funded CIP												
Amortized in the rate base	**7-2**	**($26,563.33)**		**($1,338.00)**	**($6,325.33)**	**($9,100.00)**	**($3,000.00)**	**($2,800.00)**	**($500.00)**	**($2,500.00)**	**($500.00)**	**($500.00)**
Non-rate base	**7-2**	**($4,680.00)**		**($2,360.00)**	**($2,320.00)**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Less: transfer to State Grant fund												
Annual amount		**($18,000.00)**		**($2,000.00)**	**($2,000.00)**	**($2,000.00)**	**($2,000.00)**	**($2,000.00)**	**($2,000.00)**	**($2,000.00)**	**($2,000.00)**	**($2,000.00)**
Virginia State Block Grant (b)		**($427.44)**		**($427.44)**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**	**$0.00**
Ending balance		**$85,585.47**		**$30,818.50**	**$30,594.98**	**$32,406.11**	**$36,743.42**	**$42,505.37**	**$51,126.30**	**$58,378.14**	**$71,644.93**	**$85,585.47**

(a) The Virginia Resources Authority (VRA) made a loan to the Authority in Feburary 2001 to fund the construction related to Hangar 4 and ground support equipment shop.
(b) The Commonwealth of Virginia made a loan to the Authority in 2009 to finance the site work project to accommodate parking garage D.
Source: DKMG, CHA, 2020.

Table 7-16 – Debt Service Coverage and Days Cash on Hand (in 000s)

	Source Table	PAL 1				PAL 2				
		2020	2021	2022	2023	2024	2025	2026	2027	2028
Calculation of debt service coverage ratio										
Net Revenues	7-15	$14,286.52	$14,652.83	$18,493.83	$18,702.32	$20,093.39	$20,639.94	$20,997.82	$31,322.60	$32,006.59
Total Debt Service Requirement	7-15	$4,223.72	$4,215.63	$5,582.70	$9,365.02	$9,531.45	$9,519.01	$9,245.98	$15,555.80	$15,566.04
Debt service coverage ratio		**338.2%**	**347.6%**	**331.3%**	**199.7%**	**210.8%**	**216.8%**	**227.1%**	**201.4%**	**205.6%**
Days cash on hand										
Current year unrestricted cash & equivalents	7-15	$26,973.42	$30,818.50	$30,594.98	$32,406.11	$36,743.42	$42,505.37	$51,126.30	$58,378.14	$71,644.93
Total O&M Expenses	7-9	$36,272.71	$36,892.00	$36,769.00	$37,244.00	$37,724.00	$38,214.00	$38,861.00	$39,368.00	$39,879.00
Ratio		0.74	0.84	0.83	0.87	0.97	1.11	1.32	1.48	1.80
Number of days		366	365	365	365	366	365	365	365	366
Days cash on hand		**272**	**305**	**304**	**318**	**356**	**406**	**480**	**541**	**658**
Average					**300**					**488**

Source: DKMG, CHA, 2020.

APPENDIX A – HISTORICAL DATA SETS

Table A-17 – Socioeconomic Factors

Fiscal Year	Population (000)	Employment (000)	Income ($)
2008	1,839.3	1,123.0	37,255
2009	1,844.6	1,088.5	36,975
2010	1,856.3	1,074.2	37,187
2011	1,862.8	1,074.9	38,565
2012	1,873.9	1,078.3	39,961
2013	1,881.2	1,086.0	39,822
2014	1,892.0	1,094.6	40,807
2015	1,898.8	1,112.5	42,291
2016	1,909.9	1,126.6	43,447
2017	1,922.5	1,140.6	44,649

Source: Woods & Poole Economics, Inc., CHA, 2018.

Table A-18 – Commercial Activity

Fiscal Year	Enplanements	Operations	Scheduled Seats	Average Seats Per Departure	Load Factors
2008	1,841,881	63,716	5,069,307	79.6	72.9%
2009	1,740,349	58,477	4,634,004	79.2	75.2%
2010	1,697,663	57,038	4,629,310	81.2	73.7%
2011	1,658,696	57,614	4,642,508	80.6	71.8%
2012	1,669,997	55,522	4,559,278	82.1	73.5%
2013	1,615,283	53,259	4,552,460	85.5	71.3%
2014	1,534,316	47,070	3,900,974	82.9	79.1%
2015	1,499,400	43,469	3,591,391	82.6	83.8%
2016	1,603,159	47,273	4,008,096	84.8	80.4%
2017	1,672,024	47,195	4,241,674	89.8	79.0%

Source: NAA, CHA, 2018.

Table A-19 – FAA TAFs: Enplanements

Fiscal Year	National	Regional			State
		RIC	PHF	PGV	
2008	747,466,798	1,760,914	512,799	49,453	4,618,145
2009	695,488,533	1,666,022	492,548	58,238	4,441,971
2010	702,818,621	1,639,557	508,668	60,544	4,404,345
2011	722,926,202	1,597,152	527,549	63,124	4,358,236
2012	731,053,513	1,583,114	365,600	61,524	4,226,369
2013	734,336,521	1,583,315	273,414	59,300	4,070,466
2014	753,529,877	1,647,904	265,197	60,281	4,070,499
2015	786,384,586	1,718,820	208,304	57,550	4,057,875
2016	822,586,152	1,763,247	200,223	50,044	4,222,748
2017	846,556,739	1,799,021	198,229	49,851	4,369,186

Source: NAA, CHA, 2018.

Table A-20 – ORF's Percent Market Shares: Enplanements

Fiscal Year	National Market Share	State Market Share	Regional Market Share
2008	0.2%	7.4%	44.2%
2009	0.3%	7.2%	44.0%
2010	0.2%	7.0%	43.5%
2011	0.2%	6.8%	43.1%
2012	0.2%	6.8%	45.4%
2013	0.2%	6.6%	45.7%
2014	0.2%	6.3%	43.7%
2015	0.2%	5.9%	43.0%
2016	0.2%	6.1%	44.3%
2017	0.2%	6.2%	44.8%
Average	**0.2%**	**6.64%**	**44.2%**

Source: NAA, CHA, 2018.

Table A-21 – ORF's General Aviation and Military Activity

Fiscal Year	General Aviation Operations				Military Operations		
	Itinerant	Civil	With Cargo	Without Cargo	Itinerant	Local	Total
2008	34,385	11,553	45,938	43,266	774	7,004	7,778
2009	28,160	7,719	35,879	33,439	714	1,860	2,574
2010	28,477	5,558	34,035	31,423	523	873	1,396
2011	29,012	4,274	33,286	30,664	738	370	1,108
2012	27,062	3,152	30,214	27,832	1,364	79	1,443
2013	24,534	2,491	27,025	24,502	786	461	1,247
2014	25,154	4,091	29,245	26,847	1,130	203	1,333
2015	24,225	1,488	25,713	22,532	567	343	910
2016	24,265	1,943	26,208	23,230	595	13	608
2017	23,636	1,157	24,793	22,364	508	92	600

Source: Signature, NAA, CHA, 2018.

APPENDIX B – NATIONAL TAF AND PROJECTED ENPLANEMENTS[29]

Table B-1 – National TAF and Projected Enplanements

Fiscal Year	TAF (National)	TAF (ORF)	Historical Trends		Market Shares				Regressions						Air Service	
			5-Year	10-Year	Average National	Static State	Static Regional	Adjusted Static Regional	Population Based	Employment Based	Income Based	Population-Income Based	Employment-Income Based	Population-Income-Employment Based	Short-Term	Med- to Long-Term
2017	846,556,739	1,652,323	1,672,024	1,672,024	1,672,024	1,672,024	1,672,024	1,672,024	1,672,024	1,672,024	1,672,024	1,672,024	1,672,024	1,672,024	1,672,024	1,672,024
2018	887,027,038	1,815,241	1,683,609	1,655,925	1,953,884	1,723,608	1,816,656	1,812,627	1,513,586	1,657,072	1,524,971	1,546,545	1,585,688	1,575,919	1,857,487	1,857,487
2019	927,374,941	2,008,565	1,695,275	1,639,981	2,042,760	1,804,097	2,056,552	2,089,768	1,482,420	1,658,013	1,492,895	1,534,810	1,568,428	1,564,254	2,003,360	2,003,360
2020	951,340,881	2,047,023	1,707,021	1,624,190	2,095,551	1,859,352	2,103,128	2,142,823	1,451,136	1,658,949	1,456,981	1,536,042	1,543,929	1,555,429	2,038,176	2,038,176
2021	973,596,970	2,084,292	1,718,849	1,608,551	2,144,575	1,922,509	2,147,528	2,192,905	1,419,764	1,659,884	1,417,650	1,548,883	1,513,171	1,549,288	2,072,287	2,072,287
2022	995,029,034	2,116,656	1,730,758	1,593,063	2,191,784	1,980,779	2,186,663	2,237,442	1,388,284	1,660,821	1,373,932	1,576,653	1,474,471	1,546,667	2,104,678	2,104,678
2023	1,015,797,464	2,147,644	1,742,750	1,577,724	2,237,531	2,035,945	2,224,870	2,281,421	1,356,750	1,661,755	1,326,358	1,617,702	1,428,578	1,547,086	2,115,424	2,234,279
2024	1,035,068,887	2,177,805	1,754,826	1,562,533	2,279,981	2,081,165	2,261,767	2,323,698	1,325,157	1,662,685	1,274,706	1,672,798	1,375,030	1,550,688	2,168,171	2,316,173
2025	1,054,043,471	2,206,080	1,766,984	1,547,488	2,321,777	2,120,940	2,296,861	2,364,245	1,293,635	1,663,609	1,218,334	1,744,694	1,312,639	1,558,275	2,220,800	2,397,883
2026	1,073,017,630	2,233,911	1,779,228	1,532,588	2,363,572	2,158,473	2,331,610	2,404,530	1,262,251	1,664,531	1,157,959	1,831,150	1,242,797	1,569,437	2,273,199	2,479,237
2027	1,092,560,588	2,263,883	1,791,556	1,517,831	2,406,620	2,195,140	2,369,311	2,448,419	1,231,036	1,665,444	1,093,805	1,931,508	1,165,685	1,583,904	2,325,316	2,560,152
2028	1,112,650,527	2,294,704	1,803,969	1,503,217	2,450,873	2,231,077	2,407,978	2,493,366	1,200,085	1,666,352	1,025,523	2,047,371	1,080,783	1,602,247	2,376,990	2,640,381
2029	1,133,320,175	2,325,437	1,816,468	1,488,743	2,496,402	2,266,561	2,446,872	2,538,795	1,169,334	1,667,255	953,017	2,178,812	987,939	1,624,425	2,428,333	2,720,094
2030	1,154,378,676	2,357,212	1,829,054	1,474,408	2,542,789	2,302,098	2,488,029	2,587,476	1,138,820	1,668,151	876,794	2,324,206	888,031	1,650,058	2,479,279	2,799,192
2031	1,175,949,046	2,391,205	1,841,728	1,460,212	2,590,302	2,337,685	2,531,108	2,637,832	1,109,233	1,669,041	797,541	2,483,899	782,253	1,679,981	2,528,677	2,875,886
2032	1,197,790,347	2,425,236	1,854,489	1,446,152	2,638,413	2,372,788	2,574,518	2,688,756	1,080,627	1,669,923	714,480	2,660,825	669,219	1,714,987	2,576,438	2,950,038
2033	1,219,740,641	2,458,050	1,867,338	1,432,228	2,686,764	2,407,453	2,617,059	2,739,097	1,052,830	1,670,798	627,038	2,856,304	547,830	1,755,160	2,622,848	3,022,093
2034	1,242,112,645	2,492,239	1,880,276	1,418,437	2,736,043	2,442,369	2,661,048	2,790,944	1,025,896	1,671,666	534,673	3,072,452	417,129	1,801,095	2,667,816	3,091,910
2035	1,264,545,129	2,526,083	1,893,305	1,404,780	2,785,456	2,477,090	2,704,005	2,841,200	999,796	1,672,529	436,131	3,313,540	274,947	1,853,867	2,711,393	3,159,566
2036	1,287,208,236	2,559,371	1,906,423	1,391,254	2,835,377	2,512,082	2,748,216	2,894,181	974,459	1,673,388	333,123	3,573,294	124,400	1,911,876	2,753,696	3,225,245
2037	1,310,024,370	2,592,636	1,919,632	1,377,858	2,885,635	2,547,100	2,793,020	2,948,255	949,866	1,674,244	226,612	3,848,278	-32,666	1,974,331	2,794,755	3,288,992
2038	1,333,057,375	2,627,295	1,932,933	1,364,591	2,936,370	2,582,498	2,839,646	3,004,495	925,988	1,675,099	116,000	4,140,458	-197,307	2,041,693	2,834,623	3,350,889
AAGR 2018-2038	**2.1%**	**1.9%**	**0.7%**	**-1.0%**	**2.1%**	**2.0%**	**2.3%**	**2.6%**	**-2.4%**	**0.1%**	**-12.1%**	**5.0%**	**-9.9%**	**1.3%**	**2.1%**	**3.0%**
Growth 2018-2038	**50.3%**	**44.7%**	**14.8%**	**-17.6%**	**50.3%**	**49.8%**	**56.3%**	**65.8%**	**-38.8%**	**1.1%**	**-92.4%**	**167.7%**	**-112.4%**	**29.6%**	**52.1%**	**80.4%**
% Above TAF (ORF)	**-**	**-**	**1.2%**	**36.5%**	**-26.4%**	**-48.1%**	**11.8%**	**-1.7%**	**8.1%**	**14.4%**	**-64.8%**	**-36.2%**	**-95.6%**	**57.6%**	**7.9%**	**27.5%**

Source: FAA 2018 TAF, NAA, CHA, 2019.

[29] Note: Projected enplanements take into consideration recently announced, as well as potential, non-stop service routes from ORF throughout the forecast horizon.

APPENDIX C – REGRESSIONS[30]

A. Socioeconomic Regressions

- Input Variables (All data inputs were for 2008-2017)
    - Independent Variables: Data pertaining to what the regression base is (ex, population data for the Population Based Regression), Dependent Variable: Always Enplanements
- See **Appendix B** for Regression Results

Table C-2 – Socioeconomic Regression Calculations

Population Based Regression								
Regression Statistics			ANOVA					
Multiple R	0.691373306		-	*df*	*SS*	*MS*	*F*	*Significance F*
R Square	**0.48**		Regression	1	41857580913	41857580913	7.32558385	0.02679954
Adjusted R Square	0.41274668		Residual	8	45711120663	5713890083	-	-
Standard Error	75590.2777		Total	9	87568701576		-	-
Observations	10							
-	*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	6258612.841	1701700.218	3.677858635	0.00623838	2334485.101	10182740.58	2334485.101	10182740.58
X Variable 1	-2452.093837	905.9744792	-2.70658158	0.02679954	-4541.274733	-362.9129421	-4541.274733	-362.9129421
Employment Based Regression								
Regression Statistics			ANOVA					
Multiple R	0.016969827		-	*df*	*SS*	*MS*	*F*	*Significance F*
R Square	**0.00**		Regression	1	25217600.1	25217600.1	0.002304464	0.962889191
Adjusted R Square	-0.124676028		Residual	8	87543483975	10942935497	-	-
Standard Error	104608.4867		Total	9	87568701576		-	-
Observations	10							
-	*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1576459.977	1600531.282	0.984960428	0.353491286	-2114371.778	5267291.731	-2114371.778	5267291.731
X Variable 1	69.83882807	1454.829122	0.048004832	0.962889191	-3285.003143	3424.6808	-3285.003143	3424.6808
Income Regression								
Regression Statistics			ANOVA					
Multiple R	0.599749806		-	*df*	*SS*	*MS*	*F*	*Significance F*
R Square	**0.36**		Regression	1	31498447085	31498447085	4.494140056	0.066831572
Adjusted R Square	0.279662309		Residual	8	56070254490	7008781811	-	-
Standard Error	83718.46756		Total	9	87568701576		-	-
Observations	10							
-	*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	2529242.858	414050.7205	6.108533888	0.000286763	1574440.184	3484045.532	1574440.184	3484045.532
X Variable 1	-21.84677628	10.30538117	-2.119938692	0.066831572	-45.61102789	1.917475319	-45.61102789	1.917475319
Population-Income Regression								
Regression Statistics			ANOVA					
Multiple R	0.801833099		-	*df*	*SS*	*MS*	*F*	*Significance F*
R Square	**0.64**		Regression	2	56301098574	28150549287	6.302173051	0.027202566
Adjusted R Square	0.540918123		Residual	7	31267603002	4466800429	-	-
Standard Error	66834.12623		Total	9	87568701576		-	-
Observations	10							
-	*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	16912707.69	6112918.192	2.766715856	0.027825417	2457953.081	31367462.29	2457953.081	31367462.29
X Variable 1	-9757.477882	4140.824218	-2.356409586	0.050607915	-19548.97125	34.01548494	-19548.97125	34.01548494
X Variable 2	76.47469881	42.52845066	1.798200913	0.115187336	-24.08910701	177.0385046	-24.08910701	177.0385046
Employment-Income Regression								
Regression Statistics			ANOVA					
Multiple R	0.818737332		-	*df*	*SS*	*MS*	*F*	*Significance F*
R Square	**0.67**		Regression	2	58699999498	29349999749	7.116703677	0.020571891
Adjusted R Square	0.576139625		Residual	7	28868702078	4124100297	-	-
Standard Error	64219.15833		Total	9	87568701576		-	-
Observations	10							
-	*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-124870.5181	1081149.983	-0.115497868	0.911293939	-2681383.987	2431642.951	-2681383.987	2431642.951
X Variable 1	3072.715891	1196.437924	2.568220071	0.037104064	243.5897601	5901.842022	243.5897601	5901.842022
X Variable 2	-39.94376766	10.58980332	-3.771908358	0.006965532	-64.98467341	-14.90286191	-64.98467341	-14.90286191
Population-Employment-Income								
Regression Statistics			ANOVA					
Multiple R	0.84369935		-	*df*	*SS*	*MS*	*F*	*Significance F*
R Square	**0.71**		Regression	3	62333905720	20777968573	4.940313849	0.046318568
Adjusted R Square	0.567742891		Residual	6	25234795855	4205799309	-	-
Standard Error	64852.13419		Total	9	87568701576		-	-
Observations	10							
-	*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	8412714.452	9249522.175	0.909529627	0.398132958	-14220050.97	31045479.88	-14220050.97	31045479.88
X Variable 1	-5163.502956	5554.971624	-0.929528233	0.388482898	-18756.02886	8429.022944	-18756.02886	8429.022944
X Variable 2	2000.572684	1670.393864	1.197665249	0.276210037	-2086.733859	6087.879227	-2086.733859	6087.879227
X Variable 3	18.40086983	63.67251065	0.288992371	0.782312365	-137.4001511	174.2018907	-137.4001511	174.2018907

Source: NAA, CHA, 2018.

[30] Note: Projected enplanements take into consideration recently announced, as well as potential, non-stop service routes from ORF throughout the forecast horizon.

B. Air Service Regressions

Table C-3 –Air Service Regression Calculations

Short-Term Air Service: Population Based Regression

Regression Statistics	
Multiple R	0.927878484
R Square	0.86
Adjusted R Square	0.814611308
Standard Error	41302.3389
Observations	5

ANOVA					
-	*df*	*SS*	*MS*	*F*	*Significance F*
Regression	1	31688979343	31688979343	18.57628903	0.022997266
Residual	3	5117649595	1705883198		
Total	4	36806628938			

-	*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-6068715.791	2004534.63	-3.304519553	0.0455788	-13003347.71	-244700.0529	-13003347.71	-244700.0529
X Variable 1	4094.010385	1022.365361	4.310021929	0.022997266	1152.79426	7660.039993	1152.79426	7660.039993

Medium- to Long-Term Air Service: Population Based Regression

Regression Statistics	
Multiple R	0.949441091
R Square	0.90
Adjusted R Square	0.889118183
Standard Error	79928.9327
Observations	10

ANOVA					
-	*df*	*SS*	*MS*	*F*	*Significance F*
Regression	1	4.6744E+11	4.6744E+11	73.167501	2.68889E-05
Residual	8	51109074259	6388634282		
Total	9	5.18549E+11			

-	*Coefficients*	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	-10472204.34	1434932.436	-7.298046983	8.40462E-05	-13781164.47	-7163244.205	-13781164.47	-7163244.205
X Variable 1	6356.254769	743.0913143	8.553800384	2.68889E-05	4642.683126	8069.826413	4642.683126	8069.826413

Source: FAA 2018 TAF, NAA, CHA, 2019.

APPENDIX D – GENERAL AVIATION FORECASTS

A. Based Aircraft Forecast Methodologies

Table D-4 – TAF Based Growth Scenario

Fiscal Year	TAF	TAF Based Growth	Percent Difference from TAF
2017	95	87	-8.4%
2018	96	89	-7.3%
2019	99	90	-9.1%
2020	100	92	-8.0%
2021	102	93	-8.8%
2022	104	95	-8.7%
2023	106	97	-8.5%
2024	108	98	-9.3%
2025	110	100	-9.1%
2026	112	102	-8.9%
2027	114	104	-8.8%
2028	116	106	-8.6%
2029	118	107	-9.3%
2030	120	109	-9.2%
2031	122	111	-9.0%
2032	124	113	-8.9%
2033	126	115	-8.7%
2034	128	117	-8.6%
2035	130	119	-8.5%
2036	132	121	-8.3%
2037	134	124	-7.5%
2038	136	126	-7.4%
AAGR 2018-2038	**1.8%**	**1.8%**	**-**
Growth 2018-2038	**42.1%**	**42.1%**	**-**

Source: FAA 2018 TAF, Signature, NAA, CHA, 2019.

FAA Aerospace Forecast Scenario

Table D-5 – FAA National Average Annual Growth Rates for GA Aircraft

Fiscal Year	Single Engine	Multi-Engine Piston	Turbo-Prop	Jet	Rotor-craft
AAGR 2018-2023	-0.8%	-0.3%	-0.4%	2.4%	1.9%
AAGR 2023-2028	-1.1%	-0.4%	1.8%	2.2%	1.8%
AAGR 2028-2033	-1.1%	-0.5%	2.6%	2.1%	1.8%
AAGR 2033-2038	-1.1%	-0.7%	3.4%	2.5%	2.2%
AAGR 2018-2038	**-1.0%**	**-0.4%**	**1.7%**	**2.2%**	**1.8%**

Source: FAA Aerospace Forecast FY 2018-2038, CHA, 2018.

Table D-6 – FAA Aerospace Forecast

Fiscal Year	Single Engine	Multi-Engine Piston	Turbo-Prop	Jet	Rotor-craft	Military	Total Based Aircraft
2017	46	10	9	20	2	0	87
2018	46	10	9	20	2	0	87
2019	45	10	9	21	2	0	87
2020	45	10	9	21	2	0	87
2021	45	10	9	22	2	0	87
2022	44	10	9	23	2	0	88
2023	44	10	9	23	2	0	88
2024	43	10	9	24	2	0	88
2025	43	10	9	24	2	0	88
2026	42	10	9	25	2	0	88
2027	42	10	9	25	2	0	89
2028	42	10	10	26	2	0	89
2029	41	10	10	26	2	0	89
2030	41	10	10	27	3	0	90
2031	40	10	10	27	3	0	90
2032	40	9	11	28	3	0	91
2033	39	9	11	29	3	0	91
2034	39	9	11	29	3	0	92
2035	39	9	12	30	3	0	92
2036	38	9	12	31	3	0	93
2037	38	9	13	32	3	0	94
2038	37	9	13	32	3	0	95
AAGR 2018-2038	**-1.0%**	**-0.5%**	**1.9%**	**2.3%**	**1.9%**	**0.0%**	**0.4%**
Growth 2018-2038	**-18.3%**	**-8.8%**	**44.6%**	**58.1%**	**46.3%**	**0.0%**	**8.8%**

Source: FAA Aerospace Forecast FY 2018-2038, Signature, CHA, 2018.

Additional Methodologies

Table D-7 – Market Share Scenario

Fiscal Year	Market Share		
	Static National	Static State	Static Regional
2017	87	87	87
2018	88	87	88
2019	88	88	89
2020	89	89	89
2021	90	89	90
2022	91	90	91
2023	91	91	92
2024	92	91	92
2025	93	91	93
2026	94	92	94
2027	94	93	94
2028	95	93	95
2029	96	94	96
2030	97	94	97
2031	97	95	97
2032	98	95	98
2033	99	96	99
2034	100	96	99
2035	100	97	100
2036	101	97	101
2037	102	98	102
2038	103	99	102
AAGR 2018-2038	**0.8%**	**0.6%**	**0.8%**
Growth 2018-2038	**17.3%**	**12.8%**	**16.6%**

Source: FAA 2018 TAF, Signature, CHA, 2018.

B. GA Operations Forecast Methodologies

Table D-8 – OPBA Scenario

Fiscal Year	Based Aircraft	Itinerant GA	Local GA	Total GA Operations	OPBA
2017	87	21,207	1,157	22,364	257
2018	89	21,583	1,178	22,760	257
2019	90	21,965	1,198	23,164	257
2020	92	22,355	1,220	23,574	257
2021	93	22,751	1,241	23,992	257
2022	95	23,154	1,263	24,418	257
2023	97	23,565	1,286	24,850	257
2024	98	23,982	1,308	25,291	257
2025	100	24,408	1,332	25,739	257
2026	102	24,840	1,355	26,195	257
2027	104	25,280	1,379	26,660	257
2028	106	25,729	1,404	27,132	257
2029	107	26,185	1,429	27,613	257
2030	109	26,649	1,454	28,103	257
2031	111	27,121	1,480	28,601	257
2032	113	27,602	1,506	29,108	257
2033	115	28,091	1,533	29,624	257
2034	117	28,589	1,560	30,149	257
2035	119	29,096	1,587	30,683	257
2036	121	29,611	1,616	31,227	257
2037	124	30,136	1,644	31,780	257
2038	126	30,670	1,673	32,344	257

Source: Signature, CHA, 2018.

Table D-9 – Market Share Scenario

Fiscal Year	Static National			Static State			Static Regional		
	Itinerant GA	Local GA	Total GA Operations	Itinerant GA	Local GA	Total GA Operations	Itinerant GA	Local GA	Total GA Operations
2017	21,207	1,157	22,364	21,207	1,157	22,364	**21,207**	**1,157**	**22,364**
2018	21,418	1,180	22,598	21,251	1,178	22,428	**21,029**	**1,163**	**22,192**
2019	21,527	1,193	22,720	21,295	1,191	22,486	20,879	1,171	22,050
2020	21,600	1,197	22,797	21,339	1,198	22,537	20,956	1,176	22,132
2021	21,673	1,201	22,875	21,383	1,205	22,588	21,035	1,181	22,216
2022	21,747	1,205	22,952	21,428	1,212	22,640	21,114	1,186	22,300
2023	21,821	1,210	23,031	21,472	1,220	22,692	**21,194**	**1,192**	**22,385**
2024	21,896	1,214	23,110	21,517	1,227	22,744	21,275	1,197	22,472
2025	21,972	1,219	23,191	21,561	1,235	22,796	21,356	1,202	22,559
2026	22,050	1,223	23,273	21,606	1,243	22,849	21,439	1,208	22,647
2027	22,129	1,228	23,356	21,651	1,251	22,902	21,523	1,214	22,736
2028	22,208	1,232	23,441	21,696	1,259	22,955	**21,608**	**1,219**	**22,827**
2029	22,289	1,237	23,527	21,741	1,268	23,008	21,694	1,225	22,919
2030	22,371	1,242	23,613	21,786	1,276	23,062	21,779	1,231	23,009
2031	22,455	1,247	23,701	21,831	1,285	23,116	21,865	1,236	23,101
2032	22,539	1,252	23,791	21,876	1,294	23,170	21,952	1,242	23,195
2033	22,625	1,257	23,882	21,921	1,304	23,225	**22,041**	**1,248**	**23,289**
2034	22,712	1,262	23,974	21,967	1,313	23,280	22,131	1,254	23,385
2035	22,801	1,267	24,068	22,012	1,323	23,335	22,222	1,261	23,482
2036	22,891	1,272	24,163	22,058	1,332	23,391	22,314	1,267	23,581
2037	22,982	1,278	24,260	22,104	1,342	23,446	22,408	1,273	23,681
2038	23,075	1,283	24,358	22,150	1,353	23,502	**22,502**	**1,280**	**23,782**
AAGR 2018-2038	**0.4%**	**0.4%**	**0.4%**	**0.21%**	**0.70%**	**0.23%**	**0.3%**	**0.5%**	**0.3%**
Growth 2018-2038	**7.7%**	**8.8%**	**7.8%**	**4.23%**	**14.88%**	**4.79%**	**7.0%**	**10.1%**	**7.2%**

Note: Excludes Military Operations.

Source: FAA 2018 TAF, NAA, CHA, 2019.

C. Recommended GA Forecast and Based Aircraft

Table D-10 – Recommended GA Forecast

Fiscal Year	Based Aircraft	Operations				Total GA Operations
		Itinerant	Local	Total Civil	Military	
2017	87	21,207	1,157	22,364	600	22,964
2018	89	21,583	1,178	22,760	600	23,360
2019	90	21,965	1,198	23,164	600	23,764
2020	92	22,355	1,220	23,574	600	24,174
2021	93	22,751	1,241	23,992	600	24,592
2022	95	23,154	1,263	24,418	600	25,018
2023	97	23,565	1,286	24,850	600	25,450
2024	98	23,982	1,308	25,291	600	25,891
2025	100	24,408	1,332	25,739	600	26,339
2026	102	24,840	1,355	26,195	600	26,795
2027	104	25,280	1,379	26,660	600	27,260
2028	106	25,729	1,404	27,132	600	27,732
2029	107	26,185	1,429	27,613	600	28,213
2030	109	26,649	1,454	28,103	600	28,703
2031	111	27,121	1,480	28,601	600	29,201
2032	113	27,602	1,506	29,108	600	29,708
2033	115	28,091	1,533	29,624	600	30,224
2034	117	28,589	1,560	30,149	600	30,749
2035	119	29,096	1,587	30,683	600	31,283
2036	121	29,611	1,616	31,227	600	31,827
2037	124	30,136	1,644	31,780	600	32,380
2038	126	30,670	1,673	32,344	600	32,944
AAGR 2018-2038	**1.8%**	**0.0%**	**0.0%**	**1.8%**	**0.0%**	**1.7%**
Growth 2018-2038	**42.1%**	**0.0%**	**0.0%**	**42.1%**	**0.0%**	**41.0%**

Source: FAA 2018 TAF, Signature, NAA, CHA, 2019.

Table D-11 – Based Aircraft by Aircraft Type

Fiscal Year	Single Engine	Multi-Engine Piston	Turbo-Prop	Jet	Rotorcraft	Total
2017	46	10	9	20	2	87
2018	46	10	10	21	2	89
2019	46	10	10	22	2	90
2020	46	10	10	24	2	92
2021	46	10	11	24	2	93
2022	47	10	11	25	2	95
2023	47	10	11	26	3	97
2024	47	10	11	27	3	98
2025	47	10	11	28	3	99
2026	48	10	12	29	3	102
2027	48	10	12	30	3	103
2028	48	11	13	31	3	106
2029	48	11	13	32	3	107
2030	48	11	14	33	3	109
2031	49	11	14	34	3	111
2032	49	11	14	36	3	113
2033	49	11	15	37	3	115
2034	50	11	15	38	3	117
2035	50	12	15	39	3	119
2036	50	12	16	40	3	121
2037	51	12	16	41	4	124
2038	51	12	17	42	4	126

Source: Signature, NAA, CHA, 2018.

APPENDIX E – AIRPORT-PROVIDED DATA

Tower Daily Airport Operations (-1) Count

☐ New Format ☐ Display Manual Count ONLY

Selected Date From: 10/01/2016 To: 10/31/2016

Display: ORF

Save Airport

View/Refresh Home

ORF	Itinerant					Local			Total Operations
Date	AC	AT	GA	MI	Total	Civil	Military	Total	
10/01/16	65	64	42	5	176	0	0	0	176
10/02/16	66	83	33	0	182	0	0	0	182
10/03/16	71	88	23	1	183	0	0	0	183
10/04/16	72	90	50	2	214	0	0	0	214
10/05/16	72	96	56	0	224	0	0	0	224
10/06/16	81	81	32	0	194	0	0	0	194
10/07/16	77	76	34	0	187	0	0	0	187
10/08/16	60	48	10	0	118	0	0	0	118
10/09/16	45	45	15	2	107	0	0	0	107
10/10/16	77	82	33	3	195	0	0	0	195
10/11/16	80	73	49	3	205	0	0	0	205
10/12/16	79	79	73	3	234	0	0	0	234
10/13/16	80	84	50	4	218	0	0	0	218
10/14/16	78	80	58	3	219	0	0	0	219
10/15/16	67	55	66	0	188	16	0	16	204
10/16/16	71	81	66	0	218	0	0	0	218
10/17/16	78	76	54	0	208	0	0	0	208
10/18/16	80	75	72	3	230	0	0	0	230
10/19/16	82	80	64	0	226	0	0	0	226
10/20/16	79	73	83	0	235	0	0	0	235
10/21/16	87	80	56	1	224	0	0	0	224
10/22/16	67	57	34	0	158	0	0	0	158
10/23/16	70	72	59	0	201	0	0	0	201
10/24/16	77	74	36	0	187	0	0	0	187
10/25/16	76	76	66	0	218	0	0	0	218
10/26/16	76	86	72	1	235	0	0	0	235
10/27/16	80	73	64	2	219	0	0	0	219
10/28/16	82	79	50	0	211	0	0	0	211
10/29/16	68	58	67	0	193	48	0	48	241
10/30/16	71	62	36	1	170	0	0	0	170
10/31/16	75	57	29	0	161	0	0	0	161
Total	2289	2283	1532	34	6138	64	0	64	6202

Database Range: 09/09/16 1412 - 11/10/16 1511Z

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Norfolk ATCT CountOps - Tower Historical Airport Operations Count Page 1 of 1

Tower Daily Airport Operations (-1) Count

☐ New Format ☐ Display Manual Count ONLY

Selected Date From: 11/01/2016 To: 11/30/2016

Display: ORF

Save Airport

View/Refresh Home

ORF	Itinerant					Local			Total Operations
Date	AC	AT	GA	MI	Total	Civil	Military	Total	
11/01/16	82	80	49	4	215	0	0	0	215
11/02/16	85	83	56	1	225	0	0	0	225
11/03/16	81	77	74	0	232	0	0	0	232
11/04/16	95	63	56	0	214	0	0	0	214
11/05/16	78	43	138	0	259	32	0	32	291
11/06/16	77	66	73	0	216	0	0	0	216
11/07/16	82	61	52	1	196	0	0	0	196
11/08/16	78	54	45	0	177	0	0	0	177
11/09/16	91	60	46	4	201	0	0	0	201
11/10/16	91	72	53	0	216	0	0	0	216
11/11/16	92	64	88	0	244	4	0	4	248
11/12/16	73	48	53	6	180	14	0	14	194
11/13/16	77	53	61	1	192	16	0	16	208
11/14/16	85	54	37	0	176	0	0	0	176
11/15/16	87	68	59	0	214	0	0	0	214
11/16/16	92	65	73	0	230	0	0	0	230
11/17/16	90	68	71	0	229	0	0	0	229
11/18/16	95	62	77	3	237	0	0	0	237
11/19/16	72	35	58	0	165	6	0	6	171
11/20/16	77	62	31	0	170	22	0	22	192
11/21/16	91	61	34	0	186	0	0	0	186
11/22/16	86	74	53	2	215	0	0	0	215
11/23/16	90	63	57	0	210	0	0	0	210
11/24/16	53	38	11	0	102	0	0	0	102
11/25/16	71	43	33	0	147	0	0	0	147
11/26/16	94	53	44	0	191	0	0	0	191
11/27/16	80	64	52	0	196	12	0	12	208
11/28/16	87	68	60	0	215	48	0	48	263
11/29/16	93	53	44	0	190	0	0	0	190
11/30/16	94	69	32	0	195	0	0	0	195
Total	2519	1824	1670	22	6035	154	0	154	6189

Database Range: 10/05/16 1926 - 12/06/16 2025Z

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Norfolk ATCT CountOps - Tower Historical Airport Operations Count

Tower Daily Airport Operations (-1) Count

☐ New Format ☐ Display Manual Count ONLY

Selected Date From: 12/01/2016 To: 12/31/2016

Display: ORF

Save Airport

View/Refresh

Home

ORF	Itinerant					Local			Total Operations
Date	AC	AT	GA	MI	Total	Civil	Military	Total	
12/01/16	92	69	57	1	219	0	0	0	219
12/02/16	84	81	66	0	231	0	0	0	231
12/03/16	64	40	60	0	164	12	0	12	176
12/04/16	67	63	27	6	163	0	0	0	163
12/05/16	81	68	41	5	195	0	0	0	195
12/06/16	87	67	36	0	190	0	0	0	190
12/07/16	85	72	46	2	205	0	0	0	205
12/08/16	86	80	43	0	209	10	0	10	219
12/09/16	84	81	56	0	221	0	0	0	221
12/10/16	78	36	37	0	151	16	0	16	167
12/11/16	60	61	46	2	169	0	0	0	169
12/12/16	84	61	21	0	166	0	0	0	166
12/13/16	87	67	59	0	213	0	0	0	213
12/14/16	85	75	39	6	205	0	0	0	205
12/15/16	85	75	35	4	199	0	0	0	199
12/16/16	81	63	52	0	196	0	0	0	196
12/17/16	99	32	11	0	142	0	0	0	142
12/18/16	72	48	21	0	141	0	0	0	141
12/19/16	88	63	32	0	183	0	0	0	183
12/20/16	87	65	63	0	215	2	0	2	217
12/21/16	82	58	65	1	206	0	0	0	206
12/22/16	86	57	99	0	242	22	0	22	264
12/23/16	86	54	48	0	188	10	0	10	198
12/24/16	70	39	11	0	120	0	0	0	120
12/25/16	56	28	14	0	98	0	0	0	98
12/26/16	78	52	39	0	169	0	0	0	169
12/27/16	82	67	28	0	177	0	0	0	177
12/28/16	83	57	51	2	193	12	0	12	205
12/29/16	80	59	23	0	162	0	0	0	162
12/30/16	84	55	32	0	171	0	0	0	171
12/31/16	63	43	58	0	164	4	0	4	168
Total	2486	1836	1316	29	5667	88	0	88	5755

Database Range: 11/30/16 1430 - 01/31/17 1428Z

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Norfolk ATCT CountOps - Tower Historical Airport Operations Count

Tower Daily Airport Operations (-1) Count

☐ New Format ☐ Display Manual Count ONLY

Selected Date From: 01/01/2017 To: 01/31/2017

Display: ORF

Save Airport

View/Refresh

Home

ORF	Itinerant					Local			Total Operations
Date	AC	AT	GA	MI	Total	Civil	Military	Total	
01/01/17	65	49	37	0	151	0	0	0	151
01/02/17	77	67	20	0	164	0	0	0	164
01/03/17	88	52	21	0	161	0	0	0	161
01/04/17	93	56	47	0	196	0	0	0	196
01/05/17	89	53	47	0	189	0	0	0	189
01/06/17	76	60	28	0	164	10	0	10	174
01/07/17	3	3	0	0	6	0	0	0	6
01/08/17	60	51	29	1	141	0	0	0	141
01/09/17	86	68	25	4	183	0	0	0	183
01/10/17	74	71	34	0	179	0	0	0	179
01/11/17	82	72	41	0	195	0	0	0	195
01/12/17	82	62	55	2	201	6	0	6	207
01/13/17	80	69	38	15	202	0	0	0	202
01/14/17	62	37	24	0	123	12	0	12	135
01/15/17	60	49	22	0	131	0	0	0	131
01/16/17	77	68	31	0	176	0	0	0	176
01/17/17	76	58	34	1	169	0	0	0	169
01/18/17	80	64	47	0	191	0	0	0	191
01/19/17	82	68	64	1	215	16	0	16	231
01/20/17	80	77	34	0	191	0	0	0	191
01/21/17	59	41	17	0	117	0	0	0	117
01/22/17	66	58	13	0	137	0	0	0	137
01/23/17	75	49	29	0	153	0	0	0	153
01/24/17	76	68	55	0	199	0	0	0	199
01/25/17	80	76	78	0	234	20	0	20	254
01/26/17	86	66	31	0	183	0	0	0	183
01/27/17	80	70	43	0	193	0	0	0	193
01/28/17	58	48	96	0	202	46	0	46	248
01/29/17	64	73	33	0	170	0	0	0	170
01/30/17	74	62	45	2	183	0	0	0	183
01/31/17	0	0	0	0	0	0	0	0	0
Total	2190	1765	1118	26	5099	110	0	110	5209

Database Range: 11/30/16 1428 - 01/31/17 1427Z

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Norfolk ATCT CountOps - Tower Historical Airport Operations Count — Page 1 of 1

Tower Daily Airport Operations (-1) Count

☐ New Format ☐ Display Manual Count ONLY

Selected Date From: 02/01/2017 To: 02/28/2017

Display: ORF

Save Airport | View/Refresh | Home

ORF	Itinerant					Local			Total Operations
Date	AC	AT	GA	MI	Total	Civil	Military	Total	
02/01/17	81	67	41	0	189	8	4	12	201
02/02/17	82	65	54	7	208	24	0	24	232
02/03/17	79	78	60	0	217	0	0	0	217
02/04/17	60	41	81	0	182	28	0	28	210
02/05/17	61	48	22	1	132	10	0	10	142
02/06/17	74	68	53	2	197	4	0	4	201
02/07/17	76	63	35	9	183	10	0	10	193
02/08/17	84	74	43	2	203	0	0	0	203
02/09/17	80	44	27	4	155	0	0	0	155
02/10/17	79	74	34	5	192	0	0	0	192
02/11/17	57	51	37	1	146	16	0	16	162
02/12/17	71	54	27	4	156	0	0	0	156
02/13/17	77	64	25	5	171	0	0	0	171
02/14/17	74	68	47	7	196	0	0	0	196
02/15/17	79	68	36	0	183	20	0	20	203
02/16/17	80	65	33	1	179	0	0	0	179
02/17/17	89	61	60	15	225	10	0	10	235
02/18/17	60	45	99	1	205	42	0	42	247
02/19/17	73	52	50	0	175	18	0	18	193
02/20/17	80	64	58	0	202	0	0	0	202
02/21/17	85	60	46	0	191	0	0	0	191
02/22/17	86	55	56	1	198	0	0	0	198
02/23/17	83	66	45	2	196	2	0	2	198
02/24/17	85	70	64	0	219	0	0	0	219
02/25/17	67	47	60	2	176	28	0	28	204
02/26/17	71	62	55	0	188	0	0	0	188
02/27/17	79	65	26	0	170	0	0	0	170
02/28/17	81	60	30	0	171	0	0	0	171
Total	2133	1699	1304	69	5205	220	4	224	5429

Database Range: 01/12/17 1603 - 03/15/17 1502Z

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http://orf.countops.faa.gov:5806/TowerApoDash1CountFromSummaryPage — 3/15/2017

Norfolk ATCT CountOps - Tower Historical Airport Operations Count — Page 1 of 1

Tower Daily Airport Operations (-1) Count

☐ New Format ☐ Display Manual Count ONLY

Selected Date From: 03/01/2017 To: 03/31/2017

Display: ORF

Save Airport | View/Refresh | Home

ORF	Itinerant					Local			Total Operations
Date	AC	AT	GA	MI	Total	Civil	Military	Total	
03/01/17	90	57	36	0	183	0	0	0	183
03/02/17	88	58	36	4	186	40	0	40	226
03/03/17	85	64	35	5	189	16	0	16	205
03/04/17	61	55	74	0	190	18	0	18	208
03/05/17	69	59	52	2	182	12	0	12	194
03/06/17	81	65	41	2	189	0	0	0	189
03/07/17	88	60	32	0	180	0	0	0	180
03/08/17	86	64	37	5	192	0	0	0	192
03/09/17	85	65	46	0	196	0	0	0	196
03/10/17	81	63	31	0	175	14	0	14	189
03/11/17	61	70	59	2	192	26	0	26	218
03/12/17	67	56	43	1	167	6	0	6	173
03/13/17	74	60	39	0	173	0	0	0	173
03/14/17	60	23	15	0	98	0	0	0	98
03/15/17	75	78	25	0	178	0	0	0	178
03/16/17	85	69	48	0	202	6	0	6	208
03/17/17	88	68	56	1	213	0	0	0	213
03/18/17	61	47	34	0	142	4	0	4	146
03/19/17	70	62	43	0	175	10	0	10	185
03/20/17	80	67	75	2	224	0	0	0	224
03/21/17	81	67	44	1	193	0	0	0	193
03/22/17	83	67	29	2	181	0	0	0	181
03/23/17	86	67	50	4	207	17	0	17	224
03/24/17	77	79	52	0	208	0	0	0	208
03/25/17	63	57	65	0	185	24	0	24	209
03/26/17	68	62	47	1	178	22	0	22	200
03/27/17	79	66	38	0	183	0	0	0	183
03/28/17	90	66	33	0	189	0	0	0	189
03/29/17	84	63	54	1	202	0	0	0	202
03/30/17	83	61	72	0	216	0	0	0	216
03/31/17	85	58	20	0	163	0	0	0	163
Total	2414	1923	1361	33	5731	215	0	215	5946

Database Range: 01/31/17 1635 - 04/03/17 1533Z

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http://orf.countops.faa.gov:5806/TowerApoDash1CountFromSummaryPage — 4/3/2017

Tower Daily Airport Operations (-1) Count

☐ New Format ☐ Display Manual Count ONLY

Selected Date From: 04/01/2017 To: 04/30/2017

Display: ORF Save Airport

View/Refresh Home

ORF	Itinerant					Local			Total Operations
Date	AC	AT	GA	MI	Total	Civil	Military	Total	
04/01/17	61	52	73	0	186	22	0	22	208
04/02/17	69	59	70	0	198	0	0	0	198
04/03/17	79	66	35	3	183	0	0	0	183
04/04/17	80	63	32	1	176	0	0	0	176
04/05/17	71	74	48	0	193	0	0	0	193
04/06/17	85	56	23	2	166	0	0	0	166
04/07/17	71	72	38	0	181	0	0	0	181
04/08/17	51	55	59	0	165	16	0	16	181
04/09/17	65	78	47	0	190	8	0	8	198
04/10/17	76	79	50	3	208	0	0	0	208
04/11/17	86	73	61	2	222	14	0	14	236
04/12/17	82	74	66	4	226	0	0	0	226
04/13/17	86	81	65	2	234	0	0	0	234
04/14/17	84	77	35	3	199	0	10	10	209
04/15/17	57	67	21	0	145	8	0	8	153
04/16/17	66	71	39	0	176	0	0	0	176
04/17/17	78	83	32	0	193	0	0	0	193
04/18/17	83	73	56	8	220	0	0	0	220
04/19/17	81	70	29	0	180	0	0	0	180
04/20/17	84	71	59	4	218	0	0	0	218
04/21/17	85	69	65	2	221	0	0	0	221
04/22/17	60	64	25	1	150	0	0	0	150
04/23/17	69	66	27	1	163	0	0	0	163
04/24/17	83	71	12	2	168	0	0	0	168
04/25/17	84	59	54	2	199	0	0	0	199
04/26/17	86	70	55	2	213	0	0	0	213
04/27/17	84	72	87	1	244	11	0	11	255
04/28/17	83	77	25	4	189	10	14	24	213
04/29/17	62	62	35	3	162	0	0	0	162
04/30/17	71	70	47	2	190	0	0	0	190
Total	2262	2074	1370	52	5758	89	24	113	5871

Database Range: 03/14/17 1325 - 05/15/17 1322Z

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Tower Daily Airport Operations (-1) Count

☐ New Format ☐ Display Manual Count ONLY

Selected Date From: 05/01/2017 To: 05/31/2017

Display: ORF Save Airport

View/Refresh Home

ORF	Itinerant					Local			Total Operations
Date	AC	AT	GA	MI	Total	Civil	Military	Total	
05/01/17	83	75	29	0	187	0	0	0	187
05/02/17	88	70	48	5	211	2	6	8	219
05/03/17	86	71	70	3	230	0	0	0	230
05/04/17	91	76	72	1	240	22	0	22	262
05/05/17	88	59	24	0	171	0	0	0	171
05/06/17	67	55	38	2	162	0	0	0	162
05/07/17	73	71	58	3	205	0	0	0	205
05/08/17	85	72	45	6	208	0	0	0	208
05/09/17	88	66	56	7	217	0	0	0	217
05/10/17	85	70	62	6	223	0	0	0	223
05/11/17	89	77	77	6	249	0	0	0	249
05/12/17	89	72	45	0	206	0	0	0	206
05/13/17	68	61	35	0	164	0	0	0	164
05/14/17	72	73	31	1	177	14	0	14	191
05/15/17	82	65	58	1	206	0	0	0	206
05/16/17	86	73	62	2	223	0	0	0	223
05/17/17	89	71	59	5	224	0	0	0	224
05/18/17	85	67	80	3	235	0	0	0	235
05/19/17	89	67	75	3	234	4	0	4	238
05/20/17	65	61	35	3	164	0	0	0	164
05/21/17	74	66	48	3	191	0	0	0	191
05/22/17	81	63	29	2	175	0	0	0	175
05/23/17	89	74	25	2	190	0	0	0	190
05/24/17	85	72	31	1	189	0	0	0	189
05/25/17	88	52	52	1	193	0	0	0	193
05/26/17	93	78	70	2	243	0	0	0	243
05/27/17	62	65	34	0	161	0	0	0	161
05/28/17	71	64	28	1	164	12	0	12	176
05/29/17	75	65	34	1	175	0	0	0	175
05/30/17	82	52	36	0	170	0	0	0	170
05/31/17	87	66	63	6	222	0	0	0	222
Total	2535	2089	1509	76	6209	54	6	60	6269

Database Range: 04/14/17 1831 - 06/15/17 1829Z

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Norfolk ATCT CountOps - Tower Historical Airport Operations Count

Page 1 of 1

Tower Daily Airport Operations (-1) Count

☐ New Format ☐ Display Manual Count ONLY

Selected Date From: 06/01/2017 To: 06/30/2017

Display: ORF

Save Airport

View/Refresh

Home

ORF	Itinerant					Local			Total Operations
Date	AC	AT	GA	MI	Total	Civil	Military	Total	
06/01/17	91	65	69	3	228	0	0	0	228
06/02/17	85	77	55	0	217	0	0	0	217
06/03/17	62	69	42	2	175	0	0	0	175
06/04/17	73	76	49	3	201	0	0	0	201
06/05/17	80	67	35	0	182	0	0	0	182
06/06/17	86	80	51	2	219	0	0	0	219
06/07/17	86	67	47	4	204	0	0	0	204
06/08/17	88	74	60	1	223	0	0	0	223
06/09/17	85	78	80	0	243	0	0	0	243
06/10/17	77	67	59	0	203	0	0	0	203
06/11/17	80	67	52	0	199	0	0	0	199
06/12/17	85	70	55	1	211	0	0	0	211
06/13/17	89	72	51	0	212	0	0	0	212
06/14/17	90	76	68	3	237	0	0	0	237
06/15/17	85	96	62	1	244	0	0	0	244
06/16/17	88	70	41	0	199	0	0	0	199
06/17/17	82	66	40	0	188	0	0	0	188
06/18/17	80	68	30	3	181	0	0	0	181
06/19/17	100	48	42	1	191	0	0	0	191
06/20/17	95	70	43	1	209	0	0	0	209
06/21/17	88	75	50	0	213	0	0	0	213
06/22/17	87	86	83	13	269	8	0	8	277
06/23/17	88	74	57	3	222	0	0	0	222
06/24/17	81	59	30	0	170	0	0	0	170
06/25/17	86	72	57	0	215	0	0	0	215
06/26/17	84	74	42	2	202	0	0	0	202
06/27/17	87	72	63	2	224	0	0	0	224
06/28/17	94	74	73	2	243	16	6	22	265
06/29/17	90	80	66	1	237	0	0	0	237
06/30/17	90	72	61	0	223	0	0	0	223
Total	2562	2161	1613	48	6384	24	6	30	6414

Database Range: 05/09/17 1947 - 07/10/17 1945Z

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http://orf.countops.faa.gov:5806/TowerApoDash1CountFromSummaryPage 7/10/2017

Norfolk ATCT CountOps - Tower Historical Airport Operations Count

Page 1 of 1

Tower Daily Airport Operations (-1) Count

☐ New Format ☐ Display Manual Count ONLY

Selected Date From: 07/01/2017 To: 07/31/2017

Display: ORF

Save Airport

View/Refresh

Home

ORF	Itinerant					Local			Total Operations
Date	AC	AT	GA	MI	Total	Civil	Military	Total	
07/01/17	82	60	23	0	165	0	0	0	165
07/02/17	73	59	40	0	172	0	0	0	172
07/03/17	70	58	32	2	162	0	0	0	162
07/04/17	69	69	27	0	165	0	0	0	165
07/05/17	78	73	56	1	208	0	0	0	208
07/06/17	84	72	55	0	211	0	0	0	211
07/07/17	90	73	47	0	210	0	0	0	210
07/08/17	81	59	42	0	182	0	0	0	182
07/09/17	89	68	55	0	212	0	0	0	212
07/10/17	79	67	30	0	176	0	0	0	176
07/11/17	87	79	46	0	212	0	0	0	212
07/12/17	85	74	60	6	225	0	0	0	225
07/13/17	90	64	47	0	201	0	0	0	201
07/14/17	97	78	57	2	234	0	0	0	234
07/15/17	74	71	33	0	178	0	0	0	178
07/16/17	84	72	51	4	211	0	0	0	211
07/17/17	81	67	47	1	196	0	0	0	196
07/18/17	90	82	51	2	225	0	0	0	225
07/19/17	85	81	56	0	222	0	0	0	222
07/20/17	86	88	50	1	225	0	0	0	225
07/21/17	91	87	77	4	259	0	0	0	259
07/22/17	80	64	44	6	194	10	0	10	204
07/23/17	102	70	59	0	231	0	0	0	231
07/24/17	76	74	51	0	201	0	0	0	201
07/25/17	86	86	49	8	229	0	0	0	229
07/26/17	87	90	65	11	253	0	6	6	259
07/27/17	85	90	69	0	244	0	0	0	244
07/28/17	85	71	54	0	210	4	0	4	214
07/29/17	79	70	27	0	176	0	0	0	176
07/30/17	84	69	44	2	199	0	0	0	199
07/31/17	81	80	55	0	216	0	0	0	216
Total	2590	2265	1499	50	6404	14	6	20	6424

Database Range: 06/02/17 1447 - 08/03/17 1446Z

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http://orf.countops.faa.gov:5806/TowerApoDash1CountFromSummaryPage 8/3/2017

Norfolk ATCT CountOps - Tower Historical Airport Operations Count Page 1 of 1

Tower Daily Airport Operations (-1) Count

☐ New Format ☐ Display Manual Count ONLY

Selected Date From: 08/01/2017 To: 08/31/2017

Display: ORF Save Airport

View/Refresh Home

ORF	Itinerant					Local			Total Operations
Date	AC	AT	GA	MI	Total	Civil	Military	Total	
08/01/17	88	82	51	4	225	0	0	0	225
08/02/17	92	64	35	1	192	4	0	4	196
08/03/17	89	78	57	0	224	0	0	0	224
08/04/17	78	67	48	0	193	2	0	2	195
08/05/17	79	68	44	0	191	0	0	0	191
08/06/17	86	77	66	0	229	0	0	0	229
08/07/17	77	82	29	0	188	0	0	0	188
08/08/17	89	79	52	0	220	0	0	0	220
08/09/17	86	87	50	0	223	0	0	0	223
08/10/17	85	91	60	2	238	0	0	0	238
08/11/17	89	73	45	5	212	0	0	0	212
08/12/17	78	63	21	0	162	0	0	0	162
08/13/17	93	64	58	2	217	0	0	0	217
08/14/17	82	88	54	0	224	0	0	0	224
08/15/17	88	75	56	4	223	0	0	0	223
08/16/17	86	75	71	0	232	0	0	0	232
08/17/17	86	77	86	1	250	14	0	14	264
08/18/17	97	74	49	3	223	0	0	0	223
08/19/17	77	60	36	0	173	6	0	6	179
08/20/17	79	77	38	0	194	20	0	20	214
08/21/17	80	74	52	0	206	0	0	0	206
08/22/17	91	80	59	0	230	0	0	0	230
08/23/17	90	76	52	2	220	0	0	0	220
08/24/17	88	84	74	1	247	0	0	0	247
08/25/17	108	77	46	0	231	0	0	0	231
08/26/17	71	56	62	0	189	18	0	18	207
08/27/17	77	79	45	1	202	0	0	0	202
08/28/17	81	74	34	12	201	0	0	0	201
08/29/17	97	72	14	0	183	0	0	0	183
08/30/17	85	82	54	4	225	0	0	0	225
08/31/17	88	81	74	4	247	0	0	0	247
Total	2660	2336	1572	46	6614	64	0	64	6678

Database Range: 07/11/17 1427 - 09/11/17 1425Z

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http://orf.countops.faa.gov:5806/TowerApoDash1CountFromSummaryPage 9/11/2017

Norfolk ATCT CountOps - Tower Historical Airport Operations Count Page 1 of 1

Tower Daily Airport Operations (-1) Count

☐ New Format ☐ Display Manual Count ONLY

Selected Date From: 09/01/2017 To: 09/30/2017

Display: ORF Save Airport

View/Refresh Home

ORF	Itinerant					Local			Total Operations
Date	AC	AT	GA	MI	Total	Civil	Military	Total	
09/01/17	90	80	41	1	212	0	0	0	212
09/02/17	73	58	16	0	147	0	0	0	147
09/03/17	58	68	65	0	191	8	0	8	199
09/04/17	72	77	44	0	193	0	0	0	193
09/05/17	83	69	58	0	210	0	0	0	210
09/06/17	79	83	31	0	193	0	0	0	193
09/07/17	80	78	67	0	225	0	0	0	225
09/08/17	81	89	50	0	220	18	0	18	238
09/09/17	65	57	40	1	163	12	0	12	175
09/10/17	67	72	35	0	174	0	0	0	174
09/11/17	69	72	24	2	167	0	0	0	167
09/12/17	80	82	31	2	195	16	0	16	211
09/13/17	85	90	42	1	218	0	0	0	218
09/14/17	86	83	44	1	214	0	0	0	214
09/15/17	90	89	57	3	239	3	0	3	242
09/16/17	68	63	45	0	176	0	0	0	176
09/17/17	71	82	42	1	196	0	0	0	196
09/18/17	85	84	43	0	212	0	0	0	212
09/19/17	83	78	24	3	188	0	0	0	188
09/20/17	81	78	83	0	242	2	2	4	246
09/21/17	87	83	66	0	236	0	0	0	236
09/22/17	90	85	50	0	225	0	30	30	255
09/23/17	65	56	57	0	178	0	0	0	178
09/24/17	69	82	40	0	191	0	0	0	191
09/25/17	83	83	39	0	205	0	0	0	205
09/26/17	89	83	38	2	212	0	0	0	212
09/27/17	83	91	37	1	212	0	0	0	212
09/28/17	85	87	64	4	240	2	14	16	256
09/29/17	88	88	77	0	253	0	0	0	253
09/30/17	67	65	35	1	168	0	0	0	168
Total	2352	2335	1385	23	6095	61	46	107	6202

Database Range: 08/22/17 1300 - 10/23/17 1258Z

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http://orf.countops.faa.gov:5806/TowerApoDash1CountFromSummaryPage 10/23/2017

APPENDIX F – ORF SCHEDULING DATA

Table F-12 – ORF Scheduling Data

ARRIVALS					DEPARTURES				
Origin	Flight Number	Arrival Time	Airline	Aircraft	Destination	Flight Number	Departure Time	Airline	Aircraft
MSP	3474	00:11:00	DL	CR9	LGA	3634	05:25:00	AA	ERD
ATL	2095	00:22:00	DL	M90	DCA	5520	05:29:00	AA	CR2
MDW	2255	01:10:00	WN	73H	ATL	2557	05:40:00	DL	M90
BOS	5387	08:05:00	DL	CR9	MDW	1480	05:40:00	WN	73H
TPA	----	--:--:--	F9	A320	CLT	5532	05:47:00	AA	CR7
EWR	4918	08:21:00	UA	ERJ	PHL	5546	06:00:00	AA	CR7
CLT	5045	08:57:00	AA	CR7	LGA	5021	06:00:00	DL	CR9
BWI	1418	09:10:00	WN	73W	EWR	4016	06:00:00	UA	ERJ
ORD	1892	09:13:00	UA	739	IAD	1443	06:20:00	UA	73G
PHL	5008	09:15:00	AA	ER4	BWI	1222	06:25:00	WN	73W
ATL	1113	09:19:00	DL	M88	IAH	6160	06:46:00	UA	E7W
IAD	6018	09:32:00	UA	CR7	ATL	1183	07:00:00	DL	757
DCA	5104	09:36:00	AA	CR2	MIA	4706	07:06:00	AA	E75
SFB	626	09:48:00	G4	M80	DFW	1615	07:10:00	AA	M82
JFK	3437	09:55:00	DL	CR9	CLT	1917	07:17:00	AA	319
LGA	5701	09:59:00	AA	CR2	ORD	1637	07:25:00	UA	738
ORD	2973	10:10:00	AA	CR2	DTW	6245	07:30:00	DL	CR7
LGA	5266	10:17:00	DL	CRJ	JFK	5203	07:33:00	DL	CRJ
CLT	837	10:26:00	AA	319	ORD	3682	07:53:00	AA	CR7
DTW	6278	10:35:00	DL	CR7	PHL	5088	08:10:00	AA	CR7
MCO	2114	10:55:00	WN	73W	DEN	2273	08:15:00	UA	319
DFW	2274	11:01:00	AA	M82	ATL	1252	08:20:00	DL	757
MIA	3817	11:05:00	AA	ER4	MSP	3498	08:40:00	DL	CR9
BWI	127	11:40:00	WN	73W	EWR	4925	08:51:00	UA	ERJ
ATL	2074	11:51:00	DL	M90	TPA	----	--:--:--	F9	A320
LGA	5087	11:54:00	DL	CR9	LGA	3344	09:11:00	AA	ERD
DCA	5226	12:22:00	AA	CR2	CLT	5045	09:27:00	AA	CR7
LGA	3970	13:03:00	AA	ERD	PHL	5008	09:44:00	AA	ER4
EWR	4919	13:03:00	UA	ERJ	BWI	2310	09:45:00	WN	73W
CLT	676	13:07:00	AA	319	ATL	1113	10:00:00	DL	M88
PHL	4865	13:08:00	AA	ER4	ORD	2249	10:18:00	UA	739
FLL	1758	13:18:00	G4	320	DCA	5101	10:24:00	AA	CR2
PHX	----	--:--:--	F9	A320	IAD	6018	10:25:00	UA	CR7
IAD	1144	13:52:00	UA	738	JFK	3510	10:30:00	DL	CR9
ATL	2141	14:21:00	DL	M88	SFB	627	10:33:00	G4	M80
DFW	320	14:23:00	AA	M82	ORD	2973	10:40:00	AA	CR2
DTW	5166	14:33:00	DL	CR9	LGA	5297	10:47:00	DL	CRJ
PHL	4895	14:35:00	AA	ER4	LGA	5702	10:50:00	AA	CR2
LGA	5324	14:37:00	DL	CRJ	CLT	837	11:06:00	AA	319
BWI	2374	14:50:00	WN	73W	DTW	6278	11:10:00	DL	CR7
ORD	4511	14:52:00	UA	CR7	MCO	1972	11:30:00	WN	73W
ORD	3782	15:35:00	AA	CR7	DFW	2274	11:41:00	AA	M82
CLT	5447	16:01:00	AA	CR2	MIA	3817	11:41:00	AA	ER4
ATL	2206	16:04:00	DL	M88	BWI	2329	12:10:00	WN	73W
JFK	5142	16:34:00	DL	CRJ	LGA	5103	12:30:00	DL	CR9

EWR	4998	16:34:00	UA	ERJ		ATL	2074	12:31:00	DL	M90
MDW	1756	16:45:00	WN	73W		CLT	5610	12:47:00	AA	CR2
CLT	867	16:58:00	AA	319		JFK	3846	13:28:00	AA	ERD
MIA	3367	17:21:00	AA	ER4		PHL	4865	13:34:00	AA	ER4
BWI	479	17:30:00	WN	73W		EWR	4948	13:35:00	UA	ERJ
DTW	6281	17:36:00	DL	CR7		CLT	676	13:47:00	AA	319
ORD	4516	17:39:00	UA	CR7		FLL	1759	14:03:00	G4	320
JFK	3390	17:41:00	AA	ERD		IAD	1618	14:45:00	UA	738
LGA	4073	17:43:00	DL	CRJ		PHL	4895	15:00:00	AA	ER4
ATL	1378	17:49:00	DL	M88		ATL	2141	15:01:00	DL	M88
PHL	5124	17:56:00	AA	CR7		DTW	5166	15:08:00	DL	CR9
LGA	3874	18:31:00	AA	ERD		LGA	5319	15:10:00	DL	CRJ
IAD	6025	18:31:00	UA	CR7		BWI	205	15:20:00	WN	73W
EWR	3505	18:33:00	UA	E70		ORD	4536	15:30:00	UA	CR7
CLT	5694	19:06:00	AA	CR9		DFW	320	15:35:00	AA	M82
LGA	5261	19:16:00	DL	CR9		ORD	3782	16:07:00	AA	CR7
ATL	1685	19:19:00	DL	M88		ATL	2206	16:46:00	DL	M88
PHL	5268	19:41:00	AA	CR7		JFK	3345	17:04:00	DL	CRJ
DCA	5367	20:29:00	AA	CR2		EWR	4962	17:05:00	UA	ERJ
CLT	5369	20:59:00	AA	CR7		MDW	2569	17:15:00	WN	73W
ORD	658	21:13:00	UA	73G		DCA	5510	17:18:00	AA	CR2
JFK	3749	21:41:00	AA	ERD		CLT	867	17:38:00	AA	319
ATL	1247	21:43:00	DL	757		BWI	460	18:05:00	WN	73W
ORD	4104	21:52:00	AA	CR7		JFK	3390	18:08:00	AA	ERD
PHL	5692	21:56:00	AA	CR7		DTW	6281	18:11:00	DL	CR7
IAH	6247	22:17:00	UA	E7W		MIA	3367	18:13:00	AA	ER4
DTW	6187	22:29:00	DL	CR7		LGA	5312	18:20:00	DL	CRJ
DFW	2587	22:33:00	AA	M82		ATL	1378	18:30:00	DL	M88
LGA	3513	22:46:00	AA	ERD		ORD	4545	18:30:00	UA	CR7
ATL	2275	23:00:00	DL	757		PHL	5124	18:36:00	AA	CR7
DEN	2272	23:08:00	UA	319		LGA	3874	18:56:00	AA	ERD
JFK	5315	23:25:00	DL	CRJ		EWR	3628	19:10:00	UA	E70
EWR	4266	23:30:00	UA	ERJ		PHX	----	--:--:--	F9	A320
CLT	1938	23:34:00	AA	319		IAD	6025	19:45:00	UA	CR7
BWI	1096	23:35:00	WN	73W		CLT	5694	19:54:00	AA	CR9
IAD	1807	23:36:00	UA	738		BOS	5402	19:57:00	DL	CR9
MIA	4714	23:56:00	AA	E75		ATL	1685	19:59:00	DL	M88

Note: Schedule for a standard Friday in July (2018).
Source: FlightAware, CHA, 2018.

APPENDIX G – FAA REQUIRED APPENDICES[31]

FAA Appendix B

Summarizing and Documenting Airport Planning Forecasts

Table G-13 – Forecast Levels and Growth Rates

Specified Base Year: 2017	Forecast Levels						Average Annual Compound Growth Rates				
	Base Year Level	Base Year + 1-Year	Base Year + 6-Years	Base Year + 11-Years	Base Year + 16-Years	Base Year + 21-Years	Base Year to + 1	Base Year to + 6	Base Year to +11	Base Year to +16	Base Year to +21
Passenger Enplanements											
Air Carrier	1,672,024	1,857,487	2,115,424	2,376,990	2,622,848	2,834,623	11.1%	4.0%	3.2%	2.9%	2.5%
Operations											
Itinerant	-	-	-	-	-	-	-	-	-	-	-
Air Carrier	47,195	48,986	51,889	55,177	57,488	61,430	3.8%	1.6%	1.4%	1.2%	1.3%
General Aviation (Includes Cargo)	23,636	24,058	26,284	28,715	31,372	34,274	1.8%	1.8%	1.8%	1.8%	1.8%
Military	508	508	508	508	508	508	0.0%	0.0%	0.0%	0.0%	0.0%
Local	-	-	-	-	-	-	-	-	-	-	-
General Aviation	1,157	1,178	1,286	1,404	1,533	1,673	1.8%	1.8%	1.8%	1.8%	1.8%
Military	92	92	92	92	92	92	0.0%	0.0%	0.0%	0.0%	0.0%
TOTAL OPERATIONS	**72,588**	**74,821**	**80,058**	**85,896**	**90,992**	**97,978**	**3.1%**	**1.6%**	**1.5%**	**1.4%**	**1.4%**
Peak Hour Operations	20	21	22	23	24	26	3.8%	1.6%	1.4%	1.2%	1.3%
Cargo/mail (enplaned + deplaned tons)	119,634	121,903	133,910	147,101	161,590	177,506	1.9%	1.9%	1.9%	1.9%	1.9%
Based Aircraft											
Single Engine (Non-jet)	46	46	47	48	49	51	0.0%	0.4%	0.4%	0.4%	0.5%
Multi Engine (Non-jet)	10.00	10	10	11	11	12	0.0%	0.0%	0.9%	0.6%	0.9%
Turbo-Prop	9.00	10	11	13	15	17	11.1%	3.4%	3.4%	3.2%	3.1%
Jet Engine	20.00	21	26	31	37	42	5.0%	4.5%	4.1%	3.9%	3.6%
Helicopter	2.00	2	3	3	3	4	0.0%	7.0%	3.8%	2.6%	3.4%
TOTAL	**87**	**89**	**97**	**106**	**115**	**126**	**2.3%**	**1.8%**	**1.8%**	**1.8%**	**1.8%**

Source: FAA 2018 TAF, Signature, NAA, CHA, 2019.

Table G-14 – Operational Factors

Specified Base Year: 2017	Base Year Level	Base Year + 1-Year	Base Year + 6-Years	Base Year + 11-Years	Base Year + 16-Years	Base Year + 21-Years
Average Aircraft Size (Seats) - Air Carrier	89.8	96.0	100.5	104.6	109.4	109.6
Average enplaning load factor - Air Carrier	79.0	79.5	81.1	82.4	83.4	84.2
GA operations per based aircraft	257	257	257	257	257	257

Source: FAA 2018 TAF, Signature, NAA, CHA, 2019.

[31] Note: The projected enplanements and operations that are found within the FAA Required Appendices take into consideration recently announced, as well as potential, non-stop service routes from ORF throughout the forecast horizon.

FAA Appendix C

Table G-15 – Comparing Airport Planning and TAF Forecasts

Specified Base Year: 2017	Year	Airport Forecast	TAF	AF/TAF (% Difference)
Passenger Enplanements				
Base Year Level	**2017**	1,672,024	1,652,323	1.2%
Base Year + 1-Year	**2018**	1,857,487	1,815,241	2.3%
Base Year + 6-Years	**2023**	2,115,424	2,147,644	-1.5%
Base Year + 11-Years	**2028**	2,376,990	2,294,704	3.6%
Base Year + 16-Years	**2033**	2,622,848	2,458,050	6.7%
Base Year + 21-Years	**2038**	2,834,623	2,627,295	7.9%
Commercial Operations[32]				
Base Year Level	**2017**	47,195	53,716	-12.1%
Base Year + 1-Year	**2018**	48,986	55,898	-11.0%
Base Year + 6-Years	**2023**	51,889	57,203	-16.1%
Base Year + 11-Years	**2028**	55,177	60,832	-16.0%
Base Year + 16-Years	**2033**	57,488	65,055	-18.2%
Base Year + 21-Years	**2038**	61,430	69,436	-18.1%
Total Operations[33]				
Base Year Level	**2017**	72,588	72,785	-0.3%
Base Year + 1-Year	**2018**	74,821	72,073	4.0%
Base Year + 6-Years	**2023**	80,058	77,872	2.9%
Base Year + 11-Years	**2028**	85,896	81,749	5.2%
Base Year + 16-Years	**2033**	90,992	86,330	5.3%
Base Year + 21-Years	**2038**	97,978	91,083	7.6%

Source: FAA 2018 TAF, Signature, NAA, CHA, 2019.

[32] Commercial Operations TAF = Air Carrier + Air Taxi & Commuter Operations

[33] Total Operations includes Commercial, Cargo, Military, and GA Operations.

APPENDIX H – NEW AIR SERVICE ROUTE ANNOUNCEMENTS

FRONTIER
LOW FARES DONE RIGHT

TRAVEL DEAL

Travel Advisory

Frontier Airlines Continues to Make Flying More Affordable: Adds Another 15 Routes With Fares as low as $39

June 05, 2018

Share

DENVER – Delivering on its mission to deliver low fares nationwide, today Frontier Airlines announced service on 15 new routes. Frontier will bring the most new routes to San Diego International Airport (SAN) with a total of five. Las Vegas sees three new routes and Austin, Las Vegas, Orlando and San Antonio will each see the addition of two new routes. To celebrate the addition of these new destinations, Frontier is offering special introductory fares as low as $39 available now at FlyFrontier.com.

"These additional fifteen routes are the latest evidence of Frontier's commitment to make air travel more affordable across the United States," said Daniel Shurz, senior vice president of commercial for Frontier Airlines. "We're offering not only amazing low fares, but a reliable and friendly service that allows customers to customize their travel experience to their needs and budget. This empowers more people than ever to fly. This is what our Low Fares Done Right philosophy is all about."

Highlights of this announcement:

-Now serving 31 destinations to/from **Austin, Texas** with the addition of service to/from **Louisville, KY** and **Orange County, Calif.**

-Now serving 27 destinations to/from **Las Vegas** with the addition of new service to/from **Calgary, Canada**,**Norfolk, VA and Spokane,Wash.**.

-Now serving 39 destinations to/from **Orlando** with the resumption of service to/from **Pittsburgh** and new daily service to **Ontario, Calif**.

-Now serving twelve destinations to/from **San Diego** with the addition of new service to/from **Cleveland, Indianapolis, Milwaukee, Pittsburgh** and **Raleigh/Durham**.

-Now serving 25 destinations to/from **San Antonio, Texas** with the addition of service to/from **Orange County** and **Salt Lake City**.

-Growing service from **Calgary, Canada**, now serving two destinations with service to **Denver** and **Las Vegas**.

Summary of New Service

LAS VEGAS (LAS) to/from NORFOLK (ORF)

F9 1629 Depart LAS: 6:40 a.m. Arrive ORF: 2:29 p.m.

F9 1628 Depart ORF: 9:00 p.m. Arrive LAS: 11:21 p.m.

Aircraft: Airbus A320

Frequency: Tuesday, Thursday, Sunday

Service Start: August, 14

Media Information:
720.374.4560
media@flyfrontier.com

FRONTIER AIRLINES ANNNOUNCES NEW SERVICE FROM NORFOLK, VA
NEW LOW-FARE, NON-STOP FLIGHTS TO DENVER and ORLANDO, FLA.
Fares as low as $39

NORFOLK, VA. – Low-Cost carrier, Frontier Airlines announced new low-cost, non-stop flights from Norfolk International Airport (ORF) to Denver International Airport (DEN) and Orlando International Airport (MCO). Select connections will be available in Denver and Orlando to cities across the Frontier network. The airline announced the new route today at an event with airport officials. Service will begin in August and to celebrate these flights, Frontier is offering special intro one-way fares as low as $39 which are available now at flyfrontier.com

"We are proud to bring our unique brand of Low Fares Done Right to Norfolk," said Jonathan Freed, Director of Corporate Communications for Frontier Airlines. "Frontier's new flights to Denver and Orlando will make air travel more accessible and affordable for everyone in Norfolk and the surrounding area. We look forward to making it easier for people to fly, and for people to fly more often."

Robert Bowen, Norfolk Airport Authority executive director states "Frontier Airlines' entrance into the Norfolk market is a statement of confidence in the region. Year-over-year passenger traffic at Norfolk International Airport has increased in 33 of the last 34 months. Frontier's low fares to Denver and Orlando, both popular markets, will be embraced by local travelers."

Blythe Scott, chairman of the Norfolk Airport Authority board of commissioners comments, "Frontier Airlines is welcomed at Norfolk International Airport and is further evidence of the resurgence in demand for affordable air service in the community."

"We are excited to welcome Frontier Airlines to Norfolk International Airport." said Norfolk Mayor Kenny Alexander, "Our airport is continuing its remarkable momentum with the addition of new routes and carriers. Not only are we expanding destinations, we are also providing affordable travel options for residents of Hampton Roads."

Summary of New Service:

DENVER (DEN) to/from NORFOLK (ORF)
F9 1459 Depart DEN: 6:05 a.m. Arrive ORF: 11:30 a.m.
F9 273 Depart ORF: 6 p.m. Arrive DEN: 8:08 p.m.
Aircraft: Airbus A320
Frequency: Thursday, Sunday
Service Start: August, 12

FRONTIER AIRLINES

Media Information:
720.374.4560
media@flyfrontier.com

ORLANDO (MCO) to/from NORFOLK (ORF)
F9 273 Depart MCO: 3:15 p.m. Arrive ORF: 5:10 p.m.
F9 1459 Depart ORF: 12:20 p.m. Arrive MCO: 2:25 p.m.
Aircraft: Airbus A320
Frequency: Thursday, Sunday
Service Start: August, 12

Frontier is focused on offering customers real choice and the ability to customize their travel to their needs and budget. For example, customers can purchase travel options like bags and seat selections either a la carte or in one low-priced bundle called the WORKSsm. The Works bundle is considered one of the best values in the industry and offers customers full refundability, a carry-on bag, a checked bag, the best available seat (including exit rows and Stretch seating), waived change fees and priority boarding for as low as $59 each way. The Works is only available at FlyFrontier.com.

Frontier flies one of the youngest fleets in the industry, the Airbus A320 Family of nearly 80 jet aircraft. With nearly 200 new planes on order, Frontier will continue to grow to deliver on the mission of providing affordable travel across America. Frontier's young fleet also ensures that the company will continue to keep fares low and that customers will enjoy a pleasant and reliable experience flying with the airline.

About Frontier Airlines:

Frontier Airlines is committed to delivering 'Low Fares Done Right' to nearly 90 cities in the United States, Canada, Dominican Republic and Mexico on more than 300 daily flights. Headquartered in Denver, Frontier Airlines is the proud recipient of the Federal Aviation Administration's 2016 Diamond Award for maintenance excellence and was named the industry's most fuel-efficient airline by The International Council on Clean Transportation (ICCT) as a result of superior technology and operational efficiencies.

FRONTIER AIRLINES

Media Information:
720.374.4560
media@flyfrontier.com

*About Intro Fare Offer:

Fares must be purchased by 11:59 pm Eastern time on May 9, 2018 for nonstop travel. Travel is valid Aug. 12, 2018 through Nov. 14, 2018. Fares are valid Tuesdays and Wednesdays unless otherwise specified below:

Travel from **Florida** is valid Tuesday through Friday. Travel to **Florida** is valid Sunday through Wednesday.

Travel from **Denver** is valid Tuesday through Thursday and Saturday. Travel to **Denver** is valid Monday through Wednesday and Saturday.

Fares are one way and do not require roundtrip purchase.

Discount Den fares are only available at FlyFrontier.com to members of Discount Den.

DEN	to/from	ORF	79
MCO	to/from	ORF	39

NORFOLK INTERNATIONAL AIRPORT

Media Contact: Charles Braden
Director of Market Development
757-857-3351

FOR IMMEDIATE RELEASE:

Frontier Airlines to Provide Nonstop Norfolk to Phoenix and Tampa Air Service

NORFOLK, VA. – (August 8, 2018) – Frontier Airlines has announced that it will begin nonstop air service from Norfolk International Airport to Phoenix, Arizona and Tampa, Florida effective November 17, 2018. Seasonal service will be offered Wednesdays and Saturdays via 180-seat Airbus A320 aircraft.

Norfolk Airport Authority executive director Robert Bowen states "This new nonstop service provides our local community needed access to Phoenix and Tampa at an extremely affordable price." Local travelers will enjoy Frontier's signature "low fares done right" and convenient schedules to these popular destinations. Both Phoenix and Tampa are ranked among Norfolk's top 20 destinations in terms of passenger demand.

Both Phoenix and Tampa are available for sale now on FlyFrontier.com:

Depart	**Arrive**
Norfolk 7:35PM	Phoenix 11:02PM
Phoenix 7:25AM	Norfolk 1:53PM
Depart	**Arrive**
Norfolk 9:09AM	Tampa 11:15AM
Tampa 6:23AM	Norfolk 8:19AM

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Norfolk International Airport (ORF) is the major airport serving Coastal Virginia and Northeast North Carolina with air service provided by Allegiant, American, Delta, Frontier, Southwest, United and their regional airline partners. Together they provide nonstop access to 26 major airports (includes year-round and seasonal service), most of which are international gateways, allowing convenient access to global destinations. According to the FAA, Norfolk International Airport's passenger activity is ranked in the top 15% of commercial service airports in the United States with nearly 3.4 million scheduled passengers served in 2017.

ALLEGIANT ARRIVES IN NORFOLK WITH THE ONLY LOW-COST, NONSTOP SERVICE TO 3 DESTINATIONS IN FLORIDA

Click to tweet: .@Allegiant connects @NorfolkAirport with 3 destinations in #Florida with a fare everyone can afford! @VisitFlorida #GetAway #YourWay

NORFOLK, Va. June 20, 2017 — **Allegiant** (NASDAQ: ALGT) today announces the only low-cost, nonstop service connecting Norfolk, Virginia to three destinations in Florida: Fort Lauderdale, Orlando / Sanford and Tampa / St. Pete. **There is no better time to get away your way, with one-way fares on the new routes as low as $39.***

“We’re thrilled to announce that we are bringing our unique brand of ultra-low-cost, convenient travel to Norfolk,” said Lukas Johnson, Allegiant senior vice president of commercial. “We know that Norfolk-area travelers are eager to have a convenient connection to all that Florida has to offer, and we are excited to offer nonstop service at a fare that everyone can afford.”

The new flights announced today from **Norfolk International Airport (ORF)** include:

1. **Tampa / St. Pete, Florida** via St. Pete-Clearwater International Airport (PIE) – begins Oct. 4, 2017 with fares as low as $39*

2. **Orlando / Sanford, Florida** via Orlando Sanford International Airport (SFB) – begins Nov. 17, 2017 with fares as low as $39*

3. **Fort Lauderdale, Florida** via Fort Lauderdale-Hollywood International Airport (FLL) – begins Nov. 17, 2017 with fares as low as $39*

Robert Bowen, airport authority executive director says, “We are gratified that Allegiant has chosen Norfolk International Airport to serve southeastern Virginia. Their air service will add many affordably-priced vacation destinations for our community.”

Allegiant offers a unique option to Norfolk area travelers with low base fares and savings on rental cars, hotels and activity and attraction tickets. Travelers can book their entire vacation with Allegiant for less.

***About the introductory one-way fares:**
Seats are limited. Price includes taxes and fees. Fares are one way and not available on all flights. Flights must be purchased by June 22, 2017 for travel by Feb. 13, 2018. See Allegiant.com for details. For optional services and baggage fees, please visit Allegiant.com. Additional restrictions may apply.

Allegiant®
Las Vegas-based Allegiant (NASDAQ: ALGT) is focused on linking travelers in small cities to world-class leisure destinations. The airline offers industry-low fares on an all-jet fleet while also offering other travel-related products such as hotel rooms and rental cars. All can be purchased only through the company website, Allegiant.com. Beginning with one aircraft and one route in 1999, the company has grown to over 80 aircraft and more than 300 routes across the country with base airfares less than half the cost of the average domestic roundtrip ticket. For downloadable press kit, including photos, visit: http://gofly.us/iiFa303wrtF.

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Allegiant Media Contact
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Email: mediarelations@allegiantair.com

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ALLEGIANT ANNOUNCES NEW NONSTOP SERVICE TO JACKSONVILLE WITH FARES AS LOW AS $49

Click to Tweet: .@Allegiant announces nonstop service from @NorfolkAirport to @JAXAirport with fares everyone can afford. #GetAway #YourWay

NORFOLK, Va. April 3, 2018 — **Allegiant** (NASDAQ: ALGT) today announces new nonstop service from Norfolk to Jacksonville, Florida via Jacksonville International Airport (JAX) beginning June 14, 2018. **There is no better time to get away your way, with one-way fares on the new routes as low as $49.***

"Allegiant is excited to offer Norfolk travelers their only ultra-low-cost, nonstop option to visit Jacksonville," said Lukas Johnson, Allegiant senior vice president of commercial. "The Norfolk community has been very supportive of us since we first began flying here last year, and we're pleased to be able to provide them with convenient, friendly service to enjoy all that this sunny destination has to offer."

The new seasonal service will operate twice weekly from Norfolk International Airport (ORF) to Jacksonville International Airport (JAX). With this addition, Allegiant will offer nonstop service to four cities in Florida from ORF: Fort Lauderdale, Jacksonville, Orlando / Sanford and Tampa / St. Pete. Flight days, times and the lowest fares can be found only at Allegiant.com.

"The addition of nonstop service from Norfolk to Jacksonville by Allegiant will be welcoming news for many travelers," said Robert Bowen, Norfolk Airport Authority executive director. "The natural military ties between our two communities, as well as a Florida vacation destination makes this news very exciting."

Allegiant offers a unique option to Norfolk-area travelers with low base fares and savings on rental cars and hotels. Travelers can book their entire vacation with Allegiant for less.

***About the introductory one-way fares:**
Seats are limited. Price includes taxes and fees. Fares are one way and not available on all flights. Flights must be purchased by April 4, 2018 for travel by Aug. 13, 2018. For more details, optional services and baggage fees, please visit Allegiant.com. Additional restrictions may apply.

Allegiant®
Las Vegas-based Allegiant (NASDAQ: ALGT) is focused on linking travelers to world-class leisure destinations. The airline offers industry-low fares on an all-jet fleet while also offering other travel-related products such as hotel rooms and rental cars. All can be purchased only through the company website, Allegiant.com. Beginning with one aircraft and one route in 1999, the company has grown to over 80 aircraft and more than 300 routes across the country with base airfares less than half the cost of the average domestic roundtrip ticket. For downloadable press kit, including photos, visit: http://gofly.us/ToZT30iauev.

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Allegiant Public Relations
Phone: 725-221-9937
Email: communications@allegiantair.com
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ALLEGIANT ANNOUNCES NEW NONSTOP SERVICE TO NORFOLK FROM 2 CITIES WITH FARES AS LOW AS $49* EACH WAY

NORFOLK, Va. Jan. 15, 2019 — **Allegiant** (NASDAQ: ALGT) today announces two new nonstop routes to Norfolk from two cities in Ohio: Cincinnati and Cleveland. **To celebrate, the company is offering fares on the new routes as low as $49* each way.**

"We're excited to announce yet another expansion in Norfolk," said Drew Wells, Allegiant vice president of planning and revenue. "We're sure folks in Cincinnati and Cleveland will be thrilled to take advantage of these convenient, ultra-low-cost, nonstop flights to enjoy Virginia Beach and the Outer Banks."

The new seasonal routes to **Norfolk International Airport (ORF)** include:

1. **Cincinnati, Ohio** via Cincinnati / Northern Kentucky International Airport (CVG) – beginning June 7, 2019 with fares as low as $49* each way.

2. **Cleveland, Ohio** via Cleveland Hopkins International Airport (CLE) – beginning June 7, 2019 with fares as low as $49* each way.

The new nonstop routes will operate twice-weekly and will bring nearly 4,000 passengers to the Virginia Beach and Outer Banks areas annually, contributing to visitor spending in the local economy. Flight days, times and the lowest fares can be found only at Allegiant.com.

Robert Bowen, Norfolk Airport Authority executive director states, "Both Cincinnati and Cleveland are high tourist origins for our region. Allegiant's new service from these cities into Norfolk International Airport will have a direct local economic impact on lodging, dining and other services."

Allegiant offers a unique option to Virginia Beach-bound travelers with low base airfare and savings on rental cars. Travelers can book their entire vacation with Allegiant for less.

***About the introductory fares:**
Price displayed reflects purchase of a roundtrip itinerary and includes taxes, carrier charges & government fees. Seats and dates are limited and fares are not available on all flights. Flights must be purchased by Jan. 16, 2019 for travel by Aug. 13, 2019. Fare rules, routes and schedules are subject to change without notice. Optional baggage charges and additional restrictions may apply. For more details, optional services and baggage fees, please visit Allegiant.com.

Allegiant®
Las Vegas-based Allegiant (NASDAQ: ALGT) is focused on linking travelers to world-class leisure destinations. The airline offers industry-low fares on an all-jet fleet while also offering other travel-related products such as hotel rooms and rental cars. All can be purchased only through the company website, Allegiant.com. Beginning with one aircraft and one route in 1999, the company has grown to over 80 aircraft and more than 300 routes across the country with base airfares less than half the cost of the average domestic roundtrip ticket. For downloadable press kit, including photos, visit: http://gofly.us/iiFa303wrtF.

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NORFOLK INTERNATIONAL AIRPORT

Media Contact: Charles Braden
Director of Market Development
757-857-3351

FOR IMMEDIATE RELEASE:

United Airlines to Provide Nonstop Norfolk to Denver Air Service

NORFOLK, VA. – (January 8, 2018) – United Airlines has announced that it will begin year-round daily nonstop air service from Norfolk International Airport to Denver, Colorado effective June 8, 2018. The service will be operated on 128-seat Airbus A319 aircraft with dual class service and an affordable fare structure.

Norfolk Airport Authority executive director Robert Bowen states "This new nonstop service provides our local community needed access to Denver and also offers greater west coast and pacific reach through United's Denver hub. We are gratified that United has selected Norfolk for this service expansion." Local travelers will have convenient access to over 50 destinations via the Denver hub. According to the FAA, Denver is Norfolk's 9th ranked market in terms of passenger demand.

The Norfolk to Denver service which begins June 8, 2018 is available for sale now on United.com and scheduled as follows:

Depart	Arrive
Norfolk 8:00 A.M.	Denver 10:08 A.M.
Denver 5:45 P.M.	Norfolk 11:10 P.M.

###

Norfolk International Airport (ORF) is the major airport serving Coastal Virginia and Northeast North Carolina with air service provided by Allegiant, American, Delta, Southwest, United and their regional airline partners. Together they provide nonstop access to 22 major airports (includes year-round and seasonal service), most of which are international gateways, allowing convenient access to global destinations. According to the FAA, Norfolk International Airport's passenger activity is ranked in the top 15% of commercial service airports in the United States with over 3.2 million scheduled passengers served in 2016.

NORFOLK INTERNATIONAL AIRPORT

Media Contact: Charles Braden

Director of Market Development

757-857-3351

FOR IMMEDIATE RELEASE:

SOUTHWEST AIRLINES TO EXPAND SUMMER 2019 SERVICE FROM NORFOLK INTERNATIONAL AIRPORT

NORFOLK, Va. – (November 15, 2018) – Southwest Airlines will add new nonstop service from Norfolk International Airport (ORF) to Nashville, TN and San Diego, CA on June 9, 2019. The airline has just released the June 9 – August 5 schedule and it is now on sale at Southwest.com.

Flights to both cities are summer seasonal service and will be operated on the weekends with the following schedule:

Service to Nashville (BNA) Operates on Saturday and Sunday	
Depart ORF at 6:15 P.M.	Arrive BNA at 7:10 P.M.
Depart BNA at 11:40 A.M.	Arrive ORF at 2:30 P.M.

Service to San Diego (SAN) Operates on Sunday	
Depart ORF at 12:40 P.M.	Arrive SAN at 3:00 P.M.
Depart SAN at 3:45 P.M.	Arrive ORF at 11:50 P.M.

Robert Bowen, Norfolk Airport Authority executive director states, “We welcome this wonderful news. San Diego is a popular destination for our region with close ties to the military community. The return of the previously served Nashville route will also be well received.” In addition to the service above, Southwest will also return the summer weekend nonstop service to Denver, CO.

###

Norfolk International Airport (ORF) is the major airport serving Coastal Virginia and Northeast North Carolina with air service provided by Allegiant, American, Delta, Frontier, Southwest, United and their regional airline partners. Together they provide nonstop access to 26 major airports (includes year-round and seasonal service), most of which are international gateways, allowing convenient access to global destinations. According to the FAA, Norfolk International Airport’s passenger activity is ranked in the top 13% of commercial service airports in the United States with nearly 3.4 million scheduled passengers served in 2017.

APPENDIX I – AIRLINE SCHEDULES (JULY 2017)

From : 07/01/2017		Airport : NORFOLK INTERNATIONAL (ORF)														
To : 07/31/2017		SCHEDULED DEPARTURES														
Destination	Flight No	Date From	Date To	Dep Time	Arr Time	Sys Carrier	Op Carrier	Aircraft	Mon	Tue	Wed	Thu	Fri	Sat	Sun
ATL															
	2557	7/10/2017	7/13/2017	05:45:00	07:21:00	DL	DL	M88	X	X	X	X	X		
	2557	7/12/2017	7/20/2017	05:45:00	07:21:00	DL	DL	M88	X	X	X	X	X		
	2557	7/19/2017	7/20/2017	05:45:00	07:21:00	DL	DL	M88	X	X	X	X	X		
	2557	7/19/2017	7/21/2017	05:45:00	07:21:00	DL	DL	M88	X	X	X	X	X		
	2557	7/24/2017	7/27/2017	05:45:00	07:21:00	DL	DL	M88	X	X	X	X	X		
	2557	7/26/2017	8/3/2017	05:45:00	07:21:00	DL	DL	M88	X	X	X	X	X		
	2557	7/1/2017	7/6/2017	06:00:00	07:42:00	DL	DL	M88						X	
	2557	7/8/2017	7/13/2017	06:00:00	07:42:00	DL	DL	M88						X	
	2557	7/9/2017	7/13/2017	06:00:00	07:44:00	DL	DL	M88							X
	2557	7/15/2017	7/20/2017	06:00:00	07:42:00	DL	DL	M88						X	
	2557	7/16/2017	7/20/2017	06:00:00	07:44:00	DL	DL	M88							X
	2557	7/22/2017	7/22/2017	06:00:00	07:42:00	DL	DL	M88						X	
	2557	7/23/2017	7/27/2017	06:00:00	07:44:00	DL	DL	M88							X
	2557	7/29/2017	8/3/2017	06:00:00	07:42:00	DL	DL	M88						X	
	2557	7/30/2017	8/3/2017	06:00:00	07:44:00	DL	DL	M88							X
	1183	7/1/2017	7/6/2017	07:00:00	08:42:00	DL	DL	757	X	X				X	X
	1183	7/5/2017	7/6/2017	07:00:00	08:43:00	DL	DL	757	X	X	X	X	X		X
	1183	7/5/2017	7/13/2017	07:00:00	08:43:00	DL	DL	757	X	X	X	X	X		X
	1183	7/8/2017	7/13/2017	07:00:00	08:42:00	DL	DL	757						X	
	1183	7/12/2017	7/20/2017	07:00:00	08:43:00	DL	DL	757	X	X	X	X	X		X
	1183	7/15/2017	7/20/2017	07:00:00	08:42:00	DL	DL	757						X	
	1183	7/19/2017	7/20/2017	07:00:00	08:43:00	DL	DL	757	X	X	X	X	X		X
	1183	7/19/2017	7/21/2017	07:00:00	08:43:00	DL	DL	757	X	X	X	X	X		X
	1183	7/22/2017	7/22/2017	07:00:00	08:42:00	DL	DL	757						X	
	1183	7/23/2017	7/27/2017	07:00:00	08:43:00	DL	DL	757	X		X	X	X		X
	1183	7/25/2017	7/27/2017	07:00:00	08:43:00	DL	DL	757		X					
	1183	7/26/2017	8/3/2017	07:00:00	08:43:00	DL	DL	757	X		X	X	X		X
	1183	7/29/2017	8/3/2017	07:00:00	08:42:00	DL	DL	757						X	
	1252	7/1/2017	7/1/2017	08:05:00	09:46:00	DL	DL	M88						X	
	1252	7/8/2017	7/13/2017	08:05:00	09:45:00	DL	DL	757						X	
	1252	7/15/2017	7/20/2017	08:05:00	09:45:00	DL	DL	757						X	
	1252	7/22/2017	7/22/2017	08:05:00	09:45:00	DL	DL	757						X	
	1252	7/29/2017	8/3/2017	08:05:00	09:45:00	DL	DL	757						X	
	1252	7/2/2017	7/4/2017	08:15:00	09:54:00	DL	DL	757		X					X
	1252	7/3/2017	7/3/2017	08:15:00	09:54:00	DL	DL	757	X						
	1252	7/5/2017	7/6/2017	08:15:00	09:56:00	DL	DL	757		X	X	X	X		X
	1252	7/5/2017	7/13/2017	08:15:00	09:56:00	DL	DL	757		X	X	X	X		X
	1252	7/10/2017	7/13/2017	08:15:00	09:56:00	DL	DL	757	X						
	1252	7/12/2017	7/20/2017	08:15:00	09:56:00	DL	DL	757		X	X	X	X		X
	1252	7/17/2017	7/20/2017	08:15:00	09:56:00	DL	DL	757	X						
	1252	7/19/2017	7/20/2017	08:15:00	09:56:00	DL	DL	757		X	X	X	X		X
	1252	7/19/2017	7/21/2017	08:15:00	09:56:00	DL	DL	757		X	X	X	X		X
	1252	7/23/2017	7/27/2017	08:15:00	09:56:00	DL	DL	757			X	X	X		X
	1252	7/24/2017	7/27/2017	08:15:00	09:56:00	DL	DL	757	X	X					
	1252	7/26/2017	8/3/2017	08:15:00	09:56:00	DL	DL	757			X	X	X		X
	1252	7/31/2017	8/3/2017	08:15:00	09:56:00	DL	DL	757	X	X					
	1113	7/3/2017	7/4/2017	09:45:00	11:26:00	DL	DL	M88	X	X					
	1113	7/5/2017	7/6/2017	09:45:00	11:28:00	DL	DL	M88			X	X	X		
	1113	7/5/2017	7/7/2017	09:45:00	11:28:00	DL	DL	M88			X	X	X		
	1113	7/10/2017	7/13/2017	09:45:00	11:28:00	DL	DL	M88	X	X	X	X	X		
	1113	7/12/2017	7/20/2017	09:45:00	11:28:00	DL	DL	M88	X	X	X	X	X		
	1113	7/19/2017	7/20/2017	09:45:00	11:28:00	DL	DL	M88	X	X	X	X	X		
	1113	7/19/2017	7/21/2017	09:45:00	11:28:00	DL	DL	M88	X	X	X	X	X		
	1113	7/24/2017	7/27/2017	09:45:00	11:28:00	DL	DL	M88	X	X	X	X	X		
	1113	7/26/2017	8/3/2017	09:45:00	11:28:00	DL	DL	M88	X	X	X	X	X		
	1113	7/2/2017	7/2/2017	10:29:00	12:13:00	DL	DL	M88							X
	1113	7/9/2017	7/13/2017	10:29:00	12:16:00	DL	DL	M88							X
	1113	7/16/2017	7/20/2017	10:29:00	12:16:00	DL	DL	M88							X
	1113	7/23/2017	7/27/2017	10:29:00	12:16:00	DL	DL	M88							X
	1113	7/30/2017	8/3/2017	10:29:00	12:16:00	DL	DL	M88							X
	1113	7/1/2017	7/6/2017	10:39:00	12:23:00	DL	DL	M88						X	
	1113	7/8/2017	7/13/2017	10:39:00	12:23:00	DL	DL	M88						X	
	1113	7/15/2017	7/20/2017	10:39:00	12:23:00	DL	DL	M88						X	
	1113	7/22/2017	7/22/2017	10:39:00	12:23:00	DL	DL	M88						X	
	1113	7/29/2017	8/3/2017	10:39:00	12:23:00	DL	DL	M88						X	
	2074	7/2/2017	7/4/2017	12:25:00	14:10:00	DL	DL	M88	X	X					X
	2074	7/5/2017	7/6/2017	12:25:00	14:13:00	DL	DL	M88			X	X	X		
	2074	7/5/2017	7/7/2017	12:25:00	14:13:00	DL	DL	M88			X	X	X		
	2074	7/9/2017	7/13/2017	12:25:00	14:13:00	DL	DL	M88	X	X	X	X	X		X
	2074	7/12/2017	7/20/2017	12:25:00	14:13:00	DL	DL	M88	X	X	X	X	X		X
	2074	7/19/2017	7/20/2017	12:25:00	14:13:00	DL	DL	M88	X	X	X	X	X		X
	2074	7/19/2017	7/21/2017	12:25:00	14:13:00	DL	DL	M88	X	X	X	X	X		X
	2074	7/23/2017	7/27/2017	12:25:00	14:13:00	DL	DL	M88	X	X	X	X	X		X
	2074	7/26/2017	8/3/2017	12:25:00	14:13:00	DL	DL	M88	X	X	X	X	X		X
	2074	7/1/2017	7/6/2017	12:29:00	14:14:00	DL	DL	M88						X	
	2074	7/8/2017	7/13/2017	12:29:00	14:14:00	DL	DL	M88						X	
	2074	7/15/2017	7/20/2017	12:29:00	14:14:00	DL	DL	M88						X	
	2074	7/22/2017	7/22/2017	12:29:00	14:14:00	DL	DL	M88						X	
	2074	7/29/2017	8/3/2017	12:29:00	14:14:00	DL	DL	M88						X	
	2141	7/1/2017	7/1/2017	14:25:00	16:10:00	DL	DL	M88	X	X				X	X
	2141	7/2/2017	7/6/2017	14:25:00	16:10:00	DL	DL	M88	X	X				X	X
	2141	7/5/2017	7/6/2017	14:25:00	16:12:00	DL	DL	M88	X	X	X	X	X		X
	2141	7/5/2017	7/13/2017	14:25:00	16:12:00	DL	DL	M88	X	X	X	X	X		X
	2141	7/8/2017	7/13/2017	14:25:00	16:10:00	DL	DL	M88						X	
	2141	7/12/2017	7/18/2017	14:25:00	16:12:00	DL	DL	M88	X	X	X	X	X		X
	2141	7/15/2017	7/20/2017	14:25:00	16:10:00	DL	DL	M88						X	
	2141	7/19/2017	7/19/2017	14:25:00	16:12:00	DL	DL	M90			X				

	2141	7/19/2017	7/19/2017	14:25:00	16:12:00	DL	DL	M90			X				
	2141	7/19/2017	7/20/2017	14:25:00	16:12:00	DL	DL	M90			X				
	2141	7/20/2017	7/21/2017	14:25:00	16:12:00	DL	DL	M88	X	X		X	X		X
	2141	7/22/2017	7/22/2017	14:25:00	16:10:00	DL	DL	M88						X	
	2141	7/23/2017	7/27/2017	14:25:00	16:12:00	DL	DL	M88	X	X		X			X
	2141	7/26/2017	7/28/2017	14:25:00	16:12:00	DL	DL	M90			X		X		
	2141	7/26/2017	7/27/2017	14:25:00	16:12:00	DL	DL	M90			X		X		
	2141	7/27/2017	8/3/2017	14:25:00	16:12:00	DL	DL	M88	X	X	X	X			X
	2141	7/29/2017	8/3/2017	14:25:00	16:10:00	DL	DL	M88						X	
	2206	7/1/2017	7/6/2017	16:35:00	18:23:00	DL	DL	M88						X	
	2206	7/5/2017	7/13/2017	16:35:00	18:25:00	DL	DL	M88	X	X	X	X	X		X
	2206	7/5/2017	7/6/2017	16:35:00	18:25:00	DL	DL	M88	X	X	X	X	X		X
	2206	7/8/2017	7/13/2017	16:35:00	18:23:00	DL	DL	M88						X	
	2206	7/12/2017	7/20/2017	16:35:00	18:25:00	DL	DL	M88	X	X	X	X	X		X
	2206	7/15/2017	7/20/2017	16:35:00	18:23:00	DL	DL	M88						X	
	2206	7/19/2017	7/20/2017	16:35:00	18:25:00	DL	DL	M88	X	X	X	X	X		X
	2206	7/19/2017	7/21/2017	16:35:00	18:25:00	DL	DL	M88	X	X	X	X	X		X
	2206	7/22/2017	7/22/2017	16:35:00	18:23:00	DL	DL	M88						X	
	2206	7/23/2017	7/27/2017	16:35:00	18:25:00	DL	DL	M88	X	X	X	X	X		X
	2206	7/26/2017	8/3/2017	16:35:00	18:25:00	DL	DL	M88	X	X	X	X	X		X
	2206	7/29/2017	8/3/2017	16:35:00	18:23:00	DL	DL	M88						X	
	321	7/2/2017	7/4/2017	18:25:00	20:14:00	DL	DL	M88	X	X					X
	321	7/5/2017	7/13/2017	18:25:00	20:16:00	DL	DL	M88	X	X	X	X	X		X
	321	7/5/2017	7/6/2017	18:25:00	20:16:00	DL	DL	M88	X	X	X	X	X		X
	321	7/12/2017	7/20/2017	18:25:00	20:16:00	DL	DL	M88	X	X	X	X	X		
	321	7/16/2017	7/20/2017	18:25:00	20:16:00	DL	DL	M90							X
	321	7/19/2017	7/20/2017	18:25:00	20:16:00	DL	DL	M88	X	X	X	X	X		
	321	7/19/2017	7/21/2017	18:25:00	20:16:00	DL	DL	M88	X	X	X	X	X		
	321	7/23/2017	7/23/2017	18:25:00	20:16:00	DL	DL	M90							X
	321	7/24/2017	7/27/2017	18:25:00	20:16:00	DL	DL	M88	X	X	X	X	X		X
	321	7/26/2017	8/3/2017	18:25:00	20:16:00	DL	DL	M88	X	X	X	X	X		X
	1685	7/5/2017	7/13/2017	19:55:00	21:43:00	DL	DL	M88	X	X	X	X	X		X
	1685	7/5/2017	7/6/2017	19:55:00	21:43:00	DL	DL	M88	X	X	X	X	X		X
	1685	7/12/2017	7/20/2017	19:55:00	21:43:00	DL	DL	M88	X	X	X	X	X		X
	1685	7/19/2017	7/20/2017	19:55:00	21:43:00	DL	DL	M88	X	X	X	X	X		X
	1685	7/19/2017	7/21/2017	19:55:00	21:43:00	DL	DL	M88	X	X	X	X	X		X
	1685	7/23/2017	7/27/2017	19:55:00	21:43:00	DL	DL	M88	X	X	X	X	X		X
	1685	7/26/2017	8/3/2017	19:55:00	21:43:00	DL	DL	M88	X	X	X	X	X		X
BWI															
	1560	6/28/2017	7/6/2017	06:00:00	06:55:00	WN	WN	73W			X	X	X		
	1560	7/5/2017	7/13/2017	06:00:00	06:55:00	WN	WN	73W	X	X	X	X	X		
	1560	7/12/2017	7/20/2017	06:00:00	06:55:00	WN	WN	73W	X	X	X	X	X		
	1560	7/19/2017	7/20/2017	06:00:00	06:55:00	WN	WN	73W	X	X	X	X	X		
	1560	7/19/2017	7/27/2017	06:00:00	06:55:00	WN	WN	73W	X	X	X	X	X		
	1560	7/26/2017	8/3/2017	06:00:00	06:55:00	WN	WN	73W	X	X	X	X	X		
	1560	7/3/2017	7/3/2017	06:05:00	07:00:00	WN	WN	73W	X						
	2864	7/1/2017	7/6/2017	06:35:00	07:30:00	WN	WN	73W						X	
	2864	7/8/2017	7/13/2017	06:35:00	07:30:00	WN	WN	73W						X	
	2864	7/15/2017	7/20/2017	06:35:00	07:30:00	WN	WN	73W						X	
	2864	7/22/2017	7/27/2017	06:35:00	07:30:00	WN	WN	73W						X	
	2864	7/29/2017	8/3/2017	06:35:00	07:30:00	WN	WN	73W						X	
	4824	7/4/2017	7/4/2017	06:35:00	07:30:00	WN	WN	73C		X					
	3946	7/2/2017	7/6/2017	07:00:00	07:55:00	WN	WN	73H							X
	3946	7/9/2017	7/13/2017	07:00:00	07:55:00	WN	WN	73H							X
	3946	7/16/2017	7/20/2017	07:00:00	07:55:00	WN	WN	73H							X
	3946	7/23/2017	7/27/2017	07:00:00	07:55:00	WN	WN	73H							X
	3946	7/30/2017	8/3/2017	07:00:00	07:55:00	WN	WN	73H							X
	4551	7/1/2017	7/6/2017	10:05:00	11:00:00	WN	WN	73W						X	
	4551	7/8/2017	7/13/2017	10:05:00	11:00:00	WN	WN	73W						X	
	4551	7/15/2017	7/20/2017	10:05:00	11:00:00	WN	WN	73W						X	
	4551	7/22/2017	7/27/2017	10:05:00	11:00:00	WN	WN	73W						X	
	4551	7/29/2017	8/3/2017	10:05:00	11:00:00	WN	WN	73W						X	
	1068	7/2/2017	7/2/2017	10:40:00	11:35:00	WN	WN	73W							X
	1068	7/9/2017	7/13/2017	10:40:00	11:35:00	WN	WN	73W							X
	1068	7/16/2017	7/20/2017	10:40:00	11:35:00	WN	WN	73W							X
	1068	7/23/2017	7/27/2017	10:40:00	11:35:00	WN	WN	73W							X
	1068	7/30/2017	8/3/2017	10:40:00	11:35:00	WN	WN	73W							X
	632	6/28/2017	7/6/2017	12:00:00	12:55:00	WN	WN	73W		X	X	X	X		
	632	7/3/2017	7/3/2017	12:00:00	12:55:00	WN	WN	73W	X						
	632	7/5/2017	7/13/2017	12:00:00	12:55:00	WN	WN	73W	X	X	X	X	X		
	632	7/12/2017	7/20/2017	12:00:00	12:55:00	WN	WN	73W	X	X	X	X	X		
	632	7/19/2017	7/20/2017	12:00:00	12:55:00	WN	WN	73W	X	X	X	X	X		
	632	7/19/2017	7/27/2017	12:00:00	12:55:00	WN	WN	73W	X	X	X	X	X		
	632	7/26/2017	8/3/2017	12:00:00	12:55:00	WN	WN	73W	X	X	X	X	X		
	2394	7/1/2017	7/6/2017	12:25:00	13:20:00	WN	WN	73W						X	
	2394	7/8/2017	7/13/2017	12:25:00	13:20:00	WN	WN	73W						X	
	2394	7/15/2017	7/20/2017	12:25:00	13:20:00	WN	WN	73W						X	
	2394	7/22/2017	7/27/2017	12:25:00	13:20:00	WN	WN	73W						X	
	2394	7/29/2017	8/3/2017	12:25:00	13:20:00	WN	WN	73W						X	
	1370	7/2/2017	7/6/2017	12:35:00	13:30:00	WN	WN	73W							X
	1370	7/9/2017	7/13/2017	12:35:00	13:30:00	WN	WN	73W							X
	1370	7/16/2017	7/20/2017	12:35:00	13:30:00	WN	WN	73W							X
	1370	7/23/2017	7/27/2017	12:35:00	13:30:00	WN	WN	73W							X
	1370	7/30/2017	8/3/2017	12:35:00	13:30:00	WN	WN	73W							X
	563	6/28/2017	7/6/2017	14:45:00	15:40:00	WN	WN	73C			X	X	X		
	563	7/5/2017	7/13/2017	14:45:00	15:40:00	WN	WN	73C	X	X	X	X	X		
	563	7/12/2017	7/20/2017	14:45:00	15:40:00	WN	WN	73C	X	X	X	X	X		
	563	7/19/2017	7/27/2017	14:45:00	15:40:00	WN	WN	73C	X	X	X	X	X		
	563	7/19/2017	7/20/2017	14:45:00	15:40:00	WN	WN	73C	X	X	X	X	X		
	563	7/26/2017	8/3/2017	14:45:00	15:40:00	WN	WN	73C	X	X	X	X	X		
	1234	7/3/2017	7/3/2017	15:05:00	16:00:00	WN	WN	73C	X						
	4167	7/2/2017	7/6/2017	15:15:00	16:10:00	WN	WN	73W							X
	4167	7/9/2017	7/13/2017	15:15:00	16:10:00	WN	WN	73W							X
	4167	7/16/2017	7/20/2017	15:15:00	16:10:00	WN	WN	73W							X
	4167	7/23/2017	7/27/2017	15:15:00	16:10:00	WN	WN	73W							X
	4167	7/30/2017	8/3/2017	15:15:00	16:10:00	WN	WN	73W							X

	1223	7/4/2017	7/4/2017	16:05:00	17:00:00	WN	WN	73W		X					
	137	7/3/2017	7/3/2017	16:25:00	17:20:00	WN	WN	73W	X						
	137	6/28/2017	7/6/2017	16:30:00	17:25:00	WN	WN	73W			X	X	X		
	137	7/5/2017	7/13/2017	16:30:00	17:25:00	WN	WN	73W	X	X	X	X	X		
	137	7/12/2017	7/20/2017	16:30:00	17:25:00	WN	WN	73W	X	X	X	X	X		
	137	7/19/2017	7/20/2017	16:30:00	17:25:00	WN	WN	73W	X	X	X	X	X		
	137	7/19/2017	7/27/2017	16:30:00	17:25:00	WN	WN	73W	X	X	X	X	X		
	137	7/26/2017	8/3/2017	16:30:00	17:25:00	WN	WN	73W	X	X	X	X	X		
	332	7/4/2017	7/4/2017	17:05:00	18:05:00	WN	WN	73W		X					
	4363	7/2/2017	7/6/2017	17:40:00	18:40:00	WN	WN	73W							X
	4363	7/9/2017	7/13/2017	17:40:00	18:40:00	WN	WN	73W							X
	4363	7/16/2017	7/20/2017	17:40:00	18:40:00	WN	WN	73W							X
	4363	7/23/2017	7/27/2017	17:40:00	18:40:00	WN	WN	73W							X
	4363	7/30/2017	8/3/2017	17:40:00	18:40:00	WN	WN	73W							X
	268	6/28/2017	7/6/2017	18:35:00	19:35:00	WN	WN	73C		X	X	X	X		
	268	7/5/2017	7/13/2017	18:35:00	19:35:00	WN	WN	73C	X	X	X	X	X		
	268	7/12/2017	7/20/2017	18:35:00	19:35:00	WN	WN	73C	X	X	X	X	X		
	268	7/19/2017	7/27/2017	18:35:00	19:35:00	WN	WN	73C	X	X	X	X	X		
	268	7/19/2017	7/20/2017	18:35:00	19:35:00	WN	WN	73C	X	X	X	X	X		
	268	7/26/2017	8/3/2017	18:35:00	19:35:00	WN	WN	73C	X	X	X	X	X		
	5819	7/1/2017	7/6/2017	18:35:00	19:35:00	WN	WN	73W						X	
	5819	7/8/2017	7/13/2017	18:35:00	19:35:00	WN	WN	73W						X	
	5819	7/15/2017	7/20/2017	18:35:00	19:35:00	WN	WN	73W						X	
	5819	7/22/2017	7/27/2017	18:35:00	19:35:00	WN	WN	73W						X	
	5819	7/29/2017	8/3/2017	18:35:00	19:35:00	WN	WN	73W						X	
CLT															
	1978	7/8/2017	7/13/2017	05:25:00	06:42:00	AA	AA	319						X	
	1978	7/15/2017	7/20/2017	05:25:00	06:42:00	AA	AA	319						X	
	1978	7/22/2017	7/27/2017	05:25:00	06:42:00	AA	AA	319						X	
	1978	7/29/2017	8/3/2017	05:25:00	06:42:00	AA	AA	319						X	
	5073	6/29/2017	7/6/2017	05:25:00	06:34:00	AA	16	CR9	X	X	X	X	X	X	X
	5073	7/5/2017	7/13/2017	05:25:00	06:34:00	AA	16	CR9	X	X	X	X	X		X
	5073	7/12/2017	7/12/2017	05:25:00	06:34:00	AA	16	CR9	X	X	X	X	X		X
	5073	7/13/2017	7/20/2017	05:25:00	06:34:00	AA	16	CR9	X	X	X	X	X		X
	5073	7/19/2017	7/20/2017	05:25:00	06:34:00	AA	16	CR9	X	X	X	X	X		X
	5073	7/19/2017	7/27/2017	05:25:00	06:34:00	AA	16	CR9	X	X	X	X	X		X
	5073	7/26/2017	7/26/2017	05:25:00	06:34:00	AA	16	CR9	X	X	X	X	X		X
	5073	7/27/2017	8/3/2017	05:25:00	06:34:00	AA	16	CR9	X	X	X	X	X		X
	1823	6/29/2017	7/6/2017	07:15:00	08:40:00	AA	AA	319			X	X	X	X	
	1823	7/3/2017	7/3/2017	07:15:00	08:40:00	AA	AA	319	X						
	1823	7/4/2017	7/4/2017	07:15:00	08:40:00	AA	AA	320		X					
	1823	7/5/2017	7/13/2017	07:15:00	08:40:00	AA	AA	319	X	X	X	X	X		
	1823	7/12/2017	7/20/2017	07:15:00	08:40:00	AA	AA	319	X	X	X	X	X		
	1823	7/19/2017	7/20/2017	07:15:00	08:40:00	AA	AA	319	X	X	X	X	X		
	1823	7/19/2017	7/27/2017	07:15:00	08:40:00	AA	AA	319	X	X	X	X	X		
	1823	7/26/2017	7/26/2017	07:15:00	08:40:00	AA	AA	319	X	X	X	X	X		
	1823	7/27/2017	8/3/2017	07:15:00	08:40:00	AA	AA	319	X	X	X	X	X		
	1935	7/2/2017	7/2/2017	07:15:00	08:40:00	AA	AA	319							X
	1935	7/9/2017	7/13/2017	07:15:00	08:40:00	AA	AA	319							X
	1935	7/16/2017	7/20/2017	07:15:00	08:40:00	AA	AA	319							X
	1935	7/23/2017	7/27/2017	07:15:00	08:40:00	AA	AA	319							X
	1935	7/30/2017	7/30/2017	07:15:00	08:40:00	AA	AA	319							X
	5222	7/8/2017	7/13/2017	07:15:00	08:34:00	AA	16	CR9						X	
	5222	7/15/2017	7/20/2017	07:15:00	08:34:00	AA	16	CR9						X	
	5222	7/22/2017	7/27/2017	07:15:00	08:34:00	AA	16	CR9						X	
	5222	7/29/2017	8/3/2017	07:15:00	08:34:00	AA	16	CR9						X	
	5252	6/29/2017	7/4/2017	09:25:00	10:50:00	AA	16	CR9	X	X		X	X	X	X
	5252	7/5/2017	7/13/2017	09:25:00	10:50:00	AA	16	CR9	X	X	X	X	X	X	X
	5252	7/5/2017	7/6/2017	09:25:00	10:50:00	AA	16	CR9	X	X	X	X	X	X	X
	5252	7/12/2017	7/12/2017	09:25:00	10:50:00	AA	16	CR9	X	X	X	X	X	X	X
	5252	7/13/2017	7/20/2017	09:25:00	10:50:00	AA	16	CR9	X	X	X	X	X	X	X
	5252	7/19/2017	7/27/2017	09:25:00	10:50:00	AA	16	CR9	X	X	X	X	X	X	X
	5252	7/19/2017	7/20/2017	09:25:00	10:50:00	AA	16	CR9	X	X	X	X	X	X	X
	5252	7/26/2017	7/26/2017	09:25:00	10:50:00	AA	16	CR9	X	X	X	X	X	X	X
	5252	7/27/2017	8/3/2017	09:25:00	10:50:00	AA	16	CR9	X	X	X	X	X	X	X
	616	7/2/2017	7/6/2017	11:05:00	12:26:00	AA	AA	319							X
	616	7/9/2017	7/13/2017	11:05:00	12:26:00	AA	AA	319							X
	616	7/16/2017	7/20/2017	11:05:00	12:26:00	AA	AA	319							X
	616	7/23/2017	7/27/2017	11:05:00	12:26:00	AA	AA	319							X
	616	7/30/2017	8/3/2017	11:05:00	12:26:00	AA	AA	319							X
	1970	6/29/2017	7/6/2017	11:05:00	12:26:00	AA	AA	319		X	X	X	X		
	1970	7/5/2017	7/13/2017	11:05:00	12:26:00	AA	AA	319	X	X	X	X	X		
	1970	7/12/2017	7/20/2017	11:05:00	12:26:00	AA	AA	319	X	X	X	X	X		
	1970	7/19/2017	7/20/2017	11:05:00	12:26:00	AA	AA	319	X	X	X	X	X		
	1970	7/19/2017	7/27/2017	11:05:00	12:26:00	AA	AA	319	X	X	X	X	X		
	1970	7/26/2017	7/26/2017	11:05:00	12:26:00	AA	AA	319	X	X	X	X	X		
	1970	7/27/2017	8/3/2017	11:05:00	12:26:00	AA	AA	319	X	X	X	X	X		
	5368	7/1/2017	7/6/2017	11:05:00	12:25:00	AA	16	CR9						X	
	5368	7/8/2017	7/13/2017	11:05:00	12:25:00	AA	16	CR9						X	
	5368	7/15/2017	7/20/2017	11:05:00	12:25:00	AA	16	CR9						X	
	5368	7/22/2017	7/27/2017	11:05:00	12:25:00	AA	16	CR9						X	
	5368	7/29/2017	8/3/2017	11:05:00	12:25:00	AA	16	CR9						X	
	5501	7/3/2017	7/3/2017	11:05:00	12:25:00	AA	16	CR9	X						
	4130	6/29/2017	7/4/2017	12:10:00	13:31:00	AA	ZW	CR2	X	X		X	X	X	X
	4130	7/5/2017	7/6/2017	12:35:00	13:56:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4130	7/5/2017	7/13/2017	12:35:00	13:56:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4130	7/12/2017	7/20/2017	12:35:00	13:56:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4130	7/19/2017	7/20/2017	12:35:00	13:56:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4130	7/19/2017	7/27/2017	12:35:00	13:56:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4130	7/26/2017	8/3/2017	12:35:00	13:56:00	AA	ZW	CR2	X	X	X	X	X	X	X
	5240	6/29/2017	7/6/2017	13:45:00	15:05:00	AA	16	CR9	X	X	X	X	X	X	X
	5240	7/5/2017	7/13/2017	13:45:00	15:05:00	AA	16	CR9	X	X	X	X	X	X	X
	5240	7/12/2017	7/12/2017	13:45:00	15:05:00	AA	16	CR9	X	X	X	X	X	X	X
	5240	7/13/2017	7/20/2017	13:45:00	15:05:00	AA	16	CR9	X	X	X	X	X	X	X
	5240	7/19/2017	7/27/2017	13:45:00	15:05:00	AA	16	CR9	X	X	X	X	X	X	X
	5240	7/19/2017	7/20/2017	13:45:00	15:05:00	AA	16	CR9	X	X	X	X	X	X	X

	5240	7/26/2017	7/26/2017	13:45:00	15:05:00	AA	16	CR9	X	X	X	X	X	X	X
	5240	7/27/2017	8/3/2017	13:45:00	15:05:00	AA	16	CR9	X	X	X	X	X	X	X
	5278	7/1/2017	7/1/2017	17:46:00	19:10:00	AA	16	CR2						X	
	5558	6/29/2017	7/4/2017	17:46:00	19:10:00	AA	16	CR2	X	X		X	X		X
	5083	7/5/2017	7/6/2017	17:50:00	19:13:00	AA	16	CR7	X	X	X	X	X		
	5083	7/5/2017	7/13/2017	17:50:00	19:13:00	AA	16	CR7	X	X	X	X	X		
	5083	7/12/2017	7/12/2017	17:50:00	19:13:00	AA	16	CR7	X	X	X	X	X		
	5083	7/13/2017	7/20/2017	17:50:00	19:13:00	AA	16	CR7	X	X	X	X	X		
	5083	7/19/2017	7/27/2017	17:50:00	19:13:00	AA	16	CR7	X	X	X	X	X		
	5083	7/19/2017	7/20/2017	17:50:00	19:13:00	AA	16	CR7	X	X	X	X	X		
	5083	7/26/2017	7/26/2017	17:50:00	19:13:00	AA	16	CR7	X	X	X	X	X		
	5083	7/27/2017	8/3/2017	17:50:00	19:13:00	AA	16	CR7	X	X	X	X	X		
	5441	7/8/2017	7/13/2017	17:50:00	19:14:00	AA	16	CR2						X	
	5441	7/15/2017	7/20/2017	17:50:00	19:14:00	AA	16	CR2						X	
	5441	7/22/2017	7/27/2017	17:50:00	19:14:00	AA	16	CR2						X	
	5441	7/29/2017	8/3/2017	17:50:00	19:14:00	AA	16	CR2						X	
	5103	6/29/2017	7/1/2017	19:55:00	21:13:00	AA	16	CR9				X	X	X	
	5103	7/2/2017	7/4/2017	19:55:00	21:13:00	AA	16	CR9	X	X					X
	5103	7/5/2017	7/6/2017	19:55:00	21:13:00	AA	16	CR9	X	X	X	X	X	X	X
	5103	7/5/2017	7/13/2017	19:55:00	21:13:00	AA	16	CR9	X	X	X	X	X	X	X
	5103	7/12/2017	7/12/2017	19:55:00	21:13:00	AA	16	CR9	X	X	X	X	X	X	X
	5103	7/13/2017	7/20/2017	19:55:00	21:13:00	AA	16	CR9	X	X	X	X	X	X	X
	5103	7/19/2017	7/20/2017	19:55:00	21:13:00	AA	16	CR9	X	X	X	X	X	X	X
	5103	7/19/2017	7/27/2017	19:55:00	21:13:00	AA	16	CR9	X	X	X	X	X	X	X
	5103	7/26/2017	7/26/2017	19:55:00	21:13:00	AA	16	CR9	X	X	X	X	X	X	X
	5103	7/27/2017	8/3/2017	19:55:00	21:13:00	AA	16	CR9	X	X	X	X	X	X	X
DCA															
	4123	6/29/2017	7/6/2017	05:30:00	06:31:00	AA	ZW	CR2				X	X		
	4123	7/5/2017	7/5/2017	05:30:00	06:31:00	AA	ZW	CR2			X				
	4123	7/5/2017	7/5/2017	05:30:00	06:31:00	AA	ZW	CR2			X				
	4123	7/6/2017	7/13/2017	05:30:00	06:31:00	AA	ZW	CR2	X	X	X	X	X		
	4123	7/12/2017	7/20/2017	05:30:00	06:31:00	AA	ZW	CR2	X	X	X	X	X		
	4123	7/19/2017	7/20/2017	05:30:00	06:31:00	AA	ZW	CR2	X	X	X	X	X		
	4123	7/19/2017	7/27/2017	05:30:00	06:31:00	AA	ZW	CR2	X	X	X	X	X		
	4123	7/26/2017	7/26/2017	05:30:00	06:31:00	AA	ZW	CR2	X	X	X	X	X		
	4123	7/27/2017	8/3/2017	05:30:00	06:31:00	AA	ZW	CR2	X	X	X	X	X		
	3433	7/9/2017	7/13/2017	06:50:00	07:56:00	AA	MQ	ER4							X
	3433	7/16/2017	7/20/2017	06:50:00	07:56:00	AA	MQ	ER4							X
	3433	7/23/2017	7/27/2017	06:50:00	07:56:00	AA	MQ	ER4							X
	3433	7/30/2017	8/3/2017	06:50:00	07:56:00	AA	MQ	ER4							X
	3433	7/2/2017	7/2/2017	07:50:00	09:00:00	AA	MQ	ER4							X
	4126	6/29/2017	7/6/2017	08:20:00	09:27:00	AA	ZW	CR2		X	X	X	X	X	
	4126	7/5/2017	7/13/2017	08:20:00	09:27:00	AA	ZW	CR2	X	X	X	X	X	X	
	4126	7/12/2017	7/20/2017	08:20:00	09:27:00	AA	ZW	CR2	X	X	X	X	X	X	
	4126	7/19/2017	7/20/2017	08:20:00	09:27:00	AA	ZW	CR2	X	X	X	X	X	X	
	4126	7/19/2017	7/27/2017	08:20:00	09:27:00	AA	ZW	CR2	X	X	X	X	X	X	
	4126	7/26/2017	8/3/2017	08:20:00	09:27:00	AA	ZW	CR2	X	X	X	X	X	X	
	4128	7/2/2017	7/6/2017	09:45:00	10:57:00	AA	ZW	CR2							X
	4128	7/9/2017	7/13/2017	09:45:00	10:57:00	AA	ZW	CR2							X
	4128	7/16/2017	7/20/2017	09:45:00	10:57:00	AA	ZW	CR2							X
	4128	7/23/2017	7/27/2017	09:45:00	10:57:00	AA	ZW	CR2							X
	4128	7/30/2017	8/3/2017	09:45:00	10:57:00	AA	ZW	CR2							X
	4274	6/29/2017	7/6/2017	12:00:00	13:06:00	AA	ZW	CR2		X	X	X	X		
	4274	7/3/2017	7/3/2017	12:00:00	13:06:00	AA	ZW	CR2	X						
	4274	7/5/2017	7/13/2017	12:00:00	13:06:00	AA	ZW	CR2	X	X	X	X	X		
	4274	7/12/2017	7/20/2017	12:00:00	13:06:00	AA	ZW	CR2	X	X	X	X	X		
	4274	7/19/2017	7/27/2017	12:00:00	13:06:00	AA	ZW	CR2	X	X	X	X	X		
	4274	7/19/2017	7/20/2017	12:00:00	13:06:00	AA	ZW	CR2	X	X	X	X	X		
	4274	7/26/2017	8/3/2017	12:00:00	13:06:00	AA	ZW	CR2	X	X	X	X	X		
	4134	7/1/2017	7/6/2017	13:15:00	14:27:00	AA	ZW	CR2						X	
	4134	7/8/2017	7/13/2017	13:15:00	14:27:00	AA	ZW	CR2						X	
	4134	7/15/2017	7/20/2017	13:15:00	14:27:00	AA	ZW	CR2						X	
	4134	7/22/2017	7/27/2017	13:15:00	14:27:00	AA	ZW	CR2						X	
	4134	7/29/2017	8/3/2017	13:15:00	14:27:00	AA	ZW	CR2						X	
	5369	7/1/2017	7/6/2017	15:20:00	16:30:00	AA	16	CR2						X	
	5369	7/8/2017	7/13/2017	15:20:00	16:30:00	AA	16	CR2						X	
	5369	7/15/2017	7/20/2017	15:20:00	16:30:00	AA	16	CR2						X	
	5369	7/22/2017	7/27/2017	15:20:00	16:30:00	AA	16	CR2						X	
	5369	7/29/2017	8/3/2017	15:20:00	16:30:00	AA	16	CR2						X	
	4232	6/29/2017	7/4/2017	19:59:00	21:08:00	AA	ZW	CR2		X		X	X		
	4232	7/5/2017	7/6/2017	19:59:00	21:08:00	AA	ZW	CR2	X	X	X	X	X		X
	4232	7/5/2017	7/13/2017	19:59:00	21:08:00	AA	ZW	CR2	X	X	X	X	X		X
	4232	7/12/2017	7/20/2017	19:59:00	21:08:00	AA	ZW	CR2	X	X	X	X	X		X
	4232	7/19/2017	7/20/2017	19:59:00	21:08:00	AA	ZW	CR2	X	X	X	X	X		X
	4232	7/19/2017	7/27/2017	19:59:00	21:08:00	AA	ZW	CR2	X	X	X	X	X		X
	4232	7/26/2017	8/3/2017	19:59:00	21:08:00	AA	ZW	CR2	X	X	X	X	X		X
DEN															
	4249	7/1/2017	7/6/2017	17:20:00	19:20:00	WN	WN	73H						X	
	4249	7/8/2017	7/13/2017	17:20:00	19:20:00	WN	WN	73H						X	
	4249	7/15/2017	7/20/2017	17:20:00	19:20:00	WN	WN	73H						X	
	4249	7/22/2017	7/27/2017	17:20:00	19:20:00	WN	WN	73H						X	
	4249	7/29/2017	8/3/2017	17:20:00	19:20:00	WN	WN	73H						X	
	5169	7/2/2017	7/6/2017	18:25:00	20:25:00	WN	WN	73W							X
	5169	7/9/2017	7/13/2017	18:25:00	20:25:00	WN	WN	73W							X
	5169	7/16/2017	7/20/2017	18:25:00	20:25:00	WN	WN	73W							X
	5169	7/23/2017	7/27/2017	18:25:00	20:25:00	WN	WN	73W							X
	5169	7/30/2017	8/3/2017	18:25:00	20:25:00	WN	WN	73W							X
DFW															
	1099	6/29/2017	7/6/2017	07:05:00	09:21:00	AA	AA	M82	X	X	X	X	X	X	X
	1099	7/5/2017	7/13/2017	07:05:00	09:21:00	AA	AA	M82	X	X	X	X	X	X	X
	1099	7/12/2017	7/20/2017	07:05:00	09:21:00	AA	AA	M82	X	X	X	X	X	X	X
	1099	7/19/2017	7/27/2017	07:05:00	09:21:00	AA	AA	M82	X	X	X	X	X	X	X
	1099	7/19/2017	7/20/2017	07:05:00	09:21:00	AA	AA	M82	X	X	X	X	X	X	X
	1099	7/26/2017	8/3/2017	07:05:00	09:21:00	AA	AA	M82	X	X	X	X	X	X	X
	294	6/29/2017	7/4/2017	15:15:00	17:29:00	AA	AA	M82	X	X		X	X	X	X
	294	7/5/2017	7/13/2017	15:15:00	17:29:00	AA	AA	M82	X	X	X	X	X	X	X

	294	7/5/2017	7/6/2017	15:15:00	17:29:00	AA	AA	M82	X	X	X	X	X	X	X
	294	7/12/2017	7/20/2017	15:15:00	17:29:00	AA	AA	M82	X	X	X	X	X	X	X
	294	7/19/2017	7/20/2017	15:15:00	17:29:00	AA	AA	M82	X	X	X	X	X	X	X
	294	7/19/2017	7/27/2017	15:15:00	17:29:00	AA	AA	M82	X	X	X	X	X	X	X
	294	7/26/2017	8/3/2017	15:15:00	17:29:00	AA	AA	M82	X	X	X	X	X	X	X
DTW															
	3435	7/5/2017	7/6/2017	07:15:00	09:13:00	DL	9E	CRJ	X	X	X	X	X		
	3435	7/5/2017	7/13/2017	07:15:00	09:13:00	DL	9E	CRJ	X	X	X	X	X		
	3435	7/12/2017	7/20/2017	07:15:00	09:13:00	DL	9E	CRJ	X	X	X	X	X		
	3435	7/19/2017	7/20/2017	07:15:00	09:13:00	DL	9E	CRJ	X	X	X	X	X		
	3435	7/19/2017	7/21/2017	07:15:00	09:13:00	DL	9E	CRJ	X	X	X	X	X		
	3435	7/24/2017	7/27/2017	07:15:00	09:13:00	DL	9E	CRJ	X	X	X	X	X		
	3435	7/26/2017	8/3/2017	07:15:00	09:13:00	DL	9E	CRJ	X	X	X	X	X		
	6228	7/9/2017	7/13/2017	07:15:00	09:13:00	DL	G7	CR7							X
	6228	7/16/2017	7/20/2017	07:15:00	09:13:00	DL	G7	CR7							X
	6228	7/23/2017	7/27/2017	07:15:00	09:13:00	DL	G7	CR7							X
	6228	7/30/2017	8/3/2017	07:15:00	09:13:00	DL	G7	CR7							X
	3435	7/3/2017	7/3/2017	09:00:00	10:54:00	DL	9E	CRJ	X						
	3612	7/2/2017	7/2/2017	09:00:00	10:54:00	DL	9E	CRJ							X
	3435	7/1/2017	7/1/2017	09:20:00	11:09:00	DL	9E	CRJ						X	
	3435	7/15/2017	7/20/2017	09:20:00	11:09:00	DL	9E	CRJ						X	
	3435	7/22/2017	7/22/2017	09:20:00	11:09:00	DL	9E	CRJ						X	
	3435	7/29/2017	7/29/2017	09:20:00	11:09:00	DL	9E	CRJ						X	
	4183	7/4/2017	7/4/2017	09:20:00	11:11:00	DL	9E	CRJ		X					
	3435	7/8/2017	7/8/2017	09:30:00	11:19:00	DL	9E	CRJ						X	
	4582	7/6/2017	7/6/2017	11:00:00	12:55:00	DL	OO	CR7				X			
	4582	7/7/2017	7/7/2017	11:00:00	12:55:00	DL	OO	CR9					X		
	4582	7/5/2017	7/5/2017	11:02:00	12:55:00	DL	OO	CR9			X				
	4582	7/5/2017	7/5/2017	11:02:00	12:55:00	DL	OO	CR9			X				
	3529	7/9/2017	7/13/2017	11:10:00	13:05:00	DL	OO	CR7							X
	3529	7/16/2017	7/20/2017	11:10:00	13:05:00	DL	OO	CR7							X
	3529	7/23/2017	7/27/2017	11:10:00	13:05:00	DL	OO	CR7							X
	3529	7/30/2017	8/3/2017	11:10:00	13:05:00	DL	OO	CR7							X
	4582	7/10/2017	7/13/2017	11:10:00	13:05:00	DL	OO	CR9	X	X	X	X	X		
	4582	7/12/2017	7/20/2017	11:10:00	13:05:00	DL	OO	CR9	X	X	X	X	X		
	4582	7/19/2017	7/20/2017	11:10:00	13:05:00	DL	OO	CR9	X	X	X	X	X		
	4582	7/19/2017	7/21/2017	11:10:00	13:05:00	DL	OO	CR9	X	X	X	X	X		
	4582	7/24/2017	7/27/2017	11:10:00	13:05:00	DL	OO	CR9	X	X	X	X	X		
	4582	7/26/2017	8/3/2017	11:10:00	13:05:00	DL	OO	CR9	X	X	X	X	X		
	3324	7/3/2017	7/3/2017	12:30:00	14:29:00	DL	9E	CRJ	X						
	6301	7/2/2017	7/2/2017	12:30:00	14:29:00	DL	G7	CR9							X
	3324	7/4/2017	7/4/2017	12:40:00	14:39:00	DL	9E	CRJ		X					
	6224	7/5/2017	7/13/2017	14:45:00	16:43:00	DL	G7	CR7	X	X	X	X	X		X
	6224	7/5/2017	7/6/2017	14:45:00	16:43:00	DL	G7	CR7	X	X	X	X	X		X
	6224	7/12/2017	7/20/2017	14:45:00	16:43:00	DL	G7	CR7	X	X	X	X	X		X
	6224	7/19/2017	7/20/2017	14:45:00	16:43:00	DL	G7	CR7	X	X	X	X	X		X
	6224	7/19/2017	7/21/2017	14:45:00	16:43:00	DL	G7	CR7	X	X	X	X	X		X
	6224	7/23/2017	7/27/2017	14:45:00	16:43:00	DL	G7	CR7	X	X	X	X	X		X
	6224	7/26/2017	8/3/2017	14:45:00	16:43:00	DL	G7	CR7	X	X	X	X	X		X
	6304	7/1/2017	7/1/2017	17:00:00	19:02:00	DL	G7	CR9						X	
	6304	7/4/2017	7/4/2017	17:00:00	19:03:00	DL	G7	CR9		X					
	6304	7/8/2017	7/13/2017	17:00:00	19:02:00	DL	G7	CR9						X	
	6304	7/15/2017	7/20/2017	17:00:00	19:02:00	DL	G7	CR9						X	
	6304	7/22/2017	7/22/2017	17:00:00	19:02:00	DL	G7	CR9						X	
	6304	7/29/2017	8/3/2017	17:00:00	19:02:00	DL	G7	CR9						X	
	3379	7/2/2017	7/2/2017	17:10:00	19:13:00	DL	9E	CRJ							X
	6304	7/3/2017	7/3/2017	17:20:00	19:23:00	DL	G7	CR9	X						
	6304	7/5/2017	7/12/2017	17:55:00	19:47:00	DL	G7	CR9	X		X				
	6304	7/5/2017	7/6/2017	17:55:00	19:47:00	DL	G7	CR9	X		X				
	6304	7/6/2017	7/13/2017	17:55:00	19:47:00	DL	G7	CR9		X		X			X
	6304	7/12/2017	7/20/2017	17:55:00	19:47:00	DL	G7	CR9	X		X		X		
	6304	7/13/2017	7/20/2017	17:55:00	19:47:00	DL	G7	CR9		X		X			X
	6304	7/19/2017	7/20/2017	17:55:00	19:47:00	DL	G7	CR9	X		X		X		
	6304	7/19/2017	7/21/2017	17:55:00	19:47:00	DL	G7	CR9	X		X		X		
	6304	7/20/2017	7/20/2017	17:55:00	19:47:00	DL	G7	CR9		X		X			X
	6304	7/23/2017	7/27/2017	17:55:00	19:47:00	DL	G7	CR9		X		X			X
	6304	7/24/2017	7/27/2017	17:55:00	19:47:00	DL	G7	CR9	X		X		X		
	6304	7/26/2017	8/3/2017	17:55:00	19:47:00	DL	G7	CR9	X		X		X		
	6304	7/27/2017	8/3/2017	17:55:00	19:47:00	DL	G7	CR9		X		X			X
	6304	7/7/2017	7/7/2017	18:00:00	19:52:00	DL	G7	CR9					X		
EWR															
	4866	7/5/2017	7/5/2017	06:00:00	07:30:00	UA	C5	ERJ			X				
	4866	7/5/2017	7/5/2017	06:00:00	07:30:00	UA	C5	ERJ			X				
	3593	7/3/2017	7/4/2017	06:06:00	07:36:00	UA	YX	E7W	X	X					
	3593	7/2/2017	7/6/2017	06:10:00	07:40:00	UA	YX	E7W							X
	3593	7/9/2017	7/13/2017	06:10:00	07:40:00	UA	YX	E7W							X
	3593	7/16/2017	7/20/2017	06:10:00	07:40:00	UA	YX	E7W							X
	3593	7/23/2017	7/27/2017	06:10:00	07:40:00	UA	YX	E7W							X
	3593	7/30/2017	8/3/2017	06:10:00	07:40:00	UA	YX	E7W							X
	3613	7/7/2017	7/7/2017	06:10:00	07:40:00	UA	YX	E70					X		
	4866	7/6/2017	7/13/2017	06:10:00	07:40:00	UA	C5	ERJ	X	X	X	X		X	
	4866	7/12/2017	7/20/2017	06:10:00	07:40:00	UA	C5	ERJ	X	X	X	X	X	X	
	4866	7/19/2017	7/27/2017	06:10:00	07:40:00	UA	C5	ERJ	X	X	X	X	X	X	
	4866	7/19/2017	7/20/2017	06:10:00	07:40:00	UA	C5	ERJ	X	X	X	X	X	X	
	4866	7/26/2017	8/3/2017	06:10:00	07:40:00	UA	C5	ERJ	X	X	X	X	X	X	
	4430	7/16/2017	7/16/2017	08:00:00	09:30:00	UA	EV	ERJ							X
	4430	7/1/2017	7/2/2017	08:05:00	09:35:00	UA	EV	ERJ						X	X
	4430	7/5/2017	7/13/2017	08:05:00	09:35:00	UA	EV	ERJ	X	X	X	X	X	X	X
	4430	7/5/2017	7/6/2017	08:05:00	09:35:00	UA	EV	ERJ	X	X	X	X	X	X	X
	4430	7/12/2017	7/20/2017	08:05:00	09:35:00	UA	EV	ERJ	X	X	X	X	X	X	
	4430	7/19/2017	7/27/2017	08:05:00	09:35:00	UA	EV	ERJ	X	X	X	X	X	X	X
	4430	7/19/2017	7/20/2017	08:05:00	09:35:00	UA	EV	ERJ	X	X	X	X	X	X	X
	4430	7/26/2017	8/3/2017	08:05:00	09:35:00	UA	EV	ERJ	X	X	X	X	X	X	X
	4420	7/4/2017	7/4/2017	10:25:00	11:54:00	UA	EV	ERJ		X					
	4420	7/2/2017	7/6/2017	10:36:00	12:05:00	UA	EV	ERJ	X		X	X			X
	4420	7/5/2017	7/13/2017	10:36:00	12:05:00	UA	EV	ERJ	X		X	X			X

	4420	7/11/2017	7/13/2017	10:36:00	12:05:00	UA	EV	ERJ		X					
	4420	7/12/2017	7/20/2017	10:36:00	12:05:00	UA	EV	ERJ	X		X	X	X		X
	4420	7/18/2017	7/20/2017	10:36:00	12:05:00	UA	EV	ERJ		X					
	4420	7/19/2017	7/20/2017	10:36:00	12:05:00	UA	EV	ERJ	X		X	X	X		X
	4420	7/19/2017	7/27/2017	10:36:00	12:05:00	UA	EV	ERJ	X		X	X	X		X
	4420	7/25/2017	7/27/2017	10:36:00	12:05:00	UA	EV	ERJ		X					
	4420	7/26/2017	8/3/2017	10:36:00	12:05:00	UA	EV	ERJ	X		X	X	X		X
	4841	7/1/2017	7/1/2017	10:36:00	12:05:00	UA	C5	ERJ						X	
	4903	7/8/2017	7/13/2017	10:36:00	12:05:00	UA	C5	ERJ						X	
	4903	7/15/2017	7/20/2017	10:36:00	12:05:00	UA	C5	ERJ						X	
	4903	7/22/2017	7/27/2017	10:36:00	12:05:00	UA	C5	ERJ						X	
	4903	7/29/2017	7/29/2017	10:36:00	12:05:00	UA	C5	ERJ						X	
	4981	7/7/2017	7/7/2017	10:38:00	12:30:00	UA	C5	DH2					X		
	4421	7/5/2017	7/13/2017	14:15:00	15:49:00	UA	EV	ERJ	X	X	X	X			
	4421	7/5/2017	7/6/2017	14:15:00	15:49:00	UA	EV	ERJ	X	X	X	X			
	4421	7/12/2017	7/20/2017	14:15:00	15:49:00	UA	EV	ERJ	X	X	X	X	X		
	4421	7/19/2017	7/27/2017	14:15:00	15:49:00	UA	EV	ERJ	X	X	X	X	X		
	4421	7/19/2017	7/20/2017	14:15:00	15:49:00	UA	EV	ERJ	X	X	X	X	X		
	4421	7/26/2017	8/3/2017	14:15:00	15:49:00	UA	EV	ERJ	X	X	X	X	X		
	4869	7/2/2017	7/2/2017	14:15:00	16:18:00	UA	C5	DH2							X
	4869	7/9/2017	7/13/2017	14:15:00	16:18:00	UA	C5	DH2							X
	4869	7/16/2017	7/20/2017	14:15:00	16:18:00	UA	C5	DH2							X
	4869	7/23/2017	7/27/2017	14:15:00	16:18:00	UA	C5	DH2							X
	4869	7/30/2017	8/3/2017	14:15:00	16:18:00	UA	C5	DH2							X
	4969	7/7/2017	7/7/2017	14:20:00	16:23:00	UA	C5	DH2					X		
	4869	7/3/2017	7/3/2017	14:21:00	16:24:00	UA	C5	DH2	X						
	4421	7/1/2017	7/1/2017	14:25:00	15:59:00	UA	EV	ERJ						X	
	3653	7/4/2017	7/4/2017	14:30:00	16:04:00	UA	YX	E70		X					
	3732	7/8/2017	7/13/2017	14:30:00	16:04:00	UA	YX	E70						X	
	3732	7/15/2017	7/20/2017	14:30:00	16:04:00	UA	YX	E70						X	
	3732	7/22/2017	7/27/2017	14:30:00	16:04:00	UA	YX	E70						X	
	3732	7/29/2017	8/3/2017	14:30:00	16:04:00	UA	YX	E70						X	
	4815	7/5/2017	7/6/2017	17:10:00	18:40:00	UA	C5	ERJ	X	X	X	X	X		
	4815	7/5/2017	7/13/2017	17:10:00	18:40:00	UA	C5	ERJ	X	X	X	X	X		
	4815	7/12/2017	7/20/2017	17:10:00	18:40:00	UA	C5	ERJ	X	X	X	X	X		
	4815	7/19/2017	7/27/2017	17:10:00	18:40:00	UA	C5	ERJ	X	X	X	X	X		
	4815	7/19/2017	7/20/2017	17:10:00	18:40:00	UA	C5	ERJ	X	X	X	X	X		
	4815	7/26/2017	8/3/2017	17:10:00	18:40:00	UA	C5	ERJ	X	X	X	X	X		
	4815	7/1/2017	7/1/2017	17:15:00	18:45:00	UA	C5	ERJ						X	
	4381	7/2/2017	7/2/2017	17:19:00	18:49:00	UA	EV	ERJ							X
	4815	7/3/2017	7/4/2017	17:19:00	19:15:00	UA	C5	DH2	X	X					
	4815	7/8/2017	7/8/2017	17:19:00	19:15:00	UA	C5	DH2						X	
	4815	7/22/2017	7/27/2017	17:19:00	19:15:00	UA	C5	DH2						X	
	4815	7/29/2017	8/3/2017	17:19:00	19:15:00	UA	C5	DH2						X	
	4815	7/15/2017	7/15/2017	17:28:00	19:24:00	UA	C5	DH2						X	
	4815	7/9/2017	7/13/2017	17:30:00	19:00:00	UA	C5	ERJ							X
	4815	7/16/2017	7/20/2017	17:30:00	19:00:00	UA	C5	ERJ							X
	4815	7/23/2017	7/27/2017	17:30:00	19:00:00	UA	C5	ERJ							X
	4815	7/30/2017	7/30/2017	17:30:00	19:00:00	UA	C5	ERJ							X
	3416	7/9/2017	7/13/2017	19:00:00	20:35:00	UA	YX	E70							X
	3416	7/16/2017	7/20/2017	19:00:00	20:35:00	UA	YX	E70							X
	3416	7/23/2017	7/27/2017	19:00:00	20:35:00	UA	YX	E70							X
	3416	7/30/2017	7/30/2017	19:00:00	20:35:00	UA	YX	E70							X
	3827	7/1/2017	7/6/2017	19:05:00	20:40:00	UA	EV	ERJ			X	X	X	X	
	3827	7/5/2017	7/13/2017	19:05:00	20:40:00	UA	EV	ERJ	X	X	X	X	X		
	3827	7/12/2017	7/20/2017	19:05:00	20:40:00	UA	EV	ERJ	X	X	X	X	X		
	3827	7/19/2017	7/20/2017	19:05:00	20:40:00	UA	EV	ERJ	X	X	X	X	X		
	3827	7/19/2017	7/27/2017	19:05:00	20:40:00	UA	EV	ERJ	X	X	X	X	X		
	3827	7/26/2017	8/3/2017	19:05:00	20:40:00	UA	EV	ERJ	X	X	X	X	X		
	3827	7/2/2017	7/6/2017	19:14:00	20:49:00	UA	EV	ERJ	X					X	X
	3827	7/8/2017	7/13/2017	19:14:00	20:49:00	UA	EV	ERJ						X	
	3827	7/15/2017	7/20/2017	19:14:00	20:49:00	UA	EV	ERJ						X	
	3827	7/22/2017	7/27/2017	19:14:00	20:49:00	UA	EV	ERJ						X	
	3827	7/29/2017	8/3/2017	19:14:00	20:49:00	UA	EV	ERJ						X	
IAD															
	1472	7/1/2017	7/1/2017	06:20:00	07:17:00	UA	UA	320						X	
	1472	7/2/2017	7/2/2017	06:20:00	07:18:00	UA	UA	739							X
	1472	7/3/2017	7/6/2017	06:20:00	07:17:00	UA	UA	320	X			X	X	X	
	1472	7/4/2017	7/4/2017	06:20:00	07:18:00	UA	UA	739		X					
	1472	7/5/2017	7/6/2017	06:20:00	07:17:00	UA	UA	320			X				
	1472	7/5/2017	7/13/2017	06:20:00	07:17:00	UA	UA	320			X				
	1472	7/6/2017	7/13/2017	06:20:00	07:17:00	UA	UA	320	X	X		X	X	X	
	1472	7/9/2017	7/13/2017	06:20:00	07:17:00	UA	UA	739							X
	1472	7/12/2017	7/20/2017	06:20:00	07:17:00	UA	UA	320			X				
	1472	7/13/2017	7/20/2017	06:20:00	07:17:00	UA	UA	320	X	X		X	X	X	
	1472	7/16/2017	7/20/2017	06:20:00	07:17:00	UA	UA	739							X
	1472	7/19/2017	7/27/2017	06:20:00	07:17:00	UA	UA	320			X				
	1472	7/19/2017	7/20/2017	06:20:00	07:17:00	UA	UA	320			X				
	1472	7/20/2017	7/27/2017	06:20:00	07:17:00	UA	UA	320	X	X		X	X	X	
	1472	7/23/2017	7/23/2017	06:20:00	07:17:00	UA	UA	739							X
	1472	7/26/2017	8/3/2017	06:20:00	07:17:00	UA	UA	320			X				
	1472	7/27/2017	8/3/2017	06:20:00	07:17:00	UA	UA	320	X	X		X	X	X	
	1472	7/30/2017	7/30/2017	06:20:00	07:17:00	UA	UA	739							X
	237	7/2/2017	7/6/2017	10:30:00	11:30:00	UA	UA	739							X
	237	7/9/2017	7/13/2017	10:30:00	11:30:00	UA	UA	739							X
	237	7/16/2017	7/20/2017	10:30:00	11:30:00	UA	UA	739							X
	237	7/23/2017	7/27/2017	10:30:00	11:30:00	UA	UA	739							X
	237	7/30/2017	8/3/2017	10:30:00	11:30:00	UA	UA	739							X
	4748	7/1/2017	7/4/2017	10:30:00	11:30:00	UA	AX	ER4		X				X	
	4970	7/5/2017	7/6/2017	10:30:00	11:38:00	UA	C5	DH2			X	X	X	X	
	4970	7/5/2017	7/8/2017	10:30:00	11:38:00	UA	C5	DH2			X	X	X	X	
	4970	7/10/2017	7/13/2017	10:30:00	11:30:00	UA	C5	ERJ	X	X	X	X	X		
	4970	7/12/2017	7/20/2017	10:30:00	11:30:00	UA	C5	ERJ	X	X	X	X	X		
	4970	7/15/2017	7/20/2017	10:30:00	11:38:00	UA	C5	DH2						X	
	4970	7/19/2017	7/27/2017	10:30:00	11:30:00	UA	C5	ERJ	X	X	X	X	X		
	4970	7/19/2017	7/20/2017	10:30:00	11:30:00	UA	C5	ERJ	X	X	X	X	X		

	4970	7/22/2017	7/27/2017	10:30:00	11:38:00	UA	C5	DH2						X	
	4970	7/26/2017	8/3/2017	10:30:00	11:30:00	UA	C5	ERJ	X	X	X	X	X		
	4970	7/29/2017	8/3/2017	10:30:00	11:38:00	UA	C5	DH2					X	X	
	6254	7/3/2017	7/3/2017	10:30:00	11:30:00	UA	YV	CR7	X						
	249	7/3/2017	7/3/2017	14:50:00	15:47:00	UA	UA	320	X						
	249	7/4/2017	7/6/2017	14:50:00	15:47:00	UA	UA	320	X	X	X				
	249	7/5/2017	7/13/2017	14:50:00	15:47:00	UA	UA	320	X		X		X		
	249	7/6/2017	7/13/2017	14:50:00	15:47:00	UA	UA	320				X			
	249	7/11/2017	7/13/2017	14:50:00	15:47:00	UA	UA	320		X					
	249	7/12/2017	7/19/2017	14:50:00	15:47:00	UA	UA	320	X		X		X		
	249	7/13/2017	7/20/2017	14:50:00	15:47:00	UA	UA	320				X			
	249	7/18/2017	7/20/2017	14:50:00	15:47:00	UA	UA	320	X	X					
	249	7/19/2017	7/19/2017	14:50:00	15:47:00	UA	UA	320	X		X				
	249	7/19/2017	7/19/2017	14:50:00	15:47:00	UA	UA	320	X		X				
	249	7/20/2017	7/27/2017	14:50:00	15:47:00	UA	UA	320				X			
	249	7/21/2017	7/21/2017	14:50:00	15:47:00	UA	UA	320					X		
	249	7/24/2017	7/27/2017	14:50:00	15:47:00	UA	UA	320	X						
	249	7/25/2017	7/25/2017	14:50:00	15:47:00	UA	UA	320		X					
	249	7/26/2017	7/27/2017	14:50:00	15:47:00	UA	UA	320			X		X		
	249	7/26/2017	7/28/2017	14:50:00	15:47:00	UA	UA	320			X		X		
	249	7/27/2017	7/27/2017	14:50:00	15:47:00	UA	UA	320				X			
	249	7/31/2017	7/31/2017	14:50:00	15:47:00	UA	UA	320	X						
	6148	7/1/2017	7/6/2017	14:50:00	15:47:00	UA	YV	CR7						X	
	6148	7/2/2017	7/6/2017	14:50:00	15:47:00	UA	YV	CR7							X
	6148	7/8/2017	7/8/2017	14:50:00	15:47:00	UA	YV	CR7						X	
	6148	7/9/2017	7/13/2017	14:50:00	15:47:00	UA	YV	CR7							X
	6148	7/15/2017	7/15/2017	14:50:00	15:47:00	UA	YV	CR7						X	
	6148	7/16/2017	7/20/2017	14:50:00	15:47:00	UA	YV	CR7							X
	6148	7/22/2017	7/27/2017	14:50:00	15:47:00	UA	YV	CR7						X	
	6148	7/23/2017	7/27/2017	14:50:00	15:47:00	UA	YV	CR7							X
	6148	7/29/2017	8/3/2017	14:50:00	15:47:00	UA	YV	CR7						X	
	6148	7/30/2017	8/3/2017	14:50:00	15:47:00	UA	YV	CR7							X
	6174	7/23/2017	7/23/2017	19:40:00	20:40:00	UA	YV	CR7							X
	4683	7/15/2017	7/15/2017	19:45:00	20:45:00	UA	AX	ER4						X	
	6064	7/1/2017	7/1/2017	19:45:00	20:45:00	UA	YV	E7W						X	
	6174	7/4/2017	7/4/2017	19:45:00	20:45:00	UA	YV	CR7		X					
	6174	7/5/2017	7/13/2017	19:45:00	20:45:00	UA	YV	E7W	X	X	X	X	X		
	6174	7/5/2017	7/6/2017	19:45:00	20:45:00	UA	YV	E7W	X	X	X	X	X		
	6174	7/8/2017	7/8/2017	19:45:00	20:45:00	UA	YV	CR7						X	
	6174	7/9/2017	7/13/2017	19:45:00	20:45:00	UA	YV	CR7							X
	6174	7/12/2017	7/20/2017	19:45:00	20:45:00	UA	YV	E7W	X	X	X	X	X		
	6174	7/16/2017	7/16/2017	19:45:00	20:45:00	UA	YV	CR7							X
	6174	7/19/2017	7/27/2017	19:45:00	20:45:00	UA	YV	E7W	X	X	X	X	X		
	6174	7/19/2017	7/20/2017	19:45:00	20:45:00	UA	YV	E7W	X	X	X	X	X		
	6174	7/22/2017	7/22/2017	19:45:00	20:45:00	UA	YV	CR7						X	
	6174	7/26/2017	8/3/2017	19:45:00	20:45:00	UA	YV	E7W	X	X	X	X	X		
	6174	7/29/2017	8/3/2017	19:45:00	20:45:00	UA	YV	E7W						X	
	6174	7/30/2017	7/30/2017	19:45:00	20:45:00	UA	YV	CR7							X
IAH															
	3924	7/3/2017	7/6/2017	06:00:00	08:13:00	UA	EV	ERJ	X						X
	3924	7/9/2017	7/13/2017	06:00:00	08:13:00	UA	EV	ERJ							X
	3924	7/16/2017	7/20/2017	06:00:00	08:13:00	UA	EV	ERJ							X
	3924	7/23/2017	7/27/2017	06:00:00	08:13:00	UA	EV	ERJ							X
	3924	7/30/2017	7/30/2017	06:00:00	08:13:00	UA	EV	ERJ							X
	5492	7/4/2017	7/4/2017	06:00:00	08:05:00	UA	OO	CR7		X					
	6060	7/1/2017	7/6/2017	06:00:00	08:13:00	UA	YV	E7W				X	X	X	X
	6060	7/6/2017	7/13/2017	06:00:00	08:13:00	UA	YV	E7W	X	X	X	X	X	X	
	6060	7/12/2017	7/20/2017	06:00:00	08:13:00	UA	YV	E7W	X	X	X	X	X	X	
	6060	7/19/2017	7/27/2017	06:00:00	08:13:00	UA	YV	E7W	X	X	X	X	X	X	
	6060	7/19/2017	7/20/2017	06:00:00	08:13:00	UA	YV	E7W	X	X	X	X	X	X	
	6060	7/26/2017	8/3/2017	06:00:00	08:13:00	UA	YV	E7W	X	X	X	X	X	X	
	6060	7/5/2017	7/5/2017	06:10:00	08:23:00	UA	YV	E7W			X				
	6060	7/5/2017	7/5/2017	06:10:00	08:23:00	UA	YV	E7W			X				
JFK															
	3303	7/1/2017	7/1/2017	06:08:00	07:28:00	DL	9E	CRJ						X	
	3303	7/2/2017	7/2/2017	06:08:00	07:29:00	DL	9E	CRJ							X
	3303	7/8/2017	7/13/2017	06:08:00	07:28:00	DL	9E	CRJ						X	
	3303	7/15/2017	7/20/2017	06:08:00	07:28:00	DL	9E	CRJ						X	
	3303	7/22/2017	7/22/2017	06:08:00	07:28:00	DL	9E	CRJ						X	
	3303	7/29/2017	8/3/2017	06:08:00	07:28:00	DL	9E	CRJ						X	
	3303	7/3/2017	7/6/2017	07:00:00	08:25:00	DL	9E	CRJ	X	X	X	X	X		X
	3303	7/5/2017	7/13/2017	07:00:00	08:25:00	DL	9E	CRJ	X	X	X	X	X		X
	3303	7/12/2017	7/20/2017	07:00:00	08:25:00	DL	9E	CRJ	X	X	X	X	X		X
	3303	7/19/2017	7/20/2017	07:00:00	08:25:00	DL	9E	CRJ	X	X	X	X	X		X
	3303	7/19/2017	7/21/2017	07:00:00	08:25:00	DL	9E	CRJ	X	X	X	X	X		X
	3303	7/23/2017	7/27/2017	07:00:00	08:25:00	DL	9E	CRJ	X	X	X	X	X		X
	3303	7/26/2017	8/3/2017	07:00:00	08:25:00	DL	9E	CRJ	X	X	X	X	X		X
	3364	7/1/2017	7/6/2017	13:50:00	15:18:00	AA	MQ	ER4						X	
	3364	7/8/2017	7/13/2017	13:50:00	15:18:00	AA	MQ	ER4						X	
	3364	7/15/2017	7/20/2017	13:50:00	15:18:00	AA	MQ	ER4						X	
	3364	7/22/2017	7/27/2017	13:50:00	15:18:00	AA	MQ	ER4						X	
	3364	7/29/2017	8/3/2017	13:50:00	15:18:00	AA	MQ	ER4						X	
	4276	6/29/2017	7/6/2017	13:55:00	15:19:00	AA	ZW	CR2	X	X	X	X	X		X
	4276	7/5/2017	7/13/2017	13:55:00	15:19:00	AA	ZW	CR2	X	X	X	X	X		X
	4276	7/12/2017	7/20/2017	13:55:00	15:19:00	AA	ZW	CR2	X	X	X	X	X		X
	4276	7/19/2017	7/20/2017	13:55:00	15:19:00	AA	ZW	CR2	X	X	X	X	X		X
	4276	7/19/2017	7/27/2017	13:55:00	15:19:00	AA	ZW	CR2	X	X	X	X	X		X
	4276	7/26/2017	8/3/2017	13:55:00	15:19:00	AA	ZW	CR2	X	X	X	X	X		X
	3514	7/8/2017	7/13/2017	16:40:00	18:14:00	DL	9E	CRJ						X	
	3514	7/15/2017	7/20/2017	16:40:00	18:14:00	DL	9E	CRJ						X	
	3514	7/22/2017	7/22/2017	16:40:00	18:14:00	DL	9E	CRJ						X	
	3514	7/29/2017	7/29/2017	16:40:00	18:14:00	DL	9E	CRJ						X	
	3514	7/3/2017	7/3/2017	17:05:00	18:39:00	DL	9E	CRJ	X						
	3514	7/2/2017	7/2/2017	17:06:00	18:40:00	DL	9E	CRJ							X
	3514	7/1/2017	7/1/2017	17:16:00	18:50:00	DL	9E	CRJ						X	
	3514	7/4/2017	7/6/2017	17:16:00	18:50:00	DL	9E	CRJ	X	X	X	X	X		X

	3514	7/5/2017	7/13/2017	17:16:00	18:50:00	DL	9E	CRJ	X	X	X	X	X		X
	3514	7/12/2017	7/20/2017	17:16:00	18:50:00	DL	9E	CRJ	X	X	X	X	X		X
	3514	7/19/2017	7/20/2017	17:16:00	18:50:00	DL	9E	CRJ	X	X	X	X	X		X
	3514	7/19/2017	7/21/2017	17:16:00	18:50:00	DL	9E	CRJ	X	X	X	X	X		X
	3514	7/23/2017	7/27/2017	17:16:00	18:50:00	DL	9E	CRJ	X	X	X	X	X		X
	3514	7/26/2017	8/3/2017	17:16:00	18:50:00	DL	9E	CRJ	X	X	X	X	X		X
LGA															
	3433	6/29/2017	7/6/2017	06:05:00	07:28:00	AA	MQ	ER4		X		X	X		
	3433	7/6/2017	7/13/2017	06:05:00	07:28:00	AA	MQ	ER4	X	X		X	X		
	3433	7/13/2017	7/20/2017	06:05:00	07:28:00	AA	MQ	ER4	X	X		X	X		
	3433	7/20/2017	7/27/2017	06:05:00	07:28:00	AA	MQ	ER4	X	X		X	X		
	3433	7/27/2017	8/3/2017	06:05:00	07:28:00	AA	MQ	ER4	X	X		X	X		
	3441	7/5/2017	7/6/2017	06:05:00	07:34:00	DL	9E	CRJ	X	X	X	X	X		
	3441	7/5/2017	7/13/2017	06:05:00	07:34:00	DL	9E	CRJ	X	X	X	X	X		
	3441	7/12/2017	7/20/2017	06:05:00	07:34:00	DL	9E	CRJ	X	X	X	X	X		
	3441	7/19/2017	7/20/2017	06:05:00	07:34:00	DL	9E	CRJ	X	X	X	X	X		
	3441	7/19/2017	7/21/2017	06:05:00	07:34:00	DL	9E	CRJ	X	X	X	X	X		
	3441	7/24/2017	7/27/2017	06:05:00	07:34:00	DL	9E	CRJ	X	X	X	X	X		
	3441	7/26/2017	8/3/2017	06:05:00	07:34:00	DL	9E	CRJ	X	X	X	X	X		
	4178	6/29/2017	7/6/2017	09:01:00	10:30:00	AA	ZW	CR2	X	X	X	X	X		
	4178	7/5/2017	7/13/2017	09:01:00	10:30:00	AA	ZW	CR2	X	X	X	X	X		X
	4178	7/12/2017	7/20/2017	09:01:00	10:30:00	AA	ZW	CR2	X	X	X	X	X		X
	4178	7/19/2017	7/20/2017	09:01:00	10:30:00	AA	ZW	CR2	X	X	X	X	X		X
	4178	7/19/2017	7/27/2017	09:01:00	10:30:00	AA	ZW	CR2	X	X	X	X	X		X
	4178	7/26/2017	8/3/2017	09:01:00	10:30:00	AA	ZW	CR2	X	X	X	X	X		X
	3441	7/1/2017	7/6/2017	09:15:00	10:40:00	DL	9E	CRJ						X	
	3441	7/8/2017	7/13/2017	09:15:00	10:40:00	DL	9E	CRJ						X	
	3441	7/15/2017	7/20/2017	09:15:00	10:40:00	DL	9E	CRJ						X	
	3441	7/22/2017	7/22/2017	09:15:00	10:40:00	DL	9E	CRJ						X	
	3441	7/29/2017	8/3/2017	09:15:00	10:40:00	DL	9E	CRJ						X	
	3969	7/2/2017	7/2/2017	09:15:00	10:41:00	DL	9E	CRJ							X
	3969	7/4/2017	7/4/2017	09:15:00	10:41:00	DL	9E	CRJ		X					
	3969	7/3/2017	7/3/2017	09:20:00	10:45:00	DL	9E	CRJ	X						
	3969	7/5/2017	7/6/2017	10:15:00	11:48:00	DL	9E	CRJ	X	X	X	X	X		X
	3969	7/5/2017	7/13/2017	10:15:00	11:48:00	DL	9E	CRJ	X	X	X	X	X		X
	3969	7/12/2017	7/20/2017	10:15:00	11:48:00	DL	9E	CRJ	X	X	X	X	X		X
	3969	7/19/2017	7/20/2017	10:15:00	11:48:00	DL	9E	CRJ	X	X	X	X	X		X
	3969	7/19/2017	7/21/2017	10:15:00	11:48:00	DL	9E	CRJ	X	X	X	X	X		X
	3969	7/23/2017	7/27/2017	10:15:00	11:48:00	DL	9E	CRJ	X	X	X	X	X		X
	3969	7/26/2017	8/3/2017	10:15:00	11:48:00	DL	9E	CRJ	X	X	X	X	X		X
	3364	6/29/2017	7/6/2017	12:30:00	14:00:00	AA	MQ	ER4		X		X	X		X
	3364	7/3/2017	7/5/2017	12:30:00	14:00:00	AA	MQ	ER4	X		X				
	3364	7/5/2017	7/13/2017	12:30:00	14:00:00	AA	MQ	ER4			X				
	3364	7/6/2017	7/13/2017	12:30:00	14:00:00	AA	MQ	ER4	X	X		X	X		X
	3364	7/12/2017	7/20/2017	12:30:00	14:00:00	AA	MQ	ER4			X				
	3364	7/13/2017	7/20/2017	12:30:00	14:00:00	AA	MQ	ER4	X	X		X	X		X
	3364	7/19/2017	7/27/2017	12:30:00	14:00:00	AA	MQ	ER4			X				
	3364	7/19/2017	7/20/2017	12:30:00	14:00:00	AA	MQ	ER4			X				
	3364	7/20/2017	7/27/2017	12:30:00	14:00:00	AA	MQ	ER4	X	X		X	X		X
	3364	7/26/2017	7/26/2017	12:30:00	14:00:00	AA	MQ	ER4			X				
	3364	7/27/2017	8/3/2017	12:30:00	14:00:00	AA	MQ	ER4	X	X		X	X		X
	3975	7/5/2017	7/13/2017	12:30:00	14:15:00	DL	9E	CRJ	X	X	X	X	X		X
	3975	7/5/2017	7/6/2017	12:30:00	14:15:00	DL	9E	CRJ	X	X	X	X	X		X
	3975	7/12/2017	7/20/2017	12:30:00	14:15:00	DL	9E	CRJ	X	X	X	X	X		X
	3975	7/19/2017	7/20/2017	12:30:00	14:15:00	DL	9E	CRJ	X	X	X	X	X		X
	3975	7/19/2017	7/21/2017	12:30:00	14:15:00	DL	9E	CRJ	X	X	X	X	X		X
	3975	7/23/2017	7/27/2017	12:30:00	14:15:00	DL	9E	CRJ	X	X	X	X	X		X
	3975	7/26/2017	8/3/2017	12:30:00	14:15:00	DL	9E	CRJ	X	X	X	X	X		X
	3494	7/2/2017	7/4/2017	15:15:00	16:59:00	DL	9E	CRJ		X					X
	3494	7/3/2017	7/3/2017	15:15:00	17:00:00	DL	9E	CRJ	X						
	3788	7/1/2017	7/6/2017	15:20:00	16:50:00	AA	MQ	ER4						X	
	3788	7/8/2017	7/13/2017	15:20:00	16:50:00	AA	MQ	ER4						X	
	3788	7/15/2017	7/20/2017	15:20:00	16:50:00	AA	MQ	ER4						X	
	3788	7/22/2017	7/27/2017	15:20:00	16:50:00	AA	MQ	ER4						X	
	3788	7/29/2017	8/3/2017	15:20:00	16:50:00	AA	MQ	ER4						X	
	3494	7/1/2017	7/6/2017	15:40:00	17:23:00	DL	9E	CRJ						X	
	3494	7/8/2017	7/13/2017	15:40:00	17:23:00	DL	9E	CRJ						X	
	3494	7/15/2017	7/20/2017	15:40:00	17:23:00	DL	9E	CRJ						X	
	3494	7/22/2017	7/22/2017	15:40:00	17:23:00	DL	9E	CRJ						X	
	3494	7/29/2017	8/3/2017	15:40:00	17:23:00	DL	9E	CRJ						X	
	3494	7/5/2017	7/13/2017	16:20:00	17:58:00	DL	9E	CRJ	X	X	X	X	X		
	3494	7/5/2017	7/6/2017	16:20:00	17:58:00	DL	9E	CRJ	X	X	X	X	X		
	3494	7/9/2017	7/9/2017	16:20:00	17:58:00	DL	9E	CRJ							X
	3494	7/12/2017	7/20/2017	16:20:00	17:58:00	DL	9E	CRJ	X	X	X	X	X		X
	3494	7/19/2017	7/20/2017	16:20:00	17:58:00	DL	9E	CRJ	X	X	X	X	X		X
	3494	7/19/2017	7/21/2017	16:20:00	17:58:00	DL	9E	CRJ	X	X	X	X	X		X
	3494	7/23/2017	7/27/2017	16:20:00	17:58:00	DL	9E	CRJ	X	X	X	X	X		X
	3494	7/26/2017	8/3/2017	16:20:00	17:58:00	DL	9E	CRJ	X	X	X	X	X		X
	3443	7/5/2017	7/6/2017	18:25:00	20:01:00	AA	MQ	ER4	X	X	X	X	X		
	3443	7/5/2017	7/13/2017	18:25:00	20:01:00	AA	MQ	ER4	X	X	X	X	X		
	3443	7/12/2017	7/20/2017	18:25:00	20:01:00	AA	MQ	ER4	X	X	X	X	X		
	3443	7/19/2017	7/20/2017	18:25:00	20:01:00	AA	MQ	ER4	X	X	X	X	X		
	3443	7/19/2017	7/27/2017	18:25:00	20:01:00	AA	MQ	ER4	X	X	X	X	X		
	3443	7/26/2017	7/26/2017	18:25:00	20:01:00	AA	MQ	ER4	X	X	X	X	X		
	3443	7/27/2017	8/3/2017	18:25:00	20:01:00	AA	MQ	ER4	X	X	X	X	X		
	3443	6/29/2017	7/4/2017	18:30:00	20:01:00	AA	MQ	ER4	X	X		X	X		
	3397	7/9/2017	7/13/2017	18:55:00	20:33:00	DL	9E	CRJ	X	X	X	X	X		X
	3397	7/12/2017	7/20/2017	18:55:00	20:33:00	DL	9E	CRJ	X	X	X	X	X		X
	3397	7/19/2017	7/20/2017	18:55:00	20:33:00	DL	9E	CRJ	X	X	X	X	X		X
	3397	7/19/2017	7/21/2017	18:55:00	20:33:00	DL	9E	CRJ	X	X	X	X	X		X
	3397	7/23/2017	7/27/2017	18:55:00	20:33:00	DL	9E	CRJ	X	X	X	X	X		X
	3397	7/26/2017	8/3/2017	18:55:00	20:33:00	DL	9E	CRJ	X	X	X	X	X		X
	3443	7/2/2017	7/6/2017	18:59:00	20:30:00	AA	MQ	ER4							X
	3443	7/9/2017	7/13/2017	18:59:00	20:30:00	AA	MQ	ER4							X
	3443	7/16/2017	7/20/2017	18:59:00	20:30:00	AA	MQ	ER4							X
	3443	7/23/2017	7/27/2017	18:59:00	20:30:00	AA	MQ	ER4							X

	3443	7/30/2017	8/3/2017	18:59:00	20:30:00	AA	MQ	ER4							X
MCO															
	4732	7/1/2017	7/6/2017	09:20:00	11:10:00	WN	WN	73C						X	
	4732	7/8/2017	7/13/2017	09:20:00	11:10:00	WN	WN	73C						X	
	4732	7/15/2017	7/20/2017	09:20:00	11:10:00	WN	WN	73C						X	
	4732	7/22/2017	7/27/2017	09:20:00	11:10:00	WN	WN	73C						X	
	4732	7/29/2017	8/3/2017	09:20:00	11:10:00	WN	WN	73C						X	
	1755	6/28/2017	7/6/2017	09:50:00	11:40:00	WN	WN	73W			X	X	X		
	1755	7/4/2017	7/4/2017	09:50:00	11:40:00	WN	WN	73W		X					
	1755	7/5/2017	7/13/2017	09:50:00	11:40:00	WN	WN	73W	X	X	X	X	X		
	1755	7/12/2017	7/20/2017	09:50:00	11:40:00	WN	WN	73W	X	X	X	X	X		
	1755	7/19/2017	7/20/2017	09:50:00	11:40:00	WN	WN	73W	X	X	X	X	X		
	1755	7/19/2017	7/27/2017	09:50:00	11:40:00	WN	WN	73W	X	X	X	X	X		
	1755	7/26/2017	8/3/2017	09:50:00	11:40:00	WN	WN	73W	X	X	X	X	X		
	5441	7/3/2017	7/3/2017	09:50:00	11:40:00	WN	WN	73W	X						
	1253	7/2/2017	7/6/2017	11:50:00	13:40:00	WN	WN	73C							X
	1253	7/9/2017	7/13/2017	11:50:00	13:40:00	WN	WN	73C							X
	1253	7/16/2017	7/20/2017	11:50:00	13:40:00	WN	WN	73C							X
	1253	7/23/2017	7/23/2017	11:50:00	13:40:00	WN	WN	73C							X
	1253	7/30/2017	8/3/2017	11:50:00	13:40:00	WN	WN	73W							X
	2489	7/1/2017	7/6/2017	15:35:00	17:25:00	WN	WN	73H						X	
	2489	7/8/2017	7/13/2017	15:35:00	17:25:00	WN	WN	73H						X	
	2489	7/15/2017	7/20/2017	15:35:00	17:25:00	WN	WN	73H						X	
	2489	7/22/2017	7/27/2017	15:35:00	17:25:00	WN	WN	73H						X	
	2489	7/29/2017	8/3/2017	15:35:00	17:25:00	WN	WN	73H						X	
MDW															
	1348	6/28/2017	7/6/2017	05:30:00	06:35:00	WN	WN	73H		X	X	X	X		
	1348	7/3/2017	7/3/2017	05:30:00	06:35:00	WN	WN	73H	X						
	1348	7/5/2017	7/13/2017	05:30:00	06:35:00	WN	WN	73H	X	X	X	X	X		
	1348	7/12/2017	7/20/2017	05:30:00	06:35:00	WN	WN	73H	X	X	X	X	X		
	1348	7/19/2017	7/27/2017	05:30:00	06:35:00	WN	WN	73H	X	X	X	X	X		
	1348	7/19/2017	7/20/2017	05:30:00	06:35:00	WN	WN	73H	X	X	X	X	X		
	1348	7/26/2017	8/3/2017	05:30:00	06:35:00	WN	WN	73H	X	X	X	X	X		
	730	7/2/2017	7/6/2017	06:30:00	07:35:00	WN	WN	73W							X
	730	7/9/2017	7/13/2017	06:30:00	07:35:00	WN	WN	73W							X
	730	7/16/2017	7/20/2017	06:30:00	07:35:00	WN	WN	73W							X
	730	7/23/2017	7/27/2017	06:30:00	07:35:00	WN	WN	73W							X
	730	7/30/2017	8/3/2017	06:30:00	07:35:00	WN	WN	73W							X
	1247	7/1/2017	7/6/2017	07:05:00	08:10:00	WN	WN	73H						X	
	1247	7/8/2017	7/13/2017	07:05:00	08:10:00	WN	WN	73H						X	
	1247	7/15/2017	7/20/2017	07:05:00	08:10:00	WN	WN	73H						X	
	1247	7/22/2017	7/27/2017	07:05:00	08:10:00	WN	WN	73H						X	
	1247	7/29/2017	8/3/2017	07:05:00	08:10:00	WN	WN	73H						X	
	2515	7/1/2017	7/6/2017	13:15:00	14:20:00	WN	WN	73W						X	
	2515	7/8/2017	7/13/2017	13:15:00	14:20:00	WN	WN	73W						X	
	2515	7/15/2017	7/20/2017	13:15:00	14:20:00	WN	WN	73W						X	
	2515	7/22/2017	7/27/2017	13:15:00	14:20:00	WN	WN	73W						X	
	2515	7/29/2017	8/3/2017	13:15:00	14:20:00	WN	WN	73W						X	
	3694	7/2/2017	7/6/2017	17:00:00	18:10:00	WN	WN	73W							X
	3694	7/9/2017	7/13/2017	17:00:00	18:10:00	WN	WN	73W							X
	3694	7/16/2017	7/20/2017	17:00:00	18:10:00	WN	WN	73W							X
	3694	7/23/2017	7/27/2017	17:00:00	18:10:00	WN	WN	73W							X
	3694	7/30/2017	8/3/2017	17:00:00	18:10:00	WN	WN	73W							X
	1052	7/3/2017	7/3/2017	17:25:00	18:30:00	WN	WN	73W	X						
	1052	6/28/2017	7/6/2017	17:30:00	18:35:00	WN	WN	73W			X	X	X		
	1052	7/5/2017	7/13/2017	17:30:00	18:35:00	WN	WN	73W	X	X	X	X	X		
	1052	7/12/2017	7/20/2017	17:30:00	18:35:00	WN	WN	73W	X	X	X	X	X		
	1052	7/19/2017	7/27/2017	17:30:00	18:35:00	WN	WN	73W	X	X	X	X	X		
	1052	7/19/2017	7/20/2017	17:30:00	18:35:00	WN	WN	73W	X	X	X	X	X		
	1052	7/26/2017	8/3/2017	17:30:00	18:35:00	WN	WN	73W	X	X	X	X	X		
	4916	7/4/2017	7/4/2017	17:45:00	18:50:00	WN	WN	73W		X					
	5759	7/1/2017	7/6/2017	19:50:00	20:55:00	WN	WN	73W						X	
	5759	7/8/2017	7/13/2017	19:50:00	20:55:00	WN	WN	73W						X	
	5759	7/15/2017	7/20/2017	19:50:00	20:55:00	WN	WN	73W						X	
	5759	7/22/2017	7/27/2017	19:50:00	20:55:00	WN	WN	73W						X	
	5759	7/29/2017	8/3/2017	19:50:00	20:55:00	WN	WN	73W						X	
MIA															
	3769	6/29/2017	7/6/2017	07:00:00	09:25:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3769	7/5/2017	7/13/2017	07:00:00	09:25:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3769	7/12/2017	7/20/2017	07:00:00	09:25:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3769	7/19/2017	7/20/2017	07:00:00	09:25:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3769	7/19/2017	7/27/2017	07:00:00	09:25:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3769	7/26/2017	8/3/2017	07:00:00	09:25:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3796	6/28/2017	7/6/2017	13:25:00	15:57:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3796	7/5/2017	7/13/2017	13:25:00	15:57:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3796	7/12/2017	7/20/2017	13:25:00	15:57:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3796	7/19/2017	7/20/2017	13:25:00	15:57:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3796	7/19/2017	7/27/2017	13:25:00	15:57:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3796	7/26/2017	8/3/2017	13:25:00	15:57:00	AA	MQ	ER4	X	X	X	X	X	X	X
MSP															
	4706	7/2/2017	7/6/2017	06:00:00	08:03:00	DL	OO	CR9	X	X		X	X		X
	4706	7/6/2017	7/13/2017	06:00:00	08:03:00	DL	OO	CR9	X	X	X	X	X		X
	4706	7/12/2017	7/20/2017	06:00:00	08:03:00	DL	OO	CR9	X	X	X	X	X		X
	4706	7/19/2017	7/20/2017	06:00:00	08:03:00	DL	OO	CR9	X	X	X	X	X		X
	4706	7/19/2017	7/21/2017	06:00:00	08:03:00	DL	OO	CR9	X	X	X	X	X		X
	4706	7/23/2017	7/27/2017	06:00:00	08:03:00	DL	OO	CR9	X	X	X	X	X		X
	4706	7/26/2017	8/3/2017	06:00:00	08:03:00	DL	OO	CR9	X	X	X	X	X		X
	4706	7/1/2017	7/6/2017	06:15:00	08:15:00	DL	OO	CR9						X	
	4706	7/8/2017	7/13/2017	06:15:00	08:15:00	DL	OO	CR9						X	
	4706	7/15/2017	7/20/2017	06:15:00	08:15:00	DL	OO	CR9						X	
	4706	7/22/2017	7/22/2017	06:15:00	08:15:00	DL	OO	CR9						X	
	4706	7/29/2017	8/3/2017	06:15:00	08:15:00	DL	OO	CR9						X	
ORD															
	287	7/1/2017	7/1/2017	06:35:00	07:51:00	UA	UA	739						X	
	287	7/2/2017	7/2/2017	06:35:00	07:51:00	UA	UA	739							X
	287	7/3/2017	7/6/2017	06:35:00	07:50:00	UA	UA	319	X	X	X	X	X	X	

	287	7/5/2017	7/13/2017	06:35:00	07:50:00	UA	UA	319	X	X	X	X	X	X	
	287	7/9/2017	7/13/2017	06:35:00	07:50:00	UA	UA	320						X	X
	287	7/12/2017	7/20/2017	06:35:00	07:50:00	UA	UA	319	X	X	X	X	X		
	287	7/15/2017	7/20/2017	06:35:00	07:50:00	UA	UA	320						X	X
	287	7/19/2017	7/20/2017	06:35:00	07:50:00	UA	UA	319	X	X	X	X	X		X
	287	7/19/2017	7/27/2017	06:35:00	07:50:00	UA	UA	319	X	X	X	X	X		X
	287	7/22/2017	7/22/2017	06:35:00	07:50:00	UA	UA	320						X	
	287	7/26/2017	8/3/2017	06:35:00	07:50:00	UA	UA	319	X	X	X	X	X	X	X
	2920	6/29/2017	7/6/2017	08:00:00	09:20:00	AA	OO	CR7	X	X	X	X	X	X	X
	2920	7/5/2017	7/13/2017	08:00:00	09:20:00	AA	OO	CR7	X	X	X	X	X	X	X
	2920	7/12/2017	7/12/2017	08:00:00	09:20:00	AA	OO	CR7	X	X	X	X	X	X	X
	2920	7/13/2017	7/20/2017	08:00:00	09:20:00	AA	OO	CR7	X	X	X	X	X	X	X
	2920	7/19/2017	7/20/2017	08:00:00	09:20:00	AA	OO	CR7	X	X	X	X	X	X	X
	2920	7/19/2017	7/27/2017	08:00:00	09:20:00	AA	OO	CR7	X	X	X	X	X	X	X
	2920	7/26/2017	7/26/2017	08:00:00	09:20:00	AA	OO	CR7	X	X	X	X	X	X	X
	2920	7/27/2017	8/3/2017	08:00:00	09:20:00	AA	OO	CR7	X	X	X	X	X	X	X
	498	7/3/2017	7/3/2017	10:11:00	11:29:00	UA	UA	739	X						
	498	7/6/2017	7/6/2017	10:13:00	11:30:00	UA	UA	739				X			
	498	7/13/2017	7/20/2017	10:13:00	11:29:00	UA	UA	739				X			
	498	7/20/2017	7/20/2017	10:13:00	11:29:00	UA	UA	739				X			
	498	7/27/2017	7/27/2017	10:13:00	11:29:00	UA	UA	739				X			
	498	7/1/2017	7/1/2017	10:14:00	11:32:00	UA	UA	739						X	
	498	7/2/2017	7/2/2017	10:14:00	11:32:00	UA	UA	739							X
	498	7/4/2017	7/4/2017	10:14:00	11:31:00	UA	UA	320		X					
	498	7/5/2017	7/13/2017	10:14:00	11:32:00	UA	UA	739		X	X		X		
	498	7/5/2017	7/6/2017	10:14:00	11:32:00	UA	UA	739		X	X		X		
	498	7/8/2017	7/8/2017	10:14:00	11:32:00	UA	UA	739						X	
	498	7/9/2017	7/9/2017	10:14:00	11:32:00	UA	UA	738							X
	498	7/10/2017	7/13/2017	10:14:00	11:32:00	UA	UA	739	X						
	498	7/12/2017	7/20/2017	10:14:00	11:32:00	UA	UA	739		X	X		X		
	498	7/15/2017	7/20/2017	10:14:00	11:32:00	UA	UA	739						X	
	498	7/16/2017	7/20/2017	10:14:00	11:32:00	UA	UA	739							X
	498	7/17/2017	7/17/2017	10:14:00	11:32:00	UA	UA	739	X						
	498	7/19/2017	7/20/2017	10:14:00	11:32:00	UA	UA	739	X	X	X		X		
	498	7/19/2017	7/27/2017	10:14:00	11:32:00	UA	UA	739	X	X	X		X		
	498	7/22/2017	7/27/2017	10:14:00	11:32:00	UA	UA	739						X	
	498	7/23/2017	7/27/2017	10:14:00	11:32:00	UA	UA	739							X
	498	7/26/2017	8/3/2017	10:14:00	11:32:00	UA	UA	739	X	X	X		X		
	498	7/29/2017	8/3/2017	10:14:00	11:32:00	UA	UA	739						X	
	498	7/30/2017	8/3/2017	10:14:00	11:32:00	UA	UA	739							X
	3829	7/5/2017	7/13/2017	10:41:00	12:10:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3829	7/5/2017	7/6/2017	10:41:00	12:10:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3829	7/12/2017	7/20/2017	10:41:00	12:10:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3829	7/19/2017	7/27/2017	10:41:00	12:10:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3829	7/19/2017	7/20/2017	10:41:00	12:10:00	AA	MQ	ER4	X	X	X	X	X	X	X
	3829	7/26/2017	8/3/2017	10:41:00	12:10:00	AA	MQ	ER4	X	X	X	X	X	X	X
	5486	7/2/2017	7/6/2017	11:47:00	13:08:00	UA	OO	E7W							X
	5486	7/9/2017	7/13/2017	11:47:00	13:08:00	UA	OO	E7W							X
	5486	7/16/2017	7/20/2017	11:47:00	13:08:00	UA	OO	E7W							X
	5486	7/23/2017	7/27/2017	11:47:00	13:08:00	UA	OO	E7W							X
	5486	7/30/2017	8/3/2017	11:47:00	13:08:00	UA	OO	E7W							X
	3566	7/1/2017	7/1/2017	13:44:00	15:05:00	UA	YX	E70						X	
	3987	7/8/2017	7/13/2017	13:44:00	15:05:00	UA	EV	ERJ						X	
	3987	7/15/2017	7/20/2017	13:44:00	15:05:00	UA	EV	ERJ						X	
	3987	7/22/2017	7/27/2017	13:44:00	15:05:00	UA	EV	ERJ						X	
	3987	7/29/2017	8/3/2017	13:44:00	15:05:00	UA	EV	ERJ						X	
	2887	6/29/2017	7/6/2017	16:10:00	17:32:00	AA	OO	CR7	X	X	X	X	X	X	X
	2887	7/5/2017	7/13/2017	16:10:00	17:32:00	AA	OO	CR7	X	X	X	X	X	X	X
	2887	7/12/2017	7/12/2017	16:10:00	17:32:00	AA	OO	CR7	X	X	X	X	X	X	X
	2887	7/13/2017	7/20/2017	16:10:00	17:32:00	AA	OO	CR7	X	X	X	X	X	X	X
	2887	7/19/2017	7/20/2017	16:10:00	17:32:00	AA	OO	CR7	X	X	X	X	X	X	X
	2887	7/19/2017	7/27/2017	16:10:00	17:32:00	AA	OO	CR7	X	X	X	X	X	X	X
	2887	7/26/2017	7/26/2017	16:10:00	17:32:00	AA	OO	CR7	X	X	X	X	X	X	X
	2887	7/27/2017	8/3/2017	16:10:00	17:32:00	AA	OO	CR7	X	X	X	X	X	X	X
	1801	7/16/2017	7/16/2017	16:53:00	18:13:00	UA	UA	739							X
	1801	7/2/2017	7/2/2017	16:59:00	18:22:00	UA	UA	319							X
	1801	7/3/2017	7/3/2017	16:59:00	18:22:00	UA	UA	320	X						
	1801	7/4/2017	7/6/2017	16:59:00	18:22:00	UA	UA	319		X					
	1801	7/5/2017	7/6/2017	16:59:00	18:22:00	UA	UA	319	X		X		X		
	1801	7/5/2017	7/10/2017	16:59:00	18:22:00	UA	UA	319	X		X		X		
	1801	7/6/2017	7/13/2017	16:59:00	18:22:00	UA	UA	319				X			
	1801	7/8/2017	7/8/2017	16:59:00	18:22:00	UA	UA	319						X	
	1801	7/9/2017	7/9/2017	16:59:00	18:22:00	UA	UA	320							X
	1801	7/11/2017	7/13/2017	16:59:00	18:22:00	UA	UA	319		X					
	1801	7/12/2017	7/12/2017	16:59:00	18:22:00	UA	UA	319			X				
	1801	7/12/2017	7/12/2017	16:59:00	18:22:00	UA	UA	319			X				
	1801	7/13/2017	7/20/2017	16:59:00	18:22:00	UA	UA	319				X			
	1801	7/14/2017	7/19/2017	16:59:00	18:22:00	UA	UA	319			X		X		
	1801	7/15/2017	7/15/2017	16:59:00	18:22:00	UA	UA	320						X	
	1801	7/17/2017	7/20/2017	16:59:00	18:22:00	UA	UA	319	X						
	1801	7/18/2017	7/20/2017	16:59:00	18:22:00	UA	UA	319		X					
	1801	7/19/2017	7/19/2017	16:59:00	18:22:00	UA	UA	319			X				
	1801	7/19/2017	7/19/2017	16:59:00	18:22:00	UA	UA	319			X				
	1801	7/20/2017	7/27/2017	16:59:00	18:22:00	UA	UA	319				X			
	1801	7/21/2017	7/21/2017	16:59:00	18:22:00	UA	UA	320					X		
	1801	7/22/2017	7/22/2017	16:59:00	18:22:00	UA	UA	320						X	
	1801	7/24/2017	7/27/2017	16:59:00	18:22:00	UA	UA	319	X						
	1801	7/25/2017	7/25/2017	16:59:00	18:22:00	UA	UA	319		X					
	1801	7/26/2017	7/26/2017	16:59:00	18:22:00	UA	UA	319			X				
	1801	7/26/2017	7/26/2017	16:59:00	18:22:00	UA	UA	319			X				
	1801	7/27/2017	7/27/2017	16:59:00	18:22:00	UA	UA	319				X			
	1801	7/28/2017	8/3/2017	16:59:00	18:22:00	UA	UA	319			X		X		
	1801	7/29/2017	7/29/2017	16:59:00	18:22:00	UA	UA	319						X	
	1801	7/31/2017	8/3/2017	16:59:00	18:22:00	UA	UA	319	X			X			
	1801	7/1/2017	7/1/2017	17:05:00	18:25:00	UA	UA	738						X	
	1801	7/30/2017	7/30/2017	17:05:00	18:23:00	UA	UA	320							X

	1801	7/23/2017	7/23/2017	17:18:00	18:35:00	UA	UA	739							X
PHL															
	4104	6/29/2017	7/6/2017	06:15:00	07:19:00	AA	ZW	CR2		X	X	X	X	X	
	4104	7/5/2017	7/13/2017	06:15:00	07:19:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4104	7/12/2017	7/20/2017	06:15:00	07:19:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4104	7/19/2017	7/20/2017	06:15:00	07:19:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4104	7/19/2017	7/27/2017	06:15:00	07:19:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4104	7/26/2017	8/3/2017	06:15:00	07:19:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4185	6/29/2017	7/6/2017	08:35:00	09:47:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4185	7/5/2017	7/13/2017	08:35:00	09:47:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4185	7/12/2017	7/20/2017	08:35:00	09:47:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4185	7/19/2017	7/20/2017	08:35:00	09:47:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4185	7/19/2017	7/27/2017	08:35:00	09:47:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4185	7/26/2017	8/3/2017	08:35:00	09:47:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4237	6/29/2017	7/6/2017	11:05:00	12:12:00	AA	ZW	CR2		X	X	X	X	X	X
	4237	7/5/2017	7/13/2017	11:05:00	12:12:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4237	7/12/2017	7/20/2017	11:05:00	12:12:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4237	7/19/2017	7/27/2017	11:05:00	12:12:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4237	7/19/2017	7/20/2017	11:05:00	12:12:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4237	7/26/2017	8/3/2017	11:05:00	12:12:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4167	6/29/2017	7/4/2017	13:10:00	14:21:00	AA	ZW	CR2	X	X		X	X	X	X
	4167	7/5/2017	7/6/2017	13:10:00	14:21:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4167	7/5/2017	7/13/2017	13:10:00	14:21:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4167	7/12/2017	7/20/2017	13:10:00	14:21:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4167	7/19/2017	7/27/2017	13:10:00	14:21:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4167	7/19/2017	7/20/2017	13:10:00	14:21:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4167	7/26/2017	8/3/2017	13:10:00	14:21:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4119	6/29/2017	7/4/2017	15:41:00	16:50:00	AA	ZW	CR2	X	X		X	X	X	X
	4119	7/5/2017	7/13/2017	15:41:00	16:50:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4119	7/5/2017	7/6/2017	15:41:00	16:50:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4119	7/12/2017	7/20/2017	15:41:00	16:50:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4119	7/19/2017	7/27/2017	15:41:00	16:50:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4119	7/19/2017	7/20/2017	15:41:00	16:50:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4119	7/26/2017	8/3/2017	15:41:00	16:50:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4212	6/29/2017	7/4/2017	17:38:00	18:43:00	AA	ZW	CR2	X	X		X	X	X	X
	4212	7/5/2017	7/13/2017	17:38:00	18:43:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4212	7/5/2017	7/6/2017	17:38:00	18:43:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4212	7/12/2017	7/20/2017	17:38:00	18:43:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4212	7/19/2017	7/20/2017	17:38:00	18:43:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4212	7/19/2017	7/27/2017	17:38:00	18:43:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4212	7/26/2017	8/3/2017	17:38:00	18:43:00	AA	ZW	CR2	X	X	X	X	X	X	X
	4195	6/29/2017	7/6/2017	18:10:00	19:16:00	AA	ZW	CR2		X	X	X	X		
	4195	7/5/2017	7/13/2017	18:10:00	19:16:00	AA	ZW	CR2	X	X	X	X	X		X
	4195	7/12/2017	7/20/2017	18:10:00	19:16:00	AA	ZW	CR2	X	X	X	X	X		X
	4195	7/19/2017	7/27/2017	18:10:00	19:16:00	AA	ZW	CR2	X	X	X	X	X		X
	4195	7/19/2017	7/20/2017	18:10:00	19:16:00	AA	ZW	CR2	X	X	X	X	X		X
	4195	7/26/2017	8/3/2017	18:10:00	19:16:00	AA	ZW	CR2	X	X	X	X	X		X

APPENDIX J – FAA AC 150/5060-5

AIRPORT CAPACITY AND DELAY

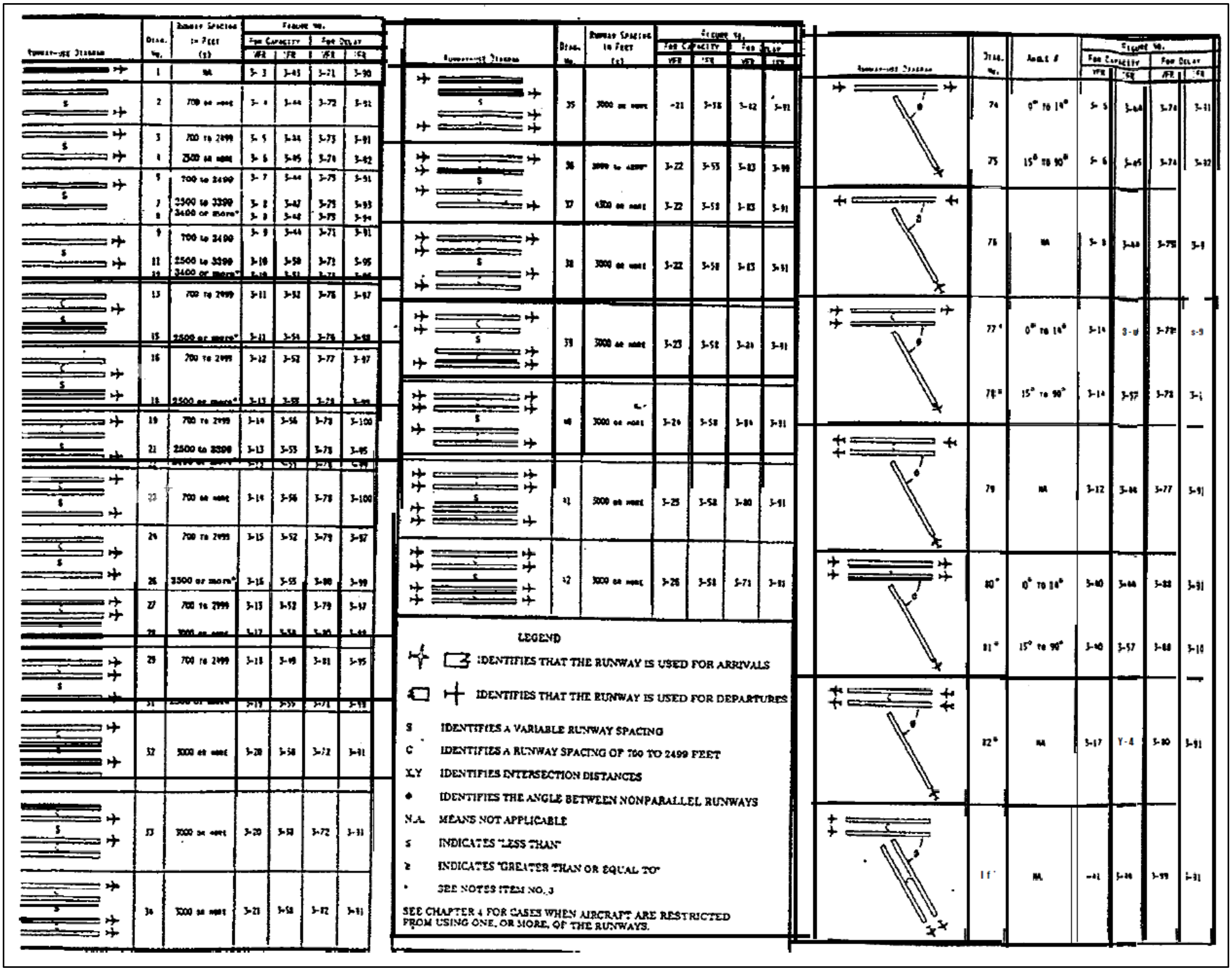
APPENDIX J – FAA AC 150/5060-5
AIRPORT CAPACITY AND DELAY

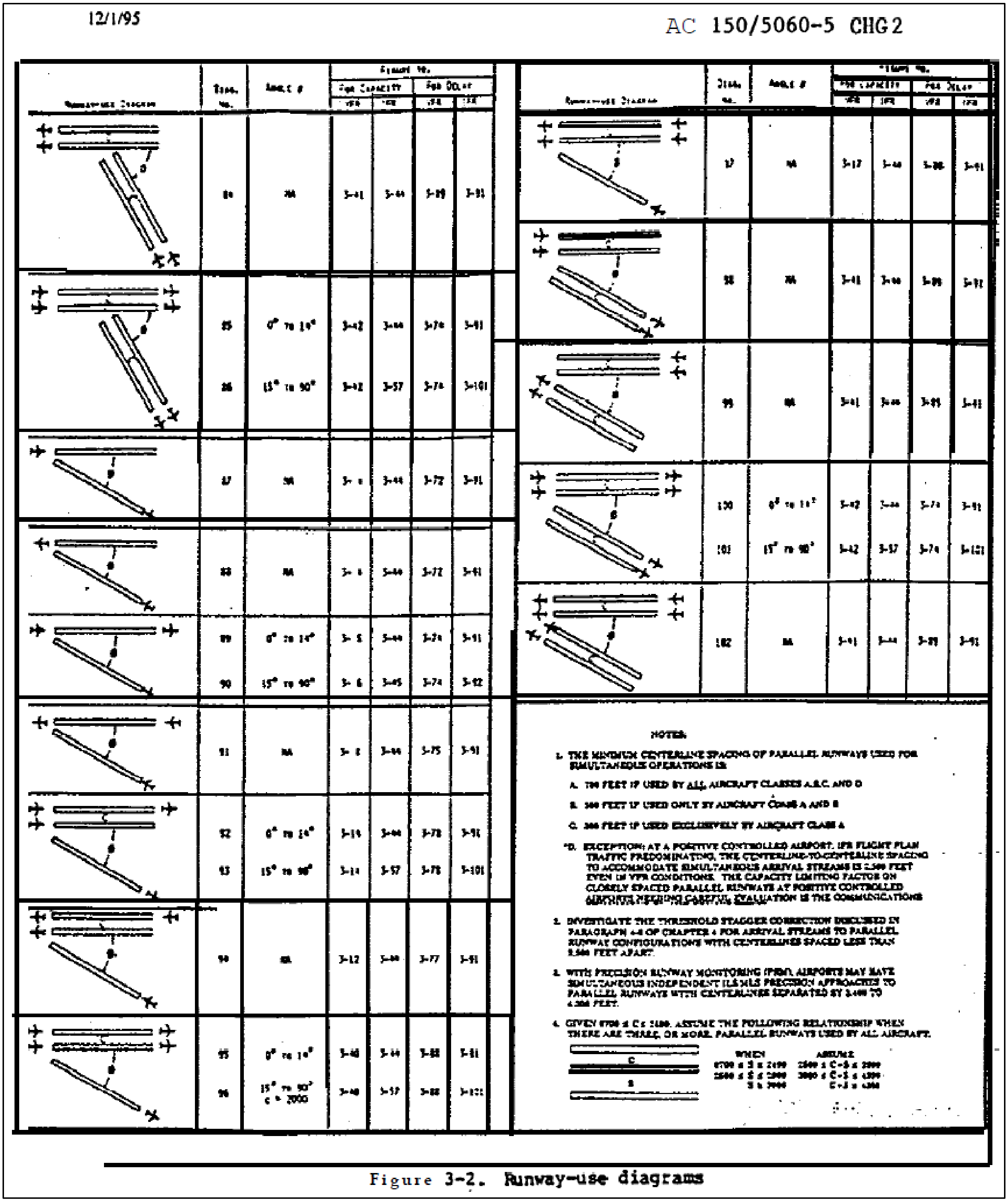
A. Table 3-1 (ASV Weighting Factors)

Table 3-1. ASV **Weighting** Factors

Percent of **Maximum** capacity	**Weighting** Factors			
	VFR	**IFR**		
		Mix Index (0-20)	**Mix Index (21-50)**	**Mix Index (51-180)**
91+	**1**	**1**	**1**	**1**
E1-90	**5**	1	3	**5**
66-80	15	2	8	15
51-65	**20**	**3**	**12**	**20**
0-50	25	**4**	16	25

B. Figure 3-2 (Runway-Use Diagrams)





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AC 150/5060-5 CHG 2

Runway-use Diagram	Diag. No.	Angle θ	Figure No. For Capacity VFR	Figure No. For Capacity IFR	Figure No. For Delay VFR	Figure No. For Delay IFR
	84	NA	3-41	3-44	3-89	3-91
	85	0° to 14°	3-42	3-44	3-74	3-91
	86	15° to 90°	3-42	3-57	3-74	3-101
	87	NA	3-[illegible]	3-44	3-72	3-91
	88	NA	3-[illegible]	3-44	3-72	3-91
	89	0° to 14°	3-5	3-44	3-74	3-91
	90	15° to 90°	3-6	3-45	3-74	3-92
	91	NA	3-8	3-44	3-75	3-91
	92	0° to 14°	3-14	3-44	3-78	3-91
	93	15° to 90°	3-14	3-57	3-78	3-101
	94	NA	3-12	3-44	3-77	3-91
	95	0° to 14°	3-40	3-44	3-88	3-91
	96	15° to 90° C ≥ 2000	3-40	3-57	3-88	3-101
	97	NA	3-17	3-44	3-88	3-91
	98	NA	3-41	3-44	3-89	3-91
	99	NA	3-41	3-44	3-89	3-91
	100	0° to 14°	3-42	3-44	3-74	3-91
	101	15° to 90°	3-42	3-57	3-74	3-101
	102	NA	3-41	3-44	3-89	3-91

NOTES:

1. THE MINIMUM CENTERLINE SPACING OF PARALLEL RUNWAYS USED FOR SIMULTANEOUS OPERATIONS IS:
   - A. 700 FEET IF USED BY ALL AIRCRAFT CLASSES A,B,C AND D
   - B. 500 FEET IF USED ONLY BY AIRCRAFT CLASS A AND B
   - C. 300 FEET IF USED EXCLUSIVELY BY AIRCRAFT CLASS A
   - *D. EXCEPTION: AT A POSITIVE CONTROLLED AIRPORT, IFR FLIGHT PLAN TRAFFIC PREDOMINATING, THE CENTERLINE-TO-CENTERLINE SPACING TO ACCOMMODATE SIMULTANEOUS ARRIVAL STREAMS IS 2,500 FEET EVEN IN VFR CONDITIONS. THE CAPACITY LIMITING FACTOR ON CLOSELY SPACED PARALLEL RUNWAYS AT POSITIVE CONTROLLED AIRPORTS NEEDING CAREFUL EVALUATION IS THE COMMUNICATIONS [illegible]
2. INVESTIGATE THE THRESHOLD STAGGER CORRECTION DISCUSSED IN PARAGRAPH 4-8 OF CHAPTER 4 FOR ARRIVAL STREAMS TO PARALLEL RUNWAY CONFIGURATIONS WITH CENTERLINES SPACED LESS THAN 2,500 FEET APART.
3. WITH PRECISION RUNWAY MONITORING (PRM), AIRPORTS MAY HAVE SIMULTANEOUS INDEPENDENT ILS/MLS PRECISION APPROACHES TO PARALLEL RUNWAYS WITH CENTERLINES SEPARATED BY 3,400 TO 4,300 FEET.
4. GIVEN 700 ≤ C ≤ 2499, ASSUME THE FOLLOWING RELATIONSHIP WHEN THERE ARE THREE, OR MORE, PARALLEL RUNWAYS USED BY ALL AIRCRAFT.

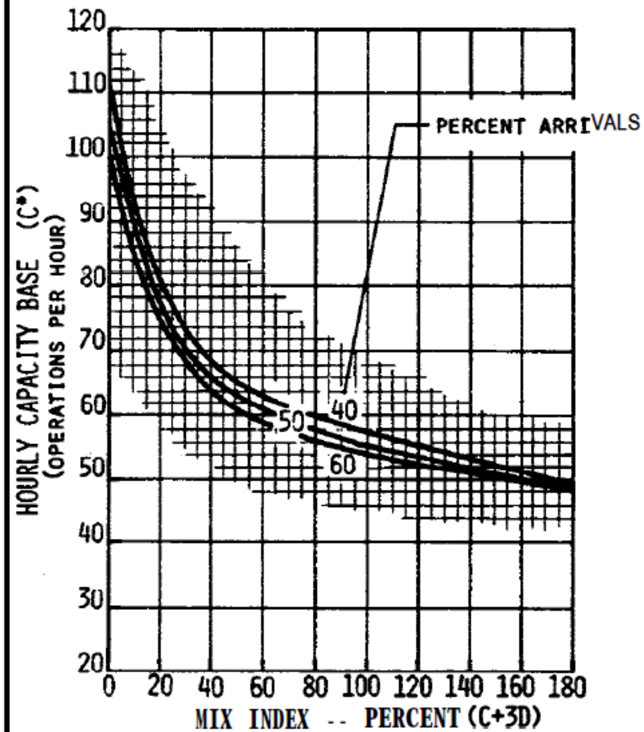
WHEN	ASSUME
700 ≤ S ≤ 2499	2500 ≤ C+S ≤ 3499
2500 ≤ S ≤ 3499	3500 ≤ C+S ≤ 4299
S ≥ 3500	C+S ≥ 4300

Figure 3-2. Runway-use diagrams

C. Figure 3-3

9/23/83 AC 150/5060-5

HOURLY CAPACITY BASE C*



TOUCH & GO FACTOR T

Percent Touch & Go	Nix Index-- Percent (C+3D)	TOUCH & GO FACTOR T
0	0 to 180	1.00
1 to 10	0 to 70	1.04
11 to 20	0 to 70	1.10
21 to 30	0 to 40	1.20
31 to 40	0 to 10	1.31
41 to 50	0 to 10	1.40

C* x T x E = Hourly Capacity

EXIT FACTOR E

To determine Exit Factor E:

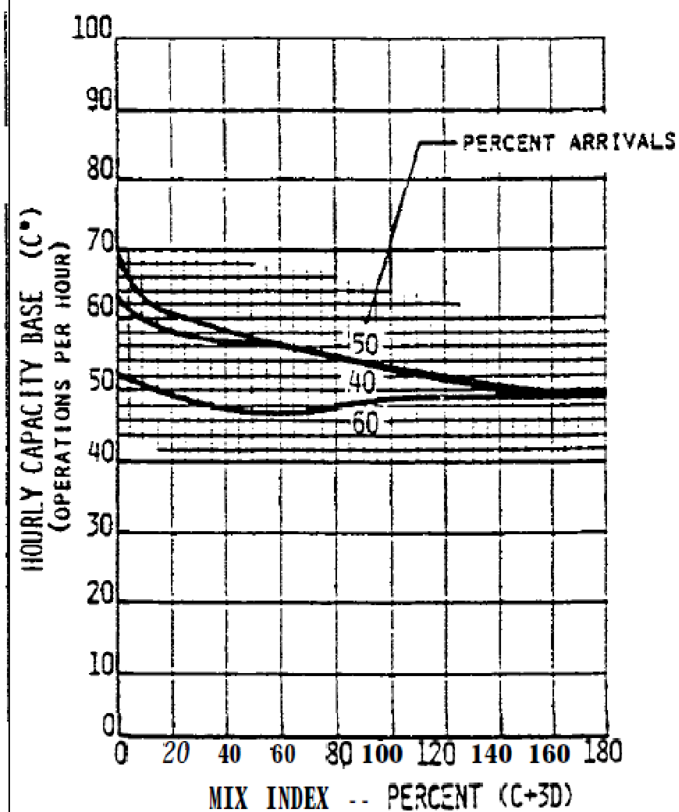
1. Determine exit range for appropriate mix index from table below
2. For *arrival* runways, determine the *average* number of exits (N) which are: (a) within appropriate exit *range*, and (b) *separated* by at least 750 feet
3. If N is 4 or *more*, Exit Factor = 1.00
4. If N is less than 4, determine Exit Factor from table below for
   - ppropriate mix *index* and percent arrivals

Nix In&x-- Percent (C+3D)	Exit Range (Feet from threshold)	EXIT FACTOR E 40% Arrivals N-O	N=1	N-2 or 3	50% Arrivals N-O	N=1	N-2 or 3	60% Arrivals N-O	N=1	N-2 or 3
0 to 20	2000 to 4000	0.72	0.87	0.94	0.70	0.86	0.94	0.67	0.84	0.92
21 to 50	3000 to 5500	0.79	0.86	0.94	0.76	0.84	0.93	0.72	0.81	0.90
51 to 80	3500 to 6500	0.79	0.86	0.92	0.76	0.83	0.91	0.73	0.81	0.90
81 to 120	5000 to 7000	0.82	0.89	0.93	0.80	0.88	0.94	C.77	0.86	0.93
121 to 180	5500 to 7500	0.86	0.94	0.98	0.82	0.91	0.96	0.79	0.91	0.97

FIGURE 3-3, HOURLY CAPACITY OF RUNWAY-USE DIAGRAM NOS.: 1,54 FOR VFR CONDITIONS.

D. Figure 3

HOURLY CAPACITY BASE C*



TOUCH & GO FACTOR T

T = 1.00

C* x T x E = Hourly Capacity

EXIT FACTOR E

To determine Exit Factor E:

1. Determine exit range for appropriate mix index from table below
2. for arrival runways, determine the average number of exits (N) which are: (a) within appropriate exit range, and (b) separated by at least 750 feet
3. If N is 4 or more, Exit Factor = 1.00
4. If N is less than 4, determine Exit Factor from table below for appropriate mix index and percent arrivals

Mix Index-- Percent (C+3D) 2-43, 2-50	Exit Range (Feet from threshold)	EXIT FACTOR E								
		40% Arrivals			50% Arrivals			60% Arrivals		
		N=0	N=1	N=2 or 3	N=0	N=1	N=2 or 3	N=0	N=1	N=2 or 3
0 to 20	2000 to 4000	0.81	0.91	0.96	0.83	0.95	0.99	0.92	1.00	1.00
21 to 50	3000 to 5500	0.79	0.86	0.92	0.77	0.85	0.92	0.89	0.98	1.00
51 to 80	3500 to 6500	0.81	0.87	0.93	0.77	0.83	0.91	0.90	0.98	1.00
81 to 120	5000 to 7000	0.83	0.89	0.94	0.80	0.86	0.92	0.83	0.91	0.97
121 to 180	5500 to 7500	0.86	0.94	0.98	0.83	0.91	0.96	0.79	0.89	0.95

FIGURE 3-43. HOURLY CAPACITY OF RUNWAY-USE DIAGRAM NOS. 1, 54 FOR IFR CONDITIONS.

APPENDIX K – AIRPORT WEATHER DATA: PROVIDED BY NOAA'S NATIONAL CLIMATE DATA CENTER (NCDC)

2009-2018	Visibility (Miles)																																									
Ceiling (ft. AGL)	0.00	0.12	0.12	0.25	0.25	0.50	0.50	0.75	0.75	0.99	1.00	1.24	1.25	1.49	1.50	1.74	1.75	1.99	2.00	2.00	2.49	2.50	2.98	3.00	3.73	4.00	4.97	5.00	5.59	6.00	6.00	6.84	7.00	7.46	8.00	8.00	8.70	9.00	9.00	9.94	10.00	10.00
0	1																																									
30	5	4	12	18	79		39		14		16		6		1					2		1		4		1		5								1						2
60			2		36	8	37		14		12																															
61			2		108		93		97		98		38		73		33			64		51		70		54		46			18		15			4			3			13
90					4		10		4		9																															
91					9		13		12		46		13		47		18			50		54		77		50		74			47		23			14			11			26
120				36	1		3	4	1		9																															
122					2		5		8		18		4		25		23			48		45		86		71		54			56		56			45			32			105
150					8				5		3																												1			
152					2		6		3		12		5		25		12			46		33		73		64		54			61		49			43			46			152
180					1				5		2																															
183	1				1		15		3		14		5		24		13			55		50		60		72		58			56		49			33			48			203
210					1				2		1																															
213					1		5				12		1		11		10			36		24		55		50		44			47		55			45			41			285
240					6	18	5	15	4	10	2												1																			
244					2		1		3		7		5		7		6			24		22		58		53		49			50		54			54			42			337
270					1				1		4																															
274					1		1		8		4		1		4		8			11		13		30		33		32			44		35			26			46			332
300					1		1		1		3																															
305							2		7		7		3		6		5			29		19		33		31		40			46		46			38			44			470
330					1		3		6		1																															
335							6		1		4		1		6		2			10		6		24		15		16			24		27			28			26			362
360									2		5																															
366					3		1		4		1		4		6		4			11		14		20		22		17			15		31			27			23			416
390											4																															
396							1		4				5		6		2			13		13		14		18		21			15		38			18			22			391
420									1																																	
427					2		2		1		6		7		7		4			4		6		10		17		21			22		17			21			19			424
450									1		1																															
457					1		2		1		2		3		6		5			18		6		21		26		33			22		16			22			25			469
480											1																															
488					1		2		1		5		3		5		1			10		4		11		14		13			17		32			12			13			367
510					1						2																															
518					1		2		2		4				9		4			7		5		14		9		15			6		15			11			9			345
540									1																																	
549					1		1		2				3		1					5		3		10		8		3			8		15			13			7			317
570							1																																		1	
579							1		2		1		1		2					4		5		6		8		7			7		10			8			7		1	273
600											3																															
610							1				2		1		3		2			4		11		7		8		10			16		11			6			8			322
640							1		1		1		2		2		3			5		3		5		9		8			7		14			8			7			271
671											2		1		1		4			8				7		5		5			6		11			6			7			226
690											1																															
701							2		1		1				1		3			7		2		6		5		10			4		12			7			7			230
720									1																																	
732							1		1		2		2		1					2		2		5		3		11			2		11			9			7			250
750					2		1		1		1																															
762									2		1		1		4		2			6		4		10		13		9			13		10			11			9			316
780					1				1																																	
792							1				2				3		1			5		2		3		6		8			3		5			6			9			233
823									1		1		4		2		1			1		4		9		2		3			4		2			9			10			227
853									2		5		2		2		2			3		6		4		11		5			6		15			9			5			256
884									1		1		1		1					2				1		4		1			5		3			7			7			228
900							1																																			
914							2								4		3			6		4		14		12		12			9		16			12			10			410
930									1																																	
945									1		1				1		3			2		2		4		4		7			2		6			5			3			215
960					1																																					
975					1		1				1		3		1		2			3				2		6		12			9		7			7			6			253
1,006									1		1		1		1					3		1		3		3		8			6		7			7			3			207
1,020									1		1																															
1,036									1											2		3		4		8		9			8		8			9			7			221
1,050											1																															
1,067									1				2		1					3		3		4		7		8			4		6			3			6		1	244
1,080									1																																	
1,097															2					2		1		3		5		3			6		9			4			13			213
1,128															2		2					1		5		1		4			5		4			2			7			206
1,158													2		1		2			2		2		4		6		8			3		7			7			10			198
1,189													2							1		2		7		3		3			4		2			2			8			183
1,200											1																															
1,219																	1			2		1		7		7		7		1	2		9			8			11			269
1,250													1		2					3		3		1		5		8			5		8			4			2			196
1,280																	2			1				3		3		7			5		9			1			6			150
1,311													1		2					2				2		3		2			6		5			2			7			187
1,320											1																															

1,341																	1			2				4		2		7			8		4		1	2			5			185
1,372											1		1				1			3		1		6		3		5			2		8			6			3			206
1,402																						1		2		3		4			4		4			6			5			177
1,433									1								1			2		2		4		4		4			3		7			4			6			184
1,463													1							1		2		3		7		6			4		9			5			2			207
1,470									1																																	
1,494													1		3					1		1		2		2		2			5		6						7			173
1,500											1																															
1,524									2		1						1			2		3		6		12		14			13		23			23			28			724
1,676													1		1					3		4		8		10		15			14		21			24			33		2	697
1,800							1																																			
1,829					1				1						1					5		7		8		18		13			18		37			23			27			1056
1,981									1						1		1			2		3		3		4		13			11		16			12			23			679
2,100									1																																	
2,134											1		1				1			1		3		7		10		20			17		27			33			31			972
2,286	1						1								1		2			1		2		3		8		9			9		16			14			26			587
2,438					5						1				1		1			1		1		7		7		9			13		19			16			14			788
2,591					1										2							2		1		4		11			8		8			14			9			468
2,700									1																																	
2,743					2										1							2		8		7		11			13		17			20			21		2	792
2,896																				1		3		6		2		7			10		9			7			10			479
3,048					1						2				1					4				4		6		12			24		32			33			28			1164
3,353																				1		1		2		8		20			12		30			26			38			1021
3,600																																										1
3,658																								2		8		14			18		47			31			35			1421
6,096																																										1
22,000					4	1	12		18	3	14	1	17		14	1	27	4		34	3	26	8	77	24	120	42	243	69		341	121	501	119		595	162	4	801	7988	28	54058
99,999	2	1		28	1	42	5	53	3	81	1	37		91	2	45	1	154	1	2	124	4	242		292	1	307	1	308			408	1	355		1	432		1	16990	26	65

APPENDIX L – TFMSC/DISTRIBUTED OPSNET DATA (2018)

OPSNET Operations Prorated By TFMS Report

From 01/2018 To 12/2018 | Airport=ORF

#	Date	Airport	Departure AC+AT	Departure GA	Departure MIL	Departure Total	Arrival AC+AT	Arrival GA	Arrival MIL	Arrival Total	Total Operations
1	Jan-18	ORF - Norfolk	1,979	483	18	2,480	1,957	464	13	2,434	4,914
2	Feb-18	ORF - Norfolk	2,003	575	27	2,605	1,977	560	13	2,550	5,155
3	Mar-18	ORF - Norfolk	2,144	669	36	2,849	2,125	646	23	2,794	5,643
4	Apr-18	ORF - Norfolk	2,216	633	32	2,881	2,193	614	25	2,832	5,713
5	May-18	ORF - Norfolk	2,459	699	47	3,205	2,438	675	37	3,150	6,355
6	Jun-18	ORF - Norfolk	2,445	793	62	3,300	2,419	769	54	3,242	6,542
7	Jul-18	ORF - Norfolk	2,533	673	19	3,225	2,511	656	14	3,181	6,406
8	Aug-18	ORF - Norfolk	2,589	821	36	3,446	2,557	802	28	3,387	6,833
9	Sep-18	ORF - Norfolk	2,455	627	26	3,108	2,432	608	13	3,053	6,161
10	Oct-18	ORF - Norfolk	2,539	756	88	3,383	2,516	732	82	3,330	6,713
11	Nov-18	ORF - Norfolk	2,450	683	29	3,162	2,423	669	16	3,108	6,270
12	Dec-18	ORF - Norfolk	2,478	578	34	3,090	2,445	562	18	3,025	6,115
OPSNET Total :			**28,290**	**7,990**	**454**	**36,734**	**27,993**	**7,757**	**336**	**36,086**	**72,820**
TFMS Total * :			**28,021**	**4,749**	**149**	**32,919**	**23,667**	**4,323**	**121**	**28,111**	**61,030**
TFMS % Of OPSNET * :			**99.05**	**59.44**	**32.82**	**89.61**	**84.55**	**55.73**	**36.01**	**77.9**	**83.81**

* - Does not include TFMS records if Userclass = O-Other or is missing and does not include TFMS records missing specific times (hour = NA).

Report created on Thu Nov 21 16:32:31 EST 2019

Sources: Traffic Flow Management System Counts (TFMSC), Aviation System Performance Metrics (ASPM)

OPSNET Operations Prorated By TFMS Report

From 08/2018 To 08/2018 | Airport=ORF

#	Date	Airport	Hour	Departure AC+AT	Departure GA	Departure MIL	Departure Total	Arrival AC+AT	Arrival GA	Arrival MIL	Arrival Total	Total Operations
1	Aug-18	ORF - Norfolk	0	21	20	23	64	37	7	20	64	128
2	Aug-18	ORF - Norfolk	1	1	2	0	3	12	2	0	14	17
3	Aug-18	ORF - Norfolk	2	1	0	1	2	1	1	0	2	4
4	Aug-18	ORF - Norfolk	4	1	0	0	1	0	0	0	0	1
5	Aug-18	ORF - Norfolk	5	98	12	8	118	2	3	5	10	128
6	Aug-18	ORF - Norfolk	6	162	25	0	187	32	5	0	37	224
7	Aug-18	ORF - Norfolk	7	237	86	0	323	24	11	0	35	358
8	Aug-18	ORF - Norfolk	8	182	65	0	247	101	54	1	156	403
9	Aug-18	ORF - Norfolk	9	140	60	1	201	230	41	0	271	472
10	Aug-18	ORF - Norfolk	10	223	66	1	290	108	61	0	169	459
11	Aug-18	ORF - Norfolk	11	178	67	0	245	146	60	0	206	451
12	Aug-18	ORF - Norfolk	12	133	41	1	175	148	49	0	197	372
13	Aug-18	ORF - Norfolk	13	147	40	0	187	105	57	0	162	349
14	Aug-18	ORF - Norfolk	14	99	64	0	163	187	55	0	242	405
15	Aug-18	ORF - Norfolk	15	195	50	0	245	108	91	0	199	444
16	Aug-18	ORF - Norfolk	16	88	77	0	165	153	88	0	241	406
17	Aug-18	ORF - Norfolk	17	127	67	0	194	204	62	0	266	460
18	Aug-18	ORF - Norfolk	18	186	12	1	199	162	64	1	227	426
19	Aug-18	ORF - Norfolk	19	146	29	0	175	151	30	0	181	356
20	Aug-18	ORF - Norfolk	20	138	13	0	151	84	19	1	104	255
21	Aug-18	ORF - Norfolk	21	64	8	0	72	114	21	0	135	207
22	Aug-18	ORF - Norfolk	22	14	13	0	27	162	15	0	177	204
23	Aug-18	ORF - Norfolk	23	8	4	0	12	286	6	0	292	304
OPSNET Total :				**2,589**	**821**	**36**	**3,446**	**2,557**	**802**	**28**	**3,387**	**6,833**
TFMS Total * :				**2,572**	**469**	**4**	**3,045**	**2,149**	**432**	**4**	**2,585**	**5,630**
TFMS % Of OPSNET * :				**99.34**	**57.13**	**11.11**	**88.36**	**84.04**	**53.87**	**14.29**	**76.32**	**82.39**

* - Does not include TFMS records if Userclass = O-Other or is missing and does not include TFMS records missing specific times (hour = NA).

Report created on Thu Nov 21 16:42:34 EST 2019

Sources: Traffic Flow Management System Counts (TFMSC), Aviation System Performance Metrics (ASPM)

OPSNET Operations Prorated By TFMS Report

From 08/2018 To 08/2018 | Airport=ORF

(Daily Averages)

#	Date	Airport	Hour	Departure AC+AT	Departure GA	Departure MIL	Departure Total	Arrival AC+AT	Arrival GA	Arrival MIL	Arrival Total	Total Operations
1	Aug-18	ORF - Norfolk	0	1	0	1	3	1	0	0	3	6
2	Aug-18	ORF - Norfolk	1	0	0	0	0	1	0	0	1	2
3	Aug-18	ORF - Norfolk	2	0	0	0	1	0	0	0	1	2
4	Aug-18	ORF - Norfolk	4	1	0	0	1	0	0	0	0	1
5	Aug-18	ORF - Norfolk	5	3	0	0	4	0	0	0	0	4
6	Aug-18	ORF - Norfolk	6	5	0	0	6	1	0	0	1	7
7	Aug-18	ORF - Norfolk	7	7	2	0	10	0	0	0	1	11
8	Aug-18	ORF - Norfolk	8	5	2	0	7	3	1	0	5	13
9	Aug-18	ORF - Norfolk	9	4	1	0	6	7	1	0	8	15
10	Aug-18	ORF - Norfolk	10	7	2	0	9	3	1	0	5	14
11	Aug-18	ORF - Norfolk	11	5	2	0	7	4	1	0	6	14
12	Aug-18	ORF - Norfolk	12	4	1	0	5	4	1	0	6	12
13	Aug-18	ORF - Norfolk	13	4	1	0	6	3	1	0	5	11
14	Aug-18	ORF - Norfolk	14	3	2	0	5	6	1	0	7	13
15	Aug-18	ORF - Norfolk	15	6	1	0	7	3	2	0	6	14
16	Aug-18	ORF - Norfolk	16	2	2	0	5	4	2	0	7	13
17	Aug-18	ORF - Norfolk	17	4	2	0	6	6	2	0	8	14
18	Aug-18	ORF - Norfolk	18	6	0	0	6	5	2	0	7	13
19	Aug-18	ORF - Norfolk	19	4	0	0	5	4	0	0	5	11
20	Aug-18	ORF - Norfolk	20	4	0	0	4	2	0	0	3	8
21	Aug-18	ORF - Norfolk	21	2	0	0	2	3	0	0	4	6
22	Aug-18	ORF - Norfolk	22	0	0	0	0	5	0	0	5	6
23	Aug-18	ORF - Norfolk	23	0	0	0	0	9	0	0	9	9
OPSNET Total :				**85.75914905**	**27.03015255**	**2.000132422**	**114.789434**	**84.67173049**	**26.64377086**	**1.221568939**	**112.5370703**	**227.3265043**
TFMS Total * :				**84.46228481**	**15.26208883**	**0.129032258**	**99.8534059**	**71.40894777**	**14.51677923**	**0.129032258**	**86.05475926**	**185.9081652**
TFMS % Of OPSNET * :				**98.49**	**56.46**	**6.45**	**86.99**	**84.34**	**54.48**	**10.56**	**76.47**	**81.78**

* - Does not include TFMS records if Userclass = O-Other or is missing and does not include TFMS records missing specific times (hour = NA).

Report created on Thu Nov 21 16:47:18 EST 2019

Sources: Traffic Flow Management System Counts (TFMSC), Aviation System Performance Metrics (ASPM)

APPENDIX M – ACRP, *REPORT 79*

Single Runway

A. Hourly Capacity (2017)

SPREADSHEET CAPACITY MODEL - SINGLE RUNWAY

INPUTS

Meteorological Conditions	VMC, % Occurrence	85%	IMC, % Occurrence		15%
VMC-Departure-Arrival Separation	2.0	nm	Arrival - Arrival Std. Dev.	18.0	sec
IMC-Departure-Arrival Separation	2.0	nm	Departure ROT Std. Dev.	6.0	sec
Length of Common Approach	7.0	nm	Z-Value, 95% Confidence	1.645	------------
Operations Assumption on Touch -N- Go's	0%		T-Factor (Touch-N-Go's)	→	1.00

RESET INPUTS

Aircraft Classification / New Category	Small - S	Small - T	Small +	Large-TP	Large-Jet	Large-757	Heavy
Previous FAA Category	A	B	C	C	C	C	D
Maximum Gross Takeoff Weight (MTOW)	Less than 12,500 lbs (Single Engine)	Less than 12,500 lbs (Twin Engine)	Between 12,500 lbs and 41,000 lbs	Between 41,000 lbs and 255,000 lbs	Between 41,000 lbs and 300,000 lbs	Boeing 757 Series	More than 300,000 lbs
Operating Fleet Mix — Enter the actual or expected % share for each aircraft class							
Share Allocations	17.0%	4.2%	1.4%	9.6%	63.9%	2.4%	1.5%
Arrival Runway Occupancy Time — Enter the estimated time from touchdown to runway exit							
Time in *Seconds*	32	40	42	45	46	51	55
Average Approach Speeds — Enter the average suggested manufacturers final approach speed under normal conditions							
Velocity in Knots	90	100	120	130	135	140	150

Runway Exit Availability (OR)	Excellent or Default	100%	Runway Crossing Delay ?	No	0
Full Parallel Taxiway	Full Taxiway	100%	Average Crossing Delay	0	sec
Airport Traffic Control Tower	Yes	Availability	Crossings during Peak Hour	0	Frequency

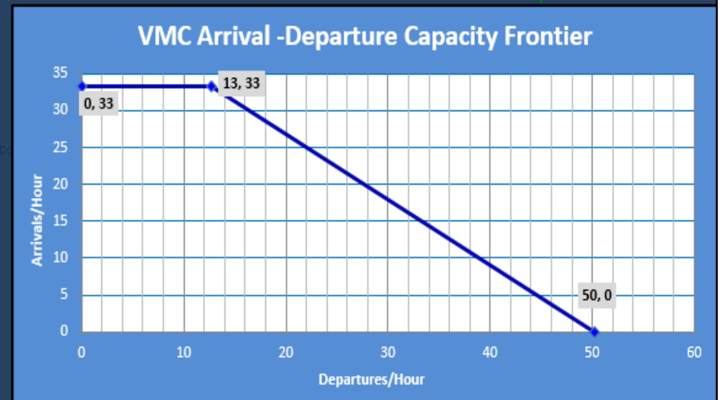
SHOW Advanced Features | HIDE Advanced Features

Use Advanced Features to change ATC procedures and adjust Arrival/Departure mix and priority

OUTPUTS

	VMC	IMC	Average
Arrivals Only Capacity	33	25	32
Arrivals Capacity (including TNG's)	33	25	32
Departures Only Capacity	50	48	50
Mixed Ops - Departure Capacity (including TNG's)	13	33	16
Total Mixed Operations Capacity	46	58	48
Arrivals Percentage	72%	43%	67%

Pareto Frontier Chart Selection: VMC



Single Runway

B. Air Service Volume Estimation (2017)

Annual Service Volume Estimation (ASV)

Use the capacities determined in the capacity model to estimate ASV

0.0	Calculated Cells
0.0	Input Cells
0.0	Linked Cells (within this worksheet)
150,000	Output Cells

ASV Calculations: {D * H * Cw = ASV}

D Factor	H Factor	Cw	ASV
337.0	14.4	46.1	223,300

D = Annual Demand/Avg. Peak Month Daily Demand
H = Avg. Peak Month Daily Demand/Avg. Peak Hour Demand

Fleet Mix Index: 51-180 (C+3D)%
(C = Large Aircraft (i.e. Large-TP + Large-Jet + Large-757), D = Heavy Aircraft)

Weighted Average Capacity Calculations:

Runway use / weather	Hourly Capacity	% Occurrence	% Max Capacity	Weighting Factor	P*C*W	P*W
VMC (Optimal)	46.0	85.2%	79.8%	15	588.3	##########
IMC (Instrument)	57.7	14.8%	100.0%	1	8.5	14.8%
other 1			0.0%	25	0.0	0.0%
other 2			0.0%	0	0.0	0.0%
other 3			0.0%	0	0.0	0.0%
	(C)	(P)		(W)		
			Weighting Factors USED			
		100.00%			596.9	1293.4%

Weighting Factors

	VMC Mix	IMC Mix Indexes		
% of Max Cap	0 - 180	0-20	21-50	51-180
91+	1	1	1	1
81 - 90	5	1	3	5
66 - 80	15	2	8	15
51 - 65	20	3	12	20
0 - 50	25	4	16	25

Above Table is from AC 150/5060-5, Airport Capacity and Delay Table 3-1

Cw = 46.1

Single Runway

A. Hourly Capacity (Base Year)

SPREADSHEET CAPACITY MODEL - SINGLE RUNWAY

INPUTS

Meteorological Conditions	VMC, % Occurrence	85%	IMC, % Occurrence	15%

VMC-Departure-Arrival Separation	2.0	nm	Arrival - Arrival Std. Dev.	18.0	sec
IMC-Departure-Arrival Separation	2.0	nm	Departure ROT Std. Dev.	6.0	sec
Length of Common Approach	7.0	nm	Z-Value, 95% Confidence	1.645	------------
Operations Assumption on Touch -N- Go's	0%		T-Factor (Touch-N-Go's)	→	1.00

RESET INPUTS

Aircraft Classification / New Category	Small - S	Small - T	Small +	Large-TP	Large-Jet	Large-757	Heavy
Previous FAA Category	A	B	C	C	C	C	D
Maximum Gross Takeoff Weight (MTOW)	Less than 12,500 lbs (Single Engine)	Less than 12,500 lbs (Twin Engine)	Between 12,500 lbs and 41,000 lbs	Between 41,000 lbs and 255,000 lbs	Between 41,000 lbs and 300,000 lbs	Boeing 757 Series	More than 300,000 lbs
Operating Fleet Mix	Enter the actual or expected % share for each aircraft class						
Share Allocations	16.5%	3.5%	1.4%	9.8%	64.4%	1.0%	3.3%
Arrival Runway Occupancy Time	Enter the estimated time from touchdown to runway exit						
Time in *Seconds*	32	40	42	45	46	51	55
Average Approach Speeds	Enter the average suggested manufacturers final approach speed under normal conditions						
Velocity in Knots	90	100	120	130	135	140	150

Runway Exit Availability OR	Excellent or Default	100%	Runway Crossing Delay ?	No	0
Full Parallel Taxiway	Full Taxiway	100%	Average Crossing Delay	0	sec
Airport Traffic Control Tower	Yes	Availability	Crossings during Peak Hour	0	Frequency

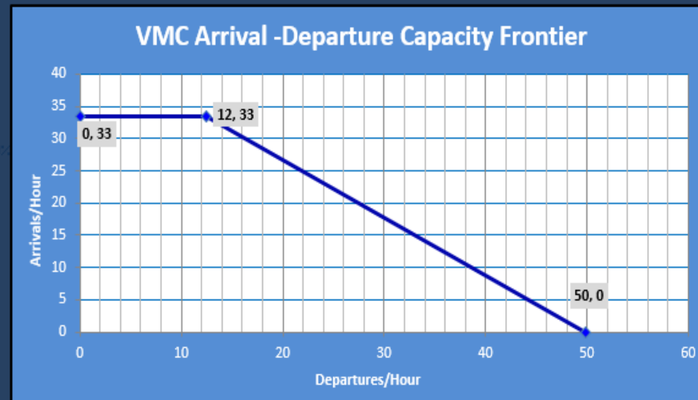
SHOW Advanced Features | HIDE Advanced Features

Use Advanced Features to change ATC procedures and adjust Arrival/Departure mix and priority

OUTPUTS

	VMC	IMC	Average
Arrivals Only Capacity	33	25	32
Arrivals Capacity (including TNG's)	33	25	32
Departures Only Capacity	50	48	50
Mixed Ops - Departure Capacity (including TNG's)	12	33	15
Total Mixed Operations Capacity	46	58	48
Arrivals Percentage	73%	43%	68%

Pareto Frontier Chart Selection	VMC



Single Runway

B. Air Service Volume Estimation (Base Year)

Annual Service Volume Estimation (ASV)

0.0	Calculated Cells
0.0	Input Cells
0.0	Linked Cells (within this worksheet)
150,000	Output Cells

Use the capacities determined in the capacity model to estimate ASV

ASV Calculations: {D * H * Cw = ASV}

D Factor	H Factor	Cw	ASV
329.9	14.7	45.9	222,200

D = Annual Demand/Avg. Peak Month Daily Demand
H = Avg. Peak Month Daily Demand/Avg. Peak Hour Demand

Fleet Mix Index: 51-180 (C+3D)%
(C = Large Aircraft (i.e. Large-TP + Large-Jet + Large-757), D = Heavy Aircraft)

Weighted Average Capacity Calculations:

Runway use / weather	Hourly Capacity	% Occurrence	% Max Capacity	Weighting Factor	P*C*W	P*W
VMC (Optimal)	45.8	85.2%	79.4%	15	585.4	1278.6%
IMC (Instrument)	57.7	14.8%	100.0%	1	8.5	14.8%
other 1			0.0%	25	0.0	0.0%
other 2			0.0%	0	0.0	0.0%
other 3			0.0%	0	0.0	0.0%
	(C)	(P)		(W)		
			Weighting Factors USED			
		100.00%			593.9	1293.4%

Weighting Factors

% of Max Cap	VMC Mix 0 - 180	IMC Mix Indexes 0-20	IMC Mix Indexes 21-50	IMC Mix Indexes 51-180
91+	1	1	1	1
81 - 90	5	1	3	5
66 - 80	15	2	8	15
51 - 65	20	3	12	20
0 - 50	25	4	16	25

Above Table is from AC 150/5060-5, Airport Capacity and Delay Table 3-1

Cw = 45.9

Single Runway

A. Hourly Capacity (PAL 1)

SPREADSHEET CAPACITY MODEL - SINGLE RUNWAY

INPUTS

Meteorological Conditions	VMC, % Occurrence	85%	IMC, % Occurrence	15%

VMC-Departure-Arrival Separation	2.0	nm	Arrival - Arrival Std. Dev.	18.0	sec
IMC-Departure-Arrival Separation	2.0	nm	Departure ROT Std. Dev.	6.0	sec
Length of Common Approach	7.0	nm	Z-Value, 95% Confidence	1.645	------------
Operations Assumption on Touch -N- Go's	0%		T-Factor (Touch-N-Go's) →	1.00	

RESET INPUTS

Aircraft Classification New Category	Small - S	Small - T	Small +	Large-TP	Large-Jet	Large-757	Heavy
Previous FAA Category	A	B	C	C	C	C	D
Maximum Gross Takeoff Weight (MTOW)	Less than 12,500 lbs (Single Engine)	Less than 12,500 lbs (Twin Engine)	Between 12,500 lbs and 41,000 lbs	Between 41,000 lbs and 255,000 lbs	Between 41,000 lbs and 300,000 lbs	Boeing 757 Series	More than 300,000 lbs
Operating Fleet Mix	Enter the actual or expected % share for each aircraft class						
Share Allocations	15.8%	3.3%	1.5%	10.1%	65.3%	0.5%	3.4%
Arrival Runway Occupancy Time	Enter the estimated time from touchdown to runway exit						
Time in *Seconds*	32	40	42	45	46	51	55
Average Approach Speeds	Enter the average suggested manufacturers final approach speed under normal conditions						
Velocity in Knots	90	100	120	130	135	140	150

Runway Exit Availability (OR)	Excellent or Default	100%	Runway Crossing Delay ?	No	0
Full Parallel Taxiway	Full Taxiway	100%	Average Crossing Delay	0	sec
Airport Traffic Control Tower	Yes	Availability	Crossings during Peak Hour	0	Frequency

SHOW Advanced Features

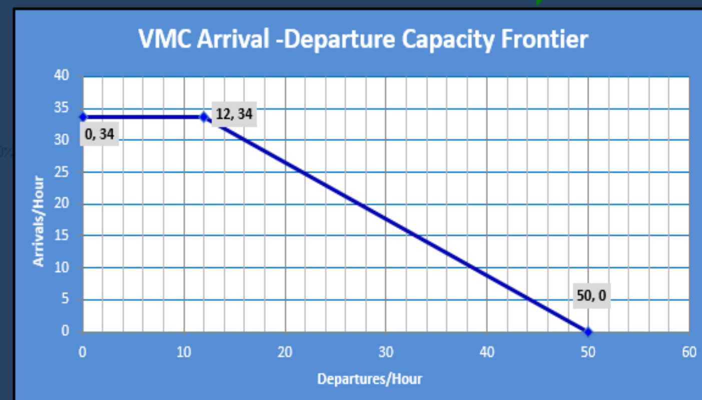
HIDE Advanced Features

Use Advanced Features to change ATC procedures and adjust Arrival/Departure mix and priority

OUTPUTS

	VMC	IMC	Average
Arrivals Only Capacity	34	26	33
Arrivals Capacity (including TNG's)	34	26	33
Departures Only Capacity	50	48	50
Mixed Ops - Departure Capacity (including TNG's)	12	33	15
Total Mixed Operations Capacity	46	59	48
Arrivals Percentage	74%	44%	68%

Pareto Frontier Chart Selection	VMC



Single Runway

B. Air Service Volume Estimation (PAL 1)

Annual Service Volume Estimation (ASV)

0.0	Calculated Cells
0.0	Input Cells
0.0	Linked Cells (within this worksheet)
150,000	Output Cells

Use the capacities determined in the capacity model to estimate ASV

ASV Calculations: {D * H * Cw = ASV}

D Factor	H Factor	Cw	ASV
329.9	14.7	45.8	221,800

D = Annual Demand/Avg. Peak Month Daily Demand
H = Avg. Peak Month Daily Demand/Avg. Peak Hour Demand

Fleet Mix Index: 51-180 (C+3D)%
(C = Large Aircraft (i.e. Large-TP + Large-Jet + Large-757), D = Heavy Aircraft)

Weighted Average Capacity Calculations:

Runway use / weather	Hourly Capacity	% Occurrence	% Max Capacity	Weighting Factor	P*C*W	P*W
VMC (Optimal)	45.7	85.2%	77.9%	15	584.2	1278.6%
IMC (Instrument)	58.7	14.8%	100.0%	1	8.7	14.8%
other 1			0.0%	25	0.0	0.0%
other 2			0.0%	0	0.0	0.0%
other 3			0.0%	0	0.0	0.0%
	(C)	(P)		(W)		
			Weighting Factors USED			
		100.00%			592.9	1293.4%

Weighting Factors

	VMC Mix	IMC Mix Indexes		
% of Max Cap	0 - 180	0-20	21-50	51-180
91+	1	1	1	1
81 - 90	5	1	3	5
66 - 80	15	2	8	15
51 - 65	20	3	12	20
0 - 50	25	4	16	25

Above Table is from AC 150/5060-5, Airport Capacity and Delay Table 3-1

Cw = 45.8

Single Runway

A. Hourly Capacity (PAL 2)

SPREADSHEET CAPACITY MODEL - SINGLE RUNWAY

INPUTS

Meteorological Conditions	VMC, % Occurrence		IMC, % Occurrence	100%

VMC-Departure-Arrival Separation	2.0	nm	Arrival - Arrival Std. Dev.	18.0	sec
IMC-Departure-Arrival Separation	2.0	nm	Departure ROT Std. Dev.	6.0	sec
Length of Common Approach	7.0	nm	Z-Value, 95% Confidence	1.645	------------
Operations Assumption on Touch -N- Go's	0%		T-Factor (Touch-N-Go's)	→	1.00

RESET INPUTS

Aircraft Classification / New Category	Small - S	Small - T	Small +	Large-TP	Large-Jet	Large-757	Heavy
Previous FAA Category	A	B	C	C	C	C	D
Maximum Gross Takeoff Weight (MTOW)	Less than 12,500 lbs (Single Engine)	Less than 12,500 lbs (Twin Engine)	Between 12,500 lbs and 41,000 lbs	Between 41,000 lbs and 255,000 lbs	Between 41,000 lbs and 300,000 lbs	Boeing 757 Series	More than 300,000 lbs
Operating Fleet Mix	Enter the actual or expected % share for each aircraft class						
Share Allocations	15.1%	3.3%	1.8%	12.1%	64.2%	0.0%	3.5%
Arrival Runway Occupancy Time	Enter the estimated time from touchdown to runway exit						
Time in *Seconds*	32	40	42	45	46	51	55
Average Approach Speeds	Enter the average suggested manufacturers final approach speed under normal conditions						
Velocity in Knots	90	100	120	130	135	140	150

Runway Exit Availability (OR)	Excellent or Default	100%	Runway Crossing Delay ?	No	0
Full Parallel Taxiway	Full Taxiway	100%	Average Crossing Delay	0	sec
Airport Traffic Control Tower	Yes	Availability	Crossings during Peak Hour	0	Frequency

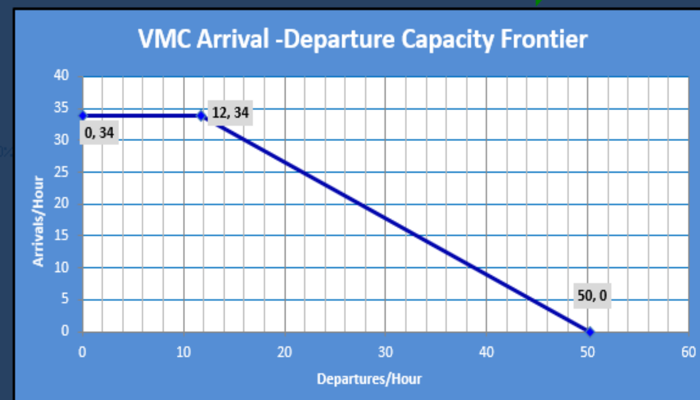
SHOW Advanced Features | HIDE Advanced Features

Use Advanced Features to change ATC procedures and adjust Arrival/Departure mix and priority

OUTPUTS

	VMC	IMC	Average
Arrivals Only Capacity	34	26	26
Arrivals Capacity (including TNG's)	34	26	26
Departures Only Capacity	50	48	48
Mixed Ops - Departure Capacity (including TNG's)	12	33	33
Total Mixed Operations Capacity	46	59	59
Arrivals Percentage	74%	44%	44%

Pareto Frontier Chart Selection	VMC



Single Runway

B. Air Service Volume Estimation (PAL 2)

Annual Service Volume Estimation (ASV)

0.0	Calculated Cells
0.0	Input Cells
0.0	Linked Cells (within this worksheet)
150,000	Output Cells

Use the capacities determined in the capacity model to estimate ASV

ASV Calculations: {D * H * Cw = ASV}

D Factor	H Factor	Cw	ASV
329.9	14.7	45.7	221,200

D = Annual Demand/Avg. Peak Month Daily Demand
H = Avg. Peak Month Daily Demand/Avg. Peak Hour Demand

Fleet Mix Index: 51-180 (C+3D)%
(C = Large Aircraft (i.e. Large-TP + Large-Jet + Large-757), D = Heavy Aircraft)

Weighted Average Capacity Calculations:

Runway use / weather	Hourly Capacity	% Occurrence	% Max Capacity	Weighting Factor	P*C*W	P*W
VMC (Optimal)	45.6	85.2%	77.2%	15	582.5	1278.6%
IMC (Instrument)	59.0	14.8%	100.0%	1	8.7	14.8%
other 1			0.0%	25	0.0	0.0%
other 2			0.0%	0	0.0	0.0%
other 3			0.0%	0	0.0	0.0%
	(C)	(P)		(W)		
			Weighting Factors USED			
		100.00%			591.2	1293.4%

Weighting Factors

	VMC Mix	IMC Mix Indexes		
% of Max Cap	0 - 180	0-20	21-50	51-180
91+	1	1	1	1
81 - 90	5	1	3	5
66 - 80	15	2	8	15
51 - 65	20	3	12	20
0 - 50	25	4	16	25

Above Table is from AC 150/5060-5, Airport Capacity and Delay Table 3-1

Cw = 45.7

Single Runway

A. Hourly Capacity (PAL 3)

SPREADSHEET CAPACITY MODEL - SINGLE RUNWAY

INPUTS

Meteorological Conditions	VMC, % Occurrence		85%	IMC, % Occurrence		15%
VMC-Departure-Arrival Separation	2.0	nm	Arrival - Arrival Std. Dev.		18.0	sec
IMC-Departure-Arrival Separation	2.0	nm	Departure ROT Std. Dev.		6.0	sec
Length of Common Approach	7.0	nm	Z-Value, 95% Confidence		1.645	------------
Operations Assumption on Touch -N- Go's		0%	T-Factor (Touch-N-Go's)		→	1.00

RESET INPUTS

Aircraft Classification / New Category	Small - S	Small - T	Small +	Large-TP	Large-Jet	Large-757	Heavy
Previous FAA Category	A	B	C	C	C	C	D
Maximum Gross Takeoff Weight (MTOW)	Less than 12,500 lbs (Single Engine)	Less than 12,500 lbs (Twin Engine)	Between 12,500 lbs and 41,000 lbs	Between 41,000 lbs and 255,000 lbs	Between 41,000 lbs and 300,000 lbs	Boeing 757 Series	More than 300,000 lbs
Operating Fleet Mix / Share Allocations (Enter the actual or expected % share for each aircraft class)	14.8%	3.2%	2.0%	13.2%	63.2%	0.0%	3.6%
Arrival Runway Occupancy Time / Time in *Seconds* (Enter the estimated time from touchdown to runway exit)	32	40	42	45	46	51	55
Average Approach Speeds / *Velocity in Knots* (Enter the average suggested manufacturers final approach speed under normal conditions)	90	100	120	130	135	140	150

Runway Exit Availability	OR	Excellent or Default	100%	Runway Crossing Delay ?	No	0
Full Parallel Taxiway		Full Taxiway	100%	Average Crossing Delay	0	sec
Airport Traffic Control Tower		Yes	Availability	Crossings during Peak Hour	0	Frequency

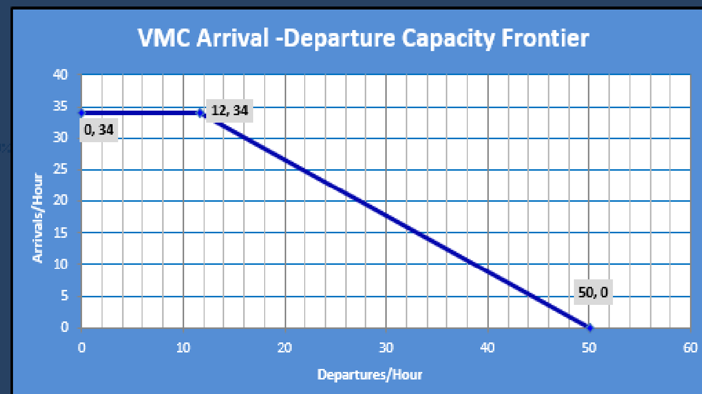
SHOW Advanced Features | HIDE Advanced Features

Use Advanced Features to change ATC procedures and adjust Arrival/Departure mix and priority

OUTPUTS

	VMC	IMC	Average
Arrivals Only Capacity	34	26	33
Arrivals Capacity (including TNG's)	34	26	33
Departures Only Capacity	50	48	50
Mixed Ops - Departure Capacity (including TNG's)	12	33	15
Total Mixed Operations Capacity	46	59	48
Arrivals Percentage	74%	44%	69%

Pareto Frontier Chart Selection: VMC



Single Runway

B. Air Service Volume Estimation (PAL 3)

Annual Service Volume Estimation (ASV)

0.0	Calculated Cells
0.0	Input Cells
0.0	Linked Cells (within this worksheet)
150,000	Output Cells

Use the capacities determined in the capacity model to estimate ASV

ASV Calculations: {D * H * Cw = ASV}

D Factor	H Factor	Cw	ASV
329.9	14.7	45.7	221,100

D = Annual Demand/Avg. Peak Month Daily Demand
H = Avg. Peak Month Daily Demand/Avg. Peak Hour Demand

Fleet Mix Index: 51-180 (C+3D)%
(C = Large Aircraft (i.e. Large-TP + Large-Jet + Large-757), D = Heavy Aircraft)

Weighted Average Capacity Calculations:

Runway use / weather	Hourly Capacity	% Occurrence	% Max Capacity	Weighting Factor	P*C*W	P*W
VMC (Optimal)	45.5	85.2%	77.2%	15	582.3	1278.6%
IMC (Instrument)	59.0	14.8%	100.0%	1	8.7	14.8%
other 1			0.0%	25	0.0	0.0%
other 2			0.0%	0	0.0	0.0%
other 3			0.0%	0	0.0	0.0%
	(C)	(P)		(W)		
			Weighting Factors USED			
		100.00%			591.0	1293.4%

Weighting Factors

	VMC Mix	IMC Mix Indexes		
% of Max Cap	0 - 180	0-20	21-50	51-180
91+	1	1	1	1
81 - 90	5	1	3	5
66 - 80	15	2	8	15
51 - 65	20	3	12	20
0 - 50	25	4	16	25

Above Table is from AC 150/5060-5, Airport Capacity and Delay Table 3-1

Cw = 45.7

Single Runway

A. Hourly Capacity (PAL 4)

SPREADSHEET CAPACITY MODEL - SINGLE RUNWAY

INPUTS

Meteorological Conditions	VMC, % Occurrence	85%	IMC, % Occurrence	15%

VMC-Departure-Arrival Separation	2.0	nm	Arrival - Arrival Std. Dev.	18.0	sec
IMC-Departure-Arrival Separation	2.0	nm	Departure ROT Std. Dev.	6.0	sec
Length of Common Approach	7.0	nm	Z-Value, 95% Confidence	1.645	------------
Operations Assumption on Touch -N- Go's		0%	T-Factor (Touch-N-Go's) →		1.00

RESET INPUTS

Aircraft Classification New Category	Small - S	Small - T	Small +	Large-TP	Large-Jet	Large-757	Heavy
Previous FAA Category	A	B	C	C	C	C	D
Maximum Gross Takeoff Weight (MTOW)	Less than 12,500 lbs (Single Engine)	Less than 12,500 lbs (Twin Engine)	Between 12,500 lbs and 41,000 lbs	Between 41,000 lbs and 255,000 lbs	Between 41,000 lbs and 300,000 lbs	Boeing 757 Series	More than 300,000 lbs
Operating Fleet Mix	Enter the actual or expected % share for each aircraft class						
Share Allocations	14.3%	3.1%	2.1%	14.1%	62.7%	0.0%	3.7%
Arrival Runway Occupancy Time	Enter the estimated time from touchdown to runway exit						
Time in *Seconds*	32	40	42	45	46	51	55
Average Approach Speeds	Enter the average suggested manufacturers final approach speed under normal conditions						
Velocity in Knots	90	100	120	130	135	140	150

Runway Exit Availability OR	Excellent or Default	100%	Runway Crossing Delay ?	No	0
Full Parallel Taxiway	Full Taxiway	100%	Average Crossing Delay	0	sec
Airport Traffic Control Tower	Yes	Availability	Crossings during Peak Hour	0	Frequency

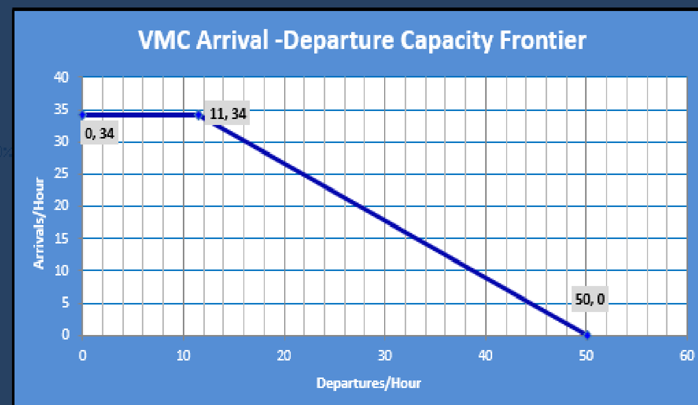
SHOW Advanced Features | HIDE Advanced Features

Use Advanced Features to change ATC procedures and adjust Arrival/Departure mix and priority

OUTPUTS

	VMC	IMC	Average
Arrivals Only Capacity	34	26	33
Arrivals Capacity (including TNG's)	34	26	33
Departures Only Capacity	50	48	50
Mixed Ops - Departure Capacity (including TNG's)	11	33	15
Total Mixed Operations Capacity	46	59	48
Arrivals Percentage	75%	44%	69%

Pareto Frontier Chart Selection	VMC



Single Runway

B. Air Service Volume Estimation (PAL 4)

Annual Service Volume Estimation (ASV)

0.0	Calculated Cells
0.0	Input Cells
0.0	Linked Cells (within this worksheet)
150,000	Output Cells

Use the capacities determined in the capacity model to estimate ASV

ASV Calculations: {D * H * Cw = ASV}

D Factor	H Factor	Cw	ASV
329.9	14.7	45.7	221,100

D = Annual Demand/Avg. Peak Month Daily Demand
H = Avg. Peak Month Daily Demand/Avg. Peak Hour Demand

Fleet Mix Index: 51-180 (C+3D)%
(C = Large Aircraft (i.e. Large-TP + Large-Jet + Large-757), D = Heavy Aircraft)

Weighted Average Capacity Calculations:

Runway use / weather	Hourly Capacity	% Occurrence	% Max Capacity	Weighting Factor	P*C*W	P*W
VMC (Optimal)	45.5	85.2%	77.3%	15	582.1	1278.6%
IMC (Instrument)	58.9	14.8%	100.0%	1	8.7	14.8%
other 1			0.0%	25	0.0	0.0%
other 2			0.0%	0	0.0	0.0%
other 3			0.0%	0	0.0	0.0%
	(C)	(P)		(W)		
			Weighting Factors USED			
		100.00%			590.8	1293.4%

Weighting Factors

	VMC Mix	IMC Mix Indexes		
% of Max Cap	0 - 180	0-20	21-50	51-180
91+	1	1	1	1
81 - 90	5	1	3	5
66 - 80	15	2	8	15
51 - 65	20	3	12	20
0 - 50	25	4	16	25

Above Table is from AC 150/5060-5, Airport Capacity and Delay Table 3-1

Cw = 45.7

APPENDIX N – ELIMINATED RUNWAY ALTERNATIVES

Table N-16 – Eliminated Runway Alternatives Summary

Alternative	Opportunities	Constraints
Alternative 1: Relocate Runway 5 Threshold	✈ Captures full length of runway for landing on Runway 5 (current Landing Distance Available is adequate for all aircraft operations)	✈ Cost and impact of relocating approach lighting system and navigational aids (glideslope, PAPIs, runway markings)
	-	✈ Off-airport tree removal required
Alternative 4: 9,000' Offset: 400'	✈ Provides secondary runway for operational flexibility	✈ 400' separation does not permit simultaneous operations
	✈ Proposed length accommodates all commercial activity	✈ Overlapping Runway Object Free Areas (ROFAs)
	✈ Avoids impacts to existing landside facilities	✈ Requires relocation or decommissioning of VORTAC
		✈ Environmental impacts to Lake Whitehurst
		✈ Significant construction costs
		✈ Approach/departure overfly Little Creek Naval Base
Alternative 5: 9,000' Offset: 876'	✈ Provides secondary runway for operational flexibility	✈ Impacts to Lake Whitehurst
	✈ Proposed length accommodates all commercial activity	✈ Impacts to on-airport facilities (airport maintenance facilities, ARFF training facility, MRO hangar, and GA parking apron)
	✈ Avoids impacts to VORTAC	✈ Significant construction costs
	✈ 876' separation enables simultaneous VFR operations	✈ Approach/departure overfly Little Creek Naval Base
Alternative 6: 7,900' and 7,200' Offset: 876'	✈ Provides secondary runway for operational flexibility	✈ Impacts to Lake Whitehurst
	✈ Proposed length accommodates all or most commercial activity	✈ Impacts to on-airport facilities (airport maintenance facilities, ARFF training facility, MRO hangar, and GA parking apron)
	✈ Avoids impacts to VORTAC	✈ Approach/departure overfly Little Creek Naval Base
	✈ 876' separation enables simultaneous VFR operations	
	✈ Reduces costs and impacts due to shorter runway lengths (7,900' or 7,200')	

Table continued on next page

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Alternative	Opportunities	Constraints
Alternative 7: 6,000', ARC-C-II (20:1)	✈ Provides secondary runway for GA airport users	✈ Length limits usage by most commercial operations
	✈ Avoids impacts to VORTAC	✈ Impacts to on-airport facilities (airport maintenance facilities, ARFF training facility, MRO hangar, and GA parking apron)
	✈ 876' separation enables simultaneous VFR operations	✈ Higher IFR visibility minimums
	✈ No direct impacts to Lake Whitehurst (however some wetland impacts will occur)	
	✈ No RPZ impacts	
	✈ Greater height over Little Creek Naval Base	-
Alternative 10: 5,500', ARC C-II (34:1)	✈ Provides secondary runway for GA airport users	✈ Length restricts usage by all commercial operations
	✈ Avoids impacts to VORTAC	✈ Impacts to on-airport facilities (airport maintenance facilities, ARFF training facility, MRO hangar, and GA parking apron)
	✈ 876' separation enables simultaneous VFR operations	✈ RPZ impacts to commercial buildings
	✈ No direct impacts to Lake Whitehurst (however some wetland impacts will occur)	
	✈ Greater height over Little Creek Naval Base	
Alternative 12A: 5,500', ARC C-II EMAS 3/4-Mile Visibility Minimum	✈ Provides secondary runway for GA airport users	✈ Length restricts usage by commercial operations
	✈ Avoids impacts to VORTAC	✈ Impacts to on-airport facilities (airport maintenance and ARFF training facilities)
	✈ 876' separation enables simultaneous VFR operations	✈ RPZ impacts to commercial buildings
	✈ No impacts to Lake Whitehurst	
	✈ No wetland impacts	
	✈ Provides separation of fleet mix (commercial and GA)	✈ Relocation of existing airfield maintenance buildings
	✈ Provides secondary runway for operational flexibility	✈ Impacts on several GA hangars, the MRO facility, the itinerant parking apron, and the ARFF training area
	✈ Provides more developable land on the east side of the airfield	✈ Difficult construction phasing

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Alternative	Opportunities	Constraints
Alternative 13A: Runway Realignment to 3-21 Orientation	✈ Avoids flyovers of Little Creek Naval Base	✈ Reduced primary runway length (7,500') to accommodate safety areas
	✈ Reduced impact to Little Creek Bay operations box	✈ Complete reconstruction of airfield
	✈ Standard full-length parallel taxiway option for primary and potential parallel runway	✈ Reduced terminal apron space
	✈ Provides the opportunity to reuse the existing primary runway as a full-length mid-field parallel taxiway	✈ Substantial costs
		✈ Impacts to on-airport facilities (airport maintenance facilities, ARFF training facility, MRO hangar, GA hangar facilities and GA parking apron)
		✈ Requires filling a portion of Lake Whitehurst
		✈ Relocation of runway NAVAIDs
		✈ Realignment over residential area
Alternative 13B: Runway Shift 400' West	✈ Limits flyovers of Little Creek Naval Base	✈ Runway length shortened to 7,900'
	✈ Provides more developable land on the east airfield for potential cargo relocation and expansion and GA facility expansion	✈ Complete reconstruction of airfield
		✈ Substantial costs
		✈ Closure of secondary airport access route Robin Hood Road
		✈ Requires removal of 6 gates on Concourse B and RON parking
		✈ Removal of air cargo building and employee lot
		✈ Requires filling a portion of Lake Whitehurst
		✈ Relocation of runway NAVAIDs, VORTAC
		✈ Relocation of the existing ARFF station, ARFF storage building, and airport triturator
Alternative 14: Secondary Runway	✈ Limits operations over Little Creek Naval Base	✈ Substantial cost
	✈ Provides separation of fleet mix (commercial and GA)	✈ Relocation of existing airfield maintenance buildings
	✈ Provides secondary runway for operational flexibility	✈ Impacts on several GA hangars, the MRO facility, the itinerant parking apron, and the ARFF training area
	✈ Provides more developable land on the east side of the airfield	✈ Difficult construction phasing

Source: CHA, 2019.

Runway 5/23 Threshold Relocation Alternatives

Relocate Runway 5 Threshold (EXHIBIT 1)

Currently the Runway 5 threshold is displaced by 1,000 feet and provides approach clearance over trees and object penetrations to the approach surface southwest of the runway. This alternative (shown in **Figure N-1**) would relocate the Runway 5 threshold to the end of pavement, recapturing 1,000 feet of landing length. Exhibit 1 shows the resulting Threshold Siting Surface (TSS) approach profile (34:1 slope). The only resulting TSS obstructions are trees, which could potentially be removed in the future without significant environmental impacts. All structures, poles, and roadways are at least 10 feet below the surface.

If the Airport were to relocate the Runway 5 threshold, the threshold lights, Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR), and glideslope would also need to be relocated. In addition to relocating the various lighting systems, runway markings would also need to be updated to eliminate the displaced threshold.

Runway 5 currently provides over 7,800 feet of landing length, which remains adequate throughout the planning period for the fleet mix serving the Airport. As such, this option would only be pursued if needs changed and/or the Airport requires additional pavement on the Runway 5 end to meet airline Landing Distance Available (LDA) requirements or the potential for runway projects impacting a significant amount of the runway. As there are future plans for runway rehabilitation and reconstruction, the threshold could be relocated to the end of pavement during construction on the Runway 23 end as part of the construction safety and phasing.

Proposed Parallel Runway 5R/23L Alternatives

Runway 5R/23L for Commercial Operations (EXHIBITS 4-7)

Ideally, the new parallel runway would be able to accommodate all airport users; however, with airport property limited by Lake Whitehurst and the local airspace influenced by the Little Creek Naval base, it is challenging to provide a commercial-capable parallel runway. As such, four alternatives were developed for this Master Plan (**Figure N-2** through **Figure N-5**) and include commercial runway concepts with lengths of 7,200 to 9,001 feet. While these concepts may be considered at a later time, the Master Plan did not advance them for additional consideration based upon the considerable environmental impacts, financial feasibility, and operations justification.

The remaining parallel runway alternatives would serve all general aviation aircraft, with occasional use by some airline and air cargo aircraft. Although limited to a subcomponent of airport users, which is a key disadvantage, it is recommended that one or more of the following runway alternatives be advanced for consideration and inclusion in the recommended plan. The benefits of these runway concepts include the following:

- Accommodates most aircraft operations (in terms of total ORF operations)
- Segregates general aviation from commercial activity (i.e., larger commercial/cargo jets from smaller single-engine piston aircraft)

- ✈ Consistent air traffic flows and beneficial airspace considerations
- ✈ Maximizes use of available airport property
- ✈ Releases critical airport property for needed landside development
- ✈ Minimizes environmental impacts

Runway 5R/23L – 6,000 Foot, ARC C-II (EXHIBIT 9)

This alternative (**Figure N-6**) is a refinement or "scale-back" of the alternative depicted in **Figure N-9**, providing instrument visibility minimums of greater than 3/4-mile. The higher minimums enable a steeper 20:1 threshold surface and corresponding greater clearance over the Little Creek Naval Base. In addition, the parallel taxiway offset may be reduced to 300 feet for ARC C-II. The other runway dimensions and configuration presented in **Figure N-10** are the same as those presented in **Figure N-9**.

Runway 5R/23L – 5,500 Foot, ARC C-II (EXHIBIT 10)

This derivative alternative (**Figure N-7**) refines or scales-back the previous concepts, providing a shorter 5,500-foot runway length while providing the lower minimums of 3/4-mile serving ARC B-II aircraft. The reduced length further reduces costs and impacts to providing a standard RSA. With the lower minimums, the threshold surface is the flatter 34:1 slope.

Runway 5R/23L – 5,500 Foot, ARC C-II (EXHIBIT 12A)

This alternative (**Figure N-8**) is the same as Alternative 12B with the exception of planned approach visibility minimums. Alternative 12A provides 3/4-mile visibility minimum, which has a wider Runway Protection Zone (RPZ) that would include both on- and off-airport existing buildings.

Runway 5R/23L – Realignment and Shift (EXHIBIT 13A & 13B)

Two final derivative runway alternatives [13A (**Figure N-9**) and 13B (**Figure N-10**)] were developed to avoid direct overflight of the Little Creek Naval Base: a runway realignment (Option A) and a runway shift (Option B). It should be noted that these concepts were examined exclusively for ground-based requirements; therefore, they were not fully vetted for airspace impacts.

Option A examines the realignment of Runway 5/23, as well as the proposed parallel runway, by approximately 20-degrees counterclockwise, designating the runways at Runway 3L/21R and Runway 3R/21L, respectively. As a result of the realignment, the primary runway (i.e., Runway 3R/21L) length is reduced to 7,500 feet to accommodate the RSA and ROFA length beyond the end of the runway and avoid significant environmental permitting to fill and grade a portion of Lake Whitehurst; however, a smaller area of the lake located northwest of the ARFF station would still require fill to accommodate portions of the parallel taxiway (i.e., Taxiway C) and associated safety areas. Furthermore, the existing ARFF station, ARFF storage building, and airport triturator would require removal and relocation if this alternative is adopted.

Additionally, the existing Runway 5/23 RPZ, given the current configuration of the runway, is located over Little Creek Bay, as well as over land being used for industrial purposes. If the runway is realigned as detailed in Option A, it will encroach upon a residential-use area (i.e., the East

Beach community) east of the bay. Finally, the depicted realignment and resulting runway length reduction would require relocation of all runway instrumentation.

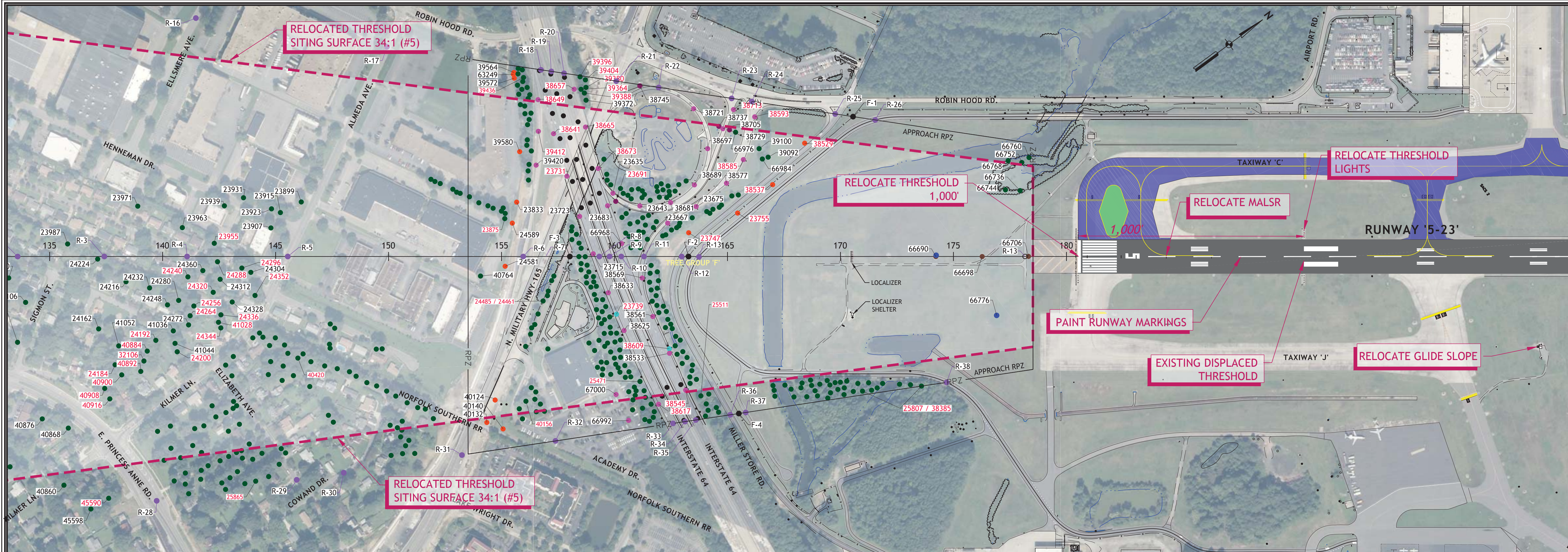
This concept also depicts a shift of the proposed parallel runway (i.e., Runway 3R/21L) and taxiway systems into portions of the existing General Aviation (GA) area. As a result, it is likely that the existing airfield maintenance, ARFF training facility, and MRO building would require removal and relocation. Portions of the GA apron would also require reconfiguration to accommodate ground movement and to ensure sufficient aircraft parking. Significant grading would also be required along the proposed Runway 21L end due to elevation changes in the terrain north of the fuel farm.

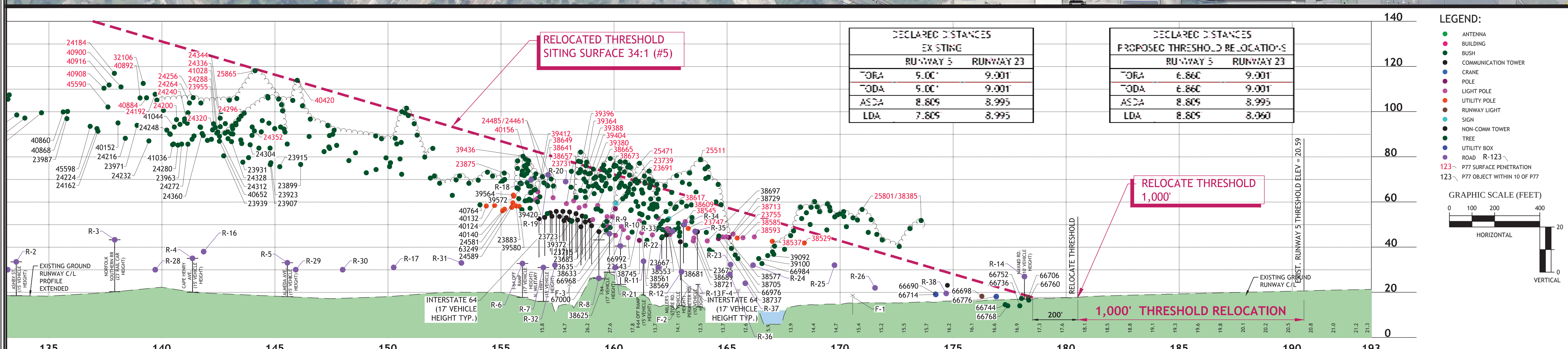
Option B depicts a 400-foot shift of Runway 5/23 to the northeast rather than a realignment. Similar to the concept shown in Option A, Option B illustrates a Runway reduction (7,900 feet) to accommodate the RSA and ROFA length beyond the end of the runway for Runway 5/23. Also. similar to Option A, this concept requires fill within portions of Lake Whitehurst directly northwest of the ARFF station to accommodate the parallel taxiway (i.e., Taxiway C) and associated taxiway safety areas. This concept also requires removal and relocation of the existing ARFF station, ARFF storage building, and airport triturator. Additionally, due to the associated shift to Taxiway C, a large portion of the passenger terminal apron would be reduced. Portions of facilities such as the southeasternmost portions of Passenger Terminal Concourse B, the air cargo building, and the air cargo employee parking lot would also be negatively impacted by the associated shift to the taxiway. Furthermore, a reconfiguration of Airport Road would be required to provide access between Robin Hood Road and Military Highway. The drainage ditch located east of the Runway 5 end would also require culverting or realignment.

Alternative 14: Rotated Runway

Based on conversations with Airport and Board representatives, an alternative (**Figure N-11**) presenting a secondary runway was established, supporting limited operations over Little Creek Naval Base. The secondary runway would also provide more operational flexibility and separation of fleet mix, with GA operators primarily arriving and departing the new runway while commercial operators continue to operate via existing Runway 5/23.

Despite limited impacts to military operations and increased operational flexibility, this alternative is not feasible from a financial or airfield safety perspective. Constructing the runway would require the demolition and/or relocation of several support facilities including GA hangars, the MRO, the GA itinerant apron, and the ARFF practice area. Construction phasing would require the closure of the primary runway due to impacts to the safety areas associated with Runway 5/23. To reduce impacts on airfield infrastructure, installation of an EMAS would be required. Furthermore, given the layout, simultaneous operations could not occur, as the safety areas associated with the new runway would be within the approach path of Runway 5/23.





DECLARED DISTANCES EXISTING		
	RUNWAY 5	RUNWAY 23
TORA	9,001'	9,001'
TODA	9,001'	9,001'
ASDA	8,809	8,995
LDA	7,809'	8,995

DECLARED DISTANCES PROPOSED THRESHOLD RELOCATIONS		
	RUNWAY 5	RUNWAY 23
TORA	6,860	9,001'
TODA	6,860	9,001'
ASDA	8,809	8,995
LDA	8,809'	8,060

NO	DATE	REVISION	BY	CK.	APPR.

DESIGNED BY XX
DRAWN BY XXXX
REVIEWED BY XXXX
APPROVED BY
SCALE: 100 0 200

CHA
design/construction solutions
CHA Consulting, Inc.
4080 Lafayette Center Drive #210A
Chantilly, Virginia 20151
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PROJECT NAME: MASTER PLAN UPDATE

SHEET TITLE: (Figure N-1) Alternative 1: RELOCATE RUNWAY 5 THRESHOLD 34:1 TSS, DIV RUNWAY

JOB NO. 33370
DATE 2018
FILE NAME
REV. NO.
DWG. NO.

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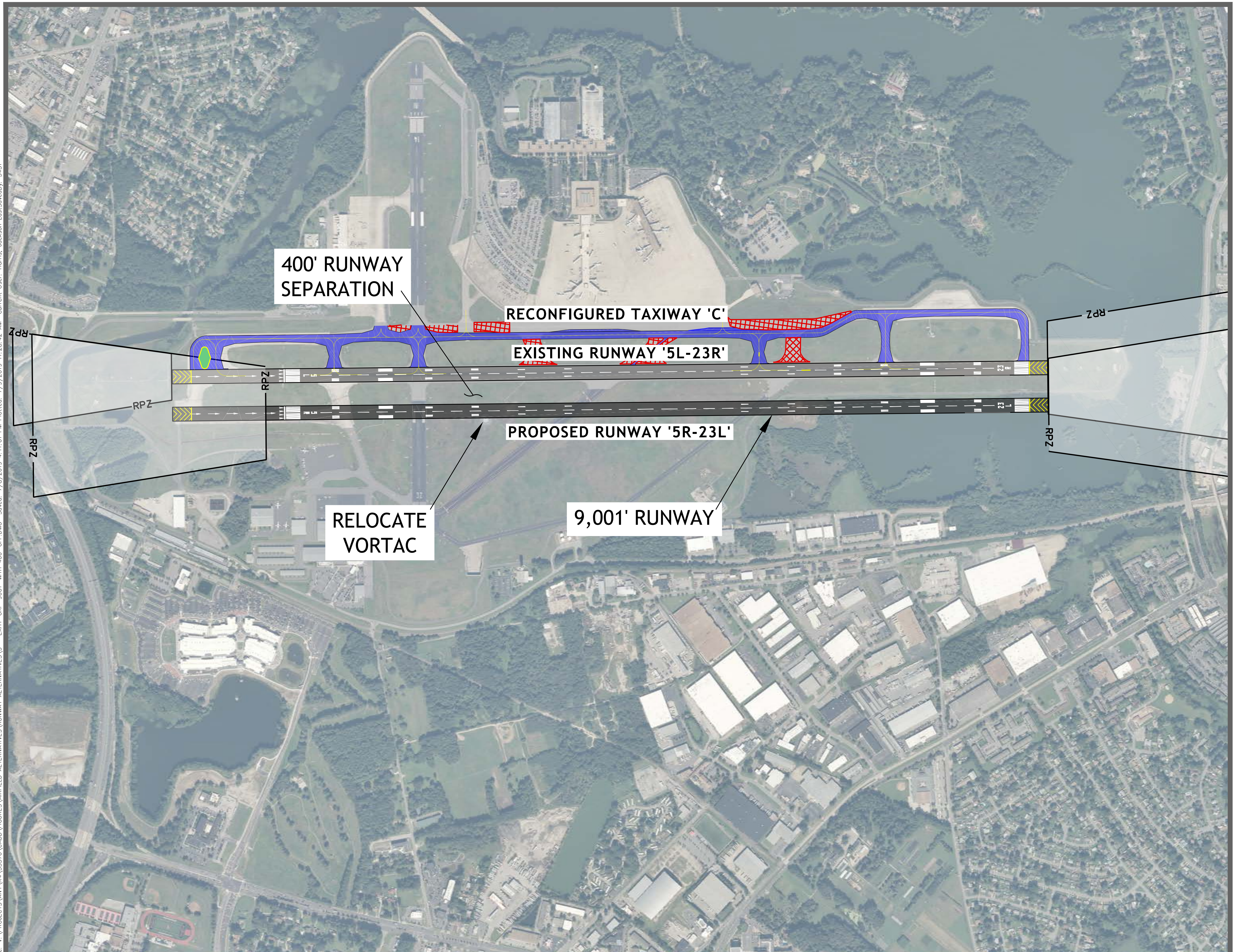

GRAPHIC SCALE (FEET)
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Figure N-2
Proposed 5R-23L - 9,001'
34:1 TSS , D-IV Runway
180' SHIP HEIGHTS
Alternative 4

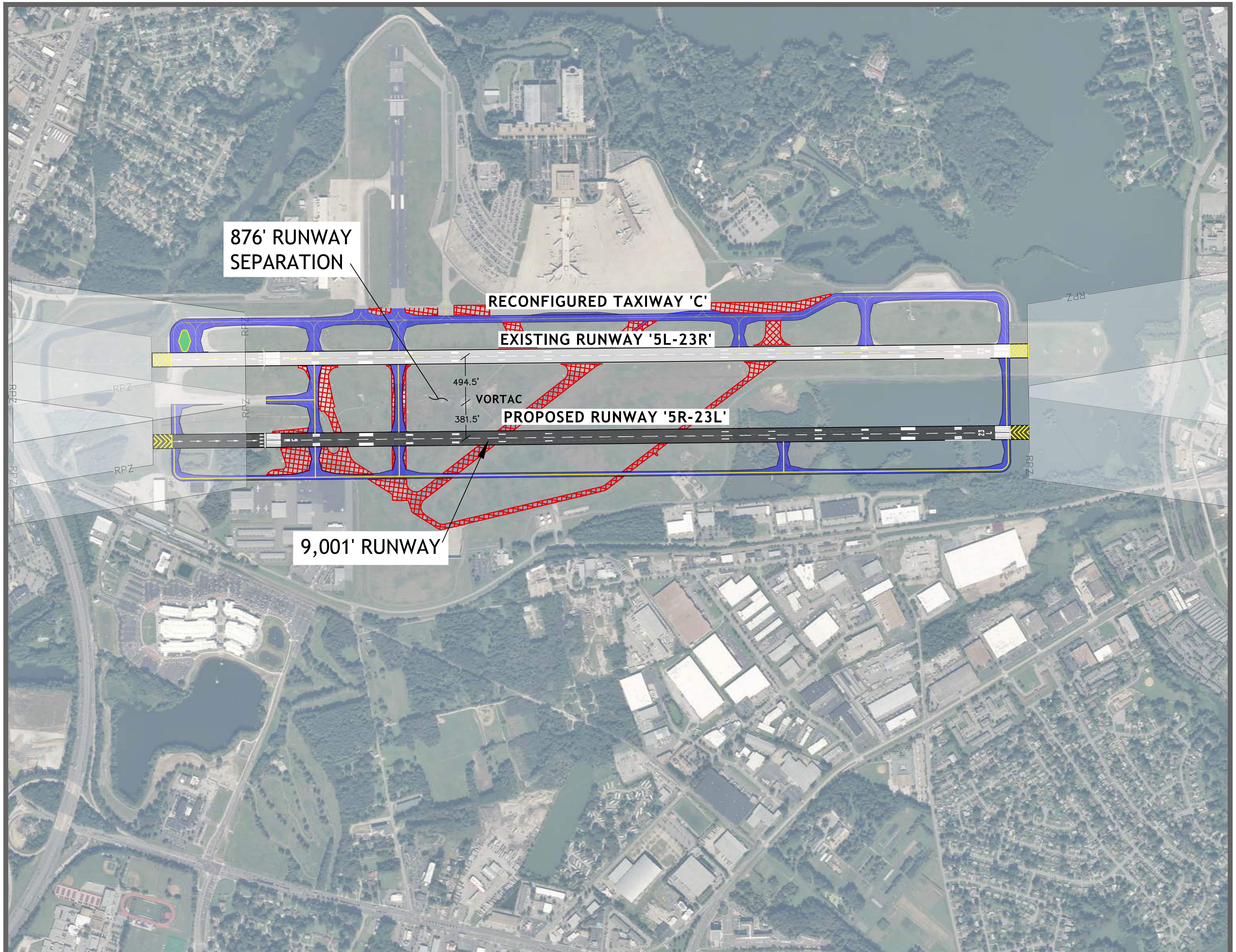

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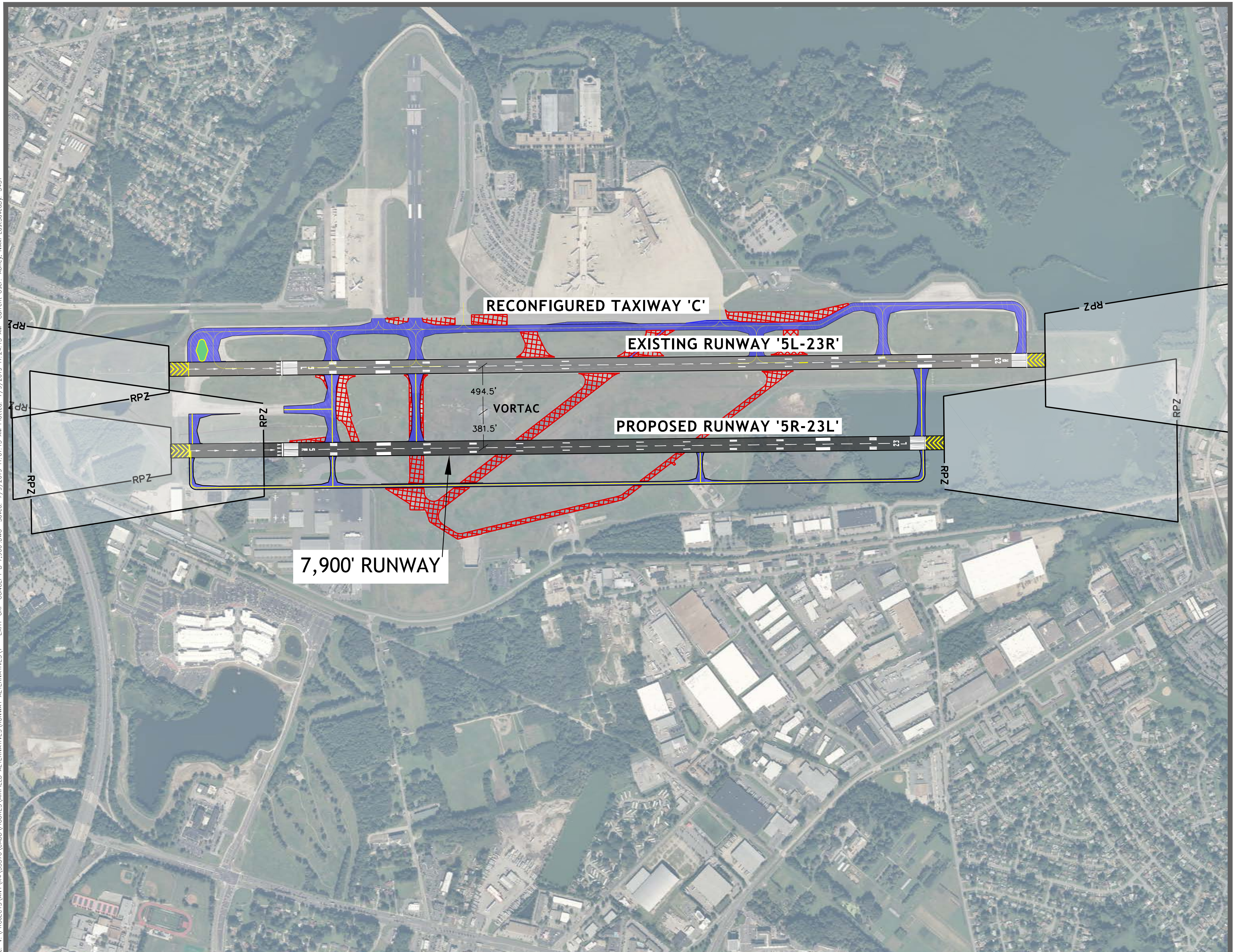
Figure N-3
PROPOSED 5R-23L - 9,001'
34:1 TSS , D-IV Runway
180' SHIP HEIGHTS
Alterative 5



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GRAPHIC SCALE (FEET)

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Figure N-4

Proposed 5R-23L - 7,900'

34:1 TSS , C-III Runway

180' SHIP HEIGHTS

Alternative 6

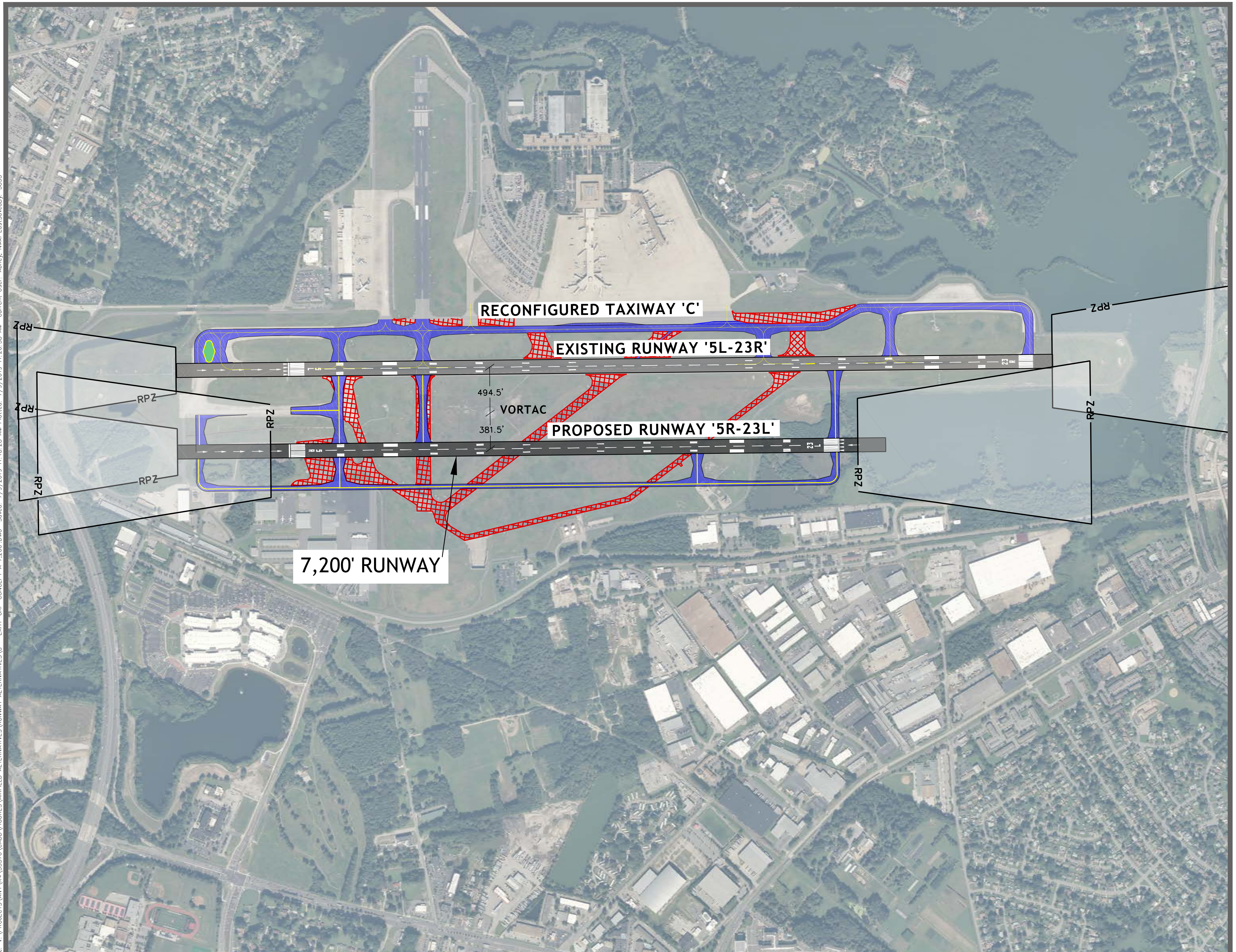

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Figure N-5
Proposed 5R-23L - 7,200'
34:1 TSS , C-III Runway
180' SHIP HEIGHTS
Alternative 7

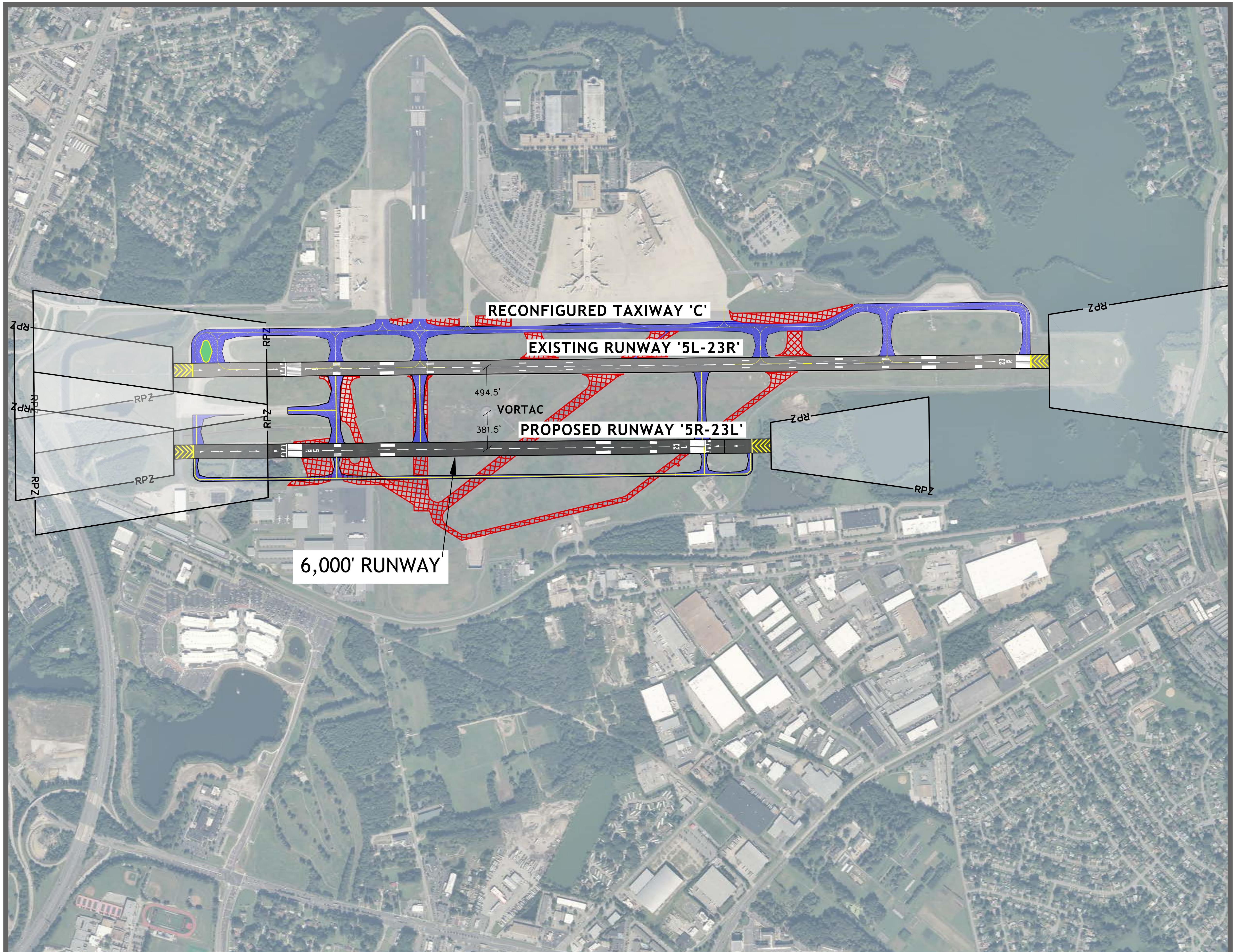

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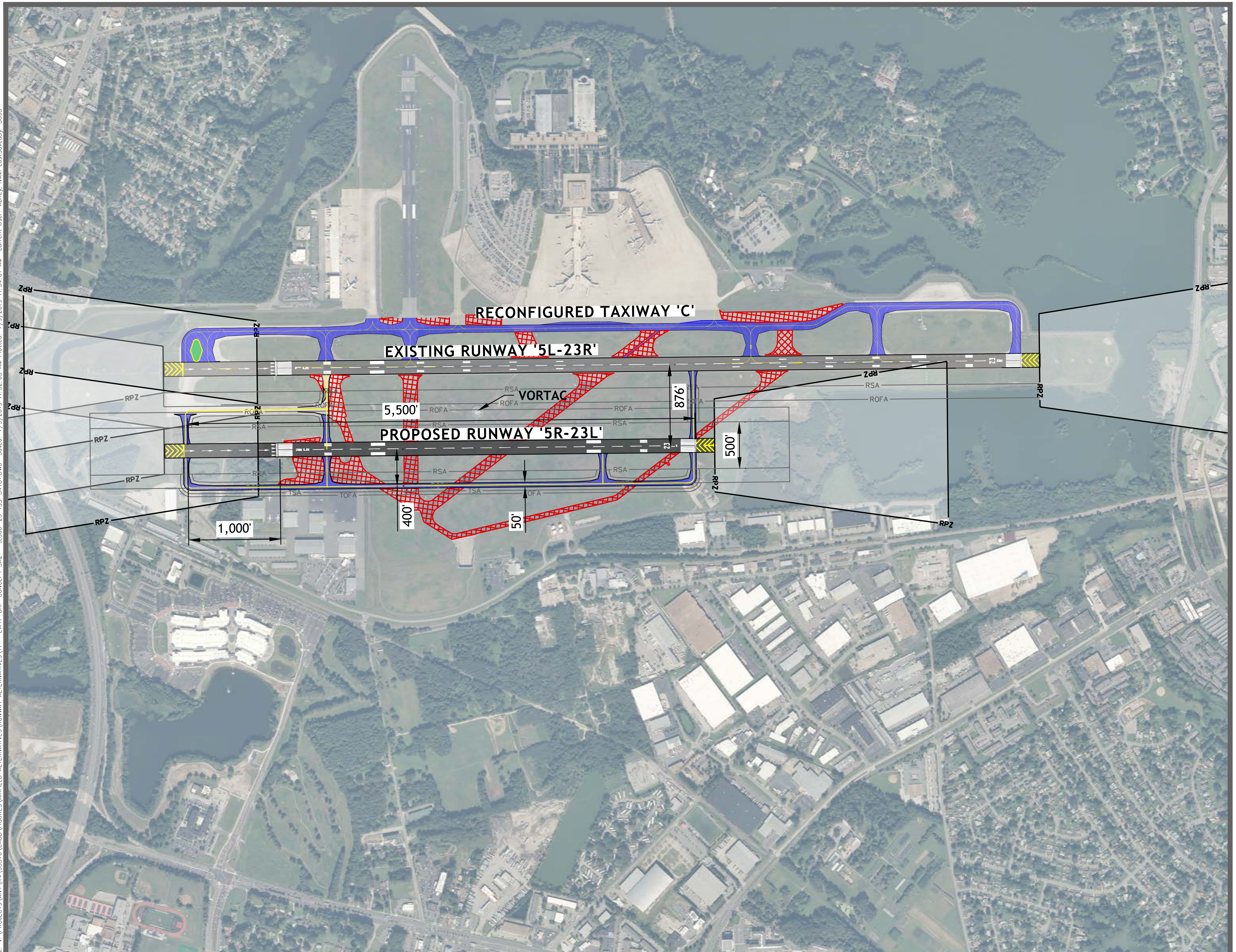
Figure N-6
Proposed 5R-23L - 6,000'
20:1 TSS , C-II Runway
180' SHIP HEIGHTS
Alternative 9



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GRAPHIC SCALE (FEET)
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DECLARED DISTANCES PROPOSED RUNWAY 5R-23L		
	RUNWAY 5R	RUNWAY 23L
TORA	5,500'	5,500'
TODA	5,500'	5,500'
ASDA	5,500'	5,500'
LDA	4,500'	5,500'

Figure N-7
Proposed 5R-23L - 5,500'
34:1 TSS , C-II Runway
180' SHIP HEIGHTS
Alternative 10

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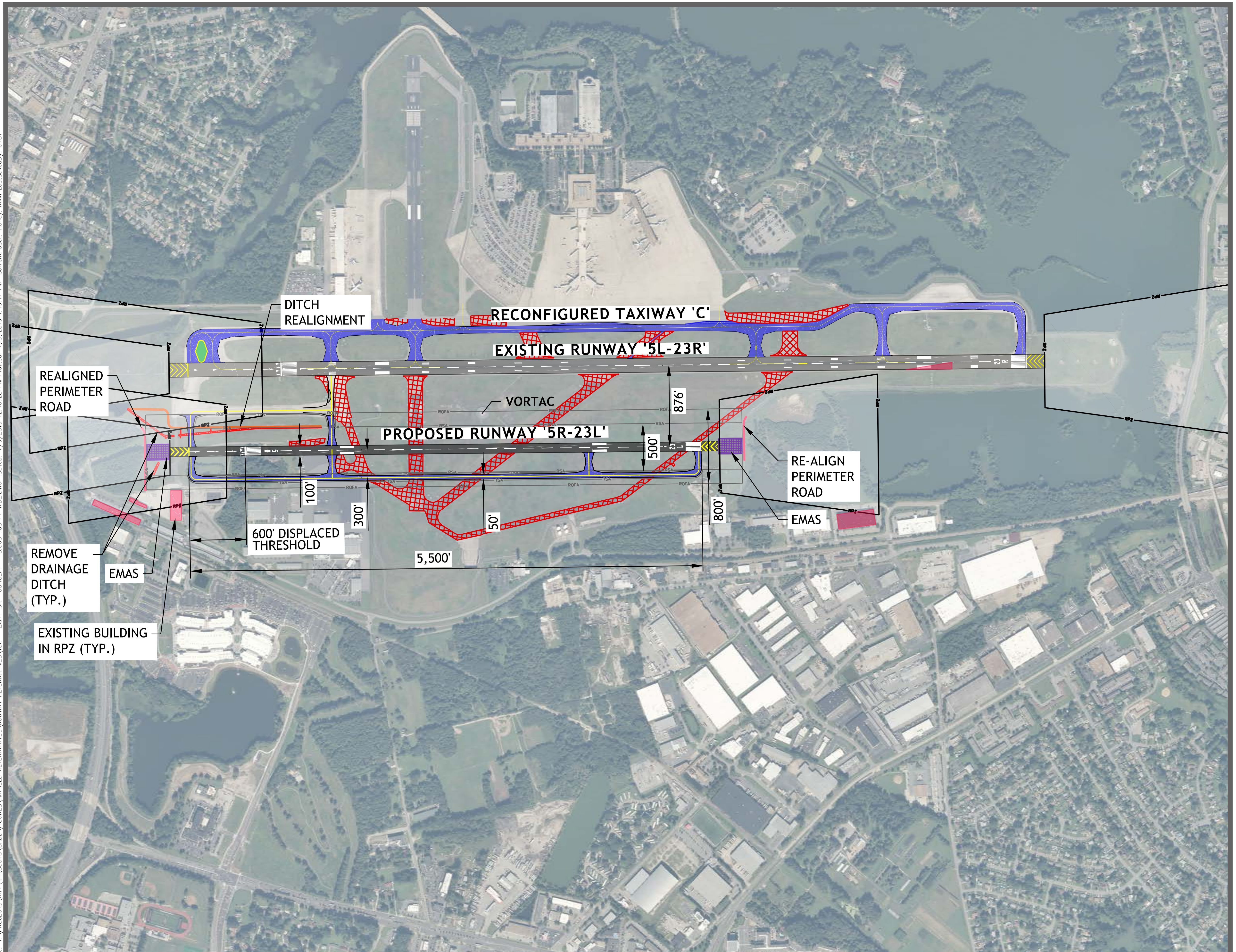

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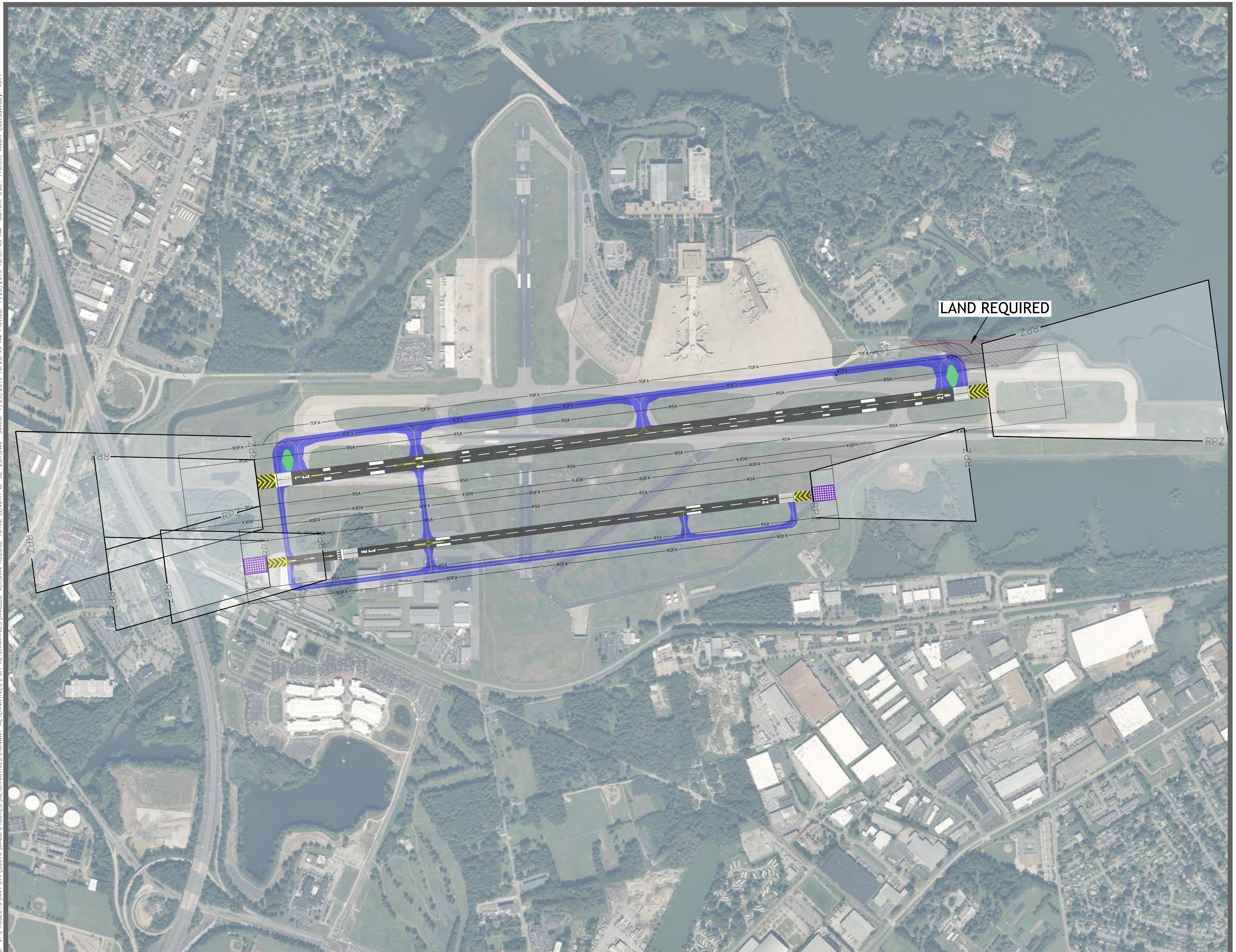
DECLARED DISTANCES PROPOSED RUNWAY 5R-23L		
	RUNWAY 5R	RUNWAY 23L
TORA	5,500'	5,500'
TODA	5,500'	5,500'
ASDA	5,500'	5,500'
LDA	4,900'	5,500'

Figure N-8
Proposed 5R-23L
5,500' With EMAS At Both Ends
20:1 TSS , C-II Runway
Not Lower than 3/4 Mile Visibility
Alternative 12A



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GRAPHIC SCALE (FEET)
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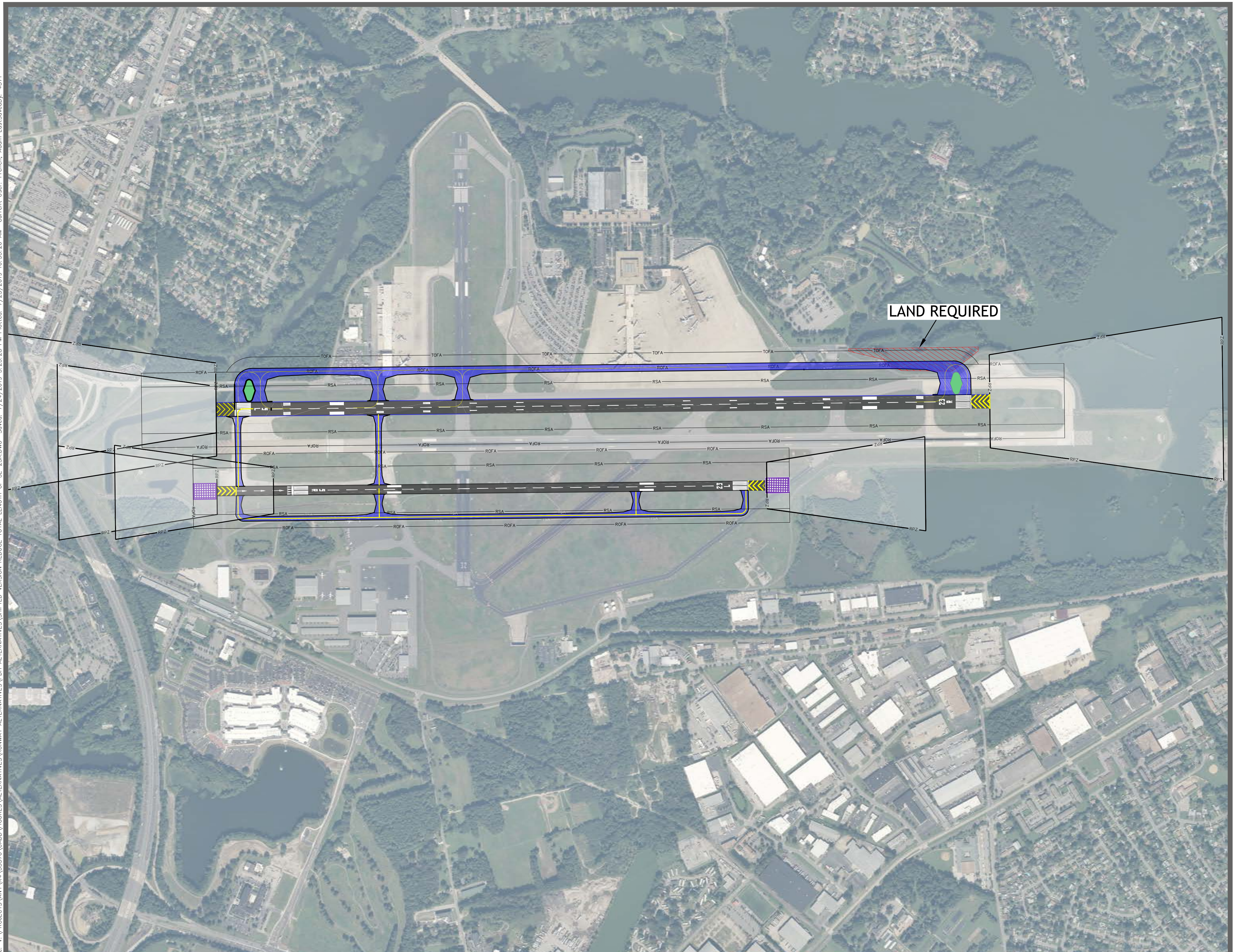
LEGEND

- Future Airfield Pavement
- Future Runway

Figure N-9
Runway Realignment
Proposed Runway 3R/21L - 7,500'
Proposed Runway 3L/21R
Alternative 13A



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MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)
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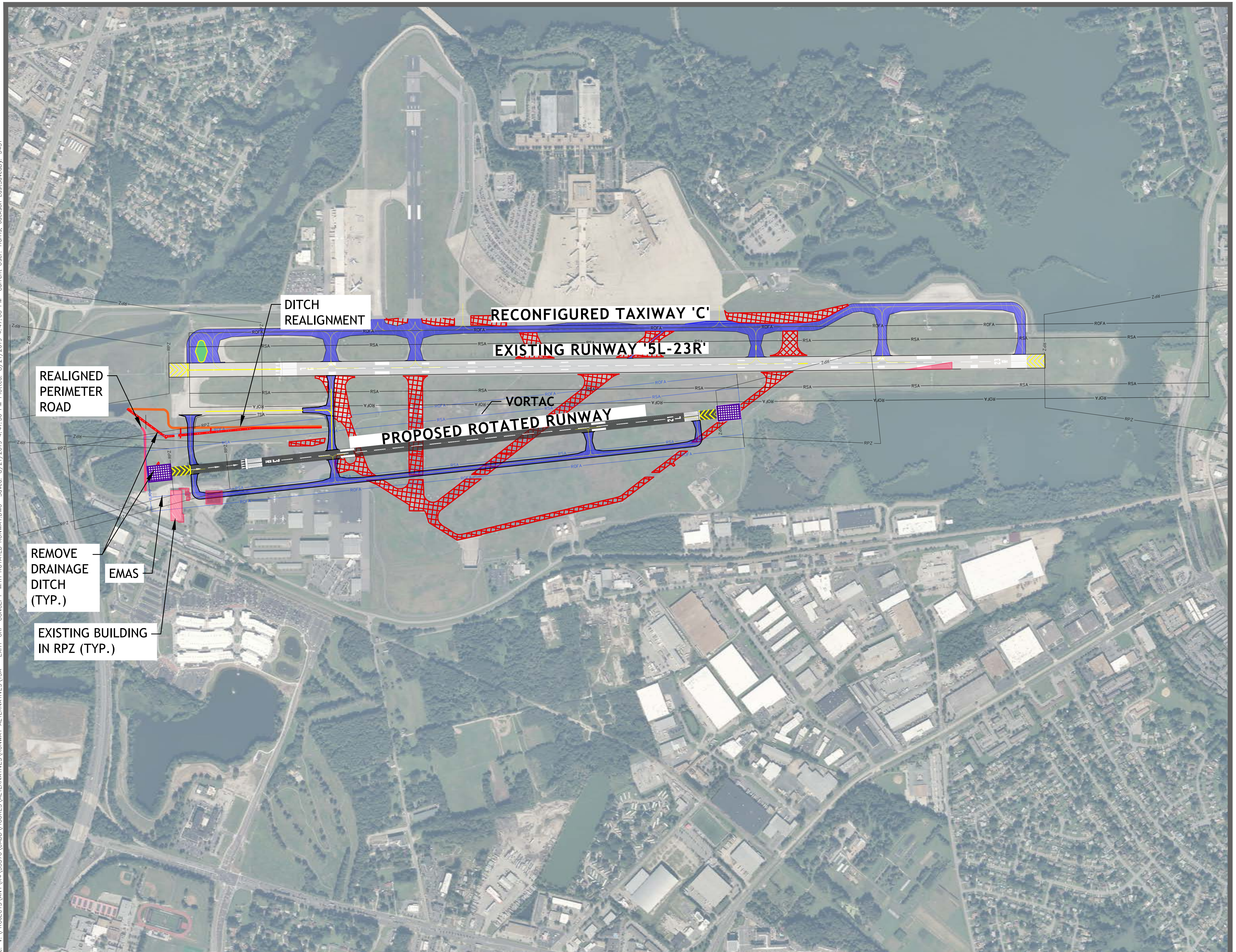
LEGEND

- Future Airfield Pavement
- Future Runway

Figure N-10
Runway Shift 400'
Proposed Runway 5R/23L - 7,900'
Alternative 13B



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MASTER PLAN UPDATE

GRAPHIC SCALE (FEET)
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Figure N-11
ROTATED 5'500' RUNWAY
Alternative 14