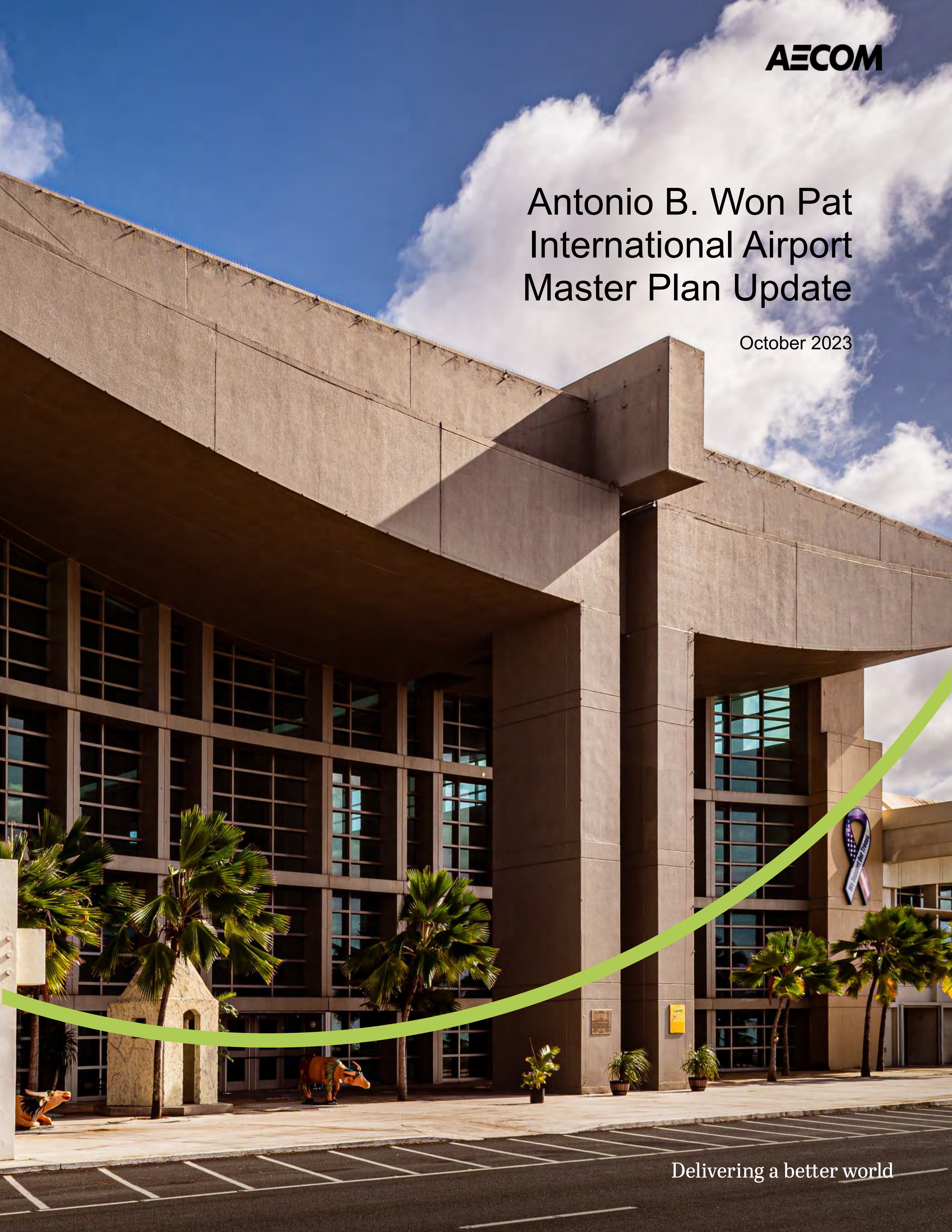

AECOM

Antonio B. Won Pat International Airport Master Plan Update

October 2023

Delivering a better world

Antonio B. Won Pat International Airport

Master Plan Update

October 2023

Prepared for:

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Prepared by:

The preparation of this document was financed in part through a planning grant from the Federal Aviation Administration as provided under the Airport and Airways Improvement Act of 1982. The contents of this report reflect the views of AECOM, which is responsible for the facts and accuracy of the data presented herein. The contents do not necessarily reflect the views or policy of the FAA. Acceptance of this report by the FAA does not in any way constitute a commitment on the part of the United States to participate in any development depicted therein, nor does it indicate that the proposed development is environmentally acceptable.

Executive Summary

Introduction

This executive summary highlights the findings and recommendations from the Master Plan Update for the Antonio B. Won Pat International Airport (Airport). The master planning process generates an important planning document from an airport management and operations perspective while guiding long-term airport development and changes within a strategic framework that reflects airport leadership priorities, airport operational characteristics, industry standards, and other relevant factors. The master plan provides a roadmap for safely and efficiently accommodating aviation demand through a 20-year planning period, while preserving the flexibility necessary to respond to evolving industry conditions, regulatory environments, and airport activity characteristics. This master plan supports the realization of the Airport's future priorities and strategic vision based on stakeholder engagement, as well as making sure the development aligns with regulatory and safety standards.

The Airport Master Plan Update is a technical document outlining the analyses and results and forms the framework for development at the Airport. The Master Plan should be consulted for additional information on the technical analyses, assumptions, and methodology supporting the findings and recommendations.

Master Plan Goals and Objectives

The goals and objectives the A.B. Won Pat International Airport Authority, Guam (GIAA) established for this Master Plan were to:

- Prepare a reasonable forecast of Airport activity for the 20-year planning period
- Determine current and future facility requirements for both demand-driven development and conformance with Federal Aviation Administration (FAA) design standards
- Identify sustainable initiatives (i.e., renewable energy, ecologically friendly vehicles, charging stations, and other features that coincide with the new Infrastructure Plan)
- Develop a landside and airside development plan that is consistent with the changing environment at the Airport
- Update the Airport Data Information Portal (ADIP) and prepare a standard Airport Layout Plan (ALP) drawing set
- Prepare a Master Plan report to accompany the ALP drawing set
- Develop an Airport Capital Improvement Program (ACIP) using planning-level estimates that will prioritize improvements, estimate project development costs, and consider funding eligibility for the 20-year planning period

Overview and Background

The Airport serves as the key link between Guam's population of about 155,000 and the global passenger and cargo networks. Since 1976, the Airport has been operated and managed by A.B. Won Pat International Airport Authority, Guam (GIAA). GIAA initiated this Master Plan Update in response to increasing passenger enplanements and aircraft operations. The goal was to update the Airport's previous master plan from 2012 and identify the physical improvements needed to accommodate the growth. However, the 2019 Novel Coronavirus (COVID-19) pandemic caused a significant decline in airport operations worldwide, including the Airport. This Master Plan discusses how the Airport is attempting to recover and surpass pre-pandemic operation levels, and prepare for aviation demand projected for the next 20-years.

Airport Role

The Airport serves as a hub for passenger and cargo flights between Asia and North America. The Airport is the only commercial service airport serving Guam. Categorized by the 2019 National Plan of Integrated Airport Systems (NPIAS) as a Primary Small Hub airport, the Airport serves between 0.05 and 0.25

percent of annual U.S. commercial enplanements. The majority of the travel demand is driven by visitors to and from the top tourism markets, e.g., Japan, Korea, and Taiwan, as well as a large government/military related travel for U.S. visitors.

COVID-19 Pandemic Impact

The COVID-19 pandemic had a severe impact on the U.S. economy and the airline industry worldwide. In April 2020, Guam lost 85.7 percent of its U.S. visitors and 99.7 percent of international visitors. While domestic travel has shown strong recovery since vaccinations were available in early 2021, international travel remains stagnant due to travel restrictions and quarantine policies of different countries.

Stakeholder Engagement

Development for the Airport Master Plan was guided by three stakeholder groups that met three times during this study. These four groups include:

- Key Stakeholders
- Operational Stakeholders
- Internal Stakeholders

Key Stakeholders include representatives from airlines servicing the Airport and federal airport safety and security organizations. Operational Stakeholders include representatives from food and beverage organizations located within the commercial passenger terminal, rental car organizations, and both air cargo and General Aviation (GA) companies. Internal Stakeholders include representatives from GIAA.

Throughout the Airport Master Plan process, the stakeholders came together to serve as a sounding board for future Airport development; provide a local understanding of the Airport users; identify opportunities and challenges facing the Airport; review, comment, and provide input on various Master Plan elements; and support communications and data gathering efforts.

Aviation Demand Forecasts

Forecasts of future aviation activity levels are the basis for effective decisions in airport master planning. They provide the foundation for determining the planning activity levels and future facility requirements in the Airport Master Plan Update as well as the development of alternatives to meet the projected demand, environmental analyses, and economic and financial plans.

Forecast scenarios were developed for enplaned passengers, air cargo tonnage, aircraft operations, and based aircraft for low, baseline, and high case scenarios. The supporting analyses required in developing the forecasts are presented in the technical report and include an explanation of the forecast approach and methodology. The FAA reviews the forecasts of aviation activity to ensure the Master Plan Update forecast is reasonable, technically sound, and consistent with the FAA's Terminal Area Forecast (TAF), which is the agency's official forecast of aviation activity. The FAA approved the Master Plan Update forecasts in December 2022.

Enplaned Passenger Forecast

Total enplaned passengers are forecast to grow at a compound annual growth rate (CAGR) of 1 percent during the planning period. Total enplaned passengers for the baseline scenario are forecast to grow from approximately 1.9 million in fiscal year (FY) 2019 to over 2.3 million in FY2039.

Air Cargo Forecast

Total air cargo tonnage is forecast to grow at a CAGR of 4.3 percent during the 20-year planning period. Total cargo tonnage for the baseline scenario is forecast to grow from approximately 22 thousand tons (or 44 million pounds) in FY2019 to 50 thousand tons (or 100 million pounds) in FY2039.

Aircraft Operation Forecast

Total aircraft operations are forecast to grow at a CAGR of 1.2 percent during the planning period. Total operations include landings and take-offs for commercial passenger aircraft, air freighter, small air cargo aircraft, general aviation aircraft, air taxi, and military aircraft. Total aircraft operations for the baseline scenario are forecast to grow from approximately 73 thousands in FY2019 to 93 thousands in FY2039.

See **Figure ES-1**, **Figure ES-2**, and **Figure ES-3** for the enplaned passenger, air cargo, and aircraft operation forecasts.

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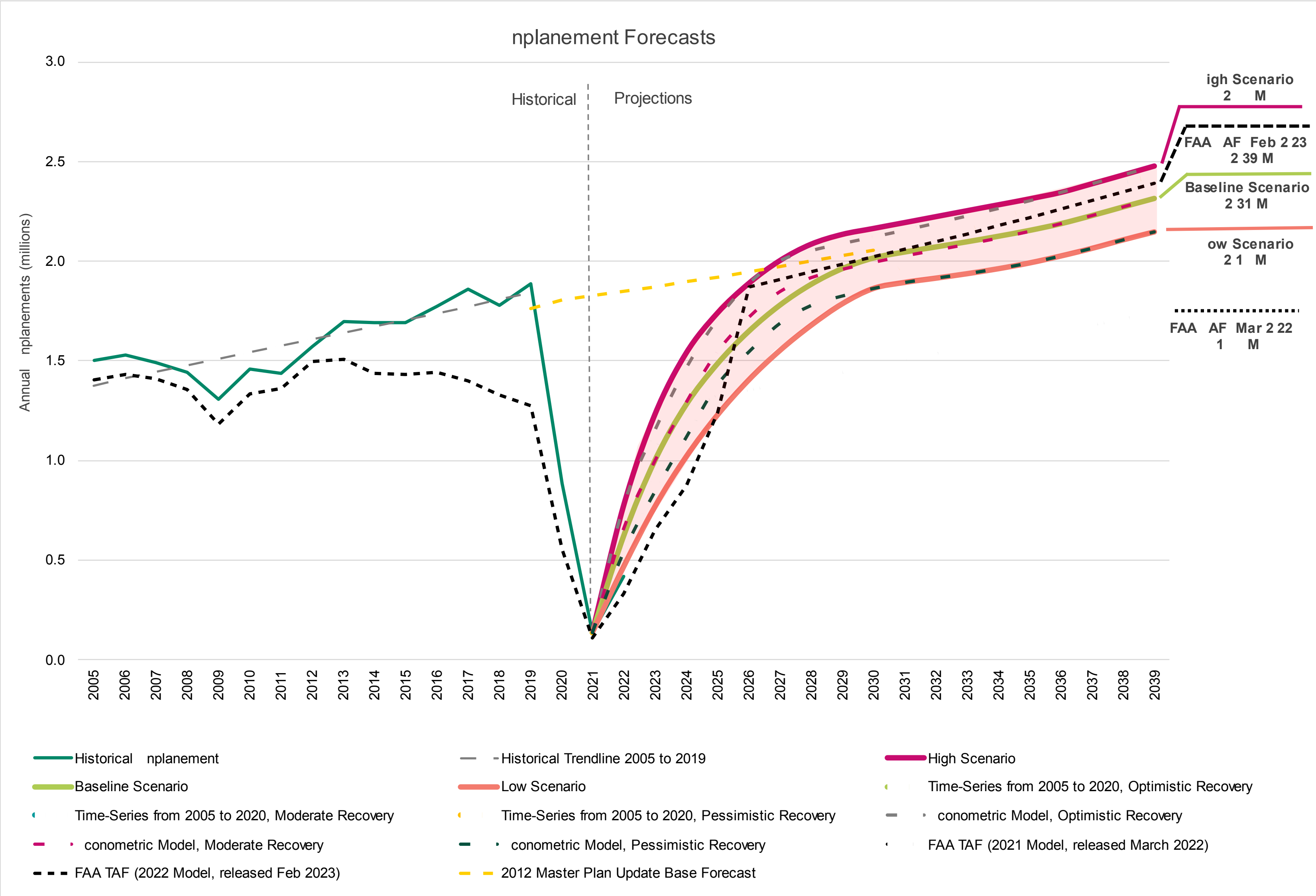

Figure ES-1: Enplanement Forecasts

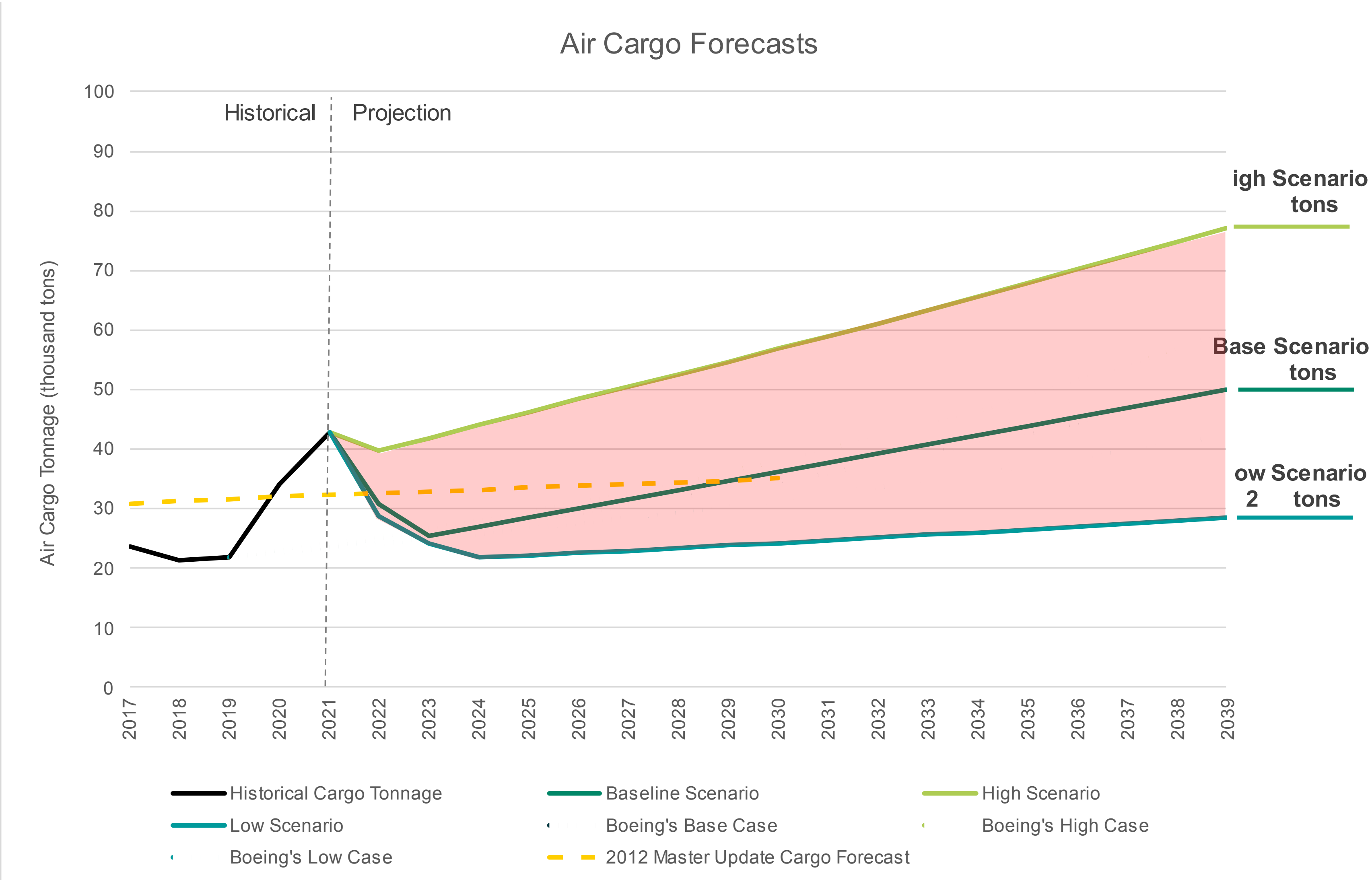

Figure ES-2: Air Cargo Forecasts

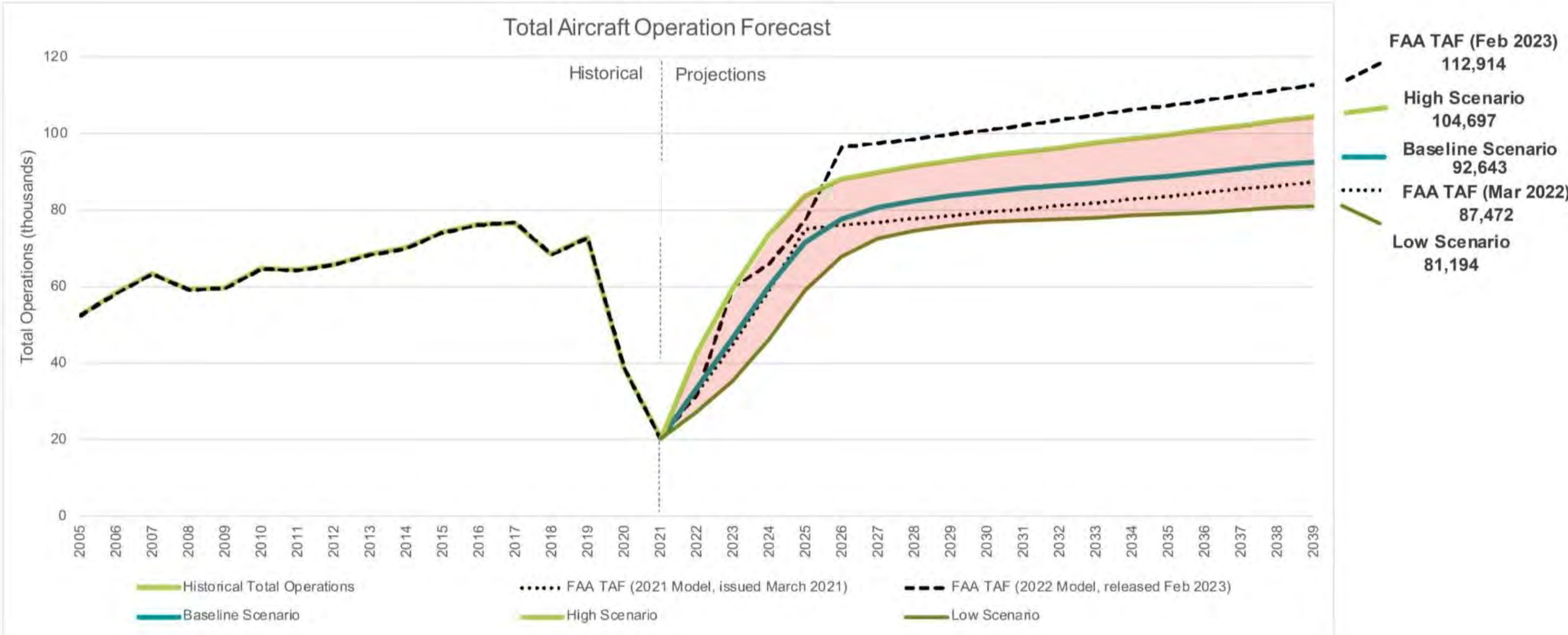

Figure ES-3: Total Aircraft Operation Forecast

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Existing Airport Facilities and Facility Requirements

The inventory of existing conditions serves as a baseline for evaluating the facilities and their current capabilities. Once established, the facility requirements assess the Airport's ability to accommodate the existing and future demand based on the existing Airport facilities.

Future facility requirements are dependent on the forecast aviation activity levels. The need for new, expanded, or enhanced facilities is often driven by capacity deficiency to accommodate forecasted growth or to meet the desired level of service using the existing facilities. The requirements can also be driven by other factors, such as updated FAA standards or guidelines from other regulatory agencies, the replacement of old or inadequate facilities, or the desire to introduce new or upgraded services and facilities.

The facility requirement analyses use the forecast enplaned passenger and aircraft operation demand levels to define planning activity levels (PALs), which trigger the need for expansion or improvement of a specific facility in order to accommodate the anticipated demands and to maintain an acceptable level of service.

Airfield

The existing airfield has two parallel runways, Runway 6L/24R (12,014 feet) and Runway 6R/24L (10,014 feet). Most aircraft operations arrive and depart using Runways 6L and 6R. The airfield also consists of the commercial passenger terminal apron, the light aircraft commuter terminal apron, and the south apron.

The airfield has sufficient capacity to handle the short and long-term demand; however, the following solutions will address the current design requirements:

- Mitigate fences, Route 8, drainage headwalls, and terrain issues within one or both Runway 6L and 6R Object Free Areas (ROFAs)
- Remove vegetation within Taxiway Object Free Areas (TOFAs)
- Remove incompatible land uses within the westernmost Runway Protection Zones (RPZs)
- Pave taxiway shoulders on taxiways that lack shoulder
- Fix non-standard taxiway filets for all taxiway intersections
- Fix non-standard taxilane centerline separations
- l iminate taxiway geometries with elevated risk to safety

Commercial Passenger erminal

The commercial passenger terminal apron consists of over one million square feet made up of 17 contact gates, one bus gate, and three ground load gates located on the air cargo building apron west of the main terminal. The terminal is made up of four levels: Basement, Apron, Concourse, and International Arrivals.

The commercial passenger terminal has sufficient gates to handle the future passenger and commercials operations projections; however, there are opportunities within the terminal to enhance the level of service and incorporate the latest technology:

- Check-in facilities:
  - Add common use touchless self-service kiosks.
  - Add baggage induction points at the 12 counters next to the entrances between the a st and West Check-in Areas.
- Security screening checkpoint (SSCP):
  - n large the queue area.

- Need reconfiguration and/or expansion if Transportation Security Administration (TSA) upgrades to checkpoint property screening system (CPSS) at the Airport.

- Holdrooms:
  - xp and or reconfigure the holdrooms.
- Restrooms:
  - Add restrooms along the sterile corridor to reduce the walking distance from the arrival gates to the first restroom for international arrival passengers experience.
  - Add restrooms in the CBP primary inspection area.
- CBP and Guam CQA:
  - Reconfigure concourse to provide separate areas for the outbound CBP visa inspection for domestic flights to the mainland/Honolulu instead of occupying existing holdroom spaces at Gates 7 and 9.

andside

The landside facilities can be accessed through Tiyan Parkway (. Sunset Blvd), which connects the western portion of Route 8 in Lower Barrigada to Route 10A. The Airport parking lots can be accessed using these roadways and these parking lots consist of public parking, employee parking, reserved parking, tour bus and tour van parking, rental car parking, and taxi parking.

The landside roadways, curb frontages, parking and rental car spaces have sufficient capacity to handle the forecasted aviation demand levels. There are no outstanding landside facility and ground access issues identified within the 20-year planning period.

However, there is a proposed, two-phased reconstruction and widening project for Route 10A, anticipated to impact the Airport. The project will widen Route 10A to five lanes, from its intersection with Route 1 to the Airport’s entry intersection. The additional lane is anticipated to impact the Airport’s lower employee, lower public, and rental car parking lots. For the rental car and tour bus lot, a two-story parking structure is anticipated in the same area as the existing lot. Level 1 would be utlilized for the tour buses, vans, and limousines while Level 2 would be utilized for rental cars. The proposed lots and parking structure are still anticipated to have adequate parking stalls throughout the 20-year planning period.

Cargo, GA, and Support Facilities

The existing General Aviation (GA), cargo, and support facilities at the Airport can be divided geographically by the northern, northeastern, and southern parts of Airport. The majority of air cargo facilities are located in the northern part of the Airport. Some of these facilities include the Guam Integrated Air Cargo Facility, Triple B Forwarders, CTSI Logistics, and DHL. The northeastern portion of the Airport consists of the aircraft fuel farm, water reservoir compound, and Airport Industrial Park. The southern portion of Airport property consists of aircraft hangars (such as the HC-5 Hangar, VQ-1 Hangar, and Nose Dock Hangar), the Aircraft Rescue and Firefighting (ARFF) station, the Air Traffic Control Tower (ATCT), and aircraft maintenance and warehouse facilities.

Several opportunities were identified within the cargo, GA, and support facilities analysis to prepare the Airport for the next 20 years. These include:

- Add space for an additional jet and aircraft maintenance to be located in the Nose Dock Hangar
- Add vehicle parking at the GA terminal
- Replace the outdated Light Aircraft Commuter Terminal
- Add a new cargo facility with associated truck stalls and vehicle parking
- Add a new widebody hangar
- Add Jet A and Avgas fuel storage tanks

Airport Development Plan

The recommended Airport Development Plan consists of the preferred alternatives from the four alternative categories. Highlights of the Airport Development Plan outside of the commercial passenger terminal are shown below and include:

- Displacing the threshold for the Runway 6R end and shifting the existing displaced threshold for the Runway 6L end
- Implementing standard taxiway geometry throughout the taxiway system
- Constructing a cargo apron and cargo facility in the northern portion of the airfield
- Constructing a GA terminal building, a GA bulk storage hangar, and a large aircraft maintenance hangar
- Constructing a new light aircraft commuter terminal and replacing the old terminal with a vehicle parking lot
- Implementing the Airport Parking Plan with the addition of two canopies for pedestrians
- Constructing Pods 1, 3, and 6 alongside the terminal

See **Figure ES-** and **Figure ES-** for the Airport Development Plan outside of the commercial passenger terminal.

Highlights of the Airport Development Plan within and around the commercial passenger terminal are shown below and include:

- Adding customer use self-service (CUSS) kiosks in the check-in area
- xp anding the floor and angling the vertical circulation elements (VC s) at SSCP queueing area
- Removing the moving walkways in the west and east concourses
- Relocating the CBP visa inspection processing space to the Gate 4-5 area
- Installing a controlled egress door between the immigration hall and the restrooms near the SSCP

See **Figure ES-6** for the Airport Development Plan within and around the commercial passenger terminal.

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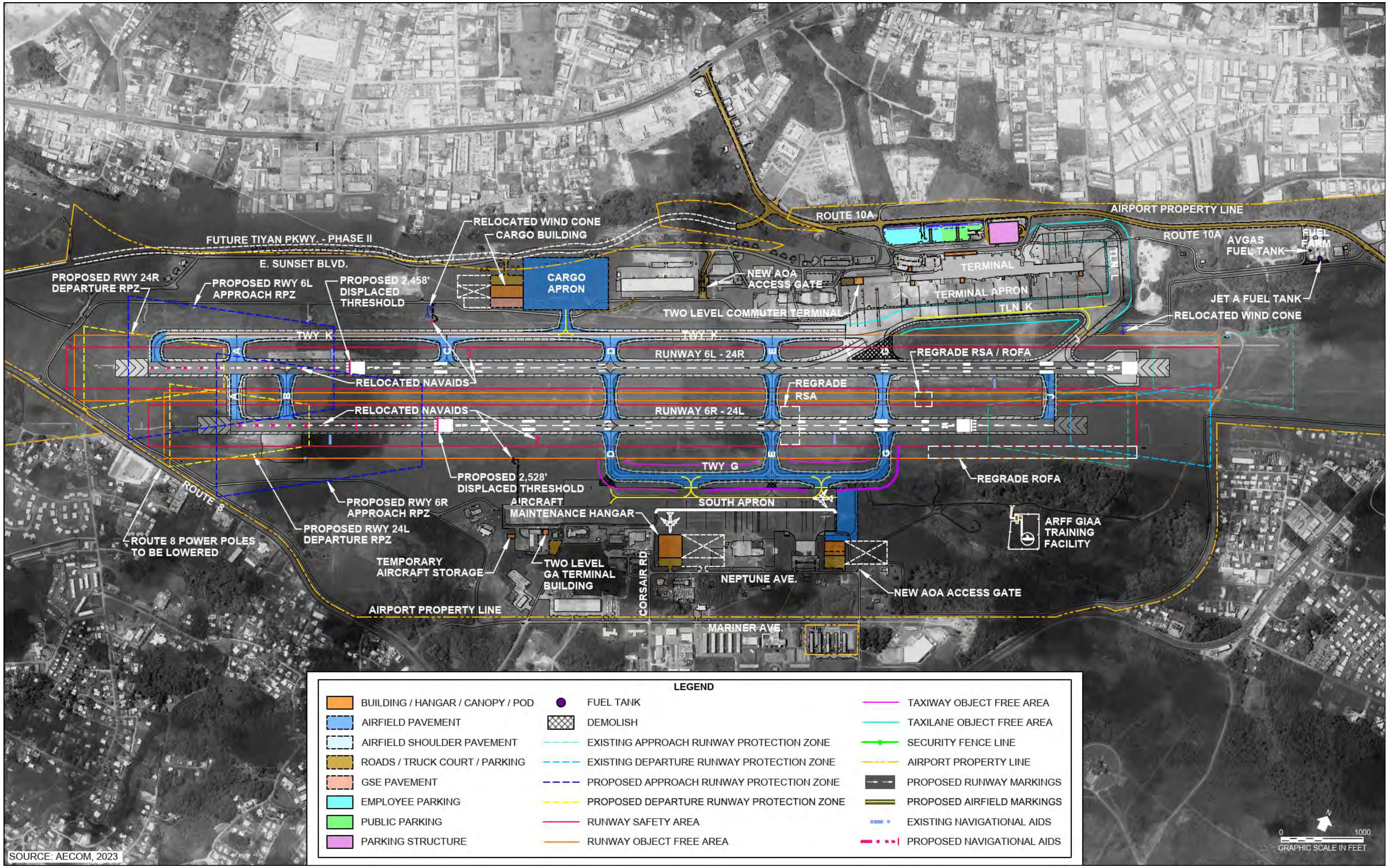
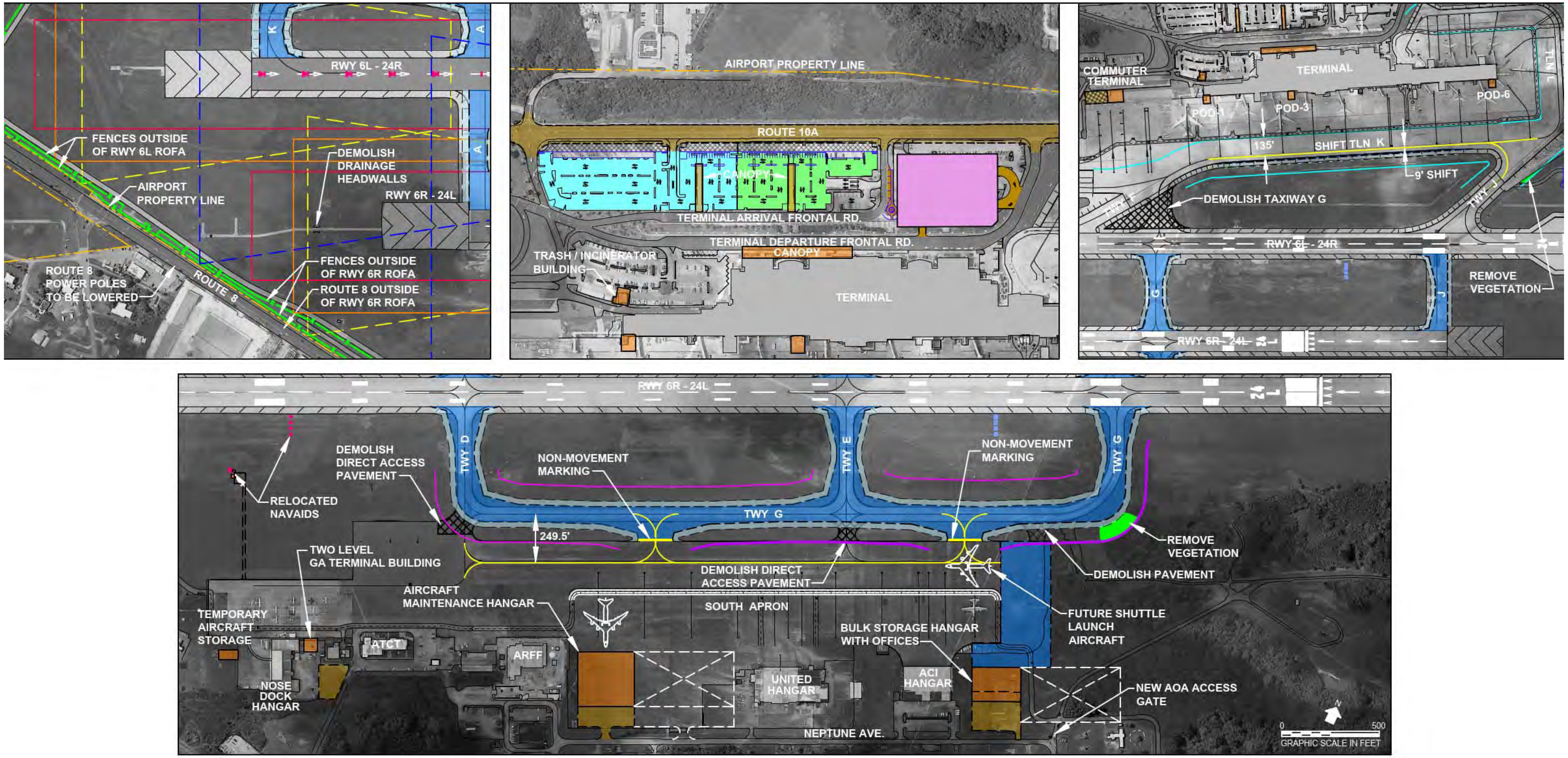


Figure ES-4: Airport Development Plan (1 of 3)



SOURCE: AECOM, 2023

Figure ES-5: Airport Development Plan (2 of 3)

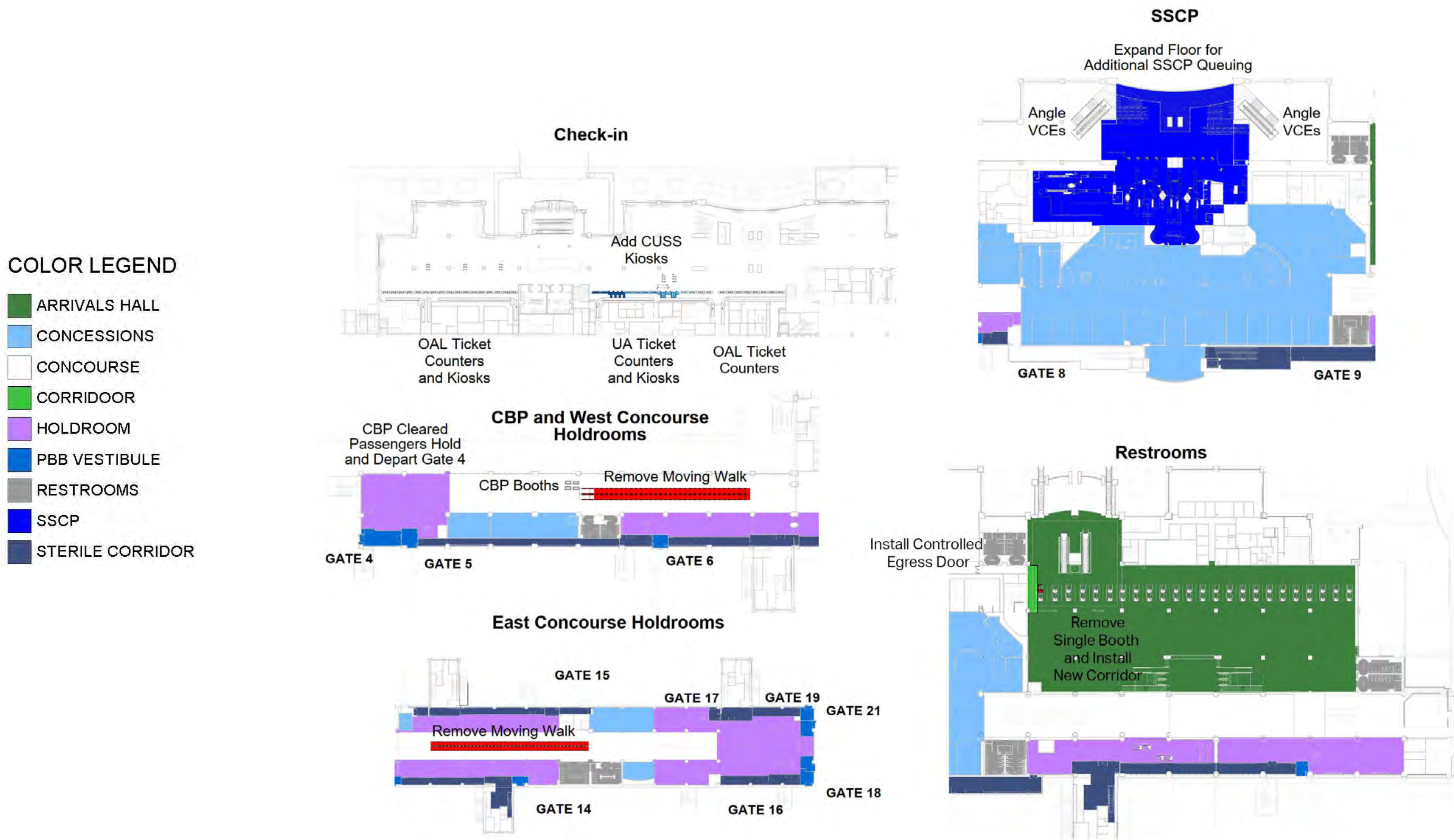


Figure ES-6: Airport Development Plan (3 of 3)

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Facilities Implementation Plan

Implementing the Airport Development Plan requires a sequence of planning and design, National n vironmental Policy Act (N PA) coordination, construction phasing, administrative actions, and funding commitments. A systematic approach is essential to initiating each project such that Airport operations are not hindered.

Phasing

Implementation of the recommended master plan improvements were planned for three phases:

- Short-term - Projects implemented in first 5 years
- Mid-term - Projects implemented in years 6 to 10
- Long-term - Projects implemented in years 11 to 20

Projects in the short-term are those of the highest priority and focus on general airfield safety, the Airport Parking Plan, and updates to the commercial passenger terminal to increase operational efficiency and the enhancement of passenger experience. Projects in the mid-term focus on runway compliance and support facility improvements, while the projects in the long-term focus on taxiway compliance and potential revenue generating cargo, GA, and support facilities.

Cost Estimates

Cost estimates for the Airport Development Plan were developed based on a planning level of detail and a summary of the cost estimates by project type can be seen in **ables ES-1**. Project costs include design, program/construction management, and administration.

ables ES-1: Implementation Plan Cost Estimates Summary by Project ype

Project ype	Short- erm Projects - Years	Mid- erm Projects 6-1 Years	ong - erm Projects 11-2 Years	otal
Airfield	$1,780,400	$54,603,000	$69,291,000	$125,664,000
Terminal	$18,760,000	$630,000	$43,840,000	$62,600,000
Landside	$6,690,000	$141,870,000	$0	$148,870,000
Cargo	$41,140,000	$0	$77,110,000	$118,250,000
General Aviation	$5,660,000	$84,310,000	$74,620,000	$164,590,000
Support Facilities	$12,220,000	$39,050,000	$90,420,000	$142,690,000
otal	**$,2 ,**	**$32 , 63,**	**$3 ,2 1,**	**$ 62,99 ,**

Source: AECOM

The proposed Airport Development Plan includes 43 projects costing more than $764 million during the 20-year planning horizon

Schedule

The implementation schedule is provided for general guidance on the phasing of the preferred development plan. The schedule includes a project identifier, project title, and approximate duration. The construction period includes a 3-month procurement and bid process. The actual timing for implementation is at the Airport's discretion depending on availability of funding and staff resources and projects may not be completed until the following phase. See **Figure ES-** for the proposed implementation schedule.

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Project ID	Project	Duration
		Year
	Short-Term (0-5 Years)	
I-A-01	Vegetation Removal	6 months
I-A-02	North Apron Improvements and Taxiway G Removal	30 months
I-A-03	Wind Cone Relocation (2)	6 months
I-T-01	Removal of Moving Walkways in Concourse (2)	12 months
I-T-02	Relocate Outbound CBP Inspection Process	9 months
I-T-03	Arrivals Hall Restroom Access Corridor	9 months
I-T-04	SSCP Queue Area Expansion	24 months
I-T-05	Check-in Facility Upgrades	12 months
I-T-06	Terminal Departure Roadway Canopy	9 months
I-T-07	Loading Docks (2)	6 months
I-L-01	Airport Parking Plan	24 months
I-C-01	Cargo Apron	24 months
I-GA-01	Temporary Aircraft Storage Facility	6 months
I-S-01	Aircraft Fuel Avgas Tank	9 months
I-S-02	North AOA Access Gate	18 months
I-S-03	Trash Facility	6 months
	Mid-Term (6-10 Years)	
II-A-01	Runway 6R/24L Safety Standards Compliance	60 months
II-A-02	South Apron Taxiway Connector Improvements	24 months
II-A-03	Shift South Apron Taxilane	24 months
II-A-04	Upgrade Taxiway D South, Taxiway E South, and Taxiway G South	24 months
II-A-05	Runway 6L/24R Safety Standards Compliance	36 months
II-T-01	Upgrade CBP Protection Booths (23)	6 months
II-T-02	Upgrade Guam CQA Booths (11)	6 months
II-L-01	Rental Car Parking Structure	24 months
II-GA-01	GA Bulk Storage Hangar	42 months
II-S-01	Aircraft Fuel Jet A Tank	9 months
II-S-02	South AOA Access Gate	18 months
II-S-03	ARFF GIAA Training Facility	24 months
	Long-Term (11-20 Years)	
III-A-01	Upgrade Taxiway A North and Taxiway K Connector	24 months
III-A-02	Upgrade Taxiway A Center	24 months
III-A-03	Upgrade Taxiway B	24 months
III-A-04	Upgrade Taxiway C	24 months
III-A-05	Upgrade Taxiway D North	24 months
III-A-06	Upgrade Taxiway D Center	24 months
III-A-07	Upgrade Taxiway E North	24 months
III-A-08	Upgrade Taxiway E Center	24 months
III-A-09	Upgrade Taxiway G Center	24 months
III-A-10	Upgrade Taxiway J	24 months
III-T-01	Construction of Pods 1, 3 and 6	30 months
III-C-01	Cargo Facilities	48 months
III-GA-01	GA Terminal	48 months
III-GA-02	Light Aircraft Commuter Terminal	60 months
III-S-01	Large Aircraft Maintenance Hangar	60 months

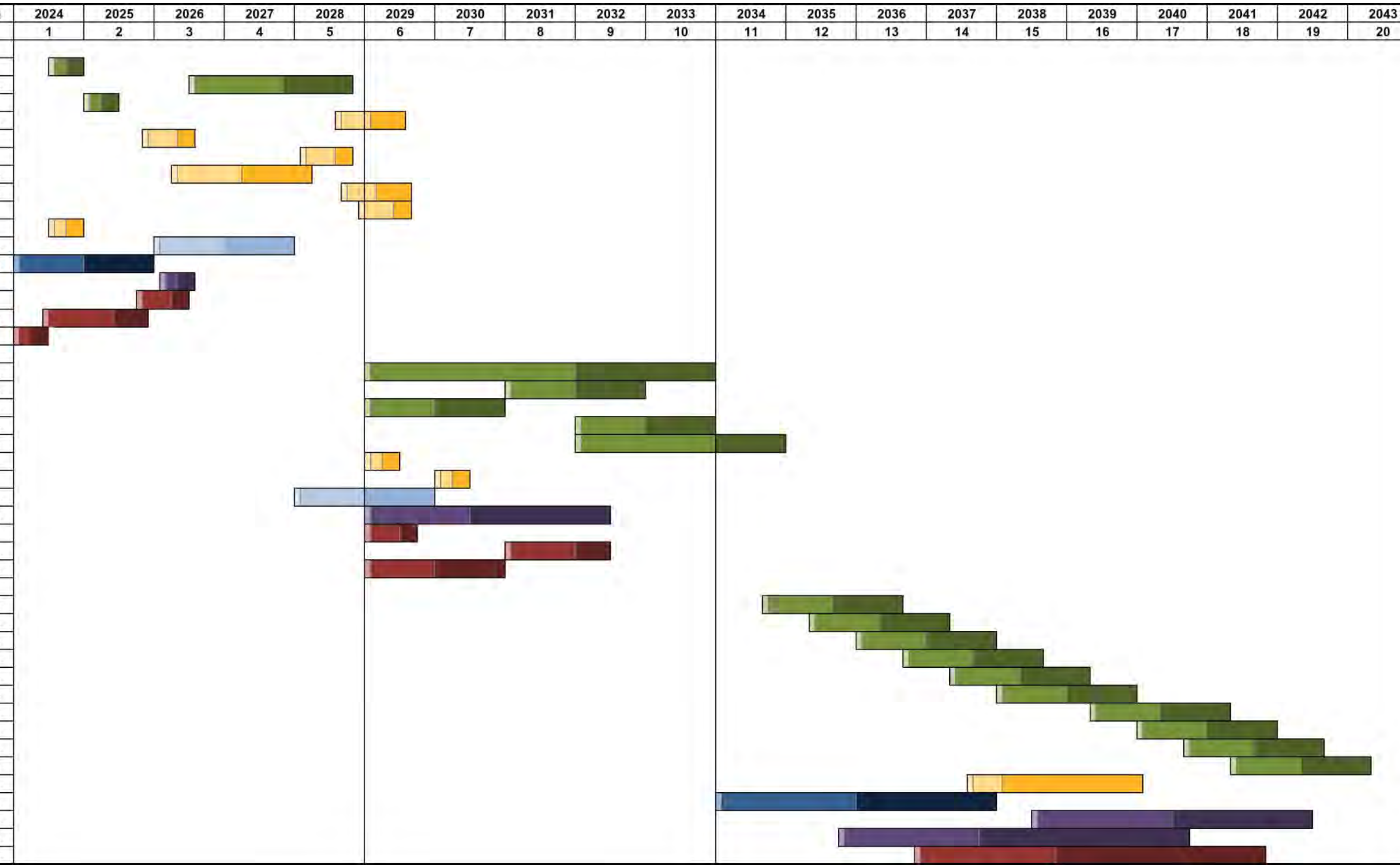

Figure ES-7: Implementation Plan Schedule

Note: The three colors are designated for NEPA coordination (lightest), design and permitting (middle), and construction (darkest) timing.

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Funding

Proposed financial funding was developed for the first 10 years of capital improvement projects assuming a 4 percent escalation. **able ES-2** and **able ES-3** summarize the assumed funding for the projects in short- and mid-term phases.

able ES-2 Short- erm Capital Improvement Project Funding

Projects	Escalated Cost	FAA AIP Grants	Bonds	Airport Funds	3rd Party	otal
Airfield						
Taxiway/Runway Maintenance	$1,964	$1,767		$196		**$1,96**
erminal						
Security Screening Checkpoint	$15,740	$14,166		$1,574		**$1 ,**
Other Improvements	$4,953	$2,476		$2,476		**$,9 3**
andside						
Airport Parking Plan	$7,379		$6,641		$738	**$,3 9**
Cargo						
Cargo Apron	$45,378	$40,840		$4,538		**$,3**
General Aviation						
Temporary Storage Hangar	$6,243				$6,243	**$6,2 3**
Support						
Various	$14,582	$10,936		$3,645		**$1 , 2**
otal	**$96,239**	**$,1**	**$6,6 1**	**$12, 3**	**$6,9 1**	**$96,239**

Notes:

A. *Funding is in thousands of dollars.*

B. *Abbreviations*
FAA = Federal Aviation Administration
AIP = Airport Improvement Program

Sources:

1. *AECOM Cost Estimates*
2. *InterVISTAS Analysis*

able ES-3 Mid- erm Capital Improvement Project Funding

Projects	Escalated Cost	FAA AIP Grants	Bonds	Airport Funds	3rd Party	otal
Airfield						
Runway Modifications	$8,106	$7,295		$811		**$,1 6**
Taxi/Apron Connectors	$10,906	$9,816		$1,091		**$1 ,9 6**
Taxiway/Taxilane Upgrades	$54,265	$48,838		$5,426		**$,26**
erminal						
CBP/CQA Booths	$845	$845				**$**
andside						
Rental Car Structure	$190,388		$171,350		$19,039	**$19 ,3**
General Aviation						
Storage Hangar	$113,143	$10,000			$103,143	**$113,1 3**
Support						
Jet A Fuel Tank	$35,093		$31,584	$3,509		**$3 , 93**
South AOA Access Gate	$456	$228		$228		**$ 6**
ARFF GIAA Burn Pit and Facility	$16,855	$15,170		$1,686		**$16,**
otal	**$ 3 , 9**	**$92,193**	**$2 2,933**	**$12, 1**	**$122,1 2**	**$ 3 , 9**

Notes:
- A. *Funding is in thousands of dollars.*
- B. *Abbreviations*
  - *FAA = Federal Aviation Administration*
  - *AIP = Airport Improvement Program*
  - *CBP = Customs and Border Protection*
  - *CQA = Customs and Quarantine Agency*
  - *AOA = Air Operations Area*
  - *ARFF = Aircraft Rescue and Firefighting*
  - *GIAA = A.B. Won Pat International Airport Authority, Guam*

Sources:
1. *AECOM Cost Estimates*
2. *InterVISTAS Analysis*

Environmental Overview

Several categories of environmental resources could be affected by construction and/operation of the Airport Development Plan projects. Based on the preliminary environmental screening analysis, it is expected that Coastal Resources is the area that may require additional analysis and agency consultation in future environmental studies, when projects are ripe for development. The entire island of Guam is designated a Coastal Zone, and as such, Airport development projects with potential to affect coastal resources may require a Coastal Zone Management consistency determination.

Sustainability

Throughout the master planning process, GIAA sought to incorporate sustainable development into the existing elements and proposed projects by developing clear sustainable strategies to guide decision making for improvements. GIAA has implemented several initiatives addressing sustainability and climate resilience at the Airport. Prior actions focused on infrastructure hardening and decarbonization and include strategies such as electrification of passenger boarding bridges, terminal lighting and air conditioning unit upgrades, and hardening infrastructure against severe storms.

The project team has identified 36 sustainability strategies and initiatives that the Authority can consider implementing within the following focus areas: n ergy and Fuels (Decarbonization), Sustainable Buildings and Infrastructure, Airport Sustainability Governance, Social Sustainability, Climate Resilience, Water Conservation and Management, and Waste and Materials Management. The strategies include:

- Reducing emissions through energy conservation and using less fossil fuel
- Using design decisions to improve sustainability performance for buildings and infrastructure
- stablishing appropriate governance structures and an airport-wide sustainability vision statement and policy
- Identifying strategies to engage the community in sustainability
- Considering and incorporating environmental justice considerations into airport actions and initiatives
- Building resilience against physical climate risk
- Identifying opportunities to conserve water use and manage stormwater
- Reducing the amount of waste destined for landfills and incineration.

There are a variety of opportunities that may be available to the Authority for funding the implementation of many of the identified strategies. These include grants, rebates, and tax incentives and are funded by federal agencies such as the Federal me rgency Management Agency and the Federal Aviation Administration.

Continuous Planning

This Master Plan presents a cohesive improvement program and implementation plan to meet future passenger and operational demand in an environmentally and fiscally sound manner. The Master Plan is not static and needs to be monitored over time. Air traffic needs to continuously be compared to the forecasts to see how the forecasts are tracking and if traffic is growing faster than planned, as some projects may need to be accelerated. However, implementation of the projects proposed in the Master Plan will help maintain Antonio B. Won Pat International Airport at the high level of customer service and convenience for which the Airport is known.

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Figures

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Appendices

1 Study Design

Executive Summary

This chapter identifies and refines any issues that may influence the study effort, finalize goals and objectives, and fully document the planning process for the Antonio B. Won Pat International Airport (Airport) Master Plan Update. Goals and objectives developed in the Airport's previous Master Plan Update were reviewed in order to determine their applicability to this Master Plan Update. Additionally, six focus areas were identified by the A.B. Won Pat International Airport Authority, Guam (GIAA), Federal Aviation Administration (FAA), and other important Airport stakeholders, as these areas were seen as having an opportunity to have major impacts directly on the Airport, as well as the island of Guam.

1.1 Introduction

The Airport is situated in the middle of the Pacific Ocean on the United States territory of Guam and was built in 1943 by the Japanese Navy in the prime of World War II. Today, the Airport serves as a hub for passenger and cargo flights between Asia and North America. The only other major aviation facility on the island of Guam is Andersen Air Force Base (AAFB), a major military base, which is located approximately 10 nautical miles (nm) to the northeast of the Airport.

In fiscal year (FY) 2019, the Airport processed more than 3.6 million passengers, surpassing its previous record from FY2018 by approximately 194,000 passengers.[1] FY2020 was anticipated to be another record-breaking year for the Airport, with the first five months surpassing previous passenger numbers, before Guam, along with the rest of the world's global markets, succumbed to the 2019 Novel Coronavirus (COVID-19) pandemic.

The Airport is the former U.S. Naval Air Station (NAS) Agana, which was closed and transferred to the Government of Guam under the Base Realignment and Closure (BRAC) Act. The Airport has been operated and managed by the GIAA since 1976. GIAA has contracted A C OM Technical Services, Inc., and its team of subconsultants, which includes . M. Chen & Associates for local engineering support, InterVISTAS for financial planning, and NV5 Geospatial for field surveys and geographic information system (GIS) mapping, to provide airport planning services associated with a Master Plan Update for the Airport. This chapter, Study Design, introduces the Airport, GIAA, the 2012 Master Plan Update, stakeholder involvement and opportunities, relevant focal points specific to the 2023 Master Plan Update, and the current Airport vision.

1.2 Airport Organization

GIAA is a self-sustaining autonomous government agency and the only civil airport operator on the island of Guam. GIAA is committed to serving its customers and partners 24 hours a day, 7 days a week. The GIAA mission statement reads, "To ensure the safety and security of the traveling public, maintain a superior and reliable level of Airport services, and support the development of air services and facilities which are integral to the island's economic growth."[2] In July 2017, GIAA launched its "Vision Hulo" campaign, which is defined as "initiatives undertaken to create future growth, development, and opportunities for the Airport and for Guam that incorporate its capital improvement projects, revenue programs, increased services, and enhanced operations."[3]

1.3 2 12 Airport Master Plan

In April 2012, the Antonio B. Won Pat International Airport Master Plan was completed as an update to the 2005 Master Plan. The 2012 Master Plan was needed because the aviation forecasts developed in the 2005 Master Plan report did not account for the recent developments in Guam at the time, namely the planned redeployment of members of the United States Marine Corps (along with their dependents), who are currently deployed in Okinawa, Japan. Other recent development included the U.S. Visa Waiver

1 A.B. Won Pat International Airport, Guam, FY2019, Annual Report and Financial Statements
2 A.B. Won Pat International Airport, Guam, FY2019, Annual Report and Financial Statements
3 A.B. Won Pat International Airport, Guam, FY2019, Annual Report and Financial Statements

Program modifications and the designation of Guam as First Point of n try Declaration by the United States.

To support the ongoing aviation operations, along with the uncertainty of the future forecasts and operations, as well as the rapid developments taking place on Guam, Airport stakeholders developed six goals ahead of the 2012 Master Plan. These goals included:

- Determine the Airport's physical facilities to meet the future needs for passengers and cargo
- n hance the passenger's overall experience from curbside to aircraft boarding and vice versa
- Develop a plan that separates arriving uninspected passengers destined to Federal Inspection Services (FIS) at the international arrivals facilities from departing passengers that conform to Transportation Security Administration (TSA), and U.S. Customs and Border Protection (CBP) requirements
- Provide a terminal and cargo facilities plan that confirms the GIAA strategic vision and sense of arrival thematic objectives
- Develop a landside plan that accommodates the loss of public parking for the widening of Route 10A
- Develop a concessions program to meet the needs of the international Asian tourist[4]

The report also identified several issues and concerns that affected both the forecasts and the terminal facility. These factors included declining tourism from Japan and Korea, arrival/departure co-mingling in the lobby area, checked bag screening in the lobby, insufficient passenger screening lanes, aging equipment (such as Passenger Boarding Bridges [PBBs]), Ground Power Units (GPUs), and Preconditioned Air Units (PCAs), insufficient Ground Support q uipment (GS) storage areas, washroom and breakroom cleanliness, and insufficient check-in counters.

Since the completion of the 2012 Master Plan, GIAA has addressed several of these issues and concerns including: the construction of a third floor sterile corridor, which eliminated arrival/departure co-mingling; the construction of a new checked baggage inspection system (CBIS), which removed the bag screening equipment from the lobby freeing up ticket counter space; and the addition of two additional standard screening lanes to the security screening checkpoint (SSCP), increasing the total from five to seven.

1.3.1 2 12 Airport ayout Plan

The 2012 Airport Layout Plan (ALP) (**Figure 1-1**) resulted from the 2012 Master Plan. Some projects proposed in the 2012 ALP update will be validated and carried over into the 2023 ALP as needed. Some of the future development projects proposed in the 2012 ALP update included:

- A displaced threshold beyond the Runway 6R end
- A runway extension/displaced threshold removal for the Runway 24L end
- A parallel taxiway extension for Taxiway M and other taxiway improvements
- A passenger terminal expansion
- Cargo aprons and miscellaneous facilities
- Route 10A (Tiyan Parkway) development
- Avigation easements[5]

Since the 2012 Master Plan, the Airport has made a few revisions to the 2012 ALP and received a Conditionally Approved ALP in October 2017.

[4] 2012 Antonio B. Won Pat International Airport Master Plan Update
[5] 2012 Antonio B. Won Pat International Airport Master Plan Update

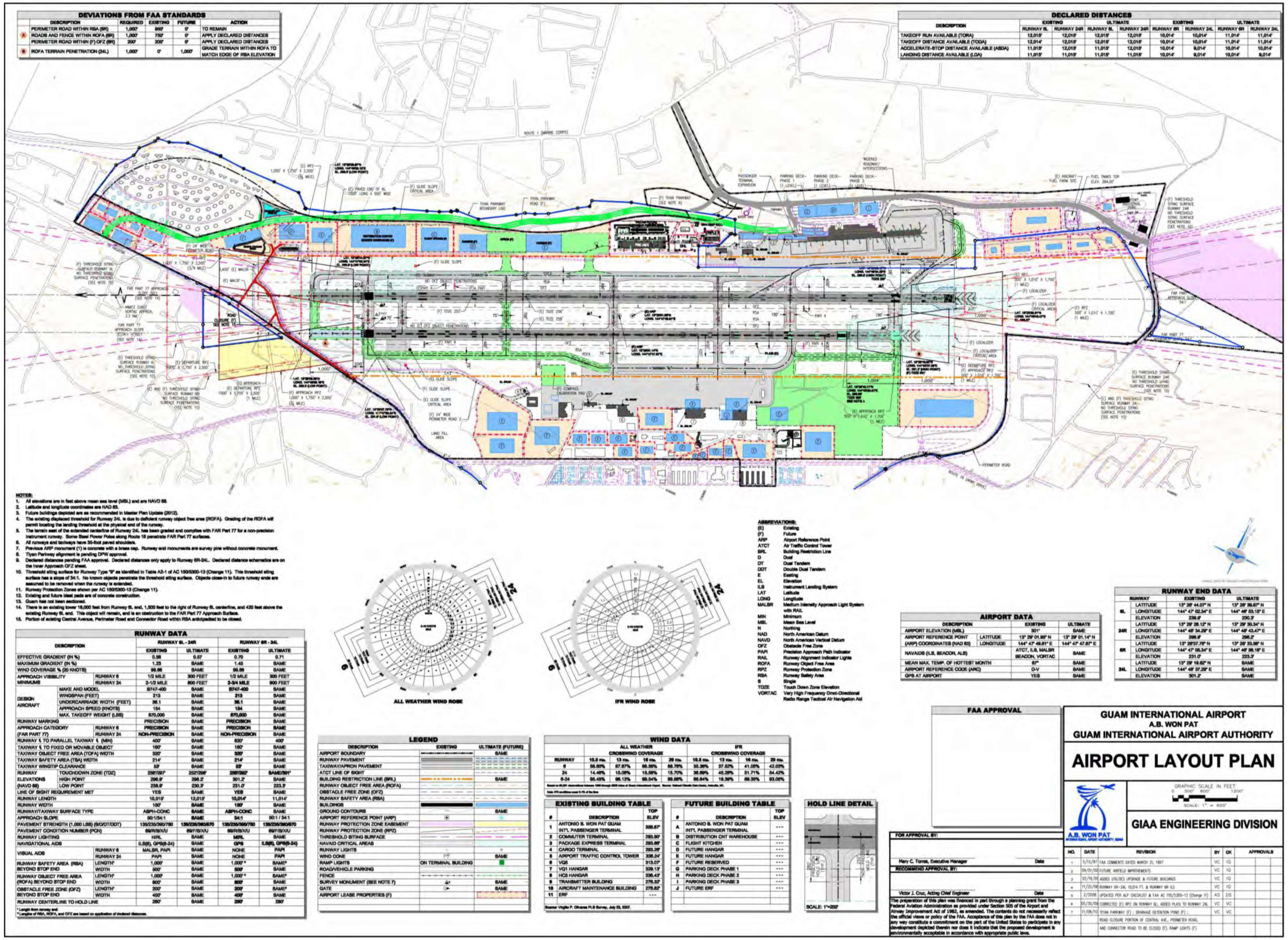

Figure 1-1. 2012 Airport Layout Plan

Source: April 2012 Antonio B. Won Pat International Airport Master Plan Update

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1.4 2 2 3 Master Plan Stakeholders

An important component to the success of any Master Plan is engaging stakeholders in the master planning process. Stakeholders are invited to attend workshops presented by the Airport sponsor, the consultant, and others.

The main roles for stakeholders are to serve as a sounding board for future Airport development; provide a local understanding of the Airport users; identify opportunities and challenges facing the Airport; review, comment, and provide input on various Master Plan elements; and support communications and data gathering efforts. The process consists of multiple meetings attended by users and tenants of the Airport, as well as operators and representatives of the Airport that includes the FAA, commercial airlines, cargo airlines, U.S. CBP, Guam Customs and Quarantine Agency (GQA), Fixed Base Operators (FBO), rental car companies, concessionaires, and more. The following sections summarize the purpose and intent of each stakeholder meeting.

1.4.1 Visioning Meetings

Visioning Meetings are the first opportunity for stakeholders to provide their ideas, input, and feedback on the existing conditions and future needs of the Airport. The purpose of Visioning Meetings is to introduce the Master Plan process, establish a project vision, analyze existing conditions and issues at the Airport, help develop demand forecasts, and finalize the overall goals and objectives of the Master Plan.

Figure 1-2. Stakeholder Visioning Meeting

Source: GIAA

Three Visioning Meetings took place over the span of three days. Two of the meetings occurred on March 2, 2022 and the other on March 4, 2022; see **Figure 1-2**. a ch meeting was targeted to a specific group of Airport stakeholders. These three groups included key stakeholders, operational stakeholders, and internal stakeholders. During each meeting, stakeholders had the opportunity to participate in identifying the Airport's needs and potential for short- and long-term development as an update to the goals and objectives identified in the Airport's 2012 Master Plan.

1.4.2 Realization Meetings

Realization Meetings are the second opportunity for stakeholders to meet with the Airport sponsor and Airport consultants to evaluate how their input from the Visioning Meetings provided a baseline for preferred, realistic, justifiable, and fiscally responsible alternatives, and how their continuing participation can aid future development. The purpose of Realization Meetings is to re-convene the stakeholders and present the facility requirements and alternate solutions to address the Airport's needs.

Realization Meetings with key and operational stakeholders occurred on December 13th, 2022 while the Realization Meeting for internal stakeholders occurred on December 14th 2022. During these meetings, the forecasts, facility requirements, alternatives process, preferred alternatives, and Airport Development Plan were discussed and analyzed. The Realization Meetings were also used to discuss any refinements that could be made to the Airport Development Plane.

1.4.3 Regulatory Meetings

Regulatory Meetings are for the stakeholders to see how their input and participation throughout the Master Plan process served as a foundation for the short- and long-term future of the Airport. The goals of the Regulatory Meetings include strategizing for future phased development; finalizing details to receive an FAA-approved ALP; and preparing stakeholders, sponsors, and staff to inform the general public about the planned development at their Airport.

Two Regulatory Meetings occurred on July 25th, 2023. During these meetings, stakeholders were able to see the latest Airport Development Plan, as well as an implementation plan which included preliminary phasing, cost estimates, an implementation schedule, and funding opportunities. The Regulatory Meetings also included high-level overviews of the environmental features surrounding the Airport and potential sustainable strategies and initiatives GIAA can implement to build a sustainability program at the Airport.

A Public Information Workshop and a meeting with the Airport Board of Directors also occurred on July 26th and 27th, 2023.

See **Figure 1-3** for an overview of the master planning process.

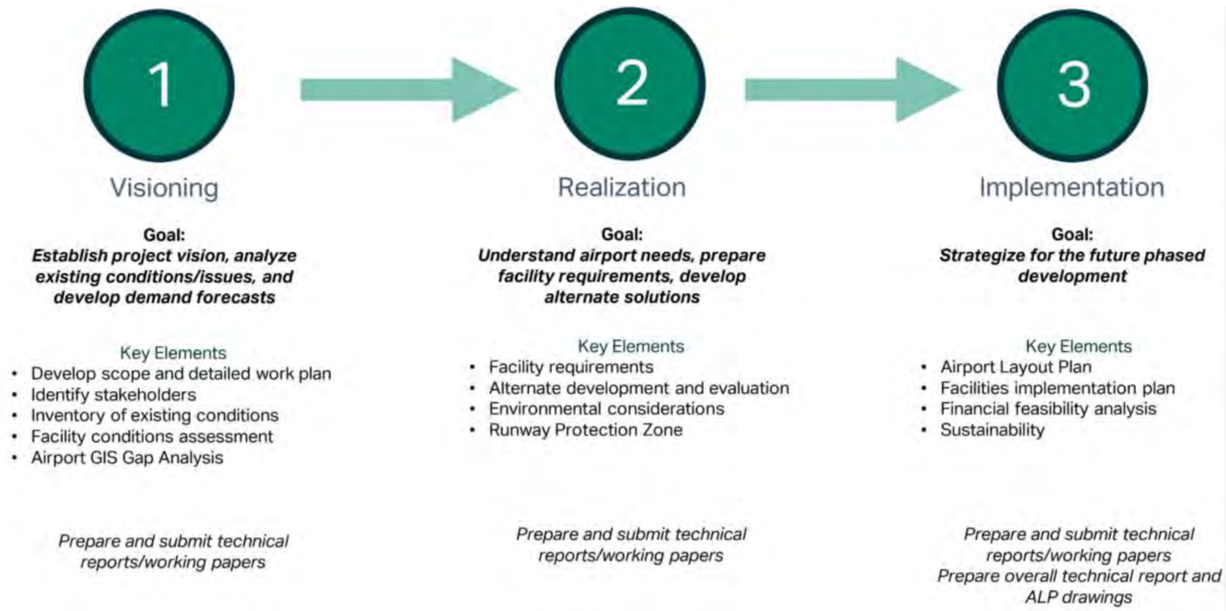


Figure 1-3. Master Planning Process

Source: AECOM

1.5 Focus Areas

The identification of key issues is an early product of a well-designed public involvement program. a ch Master Plan report should be focused on resolving specific issues and generating potential revenue opportunities that have emerged since the previous Master Plan Update. This Master Plan includes six focus areas that have become relevant discussion items among key Airport staff and stakeholders over the last decade. The six focus areas are summarized below.

1.5.1 Recovery from the COVID-19 Pandemic

The COVID-19 pandemic has been one of the deadliest pandemics that the world has ever experienced. As of March 2022, with more than 458 million confirmed cases and 6 million deaths worldwide, the pandemic has drastically changed the world we live in.[6] From an air travel perspective, the COVID-19 pandemic has dramatically and continuously impacted the world's airports, resulting in a vast reduction of aircraft operations over a long period of time.

In FY2019, the island of Guam saw record tourist numbers. According to the Guam Visitors Bureau, Guam had approximately 1.63 million visitors in FY2019, marking it the best fiscal year to date for the island's tourism industry.[7] In an instant, tourism and visitor numbers plummeted, and the economy of

[6] World Health Organization, As of March 15, 2022
[7] Guam Visitors Bureau, October 2019

Guam suffered significantly due to the severe drop in commercial airline operations. As airline operations have slowly began to rise around the time of this Master Plan, this report discusses how the Airport is recovering financially and how the Airport can help restore the island as a popular and admired tourist destination.

1.5.2 ight Aircraft Commuter erminal

The existing light aircraft commuter terminal is located along the north side of the Airport, west of the commercial passenger terminal building, along a st Sunset Boulevard. Currently, Arctic Circle Air and Star Marianas operate out of the commuter terminal as the two airlines provide both passenger and cargo services to the Northern Mariana Islands. There are three aircraft parking positions utilized for commuter terminal operations; however, the facility and aircraft apron itself is very underutilized.

As previously identified in the 2012 Master Plan, the Airport is planning on expanding the commercial passenger terminal facility to the west and demolishing the existing commuter terminal facility. This Master Plan explores options for a new commuter terminal facility, as it could provide new opportunities to attract General Aviation (GA) and light commuter aircraft.

1.5.3 Military Build-Up

The U.S. Armed Forces makes up a significant portion of the population of Guam. Guam has a population of about 170,000 residents, and more than 12,000 of those residents are military members and their families,[8] which makes up approximately 7 percent of the island's population. Most of these military personnel work at U.S. Naval Base Guam or AAFB. Though this number has dropped since 2010 when there were approximately 21,700 military members and their families living on Guam,[9] an influx of military personnel is anticipated in the future.

Starting in 2025, the Department of Defense (DoD) expects to increase the military presence on Guam by more than 50 percent. The DoD expects to move more than 5,000 Marines (and 1,500 of their family members) from Okinawa, Japan, to Marine Corps Base Camp Blaz, located in the northern part of the island. This Master Plan helps the Airport prepare for more military trainings, operations, and exercises near and around the Airport, as well as infrastructure improvements, an increase in housing, and economic growth as a result of the military build-up throughout the island.

1.5.4 Air Cargo Growth

While there has been a sharp decline in passenger flights, the Airport has experienced a growth in cargo operations as online shopping numbers have spiked since the start of the pandemic. With the increasing volume of cargo coming into the Airport, it must be equipped with adequate cargo space, shelters, and support facilities. The largest cargo facility, the Guam Integrated Air Cargo (GIAC) building, is located on the north side of the Airport between a st Sunset Boulevard and Taxiway K and encompasses more than 267,000 square feet; however, there is inadequate internal facility storage and exterior storage space. This Master Plan explores opportunities to expand cargo infrastructure and improve the efficiency of cargo-related activities.

[8] NB Guam - http://www.militarybases.us/navy/nb-guam/
[9] Military Installations - https://installations.militaryonesource.mil/in-depth-overview/joint-region-marianas-naval-base-guam

1.5.5 Passenger Experience

Figure 1-4. Commercial Passenger Terminal Facility

Source: ©2022 Photography by Elliott Lindgren

One of the most important things any airport representative, staff member, or stakeholder can consider is passenger experience. The Airport is the first thing passengers experience when they arrive in Guam, and it's the last thing they experience when they depart (**Figure 1-**). Improving the passenger experience ranges in scale from small changes such as reusable water fill stations to larger scale improvements like integrating new touchless technology. Some examples include updating technology from rental car areas to self-check-in counters to Customs and Immigration screening areas; improving communication such as wayfinding signage, information desks, and public address systems; improving Airport mobility for passengers with disabilities; and more efficient moving walkways. The data collected from tenants over the last few years can be used to help the Airport analyze what is working and what is not. This Master Plan will dive into these key ideas in order to help provide an easier and better overall experience for the passengers.

1.5.6 Spaceport Opportunities

Since the completion of the 2012 Master Plan report, the Airport, along with the FAA and Virgin Orbit, has pursued a small satellite launching company under the Virgin Group in hopes of the Airport receiving a launch operator's license and becoming the new location of the companies LauncherOne rocket and a Boeing 747-400 carrier aircraft. Launch operations would be conducted by placing a small satellite in the rocket with the rocket attached to the underside of the carrier aircraft's wing. The aircraft would depart from the Airport, climb to a certain altitude and deployment area, and launch the rocket into space where the satellite would be deployed.

Substantial planning and coordination have been accomplished with FAA and Virgin Orbit, but the proposal has currently been paused. Studies have been done and determined that when not operating, the Virgin Orbit carrier aircraft would be parked on the south apron. It is noteworthy that the aircraft will require specific blast arc radii in which no other aircraft, facility, or public road may be located, during rocket fueling and pre-launch operations. It is also noteworthy that the Boeing 747-400 is not new to the Airport and has been previously operated at the Airport on a regular basis by air carriers such as United, Korean, and Asiana Airlines, and has been the critical aircraft for ALP purposes. Therefore, the potential operations do not represent a change of the design aircraft for the ALP.

As Airport revenue significantly dropped during the COVID-19 pandemic, the development of the Virgin Orbit spaceport has the potential to help the Airport restore some of that lost revenue. This Master Plan provides alternatives with how the Airport will need to strategically plan for the future if spaceport opportunities such as this continue to develop.

1.6 2 2 3 Master Plan Goals and Objectives

Consistent with GIAA and FAA guidelines, a main goal of this Master Plan is to focus on the issues and concerns identified in the 2012 Master Plan Update that have not been addressed. However, new goals and objectives were developed for the 2023 Master Plan, which include:

- Prepare a reasonable forecast of Airport activity for the current 20-year planning period
- Determine current and future facility requirements for both demand-driven development and conformance with FAA design standards

- Identify sustainable initiatives (i.e., renewable energy, ecologically friendly vehicles, charging stations, and other features that coincide with the new Infrastructure Plan)
- Develop a landside and airside development plan that is consistent with the changing environment at the Airport
- Update the Airport Data Information Portal (ADIP) and prepare a standard ALP drawing set
- Prepare a Master Plan report to accompany the ALP drawing set
- Develop an Airport Capital Improvement Program (ACIP) using planning-level estimates that will prioritize improvements, estimate project development costs, and consider funding eligibility for the 20-year planning period

1.7 2 2 3 Master Plan Organization

This Master Plan follows the guidelines contained in FAA Advisory Circular (AC) 150/5070-6B (Change 2), *Airport Master Plans*. This Master Plan Update will identify improvements necessary to accommodate aviation demand in the short-term (5-year), mid-term (10-year), and long-term (20-year) planning horizons. This report concentrates on the goals and objectives identified for the Master Plan Update, the issues and concerns that arose from the 2012 Master Plan Update, and the focus areas mentioned above. Along with **Chapter 1:** *Study Design,* eight additional chapters, five appendices, and an ALP sheet set have been developed to address all master planning elements included in the Master Plan AC. A summary of these are provided below.

- **Chapter 2:** *Inventory of Existing Conditions* – This chapter details the inventory of the Airport's physical facilities and environmentally significant features on and around Airport property.
- **Chapter 3:** *Aviation Demand Forecasts* **–** This chapter describes the type and level of aircraft activity that currently and are expected to occur at the Airport over the planning horizon. The base year is 2019 and the majority of the data was extracted from GIAA aircraft operations. Forecasts are prepared for the short-term, mid-term, and long-term intervals.
- **Chapter :** *Facility Requirements* – The Facility Requirements chapter assesses the capacity of the airside, terminal, landside, GA, cargo, and support facility elements based on airfield demand vs. capacity/delay analysis, terminal passenger and baggage processing rates, landside level of service, and general need for additional support facilities. It also determines the requirements for additional facilities to meet aviation demand forecasts for the 5-, 10-, and 20-year planning horizons and establishes the baseline requirements that will provide a platform for the Airport development alternatives evaluation.
- **Chapter :** *Alternatives Development and Evaluation* – The Alternatives Development and va luation chapter identifies feasible alternative development plans for the Airport. The chapter also identifies alternatives for nonstandard airfield conditions, evaluates airside and landside alternatives, and identifies a recommended alternative.
- **Chapter 6:** *Environmental Overview* **–** This chapter compiles existing published environmental information and specific impact category evaluation geared towards the Airport. The impact categories included in this chapter are Air Quality, Biotic Resources, Coastal Resources, U.S. Department of Transportation (DOT) Section 4(f) Resources, Hazardous Materials and Solid Waste, Historical, Archaeological, and Cultural Resources, Natural Resources and n ergy Supply, Noise and Compatible Land Use, Socioeconomics, n vironmental Justice, and Children's Health Safety Risks, Visual f fects, and Water Resources.
- **Chapter :** *Facilities Implementation Plan* – The Facilities Implementation Plan chapter includes a recommended plan of implementation based on the timing and needs of individual facilities. This chapter identifies key activities and responsibilities associated with the projects outlined in the preferred development plan.
- **Chapter :** *Financial Feasibility Analysis* – This chapter includes a financial plan that indicates the sources of funds to finance the recommended Master Plan improvements.

- **Chapter 9:** *Sustainability* – This chapter reviews existing plans, documents, policies, and procedures, identifying current sustainability goals and initiatives planned and already implemented by GIAA and proposes new sustainable strategies GIAA could begin utilizing.
- **Appendix A:** *Information Technology (IT) Infrastructure* – The IT Infrastructure appendix explores the existing IT systems in-place at the Airport and what improvements could be made to help manage operations better and more efficiently.
- **Appendix B:** *Facility Condition Assessment (FCA)* **–** The FCA focuses on four Airport facilities: the commercial passenger terminal building, the fuel farm, the VQ-1 United hangar, and the HC-5 Aviation Concepts, Inc. (ACI) hangar. This report includes an inventory and recommendations of all the assets found in and around these four facilities.
- **Appendix C:** *Runway Protection Zone (RPZ) Assessment* – The RPZ Assessment includes the assessment and review of all RPZs for the four runway ends at the Airport. Some of the key features of this chapter include the current design standards of the RPZs, documenting the Approach and Departure RPZ dimensions, identifying existing and future uses within each RPZ, and identifying alternatives for resolving non-compliant RPZ conditions.
- **Appendix D:** *Alternatives Development and Evaluation Graphics* – This appendix illustrates the specific alternatives developed in **Chapter :** *Alternatives Development and Evaluation*.
- **Appendix E:** *Preferred Airfield Alternative – Declared Distances* – This appendix portrays a graphic of the proposed declared distances for both runways based on the alternatives evaluation process.
- **Appendix F:** *Visioning, Realization, and Regulatory Meetings – Presentations and Meeting Minutes* – This appendix includes the presentations and meeting minutes from the Visioning, Realization, and Regulatory Meetings.
- **Appendix G**: *Forecast Approval Letter* – This appendix includes the FAA forecast approval letter for this Master Plan. For more information on the forecasts, see **Chapter 3:** *Aviation Demand Forecasts*.
- **Appendix :** *Airport Layout Plan Sheet Set and Approval Letter* – This ALP sheet set includes Airport Geographic Information System (A-GIS) information that coincides with FAA ACs 150/5300-16B, *General* Guidance *and Specifications for Aeronautical Surveys: Establishment of Geodetic Control and Submission to the National Geodetic Survey (NGS),* -17C, *Standards for Using Remote Sensing Technologies in Airport Surveys*, and -18B (Change 1), *General Guidance and Specifications for Submission of Aeronautical Surveys to NGS: Field Data Collection and Geographic Information System (GIS) Standards.* Additionally, a traditional ALP drawing set was developed using ADIP data and aeronautical survey information. The ALP follows guidance provided in FAA Standard Operating Procedure (SOP) No. 2.00 ALP Review Checklist.

2 Inventory of Existing Conditions

Executive Summary

The first task of this Master Plan Update is to present an inventory of existing conditions and provide relevant information on the physical, operational, and functional characteristics that are unique to the Antonio B. Won Pat International Airport (Airport). This chapter serves as a baseline for evaluating the existing facilities and their current capabilities.

An inventory of the existing airfield facilities, commercial passenger terminal, landside facilities, and general aviation (GA), cargo, and support facilities was completed, as well as an analysis of the existing meteorological conditions, environmental features, land use, and socioeconomic activity at an around the Airport. This chapter of the Master Plan also describes the history of Guam, the Airport, and the A.B. Won Pat International Airport Authority, Guam (GIAA). This information will be used as a guide to help develop proper aviation demand forecasts in order to determine what future growth the Airport can accommodate at the Airport in the 20-year planning period.

2.1 is tory of Guam

In 1521, Ferdinand Magellan landed on the inhabited island of Guam. In 1565, Spain claimed ownership of the island, which was under the rule of Madrid until the Spanish-American War of 1898. Guam was ceded to the United States following the Spanish-American War and formally purchased from Spain in 1899. In 1941, the midst of World War II, Japan attacked Guam and interrupted the U.S. rule on the island during three years of battles. Since then, Guam has been a U.S. protectorate and an important area for U.S. military bases in the Pacific region, and is home to several U.S. defense operations.

Because of the strong military presence on the island, Guam has had a unique relationship with the U.S. The people of Guam were forced to investigate the long-term future for themselves and their land. This meant that special policies were necessary to define the roles of both Guam and the U.S. ventually, under the terms of the 1950 Organic Act of Guam, the island established internal self-government and citizenship of the U.S., but its citizens are not eligible to vote in U.S. elections.

Guahan, the native name for Guam, is a unique and vastly developing island located in the Western Pacific Ocean. It is the southernmost and largest island of the Mariana archipelago and is the westernmost Territory of the United States. Guam is situated at approximately 13° North Latitude and 144° a st Longitude which is located west of the International Dateline and is therefore, one day ahead of the mainland United States, giving rise to the phrase, “Where America’s Day Begins.”

The island of Guam is also known as the “Hub of the Pacific,” offering a wide range of industries to international countries within the Western Pacific Ocean and mainland United States. The island is approximately 3,300 miles west-southwest of Honolulu, 5,300 miles west of San Francisco, 1,500 miles southeast of Tokyo, 1,850 miles southeast of Hong Kong, 1,500 miles east of Manila, and 3,000 miles northwest of Sydney.[10] Additionally, the island is located northwest of the Mariana Trench, which is the deepest oceanic trench with a depth of more than 39,000 feet.

The island of Guam stretches 30 miles in length (north to south) with a width ranging from 12 miles at its widest point to 4 miles at its most narrow point (east to west), with a total land area of approximately 212 square miles. The island is formed by the union of two volcanoes, giving it two distinct geological profiles. The northern cliff lines drop precipitously into the sea with an elevation ranging from 300 to 600 feet above mean sea level (AMSL). The southern features are volcanic with an elongated ridge dividing the inland valleys and coastline with elevations ranging from 700 feet AMSL to the highest point of Mount Lamlam of 1,334 feet AMSL.

Guam is currently the most developed island in the Micronesian area and is determined to be the region’s focal point for development. Neighboring Micronesian islands have greatly depended on Guam’s services, especially the shipping of supplies and commodities. The future development of Guam is essential to the

[10] Distances are measured in nautical miles (nm).

needs of these islands, and it is expected that Guam will continue to play a major role, especially in the economic future of Micronesia.

Over a period of 20 years, Guam has diversified itself, complimenting the presence of the U.S. military, while maintaining and developing a strong tourism-oriented industry to sustain its local economy.

2.1.1 Airport ocation and Background

Figure 2-1. Commercial Passenger Terminal

Source: GIAA

The Airport is situated in the central part of Guam in both the villages of Tamuning and Barrigada. In 1943, the original Airport was built by the Japanese Navy during World War II. After the liberation of Guam, the Airport was used by the United States Air Force until 1947 when the Airport was transferred to the United States Navy and was ultimately renamed Naval Air Station (NAS) Agana. In January 1976, GIAA took over civilian operations of the Guam International Airport Terminal (GIAT) and a joint agreement with the U.S. Navy was developed which allowed civil operations on the NAS's runways, taxiways, and even use of the air traffic control tower (ATCT). In 1989, the GIAT was officially renamed to the Antonio B. Won Pat International Airport in honor of Guam's first elected delegate to the U.S. House of Representatives, Antonio Borja Won Pat.

The Airport overlooks much of Guam's western coast, shoreline, and the Philippine Sea and is located approximately 6 miles northeast of Hagåtña, the capital of Guam, and about 2 miles from the island's main tourist area, Tumon.

Currently, Airport property consists of 1,654.19 acres of land and 220.46 acres of avigation easements, drainage easements, and a roadway easement. The property is oriented in a north-easterly/south-westerly direction with most of its facilities located on a plateau about 250 feet AMSL. The plateau is not quite flat and has an increasing slope of approximately 3 percent toward the northeasterly portion of the property. Most of the airfield area has been graded to accommodate the runways.

The commercial passenger terminal, as seen in **Figure 2-1**, is situated on the northeastern portion of the property facing the western coastline of Guam. North of the Airport terminal are the parking facilities and transportation services. On the eastern side of the property is the Airport Industrial Park, which sits on a plateau 40 to 50 feet below the airfield and terminal elevations. South of the terminal are the runways, taxiways, and support facilities. The northwestern portion of the property consists of former NAS family houses and commercial property. **Figure 2-2** depicts a timeline of the history and major milestones at the Airport.

Source: guamairport.com

Figure 2-2. Airport History Timeline

2.1.2 and Ownership

Under the 1993 Base Realignment and Closure (BRAC) Act, an independent commission established by Congress, recommended the closure of NAS Agana. As mentioned, GIAA operated the Airport under a joint agreement with the U.S. Navy. As of September 2000, GIAA property was no longer controlled by the joint-use agreement and GIAA assumed responsibility for all operations, while the Federal Aviation Administration (FAA) took over all air traffic control (ATC) responsibilities. Through the BRAC, as amended, GIAA had acquired ownership of the 1,653.33 acres of former NAS property. The agreement between the United States and GIAA pursuant to the BRAC Act of 1993 as amended, and the Federal Property and Administrative Service Act of 1949 as amended, and regulations issued pursuant thereto dictate the terms and conditions governing all Airport properties.

2.1.3 Airport Role

The National Plan of Integrated Airport Systems (NPIAS) recognizes the Airport as a primary, small hub airport within the national airport system.[11] Primary airports within the NPIAS can be divided up into four categories: large hub, medium hub, small hub, and non-hub airports. As a primary airport within the NPIAS, the Airport is eligible to receive an annual apportionment through the FAA's Airport Improvement Program (AIP). This funding is based on the number of enplaned passengers in a calendar year. Additionally, the Airport serves both passenger and cargo flights to and from the United States, Asia, Australia, and various islands in the Pacific region and serves as a hub for both Asia Pacific Airlines and United Airlines.

2.2 Airfield Facilities

The Airfield Facilities section provides a summary of the overall airfield footprint, which includes the existing runway system, taxiway system, and navigational aids (NAVAIDs).

2.2.1 Runways

The Airport has two parallel runways which are designated as 6L/24R and 6R/24L and are oriented in a northeast/southwest configuration. Runways receive their designations using the first two digits of the compass (magnetic) bearings of their approach headings and are rounded to the nearest 10 degrees. In the case of both Runway 6 ends, the runways' magnetic bearings are 64, while both Runway 24 ends have magnetic runway bearings of 244. When airfields have two or more parallel runways, or runways with the same or similar approach headings, FAA AC 150/5300-13B, *Airport Design*, requires using L (left), R (right), and C (center) designations to differentiate.

Runway 6L/24R measures 12,014 feet in length by 150 feet wide, while Runway 6R/24L, pictured in **Figure 2-3**, measures 10,014 feet in length by 150 feet wide. Both runways have 35-foot paved shoulders, and all four runway ends have runway blast pads all measuring approximately 400 feet in length by 220 feet in width.

Figure 2-3. Aircraft Departing on Runway 6R/24L

Source: ©2022 Photography by Elliott Lindgren

2.2.1.1 Displaced hresholds

A displaced threshold is a shifted runway threshold that shortens the distance available for landing on the side of the displacement. Though the reasons can vary, it is typically displaced to clear obstacles near the end of the runway. The ends of both Runway 6L and Runway 24L have displaced thresholds. The displaced threshold for Runway 6L measures 1,000 feet long while the displaced threshold for Runway 24L measures 1,004 feet long. **Table 2-1** summarizes the runway characteristics.

[11] In 2019, the base year of the Master Plan, the Airport was designated as a small, primary hub airport however, subsequently, the airport has been designated as a primary, non-hub airport in the 2023-2027 National Plan of Integrated Airport Systems (NPIAS).

able 2-1 Existing Runway Data

Runway Characteristics	Runway 6	Runway 2 R	Runway 6R	Runway 2
Runway Bearing	64º	244º	64º	244º
Length	12,014'	12,014'	10,014'	10,014'
Width	150’	150’	150’	150’
Surface Type	Asphalt-Concrete	Asphalt-Concrete	Asphalt-Concrete	Asphalt-Concrete
Surface Treatment	Good	Good	Good	Good
Surface Condition	Grooved	Grooved	Grooved	Grooved
Runway Weight Bearing Capacity[A]	S – 135,000 lbs. D – 235,000 lbs. 2S – 390,000 lbs. 2D – 780,000 lbs.	S – 135,000 lbs. D – 235,000 lbs. 2S – 390,000 lbs. 2D – 780,000 lbs.	S – 135,000 lbs. D – 235,000 lbs. 2S – 390,000 lbs. 2D – 780,000 lbs.	S – 135,000 lbs. D – 235,000 lbs. 2S – 390,000 lbs. 2D – 780,000 lbs.
Pavement Classification Number (PCN) [B]	69/F/B/X/U	69/F/B/X/U	69/F/B/X/U	69/F/B/X/U
Runway nd Latitude/Longitude	13º28’39.86” N 144º46’53.12”	13º29’30.30” N 144º48’43.45”	13º28’37.77” N 144º47’05.33”	13º29’19.82” N 144º48’37.28”
Runway nd levations	233.7’	305.0’	231.0’	301.0’
Displaced Threshold	1,000’	None	None	1,004’
Displaced Threshold Latitude/Longitude	13º28’44.07” N 144º47’02.33”	None	None	13º29’19.82” N 144º48’37.28”
Displaced Threshold levation	239.9’	None	None	293.0’
Declared Distances[C]	TORA: 12,014’ TODA: 12,014 ASDA: 12,014’ LDA: 11,014’	TORA: 12,014’ TODA: 12,014’ ASDA: 12,014’ LDA: 12,014’	TORA: 10,014’ TODA: 10,014’ ASDA: 10,014’ LDA: 10,014’	TORA: 9,714’ TODA: 9,714’ ASDA: 9,714’ LDA: 8,710’
Touchdown Zone levation (TDZ)	256.1’	305.1’	257.9’	293.0’
Runway Lighting dge Intensity	High	High	High	High
Runway Shoulders	35’ wide bituminous pavement	35’ wide bituminous pavement	35’ wide bituminous pavement	35’ wide bituminous pavement
Runway Blast Pad	Yes (400’ x 225’)	Yes (400’ x 225’)	Yes (400’ x 225’)	Yes (400’ x 225’)
Runway Centerline to Parallel Runway Centerline	700’	700’	700’	700’

Notes:
2D = Double-Dual Tandem Wheel
2S = Dual-Tandem Wheel
B = Medium Strength
D = Dual Wheel
F = Flexible
S = Single Wheel
U = Usage
X = High

Declared Distances Definitions:
ASDA = Accelerate-Stop Distance Available
LDA = Landing Distance Available
TODA = Takeoff Distance Available
TORA = Takeoff Run Available
Sources: AirNav, FAA 5010 Airport Master Record, FAA National Flight Data Center (November 29, 2021)

2.2.2 axiways

The taxiway system at the Airport connects multiple areas of the airfield together, particularly the two parallel runways with the north apron and south apron. The taxiway system at the Airport includes one partial parallel taxiway that connects the Runway 6L end with the north apron, multiple connector taxiways, (specifically between the parallel runways), and a few taxilanes within the non-movement areas. All taxiways and taxilanes are constructed with asphaltic concrete (see **Figure 2-4**). **Table 2-2** provides a summary of the existing taxiways and taxilanes at the Airport.

Figure 2-4. Aircraft Taxiing After Landing

Source: ©2022 Photography by Elliott Lindgren

able 2-2 Existing axiway/ axilane Data

axiway/ axilane Identifier	ocations/Descriptions	Width	Paved Shoulder Width
A	Connects Taxiway K and Runway 6L/24R Connects Runway 6L/24R and Runway 6R/24L	150’ 150’	35’ 35’
B	Connects Runway 6L/24R and Runway 6R/24L	75’	0’
C	Connects Taxiway K with Runway 6L/24R	125’	30’
D	Connects Taxiway K and Runway 6L/24R Connects Runway 6L/24R and Runway 6R/24L Connects Runway 6R/24L with the south apron	125’ 75’ 75’	30’ 0’ 0’
	Connects Taxiway K and Runway 6L/24R Connects Runway 6L/24R and Runway 6R/24L Connects Runway 6R/24L with the south apron	125’ 75’ 75’	30’ 0’ 0’
F	Connects Runway 6L/24R and Taxiway K	115’	30’
G	Connects the north apron and Taxiway K with Runway 6L/24R Connects Runway 6L/24R and Runway 6R/24L Connects Runway 6R/24L with the south apron	115’ 150’ 75’	30’ 0’ 0’
J	Connects Runway 6L/24R and Runway 6R/24L Leads into Taxiway L and the north apron	150’ 75’	0’ 35’
K	Partial parallel taxiway for Runway 6R/24L	75’	35’
K	Starts at the non-movement area and runs along the south side of the north apron	75’	35’
L	Connects Taxilanes K and J with Gates 20 and 21 along the east and north side of the north apron Wraps around the north side of the north apron and services Gates 13, 15, 17, and 19	75’ 75’	35’ 25’
South Apron	Runs parallel to Taxiway G between the non-movement area along Taxiway D and the edge of apron Starts at the non-movement area along Taxiway D and ends at the nose dock hangar area	148’ 56’	0’ 0’

Sources: Antonio B. Won Pat International Airport, Airport Diagram

2.2.3 Navigational Aids

NAVAIDs assist pilots to ensure the safe, efficient, and coordinated movement of aircraft throughout the National Airspace System (NAS). At an airport, NAVAIDs are typically divided into visual, instrument, and weather aids.

2.2.3.1 Visual Aids

Airport visual aids assist pilots during visual approaches, which occurs in clear daytime and clear nighttime conditions, and during the last segment of an Instrument Flight Rules (IFR) approach. Approach Lighting Systems (ALS), Precision Approach Path Indicator (PAPI), and other types of lighting systems are used as visual guides in the final approaches to runways as support aids to electronic NAVAIDs.

All four runway ends are currently equipped with PAPI boxes to provide vertical guidance on approach and the Runways 6L and 6R ends are each equipped with a Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR) approach system. The MALSRs provide pilots with visual cues concerning aircraft alignment, height above the ground, and position relative to the runway end or threshold. The Airport also contains one lighted, rotating beacon located on top of the commercial passenger terminal building. The beacon flashes green and white lights indicating the location of the Airport.

2.2.3.2 Instrument Aids

In order to fly during poor weather and low visibility conditions, airports must be equipped with the appropriate instrumental NAVAIDs. Pilots use Instrument Approach Procedures (IAPs), which can be divided into three classifications: Precision Approaches (PA), Non-Precision Approaches with Vertical Guidance (APV), and Non-Precision Approaches (NPA). PAs and APVs provide both lateral and vertical guidance while NPAs provide just lateral guidance.

The instrument aids located at or around the Airport include:

- Localizer (LOC) – q uipped with Distance Measuring quipment (DM) Antenna (2)
- Glide Slope (GS) Antenna (2)
- Very High Frequency Omnidirectional Range Collocated Tactical Air (VORTAC) (1)
- Non-Directional Beacon (NDB) (1)

Along with physical instrument NAVAIDs, certain runway ends utilize Area Navigation (RNAV) approach procedures, which use Global Positioning System (GPS) and Required Navigation Performance (RNP) technology. RNAV (GPS) uses global positioning systems to guide navigation, while RNAV RNP requires on-board monitoring equipment to advance performance and accuracy. **Table 2-3** summarizes the existing NAVAIDs, IAPs, and instrument approach minimums at the Airport.

2.2.3.3 Weather Aids

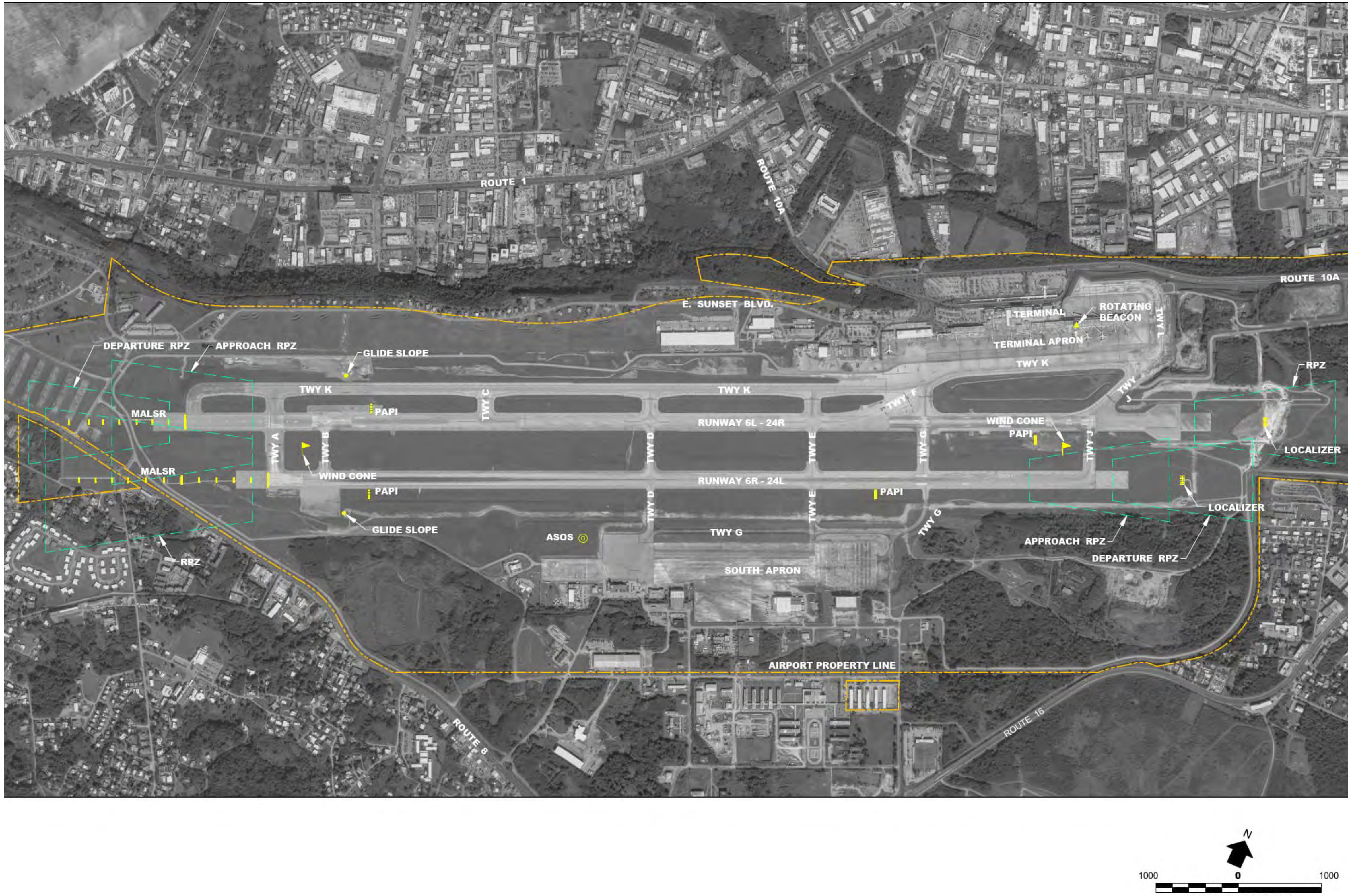
Weather aids help to accurately measure the cloud coverage, ceiling, visibility, wind speed, direction, temperature, and dew point at and around an airport. One weather aid at the Airport is an Automated Surface Observing System (ASOS), located near the South Apron in front of the GA apron. The ASOS provides pilots and air traffic controllers (ATCs) with current meteorological information at and in the vicinity of the Airport. Additionally, the Airport has two lighted wind cones, both located between the parallel runways, toward the end of each runway. **Figure 2-5** shows the locations of the existing runways, taxiways, and NAVAIDs at the Airport.

able 2-3 Navigational Aids, Approach ypes, and Approach Minimums

Runway	Visual Approach Aids[A]	Instrument Approach Aids[B]	Instrument Approaches – ype of Approach[C]	Instrument Approach Minimums[D]
Runway 6L	4-Light PAPI on Left MALSR	LOC/DM GS Antenna VORTAC	CAT I ILS – PA LOC – NPA RNAV (RNP) – APV RNAV (GPS) – APV VOR – NPA TACAN – NPA VOR A – NPA	590-1/2 SM 1,100-3/4 SM 511-1/2 SM 720-1/2 SM 760-1/2 SM 760-1/2 SM 880-1 SM
Runway 24R	4-Light PAPI on Left	NDB VORTAC	RNAV (RNP) – APV RNAV (GPS) – APV VOR – NPA TACAN – NPA NDB – NPA VOR A – NPA	1,014-2 1/2 SM 1,160-1 SM 1,180-1 SM 1,180-1 SM 1,220 – 1 1/4 SM 880-1 SM
Runway 6R	4-Light PAPI on Right MALSR	LOC/DM GS Antenna VORTAC	CAT I ILS – PA LOC – NPA RNAV (RNP) – APV RNAV (GPS) – APV VOR A – NPA	603-3/4 SM 980-3/4 SM 508-1/2 SM 980-3/4 SM 880-1 SM
Runway 24L	4-Light PAPI on Left	VORTAC	RNAV (RNP) – APV RNAV (GPS) – APV VOR A – NPA	1,103-2 3/4 SM 1,180-1 1/4 SM 880-1 SM

Notes:
Visual Approach Aids:
MALSR = Medium-Intensity Approach Lighting System with Runway Alignment Indicator Lights
PAPI = Precision Approach Path Indicator
Instrument Approach Aids:
LOC = Localizer
GS = Glide Slope
DME = Distance Measuring Equipment
VORTAC = Very High Frequency Omnidirectional Range Collected Tactical Air
NDB = Non-Directional Beacon
Sources:
AirNav, FAA 5010 Airport Master Record, FAA National Flight Data Center (November 29, 2021)
FAA Airport Data and Information Portal (ADIP)

Instrument Approach Types:
CAT I ILS = Category I Approach that has a Runway Visual Range (RVR) of at least 2,400’
LOC = Localizer
RNAV (RNP) = Area Navigation (Required Navigation Performance)
RNAV (GPS) = Area Navigation (Global Positioning System)
VOR = Very High Frequency Omnidirectional Range
TACAN = Tactical Air Navigation
NDB = Non-Directional Beacon
PA = Precision Approach
APV = Approach Procedure with Vertical Guidance
NPA = Non-Precision Approach
Instrument Approach Minimums:
SM = Statute Mile



Source: AECOM

Figure 2-5. Existing Airfield

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2.3 Airspace and Air raffic Control Data

The NAS is a safe, yet complex system as it helps network both controlled and uncontrolled airspace. This section establishes the conditions and unique aircraft activity within and around the Airport's airspace, airspace classification, information on nearby airports, and the ATC facility at the Airport.

2.3.1 Airspace Classification

The NAS separates airspace into controlled and uncontrolled airspace and is further divided into Classes A through G (excluding F) where all but Class G airspace is considered controlled airspace. Additionally, the NAS consists of special use airspace, which involves airspace wherein activities must be confined because of their nature, or limitations, are imposed upon aircraft operations that are not a part of those activities, or both. Due to the Airport's close proximity to Andersen Air Force Base (AAFB), special use airspace is common in this area.

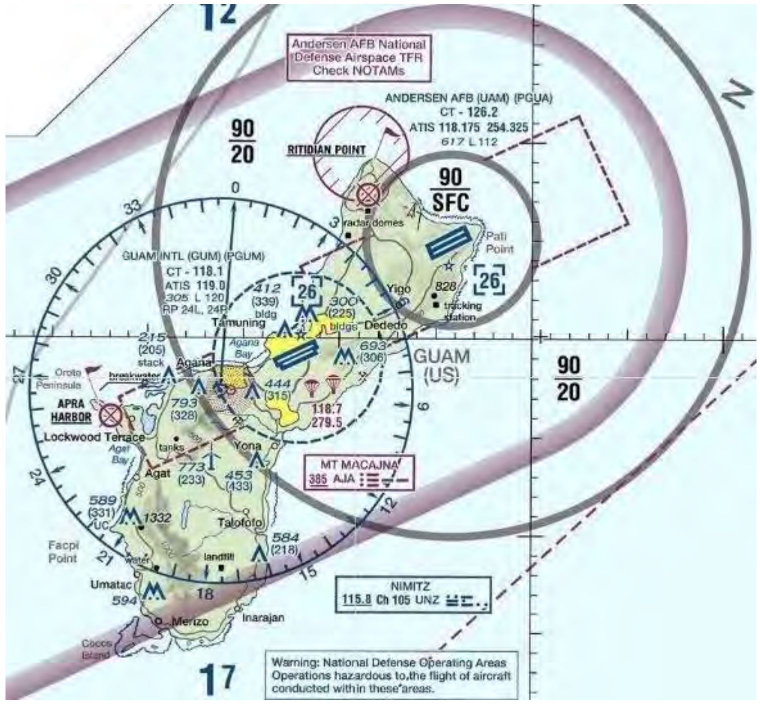

Figure 2-6. Guam Sectional Chart

Source: SkyVector

Special use airspace includes:

- Military Operations Areas (MOAs)
- Prohibited Areas
- Restricted Areas
- Warning Areas
- Alert Areas
- Controlled Firing Areas

The Airport is surrounded by Class D airspace (see **Figure 2-6**). This airspace around the Airport starts at the surface and has a ceiling of 2,600 feet above the Airport elevation (measured in AMSL). The configuration of each Class D airspace area is individually tailored, and when instrument procedures are published, the airspace will normally be designed to contain the procedures.[12] a ch aircraft in Class D airspace must be equipped with two-way radio communications and a 4096-code transponder. These aircraft must maintain communication with ATC prior to entering and while actively flying in Class D airspace.

[12] https://www.faa.gov/air_traffic/publications/atpubs/aim_html/chap3_section_2.html

2.3.2 Surrounding Airports

Due to Airport's unique location, there are only a few neighboring airports, with only one other on the island of Guam. These airports within a 150 nm radius of the Airport include:

- Andersen Air Force Base (PGUA)
- Benjamin Taisacan Manglona (Rota) International Airport (PGRO)
- Tinian International Airport (PGWT)
- Francisco C. Ada/Saipan International Airport (PGSN)

As mentioned, AAFB, located just 11 miles northeast of the Airport, has a major impact on the airspace around the island. Not only is this Air Force Base (AFB) located close to the Airport, but the AFB conducts multi-national military training exercises throughout the year, creating strict Temporary Flight Restrictions (TFRs). When TFRs are active, they can create a large overlap with the Airport's Class D airspace.

The other airports that surround the island of Guam, shown in **Figure 2-7**, also play a large part in Airport airspace. Specifically, inner island travel through airlines like Micronesian Air Cargo Services (MACS), Arctic Circle Air, and Star Marianas Air. These airlines serve Saipan, Tinian, and Benjamin Taisacan Manglona Rota International Airports.

Figure 2-7. Surrounding Airports

Source: AECOM and Google Earth

2.3.3 Air raffic Control

Figure 2-8. Airport Traffic Control Tower

Source: ©2022 Photography by Elliott Lindgren

The Airport Traffic Control Tower (ATCT), shown in **Figure 2-8**, sits roughly mid-field, south of the airfield and on the southwest side of the south ramp. The facility houses the ATCT, Guam Combined n Route Approach Control (C R AP) (ZUA), which includes the Guam Air Route Traffic Control Center (ARTCC) and the Guam Terminal Radar Approach Control (TRACON). Owned and operated by the FAA, the Guam C R AP is responsible for nearly 260,000 square miles of airspace and provides air traffic services for the Airport, AAFB, and the airports in the Northern Mariana Islands, which include Rota, Saipan, and Tinian. Additionally, the C R AP supports military exercises such as Cope North, Rim of the Pacific (RIMPAC), and Valiant Shield.[13]

[13] https://medium.com/faa/guam-air-traffic-control-center-supports-multinational-air-exercises-e94999d57c6a

2.4 Commercial Passenger erminal

The Antonio B. Won Pat Guam International Air Terminal, completed in 1982, is the main commercial passenger terminal for both inter-island (commuter) flights and major international airline flights. This four-level facility consists of approximately one million square feet of space with 17 contact gates and one bus gate. An upper-level corridor was constructed in 2021 to facilitate international passenger movement to immigration and customs areas without having to intermingle with departing passengers.

Pictured in **Figure 2-9**, the commercial passenger terminal building is constructed of reinforced concrete and steel structures, with large panel glazing with steel framing. The roof line and architectural design of the terminal depicts the characteristics of ancient canoes called Proa, used by native Chamorros to travel within the Micronesian Islands.

Below is a list of some of the commercial passenger terminal areas.

- Check-In/Ticketing Counters
- Security Screening
- Holdrooms
- Restaurants
- Specialty Retail Concessions
- Food Concessions
- Bar/Lounge
- Public Restrooms
- Customs and Immigration
- Baggage Claim Lobby
- Rent-A-Car/Tour Counters
- Airport Administrative Offices
- Airport Airline Offices
- Transportation Security Administration (TSA) Offices
- Airport Police
- Airport Security

Figure 2-9. Airport Passenger Terminal

Source: ©2022 Photography by Elliott Lindgren

2.4.1 evel 1 – Basement evel

The basement level, pictured in **Figure 2-10**, consists of the baggage claim lobby, the Guam Customs and Quarantine Agency (CQA) screening area and offices, the car rental offices, and the arrivals lounge. In addition, the GIAA Airport police station, known as the “Arcade,” is located there along with the Lotte Duty Free warehouse and main loading dock area located toward the western end of the Airport basement level.

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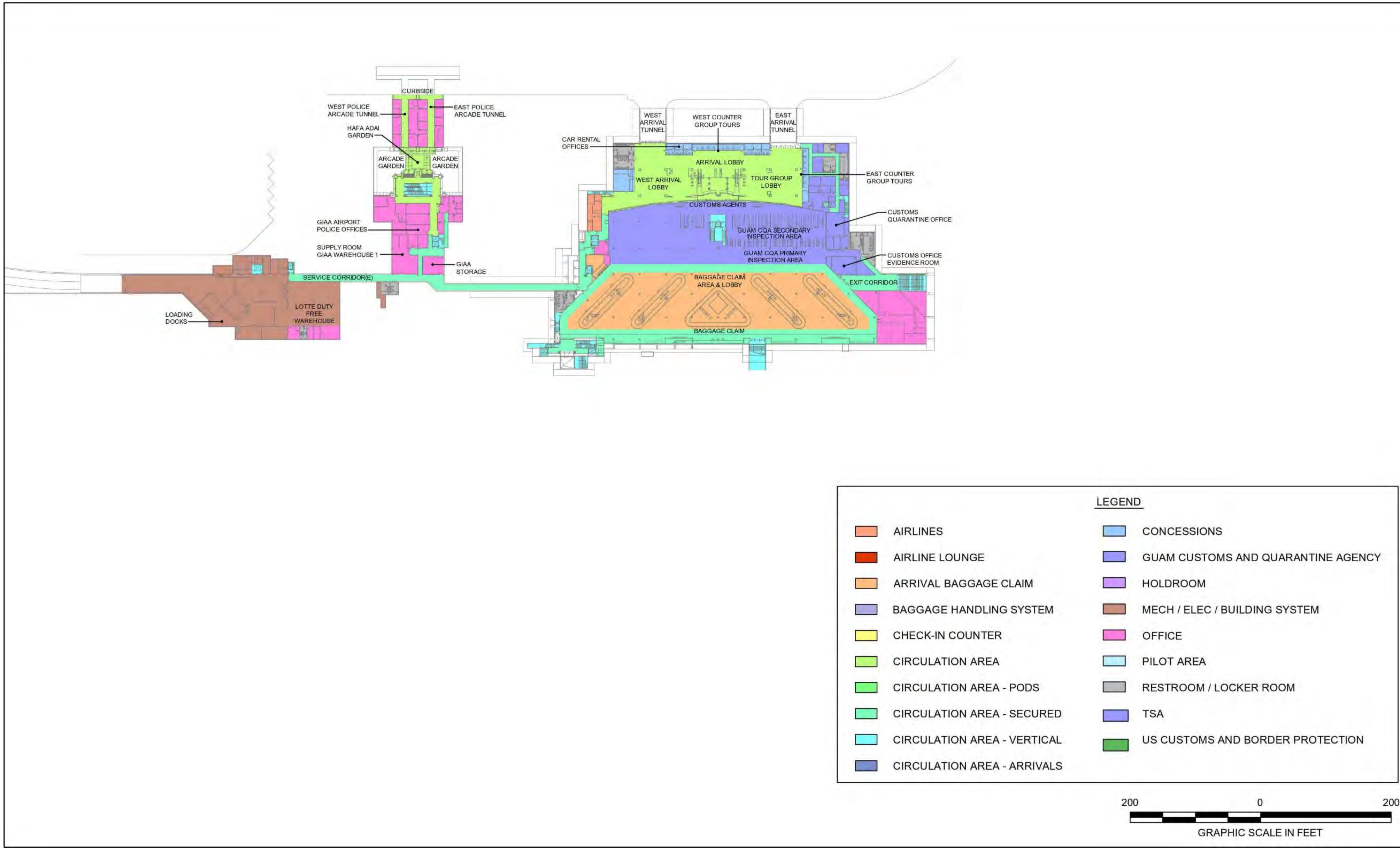

Source: AECOM and E.M. Chen

Figure 2-10. Commercial Passenger Terminal – Basement Level

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2.4.1.1 Baggage Claim obby

The baggage claim lobby has five carousels and one oversize baggage conveyor located at the back wall. Internationally arriving passengers enter the baggage claim lobby from the U.S. Customs and Border Protection (CBP) immigration inspection area located on the concourse level toward the center of the lobby, while domestic arriving passengers enter the lobby from the stairs located at the southwest corner between Gates 8 and 9. Once arriving passengers retrieve their luggage, they proceed to the Guam CQA screening primary inspection area toward the northeast portion of the lobby and exit the lobby out toward the arrivals lobby.

2.4.1.2 Guam CQA Screening Area

The Guam CQA screening area is located at the northeast portion of the basement. This area includes the primary and secondary inspection areas and is located adjacent to the baggage claim lobby. Currently, there are 22 primary inspection booths and 18 secondary inspection lanes. The Guam CQA offices are located on the east side of the arrivals lobby behind the east group tour counters and toward the northeast area of the baggage lobby. This area also contains the Guam CQA evidence room.

2.4.1.3 Arrivals obby

Arriving passengers enter the lobby through the central portion of the commercial passenger terminal via a secured door after retrieving their luggage and clearing through Guam CQA. The southwest arrival lobby acts as a waiting area for passengers who need taxis, are waiting for a Transportation Network Company (TNC) vehicle, or are being picked up by friends or relatives. The northeast tunnel is mainly used by tour companies and leads to the tour bus, tour van, and rental car parking area.

2.4.1.4 Car Rental and Group our Offices

The car rental offices are located opposite the customs area. Currently, six rental car companies are stationed at the Airport. These include Avis Rent A Car, Budget Car Rental, Dollar Rent A Car, Hertz Rent A Car, National Car Rental, and Nissan Rent-A-Car, Guam. The rental car vehicles are located outside the east tunnel toward the northeast parking lot. Both the east and west group tour counters contain various services such as money exchanges and hosts the group tour companies such as Guam Sanko Transportation, PMT Guam Corporation, and H.I.S. Guam. Additionally, public restrooms and the United Airlines baggage claim office are located near the southwest corner of the lobby.

2.4.1.5 af a Adai Garden and GIAA Airport Police

The central part of the basement level contains GIAA Airport police offices and is also the main access point between the commercial passenger terminal entrance and the employee and public parking lots. Inside, an escalator leads up to the departures hall. There are additional Airport offices located toward the south side, as well as the GIAA supply room warehouse and employee lounge. This is also the access point to the service corridor that leads from the west loading dock toward the arrivals lobby and customs area.

2.4.1.6 Maintenance Areas

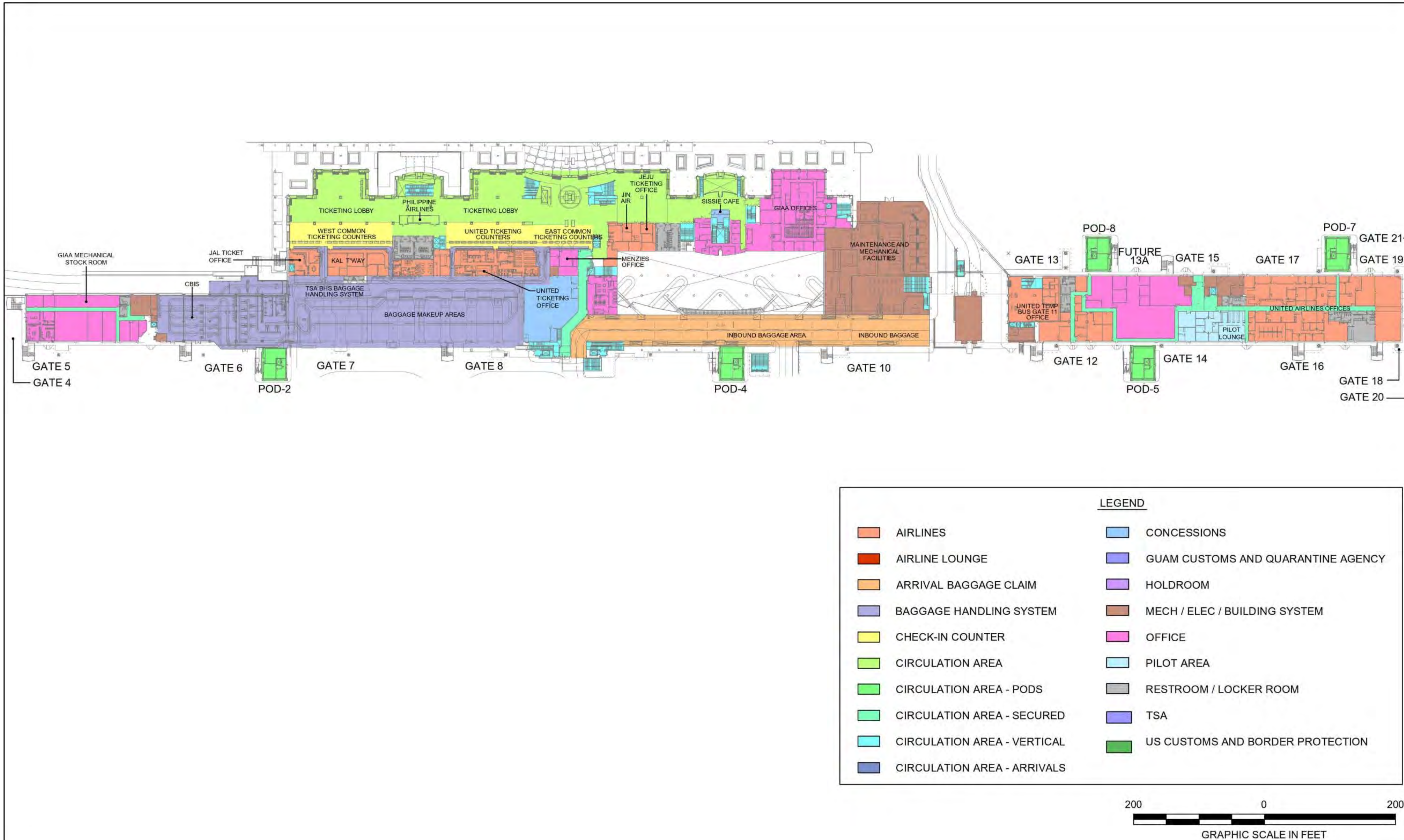
The maintenance warehouse supply room and generator/transformer/electrical rooms are located on the ground floor of the commercial passenger terminal. These rooms provide backup electrical power for the facility.

2.4.1.7 oading Dock Area

The loading dock area consists of two truck loading/unloading docks, both with dock levelers. The loading dock is accessed from the west off Tiyan Parkway (. Sunset Boulevard), just south of the upper employee parking lot. This area has a narrow access road leading in and out of the loading docks. Additionally, the loading dock area is also the location for trash pickup and is known to cause congestion.

2.4.2 evel 2 – Apron evel

The apron level, shown in **Figure 2-11**, consists of the departure level drop-off curb, the ticketing/check-in counters, office spaces for various airline agencies, a small restaurant located on the landside, the inbound baggage drop-off area, the outbound baggage handling system, and multiple GIAA offices.



Source: AECOM and E.M. Chen

Figure 2-11. Commercial Passenger Terminal – Apron Level

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2.4.2.1 icket Counter obby

The ticket counter lobby, shown in **Figure 2-12** and **Figure 2-13**, is comprised of two main areas separated by a restroom facility and offices. There are 88 check-in/ticketing counters, 44 on the east side of the lobby and 32 on the west side of the lobby. Ticket counters are numbered from east to west. Counters 1-18 are common-use ticket counters. United Airlines occupies counters 19-40; 19-23 for group and military check-in, 24-28 for Premier Access, and 29-40 for co nomy. Full-service ticket counters have been replaced with self-service kiosks at counters 27-38. Counters 45-66 are common use, and 41-44 and 67-76 are currently not in use. Baggage check is available at all 76 check-in counters. Currently, China Airlines, Korean Air, and Philippine Airlines all share similar counter space.

There are an additional six counters (not numbered) which include 12 check-in positions located in the entry vestibules that are not connected to the baggage conveyors. These were added when the Airport was operating at maximum capacity. Baggage checked at these counters are collected and manually carted to the baggage handling system.

Figure 2-12. Self-Service Check-In Kiosks

Source: ©2022 Photography by Elliott Lindgren

Figure 2-13. West Common Ticketing Counters

Source: ©2022 Photography by Elliott Lindgren

2.4.2.2 Baggage a ndling Facilities

Behind the ticket counters and associated airline ticket offices is the outbound baggage handling system. This system includes a checked baggage inspection system (CBIS) to the west. Once the bags are inspected, the conveyors take the baggage to the make-up area where they are loaded on to tugs and delivered to the aircraft as shown in **Figure 2-1** .

The inbound baggage drop-off area is located toward the east side of the terminal and above baggage claim. This area is accessed from an internal tug drive running parallel to the concourse between Gates 9 and 12.

Figure 2-14. Baggage Make-up Area

Source: ©2022 Photography by Elliott Lindgren

2.4.2.3 Office Spaces

There are several office spaces located throughout the apron level that are used by various tenants and Airport staff. On the west side of the commercial passenger terminal building, between Gates 4 and 6, there are several airline operations office spaces. Behind and to the east of the ticketing counters are airline ticket offices. This is also the location of the Lotte Duty Free warehouse and lounge. Beyond the escalators is a small concessionaire, Sissie Café. Behind the café are several vacant office spaces, and just east of the café are the GIAA offices. The east side of the commercial passenger terminal building on the apron level, between bus Gate 11 and the eastern end of the terminal, includes offices currently occupied by United Airlines.

2.4.2.4 Main Electrical and Mechanical Facilities

The commercial passenger terminal's main mechanical and electrical level is located behind the GIAA offices. This area contains the electrical room, switchgear, generators, chillers, air handling unit (AHU) room, transformers, and cooling towers. The cooling towers are in an exterior yard that can be accessed from the reserved parking lot. The four generators provide sufficient power to run the terminal with 24 hours of fuel. These generators are powered by jet fuel that can be pumped directly from the fuel farm to the tank within the generator room.

2.4.3 evel 3 – Concourse evel

The concourse level includes the security screening checkpoint (SSCP), shopping area, food court, airline lounges, and holdrooms. Additionally, the Federal Inspection Services (FIS)/U.S. CBP area is located on this level, as well as CBP and TSA offices. The concourse is linear, extending from Gate 4 on the southwest end to Gate 21 on the northeast end. The entrance to the concourse area is located in the center between Gates 8 and 9. Photos of the concourse area are show in **Figure 2-1** and **Figure 2-16** and the floor plan for the concourse level is displayed in **Figure 2-1** .

Figure 2-15. Concourse Level Circulation Area

Source: ©2022 Photography by Elliott Lindgren

Figure 2-16. Concourse Level Artwork

Source: ©2022 Photography by Elliott Lindgren

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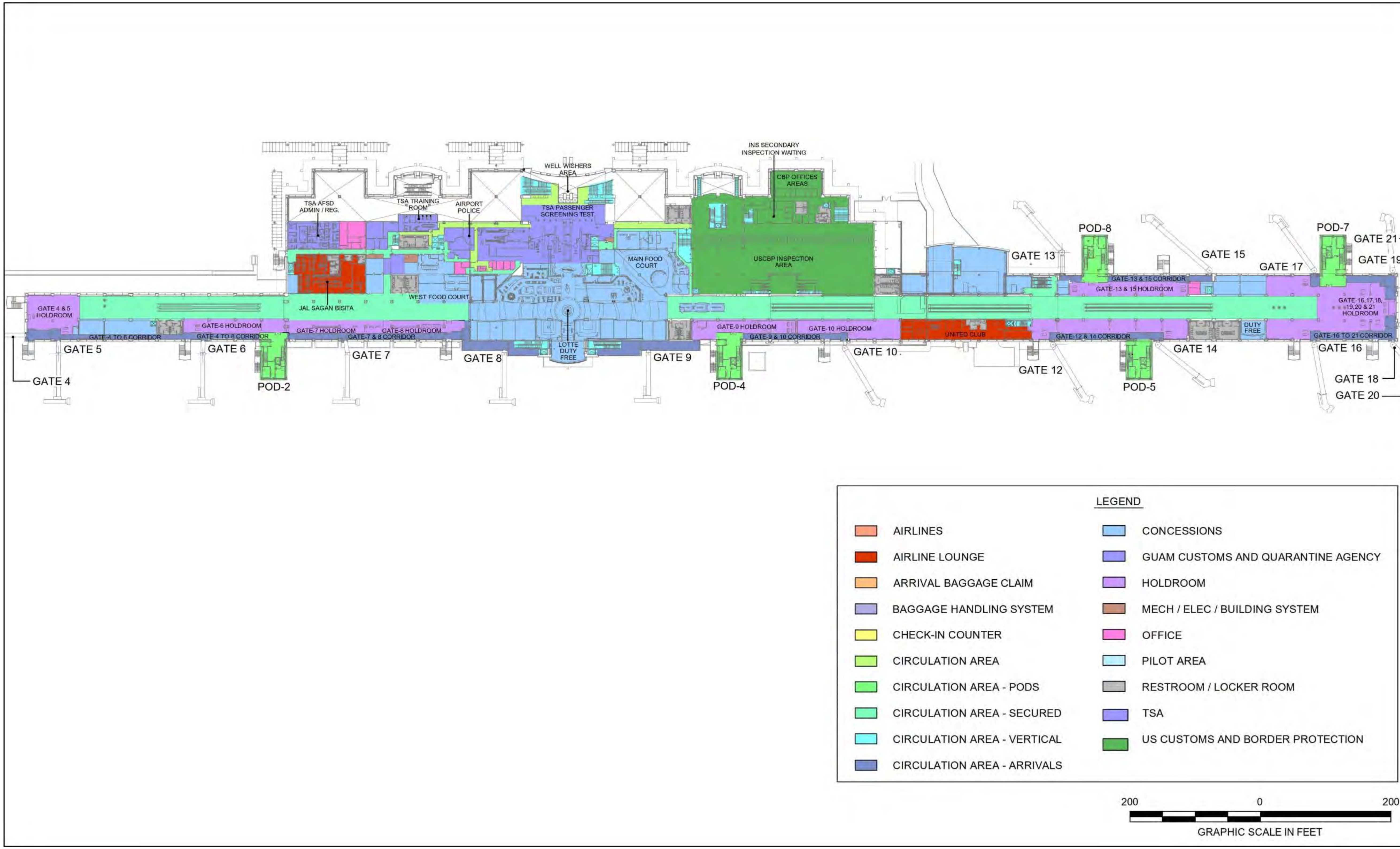

Figure 2-17. Commercial Passenger Terminal – Concourse Level

Source: AECOM and E.M. Chen

2.4.3.1 Security Screening Checkpoint

The SSCP is centrally located and is accessible by elevator or two flights of stairs on opposite sides. The SSCP has seven security screening booths. The security booth located farthest to the west is dedicated to passengers with Known Traveler Numbers (KTNs) (i.e., TSA pre-check lanes); however, there are no dedicated screening lanes for passengers with KTNs.

Prior to 2019, there were five security screening lanes at the SSCP. During peak periods, passenger queues would encompass the entire queuing area and extend down the stairs into the check-in/ticketing lobby on the apron level. In 2019, two additional security screening lanes were opened on the west side of the screening area, bringing the total to seven lanes. a ch two-lane or one-lane module includes Checkpoint Property Screening Systems (CPSS) units for carry-on baggage screening, and walk-through metal detectors (WTMD) and Advanced Imaging Technology (AIT) for passengers and staff. Additionally, there are TSA administrative offices located to the west of the screening area.

2.4.3.2 Concessions

Lotte Duty Free is the current tenant utilizing the main shopping area inside the concourse. They operate in the main concession space located between Gates 8 and 9 and a second, smaller space on the east side of the commercial passenger terminal between Gates 14 and 16. In addition to Lotte, there are additional smaller spaces available for future tenants currently not being utilized.

Figure 2-18. Terminal Food Court

Source: ©2022 Photography by Elliott Lindgren

The main food court, pictured in **Figure 2-1** , is located to the east of the shopping area. Seven tenants at the food court share a common dining/seating area. There is a smaller food court to the west of the shopping area which contains two restaurants: Clippers Lounge, pictured in **Figure 2-19**, and Oasis Cafe/Ramen Ya.

2.4.3.3 Airline ounges

There are two airport lounges: the United Club and the Japan Airlines Sagan Bisita. The United Club is located on the east side of the commercial passenger terminal between Gates 10 and 12. There are plans to move the United Club to the opposite side of the concourse between Gates 13 and 15. Japan Airlines Sagan Bisita is located on the west side of the shopping area across from Gate 7. Both lounges have restrooms and dining facilities for their customers.

Figure 2-19. Clippers Lounge Sign

Source: ©2022 Photography by Elliott Lindgren

2.4.3.4 o ldrooms

The concourse level includes eight holdroom areas which are mostly shared among multiple gates. The holdrooms are located at Gates 4-5, 6, 7-8, 9, 10, 12 and 14, 13 and 15, and 16-21.

2.4.3.5 Federal Inspection Services/Customs and Boarder Protection

The FIS/CBP primary inspection/processing area is located across from Gates 9 and 10. With the completion of the sterile corridor on Level 4, international passengers arriving on the concourse level are directed up to the sterile corridor through the vertical pods, namely Pod-2, Pod-4, Pod-5, Pod-7, and Pod-8, and then enter the immigration area on the concourse level in the middle portion of the sterile corridor. The immigration area has 48 inspection booths, numbered 23 to 70, arranged in a linear pattern from west to east. The western-most booths are designated for passengers with Global n try. The secondary inspection/processing area, holdrooms, and various offices are located behind the inspection counters. Once past the inspection area, passengers transition down to the basement level to baggage claim and customs. CBP also has inspection counters and holdrooms located at Gates 8, 9, and 10 for departing passengers.

2.4.4 evel – International Arrivals

The recently completed (2021) international arrivals corridor on Level 4, shown in **Figure 2-21**, provides a sterile corridor that leads international arriving passengers and crew to the FIS/CBP processing area and prevents physical contact with other types of passengers, the general public, and unauthorized airline and Airport employees. Before the completion of this sterile corridor, passengers were separated by temporary movable partitions placed throughout the Airport. The sterile corridor leads passengers toward the center part of the terminal, which transitions down to the FIS/CBP primary inspection/processing area.

Figure 2-20. Vertical Circulation Pod

Source: ©2022 Photography by Elliott Lindgren

The upper-level sterile corridor can be accessed from five newly built vertical circulation pods (**Figure 2-2**), which include stairs, escalators, and elevators. There are two moving walkways located along the corridor: one located at the east end of the terminal building by Pod-7 and the other at the west end of the terminal building by Pod-2. There are plans to build three additional pods in the future.

Table 2-4 summarizes the commercial passenger terminal space allocation.

Figure 2-21. Commercial Passenger Terminal – International Arrivals Corridor Level

Source: AECOM and E.M. Chen

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able 2-   Existing Commercial Passenger   erminal Space

Space	Basement evel	Apron evel	Concourse evel	International Arrivals Corridor evel
Airlines	1,254	43,805	-	-
Airline Lounge	-	-	11,104	-
Arrival Baggage Claim	36,130	25,928	-	-
Baggage Handling System	-	60,579	-	-
Check-In Counter	-	19,136	-	-
Circulation Area	28,886	43,483	4,931	-
Circulation Area – Pods	-	10,413	14,678	11,912
Circulation Area – Secured	30,615	9,929	59,125	-
Circulation Area – Vertical	7,744	13,199	11,151	3,471
Circulation Area – Arrivals	-	-	19,112	30,203
Concessions	4,453	7,218	68,401	-
Guam Customs and Quarantine Agency	38,586	-	-	-
Holdroom	-	3,137	44,853	-
Mechanical/ lectric/Building System	24,511	32,506	523	20,593
Office	22,451	42,388	3,147	6,921
Pilot Area	-	4,713	-	-
Restroom	5,799	8,745	11,092	832
Transportation Security Administration	-	-	23,969	-
U.S. Customs and Border Protection	-	-	40,255	-
otals	**2 , 29**	**32 ,1 9**	**312,3 1**	**3,932**

Notes: All quantities are measured in square feet.
Source: AECOM

2.4.5 Commercial Passenger   erminal Aircraft Parking

Figure 2-22. Aircraft Parked at Gate 7

Source: ©2022 Photography by Elliott Lindgren

The commercial passenger terminal, located on the north apron, has 18 aircraft gates: 17 contact gates (Gates 4-10 and 12-21 – Gate 7 pictured in **Figure 2-22**), and one remote gate (Gate 11 – used as a bus gate, where passengers take a bus to Stand 3) that are positioned along the concourse in a linear fashion starting on the west side and wrapping around the concourse at the east end towards the north end. Gates 1-2 are reserved for aircraft parking at the light aircraft commuter terminal and along with Gate 3, do not consist of passenger boarding bridges (PBBs) connected to the commercial passenger terminal.

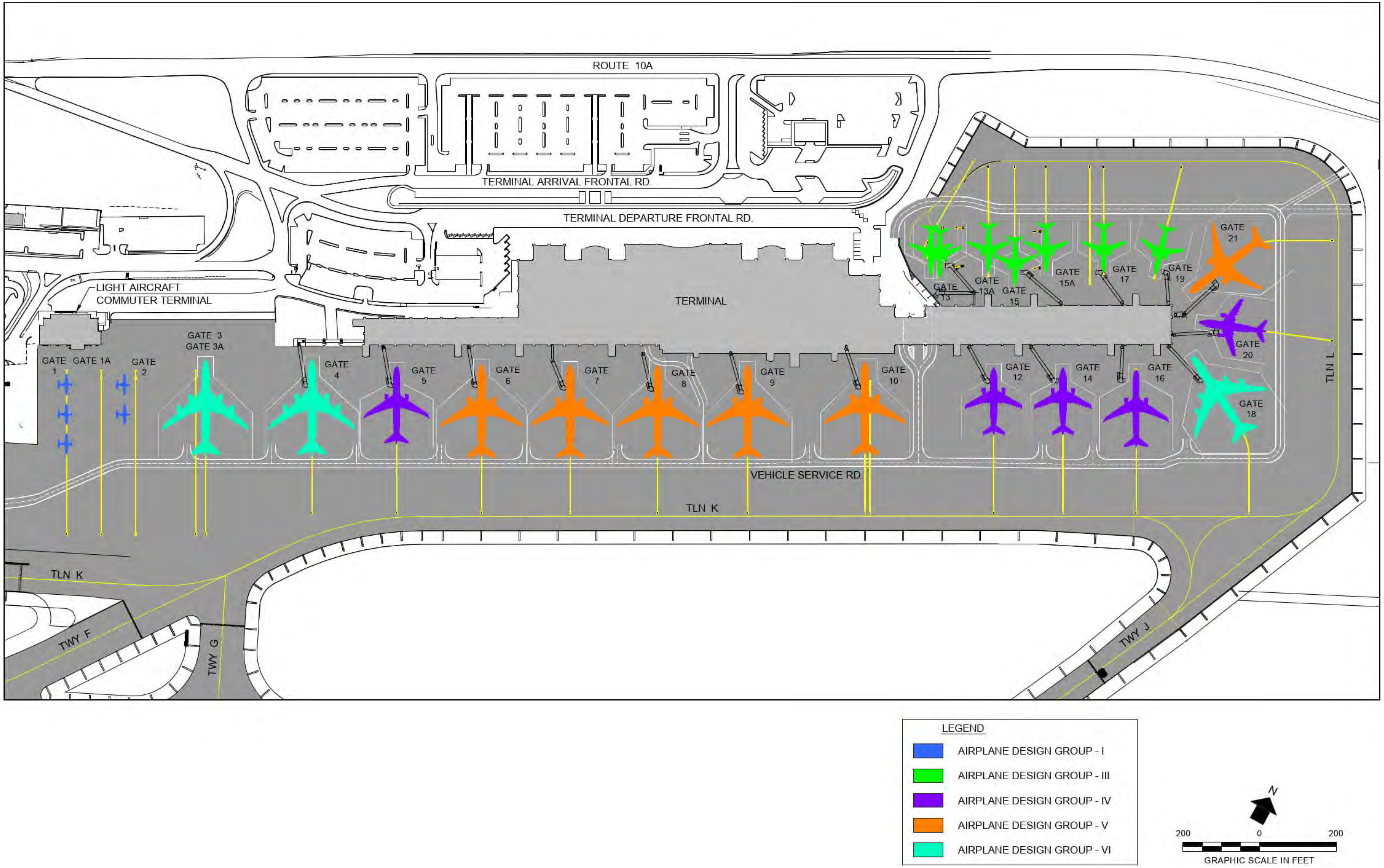
As shown in **Figure 2-23**, existing gates that make up the commercial passenger terminal apron can accommodate aircraft between Airplane Design Group (ADG) III (aircraft with tail heights between 30 and 45 feet and wingspans between 79 and 118 feet) and ADG VI (aircraft with tail heights between 66 and 80 feet and wingspans between 214 and 262 feet) aircraft.[14] Gate 11 is the only gate along the commercial passenger terminal not served by a PBB, and instead consists of a walk-out stand.

2.4.6 South Apron Aircraft Parking

The south apron is comprised of two main aircraft parking areas. The eastern portion of the south apron are nine, hardstand aircraft parking positions. These positions are aligned linearly, numbered S1-S9, and labeled from east to west. All parking positions can accommodate ADG V designated aircraft (aircraft with tail heights between 60 and 66 feet and wingspans between 171 and 214 feet) except position S4, which can accommodate aircraft designated ADG IV (aircraft with tail heights between 45 and 60 feet and wingspans between 118 to 171 feet).[15] Aircraft that are parked in this area of the south apron are typically air cargo or GA aircraft associated with the HC-5 or VQ-1 hangars. The tenants that utilize these hangars also perform aircraft maintenance which is performed either within the hangars or on the apron. **Figure 2-24** depicts aircraft parked along this portion of the south apron.

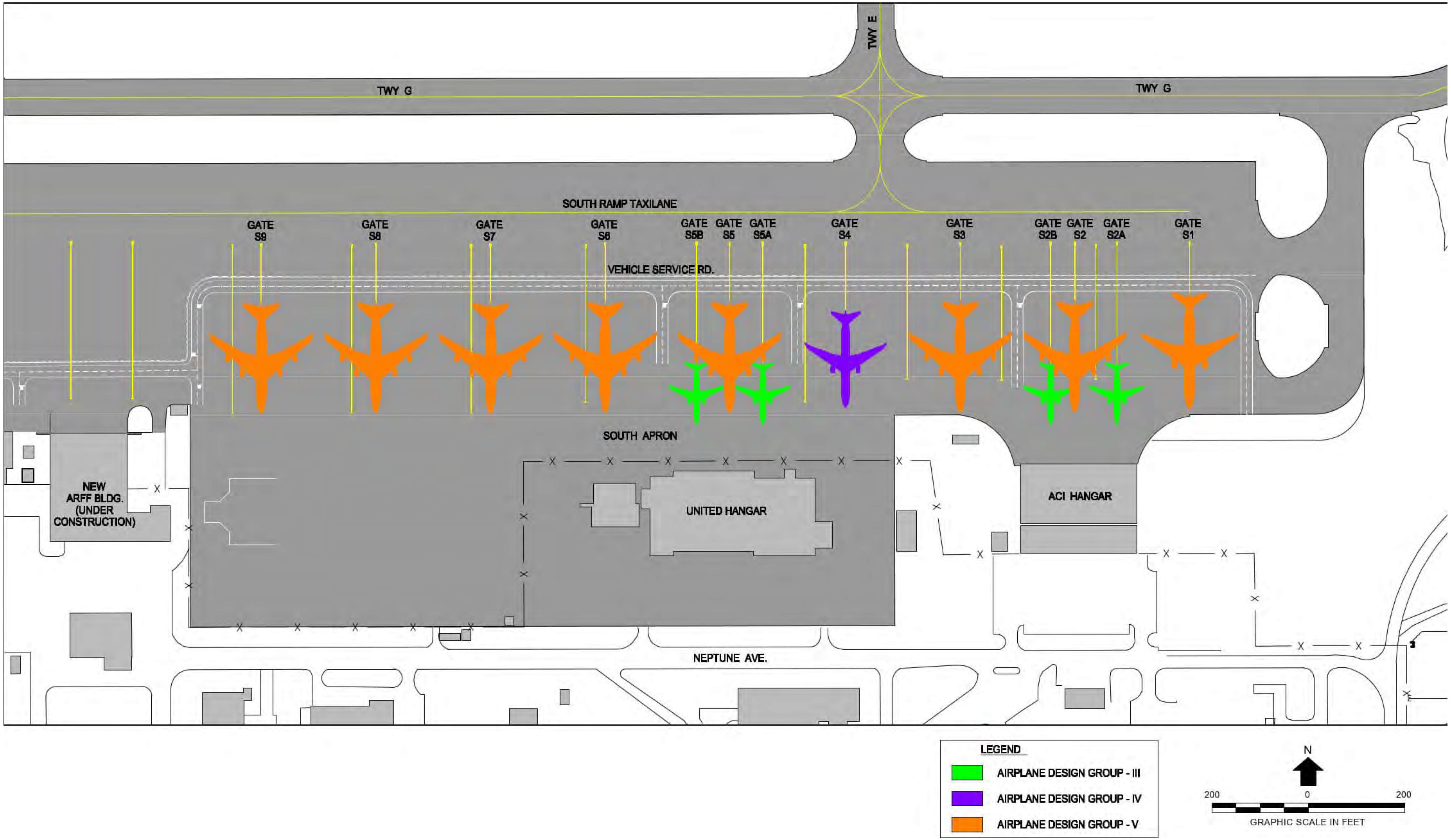
The western side of the south apron is designated for smaller, transient, GA aircraft, not larger than ADG III sized aircraft (aircraft with tail heights between 30 and 45 feet and wingspans between 79 to 118 feet).[16] This apron area totals more than 2,825 square feet and is home to the Nose Dock Hangar. The majority of aircraft parked here belong to tenants that offer services such as flight training, drone/small Unmanned Aircraft Systems (UAS) training, skydiving, sightseeing, and non-scheduled operations (such as air cargo, air charter, and air taxi flights). Aircraft parked in this area are typically tied-down and similar to the eastern portion of the south apron, aircraft maintenance may be performed on the apron as well.

[14] Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5300-13B, *Airport Design*
[15] Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5300-13B, *Airport Design*
[16] Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5300-13B, *Airport Design*



Source: AECOM

Figure 2-23. Commercial Passenger Terminal and Light Aircraft Commuter Terminal Parking Along the North Apron



Source: AECOM

Figure 2-24. South Apron Aircraft Parking

2.5 andside Facilities

The Landside Facilities section discusses the roadways, vehicle parking, and traffic patterns at the Airport.

2.5.1 Regional Access

Public entry to the commercial passenger terminal building is accessed through Tiyan Parkway (. Sunset Blvd), which connects the western portion of Route 8 in Lower Barrigada to Route 10A. Tiyan Parkway was completed in 2015, allowing the closure of Central Avenue, which was situated in the Runway Safety Area (RSA) beyond the Runway 6L end. The majority of Tiyan Parkway is a two-lane road that widens into five lines at the intersection of Route 8. Tiyan Parkway also widens as the road passes the United Airlines office building, providing a central lane, but transitions back to a two-lane road as it intersects Route 10A.

Airport access is also available through Route 10A from the western and eastern directions. Route 10A, also known as Airport Road, connects Route 1 (Marine Corps Drive) and Route 16. Route 10A starts from the north at Route 1 as a two-lane road and widens to three lanes. In the eastbound direction, it splits, allowing travelers to either head right toward the Airport or continue left toward Route 16. The road continues past the Airport as a three-lane road toward Route 16 with two lanes heading west and one lane heading east. After the last intersection on the eastern end of the Airport, the road transitions to two lanes. The road widens again as it transitions to the overpass at Route 16 near the Airport Industrial Park. See **Figure 2-2** for a graphic of the Airport access roads.

Access to the south side of the Airport is achieved via Admiral Sherman Boulevard which is accessible from Route 8. Admiral Sherman Boulevard provides access to Mariner Avenue which follows the southern perimeter of the Airport property line.

2.5.2 Arrivals and Departures Roads

Route 10A and Tiyan Parkway intersect at the west side of the commercial passenger terminal and then diverge into two traffic flows, both heading in the eastbound direction along the north side of the commercial passenger terminal. The two leftmost lanes form the Terminal Arrival Frontal Road and lead to the public parking and arrivals area, while the two rightmost lanes form the Terminal Departure Frontal Road and lead to the upper-level departure area. This is where the entrance of the commercial passenger terminal is located.

When arriving at the commercial passenger terminal, the Terminal Arrival Frontal Road maintains two lanes throughout with an additional third lane on the right-hand side for taxi queuing and TNC parking. When exiting, the exit road leading into Route 10A narrows to two lanes, one to turn left and one to turn right. When arriving at the commercial passenger terminal, the Terminal Departure Frontal Road widens into four lanes, with the right-most lane acting as a parking lane. When exiting, the exit road that leads into Route 10A narrows to three lanes; two lanes turn left and one lane turns right. Additionally, the exit from the rental car/tour bus/van services area exits through the Terminal Departure Frontal Road near the east side of the commercial passenger terminal. See **Figure 2-26** for the Airport circulation roads.

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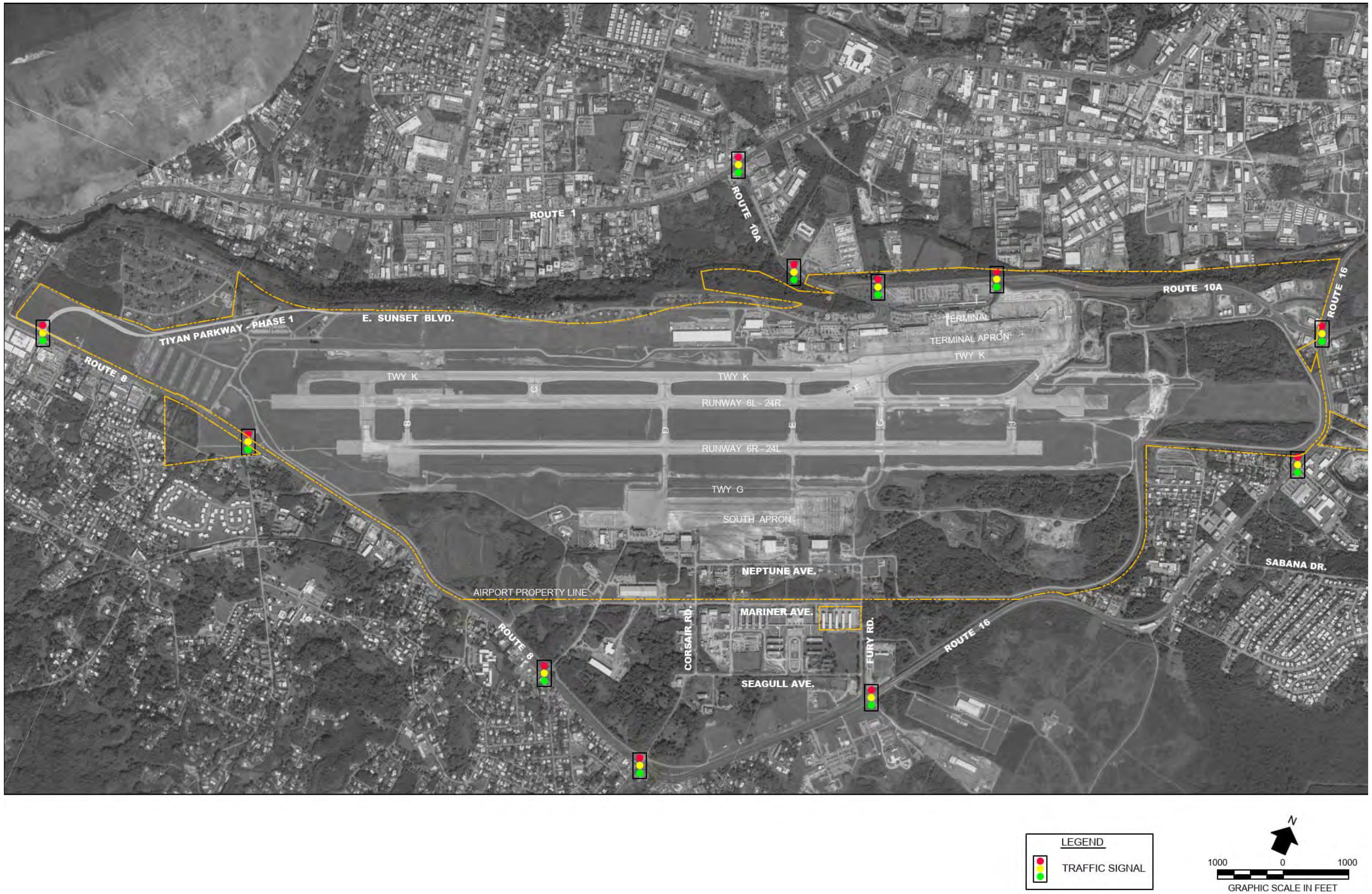
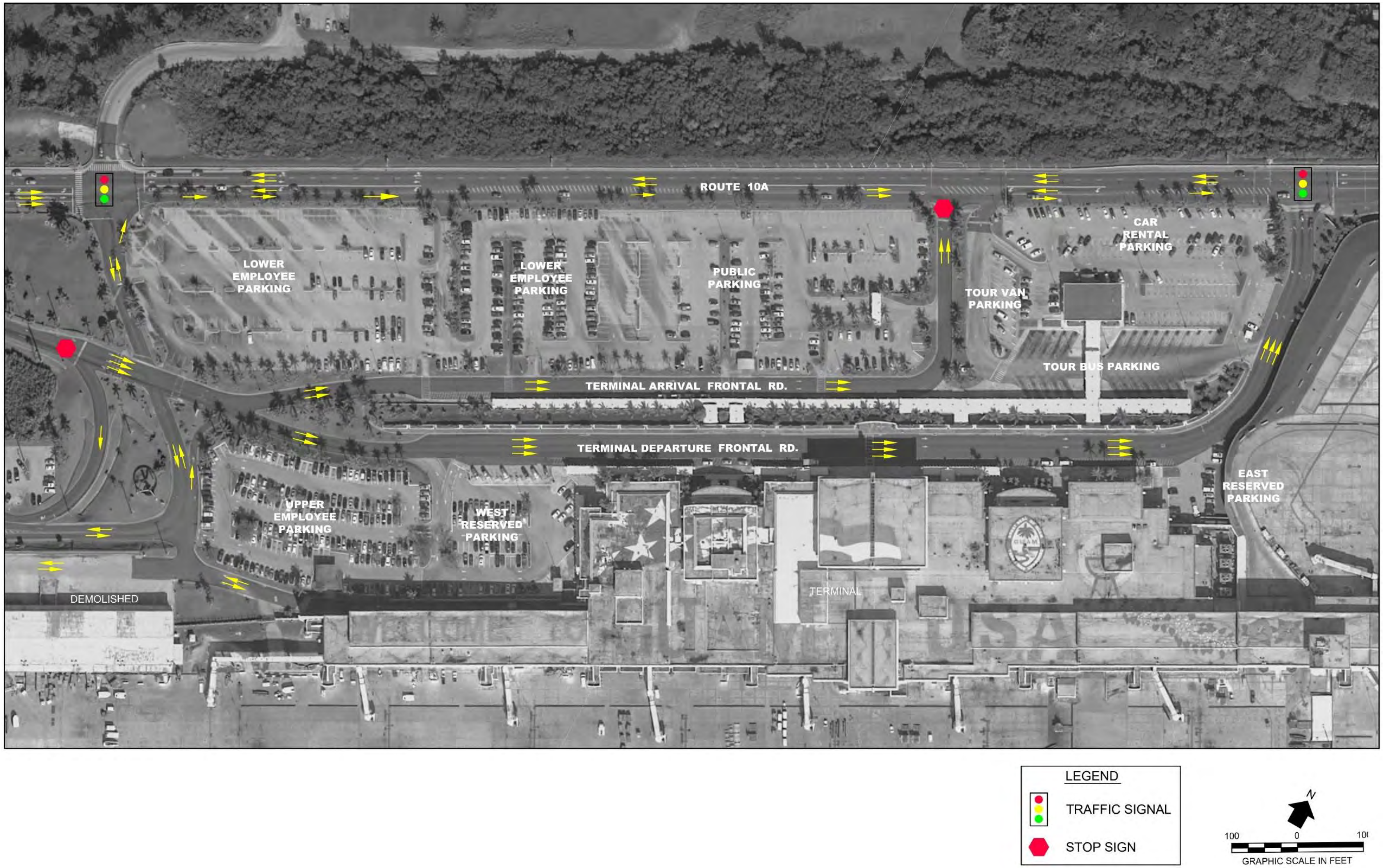


Source: AECOM

Figure 2-25. Airport Access Roads



Source: AECOM

Figure 2-26. Airport Circulation Roads

2.5.3 Airport Parking

Vehicle parking at the Airport can be split up into upper level and lower level parking. Parking lots below the Terminal Departure Front Road is considered lower level parking, while parking above the Terminal Departure Level Road is considered upper level parking. This section describes the different vehicle parking lots offered at the Airport.

2.5.3.1 Public Parking

The main public parking area is located between Route 10A and the commercial passenger terminal building. Access to the lower level parking lot is accessed via the Terminal Arrival Frontage Road while the upper parking lot area is accessed from the curve at Tiyan Parkway (. Sunset Boulevard). The upper parking area is designated for special reserved parking as determined by the Airport.

2.5.3.2 Employee Parking

Similar to public parking, employee parking is divided into lower and upper parking lots. Lower employee parking is located in two areas at the west side of the Airport, while the upper employee parking area is located on the west side of the commercial passenger terminal adjacent to the building. The lower parking area extends to the intersection of Route 10A and Tiyan Parkway (. Sunset Boulevard). Both entrances have gate access control, and all exits have traffic spikes. Parking decals are required for all employee parking lots.

2.5.3.3 Reserved Parking

There are two reserved parking areas located on the upper level via the Terminal Departure Frontal Road. The reserved parking on the west side is designated for use as determined by GIAA. The other reserved parking area is located on the east side of commercial passenger terminal and extends into a portion of the departure curb adjacent to the GIAA offices. The lot has 15 parking spaces and is reserved for Airport personnel. In addition, there are eight handicap spaces provided just before the departure area drop off.

2.5.3.4 our Bus and our Van Parking

The tour bus and van parking lots are located on the east side of the lower-level parking area. The tour van parking area has 11 parking positions, while the tour buses have 26 parking spots. Passengers arriving at the Airport can exit through the east tunnel at the arrival lobby to access these parking areas. There is a partially covered walkway that crosses over from the commercial passenger terminal to the former car rental building where the buses and vans are located. Tour buses and vans return to their respective parking area via Route 10A.

2.5.3.5 Rental Car Parking

Similar to the tour bus parking area, the rental car parking area is also located at the east side of the parking lots beyond the tour bus parking such as displayed in **Figure 2-2** . Passenger access to the parking area is also available through the east tunnel from the arrivals lobby. Rental car parking is past the former car rental building constructed in the middle of the parking area.

Figure 2-27. Airport Rental Cars

Source: ©2022 Photography by Elliott Lindgren

For individuals renting cars, the parking lot exit is on the far eastern portion of the lot and all exiting vehicles must turn left out of the parking lot to merge with the Terminal Departure Frontal Road before reaching a traffic light at Route 10A. For individuals returning vehicles, as well as those arriving on tour buses or tour vans, access to the rental lot is at the far western portion of the lot. Vehicles may turn left into the lot coming off of Route 10A. Cleaning and maintenance of vehicles are handled off site.

2.5.3.6 axi Parking

Taxi parking is located curbside along the Terminal Arrival Frontal Road past the entrance to the Airport police station arcade, pictured in **Figure 2-2** . The taxi parking area allows for approximately 14 taxis to be parked along the curb while waiting for passengers. Additionally, there are several spaces reserved in front of the arcade area that are designated for the Airport police and two spaces reserved for TNC/app-based rides further down the lane. The total curb area reserved for taxis is approximately 400 feet.

See **Figure 2-29** for a complete map of all Airport parking, **Figure 2-30** for the makeup of the rental car parking lot, and **Table 2-5** and **Table 2-6** for the number of parking spaces per lot.

Figure 2-28. Taxi Parking

Source: ©2022 Photography by Elliott Lindgren

able 2- ower evel Parking

ot Name	Public Spaces	Employee Spaces	Car Rental Spaces	Commercial Vehicle Spaces
mployee Parking Lot (West nd)	-	581	-	-
Public Parking Lot (Middle)	258	-	-	-
Handicap Parking	13	-	-	-
Tour Bus Parking	-	-	-	26
Rental Car Parking Area	-	-	118	-
Tour Van Parking	-	-	-	11

Source: E.M. Chen & Associates, Inc.

able 2-6 Upper evel Parking

ot Name	Public Spaces	Employee Spaces	Car Rental Spaces	Commercial Vehicle Spaces
mployee Parking Lot	-	205	-	-
Reserved Parking Spaces	-	73	-	-
Handicap Parking	8	-	-	-
Government Vehicle Parking (ast Side)	-	16	-	-
Government Vehicle Curb Side (ast Side)	-	14	-	-

Source: E.M. Chen & Associates, Inc.

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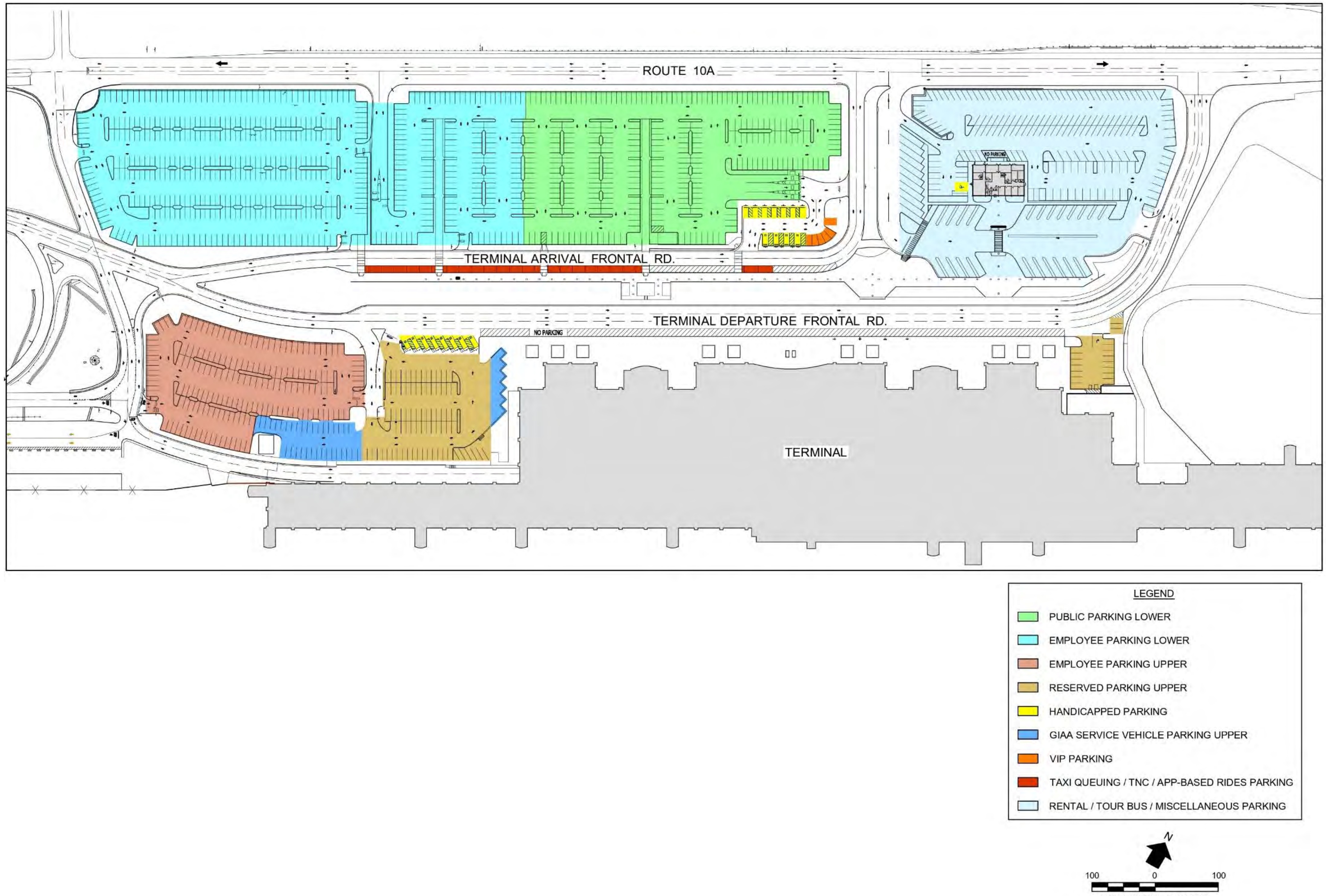
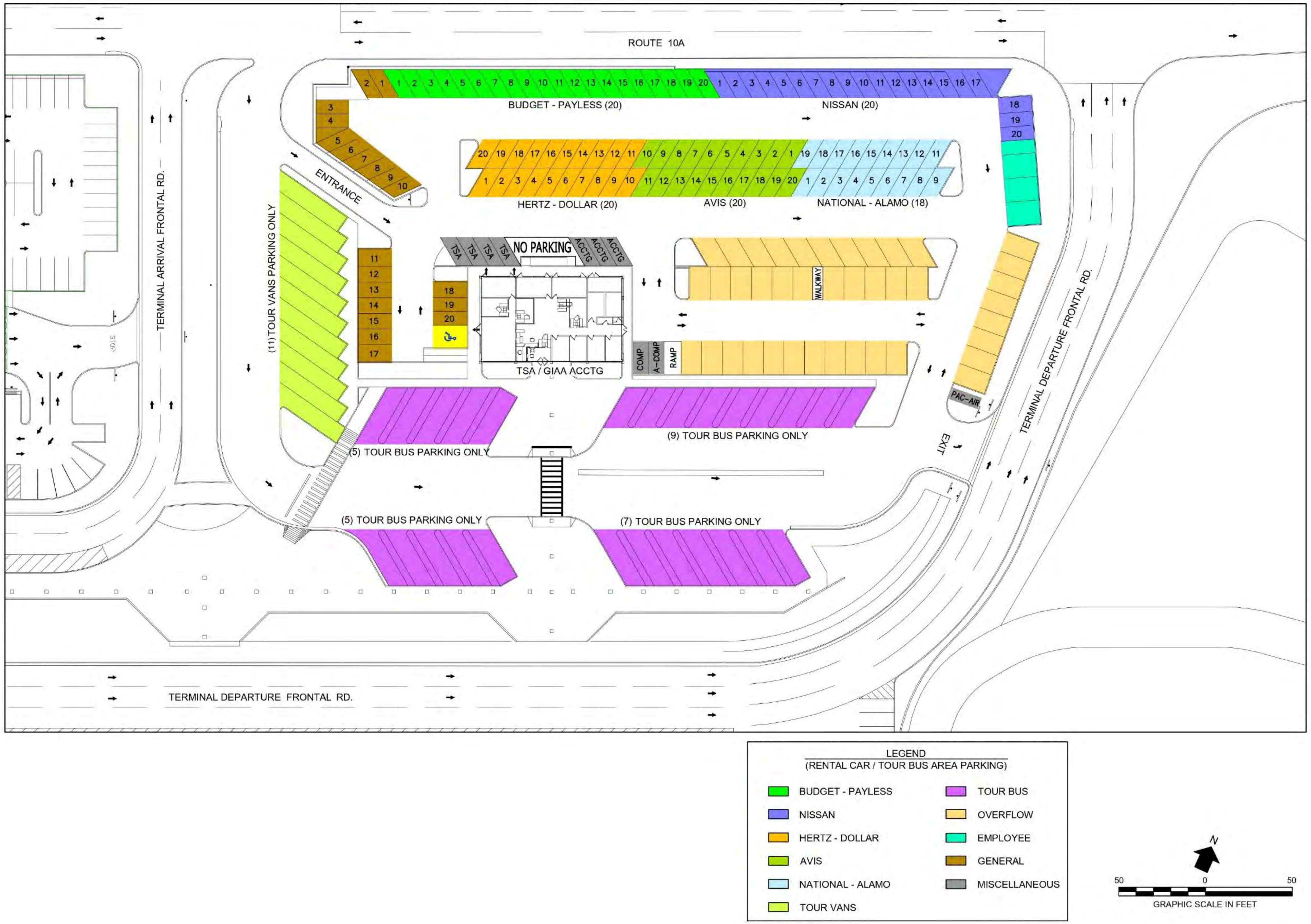


Source: AECOM

Figure 2-29. Airport Parking



Source: AECOM

Figure 2-30. Rental Car Parking Lot

2.6 General Aviation, Air Cargo, and Support Facilities

The Airport is equipped with support facilities throughout the property. Some of these facilities include aircraft hangars, GA facilities, air cargo facilities, FAA facilities, and general airfield maintenance facilities. The existing facilities at the Airport can be divided geographically by the northern, northeastern, and southern parts of Airport property. The following sections describe the airfield and support facilities at the Airport.

2.6.1 Northern Area of Airport Property

Facilities located in the northern area of Airport property are described below.

2.6.1.1 Air Cargo Facilities

The majority of air cargo facilities located on Airport property are located in the northern part of the Airport (see **Figure 2-31**). Air cargo operations at the Airport are west of the commercial passenger terminal building. GIAA has designated an area on the apron extending from the buildings out toward Taxiway K for cargo airline use. There are four buildings that serve the cargo operations area. The buildings are operated by the Guam Integrated Air Cargo Facility, Triple B Forwarders, CTSI Logistics, and DHL. Vehicle parking is available at all of these facilities, and traffic consists of both large and small trucks including customer and employee automobiles. Additionally, loading docks connected to the buildings are integrated into the parking area.

The Guam Integrated Air Cargo (GIAC) facility is the western-most building in this area and is a long, linear cargo building containing multiple government agencies and businesses. The building is constructed of steel frame and sheeting and is approximately 163,000 square feet. The following companies operate out of the GIAC facility:

- Pacific Air Properties
- U.S. Citizenship and Immigration Services (USCIS)
- National Oceanic and Atmospheric Administration (NOAA) Fisheries
- Department of Veteran Affairs
- Social Security Office
- United Airlines Cargo
- United States Department of Agriculture (USDA) Service Center
- Baker
- Natural Resources Conservation Service (NRCS)
- Farm Service Agency (FSA)
- Japan Airlines Cargo
- Menzies Aviation
- Korean Air
- Philippine Airlines

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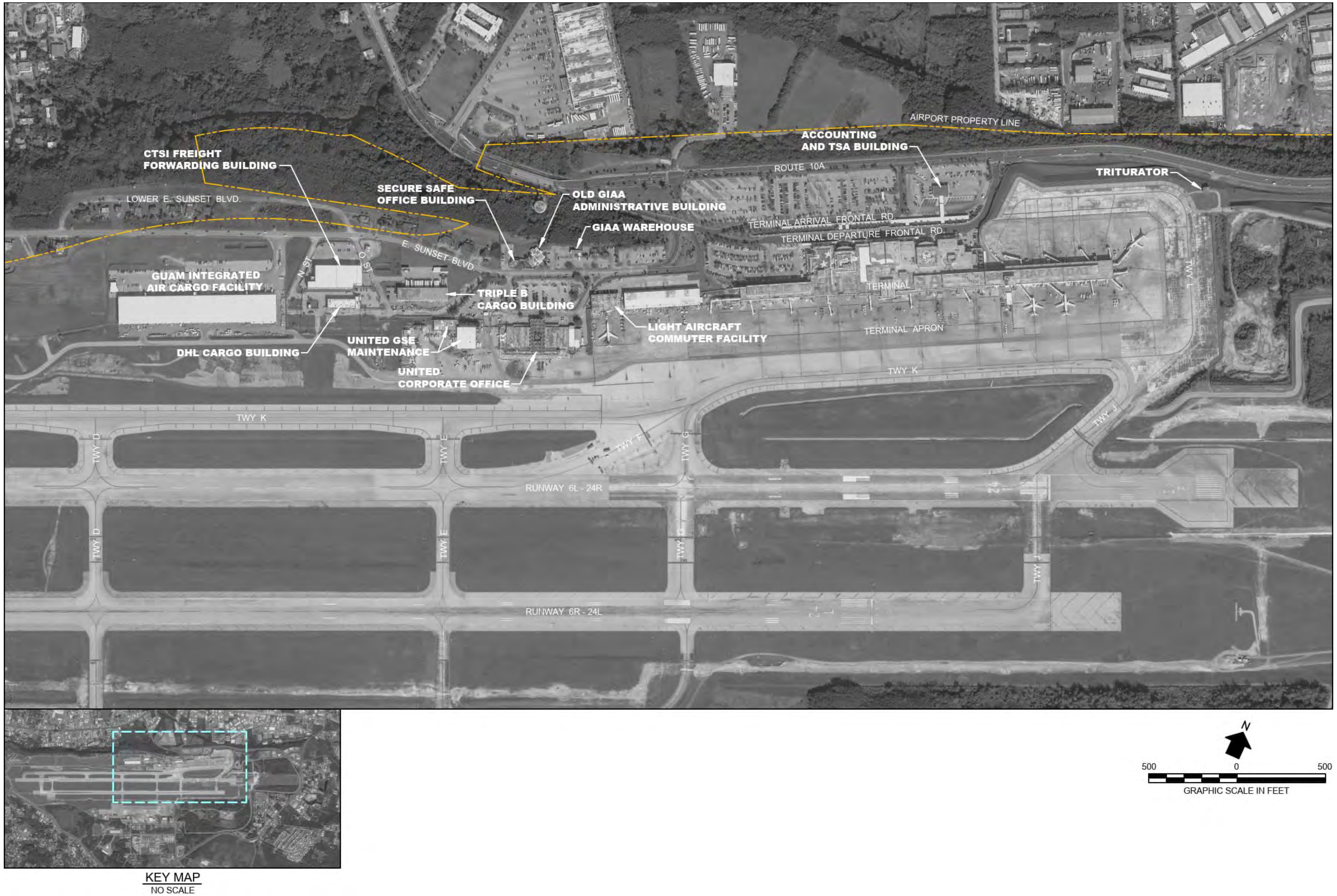

Source: AECOM

Figure 2-31. General Aviation, Air Cargo, and Support Facilities – Northern Portion of the Airport

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The DHL cargo facility broke ground at the Airport in 2005 and built a 10,000-square-foot concrete building. DHL was the first tenant to build in the Tiyan area, and the company signed a long-term lease with options.

The Triple B Forwarders facility, **Figure 2-32**, is a 22,000-square-foot building. The building is located west of Gate 4 of the commercial passenger terminal. The facility is located off of a st Sunset Boulevard, between N Street and O Street.

The fourth air cargo facility located in the northern part of Airport property, belongs to CTSI Logistics. The facility includes a concrete building with approximately 35,600 square feet of space. It is located next to DHL between Triple B Forwarders and the GIAC facility.

Figure 2-32. Triple B Forwarders

Source: E.M. Chen & Associates, Inc.

There are four additional facilities located west of the commercial passenger terminal building that all have airside access. These are the light aircraft commuter terminal, United Airlines corporate office (old commuter terminal), and two dedicated United Airlines ground service equipment (GS) maintenance facilities.

2.6.1.2 ight Aircraft Commuter erminal

The light aircraft commuter terminal, shown in **Figure 2-33**, is a smaller terminal facility located west of the commercial passenger terminal and is being used for commuter aircraft flights. The majority of commuter operations were integrated within the commercial passenger terminal facility in 2003, but Arctic Circle Air and Star Marianas continue to operate out of this facility. Both airlines provide passenger and cargo services to the Northern Mariana Islands. There are two dedicated parking positions (Gates 1 and 2) outside of the facility. These two parking positions are not associated with the commercial passenger terminal and are designated as remote gates. They are designed to accommodate ADG I aircraft (tail heights under than 20 feet and wingspans under 49 feet).[17]

Figure 2-33. Light Aircraft Commuter Terminal

Source: ©2022 Photography by Elliott Lindgren

[17] Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5300-13B, *Airport Design*

2.6.1.3 United Airlines Office Building Old Commuter erminal

The "Old Commuter Terminal" was upgraded in 1982 to provide a much needed and improved impression of Guam. This was used until the completion of the commercial passenger terminal building. This facility formerly served as the light aircraft commuter terminal but is no longer being used to serve passengers. Instead, it is occupied by United Airlines for administrative purposes. This building consists of approximately 46,000 square feet of space; see **Figure 2-34**.

Figure 2-34. United Airlines Office Building (Old Commuter Terminal)

Source: ©2022 Photography by Elliott Lindgren

2.6.1.4 United Airlines GSE Maintenance

There are two facilities located west of the United Airlines office building that are designated for GS (**Figure 2-35**) for United Airlines. The facilities contain baggage dollies, aircraft chocks, tugs, catering vehicles, and more. There is not sufficient storage space for GS ; therefore, the equipment is stored on the pavement, in front of the United Airlines GS maintenance facility.

Figure 2-35. Ground Service Equipment on the North Apron

Source: ©2022 Photography by Elliott Lindgren

2.6.1.5 Miscellaneous Northern Area Facilities

There are three additional facilities situated on the northern side of . Sunset Boulevard across from the light aircraft commuter terminal and the parking lot for the United Airlines office building. These facilities are a former GIAA Administrative Office, a GIAA Warehouse, and the SecureSafe Solutions office building. Additionally, within the rental car and tour bus parking lot is the GIAA Accounting and TSA office. Within this facility, GIAA Accounting encompasses 2,260 square feet, while TSA occupies 1,222 square feet. Also, the Airport triturator is located northeast of the north apron, between Taxilane L and Route 10A. The triturator helps with the disposal of airline waste by flushing the waste through the Airport's sewer system. There are also three houses located on Airport property located toward the northwest side of the Airport that are being used as field offices.

2.6.2 Northeastern Area of Airport Property

There are six facilities, or groups of facilities, located within the northeastern part of the Airport, four of which are situated in the Airport Industrial Park. The Airport Industrial Park is located on the corner of Route 16 (Army Drive) and Route 10A but can only be accessed from Route 10A. The Airport Industrial Park, contains 10 lots of land, six of which are vacant and four that are occupied by three different facilities.

Figure 2-36. MSA Logistics

Source: E.M. Chen & Associates, Inc.

Marianas Steamship Agencies, Inc. (MSA) Logistics, in **Figure 2-36**, is one facility located within the industrial park and encompasses two of the four occupied lots. MSA Logistics possesses a 20,000-square-foot concrete warehouse and office building. The two other facilities located within the Airport Industrial Park are Papa's Restaurant, a bar and steakhouse, and NAPA Safety & Supply, part of the NAPA Auto Parts franchise. Furthermore, the only facility in this area located south of the Airport Industrial Park off of Route 10A is the 76 Circle K Ocean Vista gas station.

Figure 2-37. Airport Fuel Farm

Source: ©2022 Photography by Elliott Lindgren

The two other groups of facilities within this area belong to the water reservoir compound and Airport fuel farm, shown below in **Figure 2-37**. Both areas can only be accessed from Route 10A or a private service road between Route 10A and the north apron. The fuel farm consists of two 320,000-gallon storage tanks of Jet A fuel, one 15,000-gallon storage tank of Avgas, a truck loading stand, and an operations building located close to Route 16. The storage facility is connected by an underground, 16-inch-diameter pipeline to a distribution system located beneath the aircraft aprons. a ch of the aircraft gates is equipped with in-pavement fuel pits. **Figure 2-38** depicts the facilities located in the northeastern portion of Airport property.

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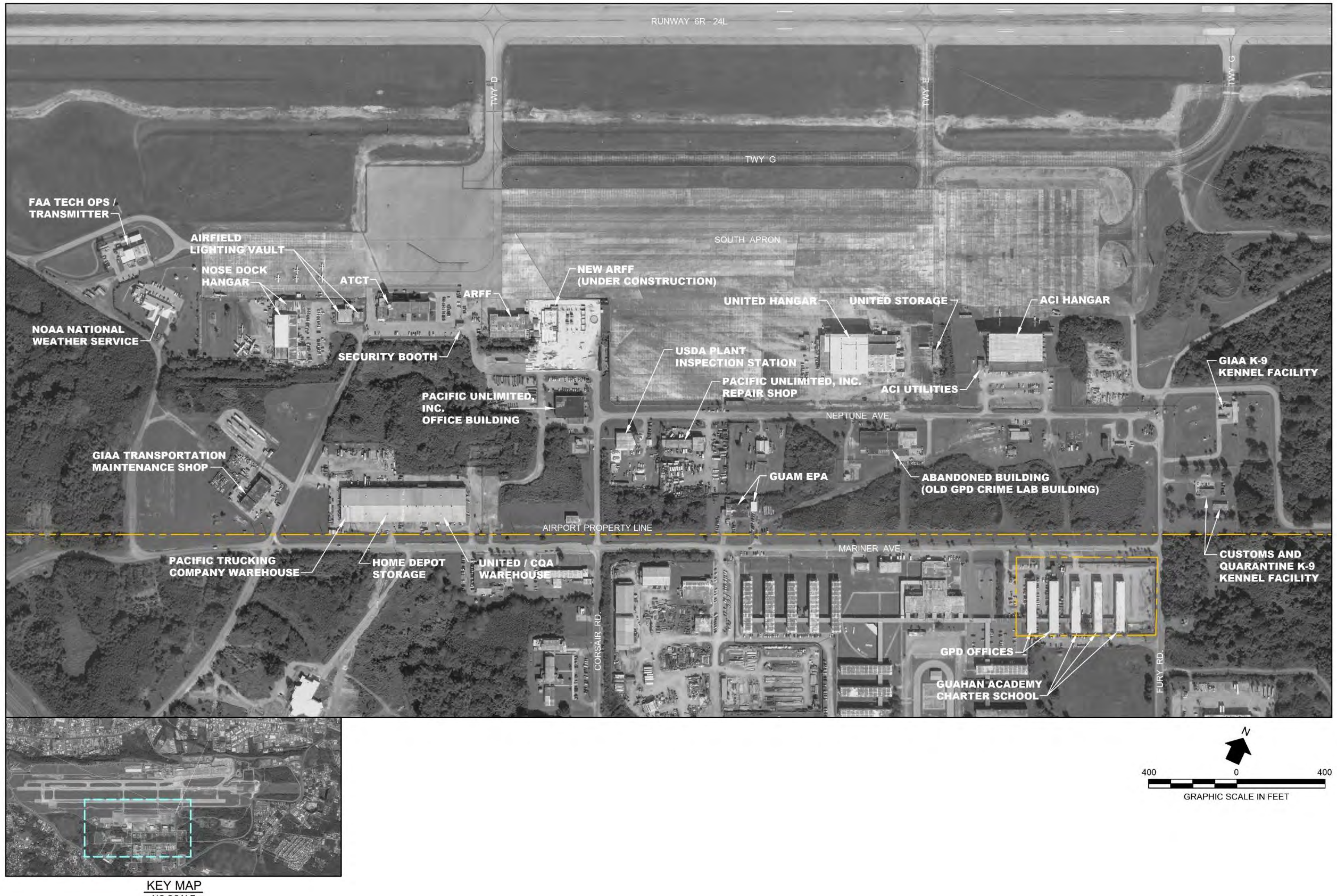
Source: AECOM

Figure 2-38. General Aviation, Air Cargo, and Support Facilities – Northeastern Portion of the Airport



Source: AECOM

Figure 2-39. General Aviation, Air Cargo, and Support Facilities – Southern Portion of the Airport

2.6.3 Southern Area of Airport Property

Facilities located in the southern portion of Airport property are described below and shown in **Figure 2-39**.

2.6.3.1 an gar Buildings

The southern area of Airport property contains three aircraft hangars all located along the southern apron. These facilities are designated as the HC-5 Hangar (**Figure 2-40** , VQ-1 Hangar (**Figure 2-41**), and Nose Dock Hangar. Aircraft parking positions are available for maintenance and service at all three hangars. Built in 1974, the HC-5 Hangar is currently being used by Aviation Concepts, Inc. (ACI) and Sky Dive Guam, and the hangar totals approximately 51,600 square feet. Constructed in 1962 and then renovated in 2005, the VQ-1 Hangar is currently operated by United Airlines and is approximately 71,700 square feet. Both hangars are two-story facilities with office space located on the second floor. They are also both located toward the eastern part of the south apron. The HC-5 hangar has a separate utility facility alongside, and the VQ-1 Hangar has a storage facility located to the east of the hangar. Moreover, the smaller Nose Dock Hangar is located toward the southwest portion of the south apron and is mainly used by GA aircraft. The hangar's current tenants are Micronesian Aviation System, Sky Guam Aviation, Aire Services, and Micronesian Air Cargo Services.

Figure 2-40. HC-5 Hangar

Source: ©2022 Photography by Elliott Lindgren

2.6.3.2 South Apron Airfield Support Facilities

The Aircraft Rescue and Fire Fighting (ARFF) facility is located along the south apron. There are seven ARFF trucks (**Figure 2-42**) that belong to the facility; however, three of them are currently unavailable. A new facility was opened in 2022 adjacent to the old facility to meet the current FAA ARFF standards as described in FAA AC 150/5220-17B, Airport *Rescue and Fire Fighting (ARFF) Training Facilities.* The new ARFF building totals 28,090 square feet and has five drive-through vehicle bays as compared to the old ARFF building, where the trucks were required to back-in to park. GIAA repurposed the old ARFF building for airport maintenance purposes.

Figure 2-41. VQ-1 Hangar

Source: ©2022 Photography by Elliott Lindgren

Other airfield support facilities along the south apron include two buildings associated with the airfield lighting vault and the Guam C R AP, which includes the Airport's ATCT. These facilities are located between the Nose Dock Hangar and the existing ARFF facility. The airfield lighting vault consists of two buildings; the main facility was built in 2000 and is 4,400 square feet. The lighting vault contains a generator room, an electrical room, a vault room, and a training room. The facility includes a covered portable generator and fuel storage tank.

Figure 2-42. Airport Rescue and Fire Fighting Truck

Source: ©2022 Photography by Elliott Lindgren

The ATCT is located within the 14,760-square-foot C R AP building, which is situated east of the airfield lighting vault. Both facilities are FAA owned and operated; however, GIAA owns the visitor parking area along the fence and outside the main gate. Access to the C R AP and ATCT is controlled via a security booth along the arrival road.

2.6.3.3 Southern Airport Maintenance and Warehouse Facilities

Within the south apron area (**Figure 2-43**), GIAA operates a transportation maintenance shop, a large warehouse used by tenants such as United Airlines, the CQA, Home Depot, and the Pacific Trucking Company, a Pacific Unlimited, Inc. office building, and Pacific Unlimited, Inc. repair shop. These facilities are used for Airport purposes, variously located throughout the southern part of the Airport, outside of the Airport Operations Area (AOA) fence line.

Figure 2-43. Asia Pacific Aircraft on the South Ramp

Source: ©2022 Photography by Elliott Lindgren

Since the transfer of the airfield from the U.S. Navy to GIAA in 1995, the Navy no longer maintains the airfield. Maintenance of runways, taxiways, and aprons are handled by GIAA maintenance personnel. GIAA contracts the maintenance of jetways, elevators, and escalators within the Airport's commercial passenger terminal. The commercial passenger terminal maintenance and warehouse areas provide workspace and equipment storage for various maintenance functions for the Airport. These functions consist of maintenance landscape equipment and storage areas.

2.6.3.4 Other South Apron Support Facilities

There are multiple facilities located within the southern portion of Airport property, away from the AOA, all with various functions. These include:

- FAA Transmitter facility
- NOAA National Weather Service building
- USDA Plant Inspection station
- Two Guam n vironmental Protection Agency (P A) buildings
- Two Guam Police Department (GPD) buildings
- Three buildings for the Guahan Academy Charter School
- GIAA K-9 Kennel facility
- Two buildings for the CQA K-9 Kennel facility
- One abandoned building (former GPD Crime Lab)

See **Table 2-11** for a full list of current GIAA facilities.

2.6.4 Flight Easements

Airports acquire easements, in the form of avigation easements, to protect airspace used by aircraft during takeoff and landing and to help avoid safety hazards. The Airport currently has two avigation easements adjacent to Airport property. The first flight clearance easement is located south of Runway 6L and totals 5.2 acres. The main reason for this easement is to protect the approach and departure operations at the end of Runway 6L. Overall, it encompasses small portions of Chalan R S Sanchez Street and Ramirez Way, Benson Guam Do it Best, and a vacant lot.

The second easement is located northeast of Runway 24R and totals 155.4 acres. This easement protects the approach and departure operations of the Runway 24 ends. Businesses located within this easement include RTOY Auto Repair, Geno's Auto Service Guam, Kautz & Son's Glass Co. Inc, Guam Badminton Sports Center, the GPD Armory, Geo- n gineering and Testing, Inc., Cloud K-9 Grooming, and the Jesus Baptist Church Guam. Households within this area are located along Army Drive, Alageta Street, Macheche Road, Agoun Way, Bello Road, Old Perez Coral Road, Tun Pedro Maria Benavente Street, and the northern part of Boman Street.

2.7 Existing Utilities

The development and operation of the Airport or any ongoing or future construction depends on the capacity of utilities. This section describes the major infrastructure that serves the Airport utility requirements.

2.7.1 Storm Drainage System

The existing Airport drainage facility consists of several storm drainage systems. The northern portion of Airport property is divided into two drainage sections. Stormwater runoff from Gate 4 and west of the commercial passenger terminal building, United Airlines office building, aircraft aprons, parking lots, and associated buildings is collected through a network of catch basins and routed by a storm drainage line to an existing concrete channel that discharges into the Harmon Sink. The remaining northern section consists of the commercial passenger terminal area and aprons, as well as the Airport Industrial Park. The runoff from these areas is routed to the infiltration basin located below Route 10A.

The stormwater runoff from the commercial passenger terminal apron and west of Gate 4 is routed to a sampling station before it enters the infiltration basin. Runoff from this portion of the apron does not have an oil/water separator and is proposed to be included in future Airport drainage improvements. A stormwater monitoring station is also used to perform required water sampling. Where fueling activity is conducted east of Gate 4, the runoff is directed through an oil/water separator prior to entering the drainage system.

The runoff from the remaining portions of the Airport is currently directed to several drainage basins located outside Airport property, within the co nomic Development Zone. GIAA owns certain drainage easement parcels totaling 41 acres. GIAA also maintains a National Pollutant Discharge l imination System (NPD S) permit required to discharge stormwater runoff into the infiltration system and the Harmon Sink.

GIAA depends on two main sources of water reservoirs to supply water to all existing facilities at the Airport. The Barrigada Reservoir is the current source providing water to the commercial passenger terminal building, domestic and fire protection water for the fuel farm, and water to the Airport Industrial Park facilities.

2.7.2 Wastewater System

Sewage from the north and south portions of the Airport are directed to an 18-inch main sewer line along Route 8. The main terminal sewage system is directed to a 14-inch sewer line along Route 10A, which then flows into a 16-inch main sewer line along Marine Corps Drive. The Airport Industrial Park area utilizes a 14-inch main sewer line along Route 16 to discharge the sewage generated in that area. Main lines flow to a treatment facility and effluent is disposed of through an ocean outfall into the Philippine Sea. GIAA pays for these services; however, the main sewer lines are owned and operated by the Guam Waterworks Authority (GWA).

2.7.3 Electrical Power Distribution System

GIAA purchases its power requirements from the Guam Power Authority (GPA), through several substations and distribution power lines: one line at 34.5 kilovolts (kV) for the commercial passenger terminal building and the rest at 13.8 kV. Currently, the capacity of the GPA power system is more than adequate to provide all the present power requirements for GIAA; however, in order to meet any appreciable increase, the GPA must be informed well in advance of GIAA's projected power requirements.

There are weaknesses in the existing GPA electric distribution system to GIAA at both the 34.5 kV and 13.8 kV voltage levels. The commercial passenger terminal building is served from a GPA 34.5 kV switching station through only a single 34.5 kV underground line connected to a 9,375 kilovolt-amps (kVA) transformer located on the ground floor of the commercial passenger terminal building. The recorded maximum billing demand kilowatt (kW) transformer is a little over 4,000 kW. A cable failure on this circuit could require several hours or days to repair or replace before normal power is restored to the commercial passenger terminal building. A transformer failure of this size (9,375 kVA) will take several months to a year for repair or replacement. On-site stand-by generation in excess of 4,000 kW is required to maintain continuity of full electric service.

The light aircraft commuter terminal, northern cargo buildings, and other small Airport facilities in the northern vicinity receive their power requirements from the GPA Tumon Substation through a single aerial 13.8 kV distribution line, which also feeds other non-GIAA related loads.

The airfield (runway and taxiway) lighting and other small GIAA facilities in the vicinity (Southeast Tiyan) receive their power requirements from the GPA Barrigada Substation through two aerial radial 13.8 kV distribution lines, which also serve several facilities unrelated to GIAA operations and maintenance. These distribution lines recently experienced the damaging effects of two super typhoons. The lines were badly damaged with no recorded permanent repair other than a quick fix by GPA to restore service as quickly as possible.

2.8 Meteorological Conditions

ve n when there are predominant weather conditions, airports are designed to operate in strong winds, prolonged periods of low visibility, and wet pavement circumstances. Depending on the locality of the airport, the weather may cause the need for new facilities or upgraded infrastructure, new or expanded runways to account for wet pavement, and making sure NAVAIDs are working and up to standard. At the Airport, there are temperate conditions, but the island of Guam is prone to typhoons, tropical storms, atmospheric corrosion, and earthquakes, which can delay or alter Airport operations at any time.

2.8.1 Climate and Wind Conditions

The climate in Guam is a tropical marine climate, which is generally characterized by high humidity and is moderated by the seasonal wet and dry periods. Guam's tropical climate ranges from the low 70s to the mid-80s with a mean annual average temperature of 81 degrees.[18] The island is coolest and least humid between the months of December and February, marked by prevailing westerly trade winds. The warmest months are from March through August. The annual rainfall totals are between 80 and 110 inches, and the average humidity varies from an early-morning high of 86 percent to an afternoon low of 72 percent. The warm ocean around Guam helps keep the temperature warm at night and makes the air feel warm and humid. The atmosphere's high moisture content during the wet season, combined with the warm temperatures, contributes to the rapid deterioration of man-made materials through rust, rot, and mildew.

There are two seasons: the dry season and the rainy season. The rainy season usually runs from July through December and the dry season from January to June. Guam averages approximately 86 inches of rain per year, much of which occurs during the late night and early morning hours, while March is the driest month, with an average of less than 2.5 inches of rain. The steady easterly trade winds bring cooler, drier air to the island during the dry season.

NOAA and the National Climatic Data Center (NCDC) maintains the most up-to-date and accurate climate data and information for the island. This temperature and weather data has been collected from the years 2011 to 2020. See **Table 2-7** for the average precipitation and high and low temperatures over that 10-year period for the island.

able 2- Guam Weather Conditions

Item	Condition
Average Annual Precipitation Total	0.2820 Inches
Maximum Average Monthly Precipitation Total	0.5769 Inches (September)
Minimum Average Monthly Precipitation Total	0.0958 Inches (March)
Average Daily Temperature of Hottest Month	84.27° F (June)
Average Daily Temperature of Coldest Month	80.83° F (February)

Notes: NCDC data pulled from 2011-2020
Source: NOAA, Record of Climatological Observations and AECOM Analysis

2.8.2 Wind Roses

Wind roses are used when analyzing wind data. When analyzing this data, it is important to use the true bearing of a runway because winds are always recorded relative to true north. The movement of the magnetic field on earth is what determines magnetic declination to show the movement over time. This changing magnetic field can affect aircraft operations, aircraft paths, and cause runway identifiers to change. Currently Guam's movement is changing by 0º 1' W each year. Compared to other parts of the world, this is a very small movement.

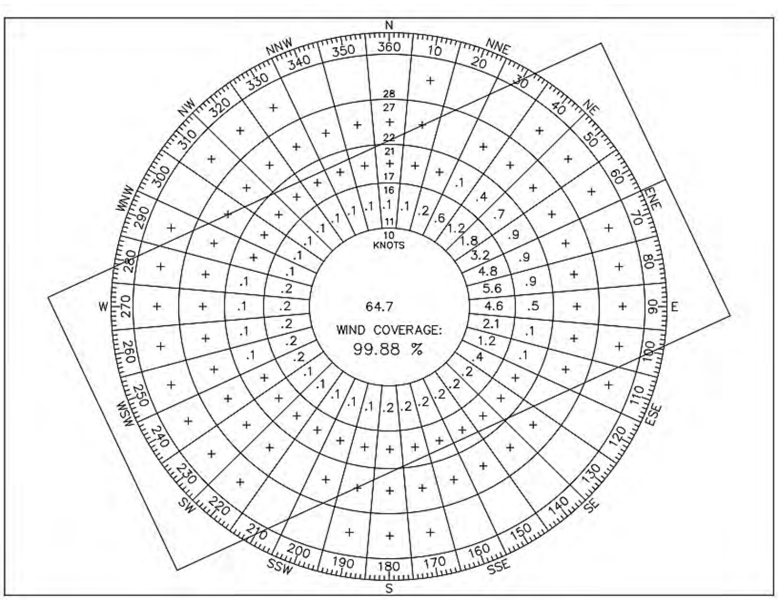
The Airport wind roses for all weather, visual flight rules (VFR), and IFR conditions are shown in **Figure 2-44**, **Figure 2-45**, and **Figure 2-46**, respectively. Wind roses are important because they help determine the best orientation for the runways. According to the wind roses below, the existing runway orientation fulfills the FAA's desirable wind coverage of providing at least 95 percent wind coverage during all weather, IFR, and VFR conditions. Additionally, see **Table 2-8** for the all-weather, IFR, and VFR wind coverage based on the crosswind component.

[18] Temperatures are in degrees Fahrenheit.

able 2-   Wind Coverage at the Airport

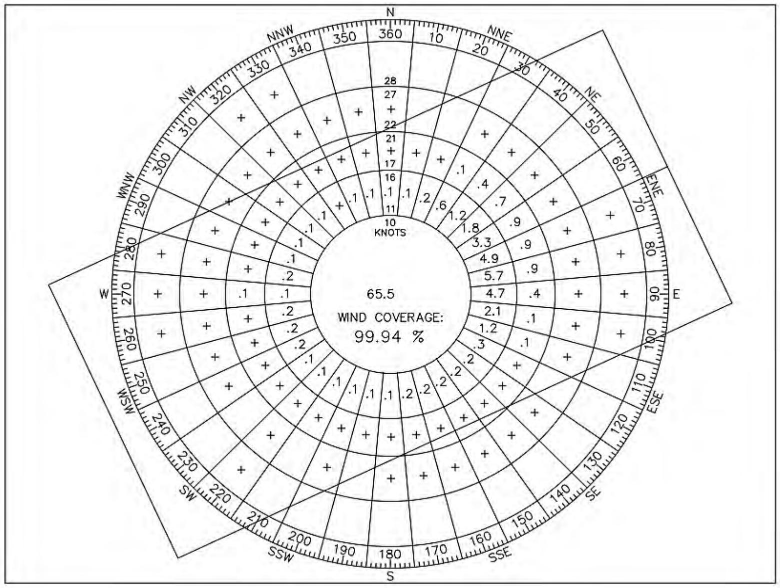
Crosswind Component	All-Weather			IFR			VFR		
	6L-24R	6R-24L	Total	6L-24R	6R-24L	Total	6L-24R	6R-24L	Total
10.5 knots	96.01%	96.01%	96.01%	86.68%	86.68%	86.68%	96.57%	96.57%	96.57%
13 knots	98.24%	98.24%	98.24%	92.67%	92.67%	92.67%	98.57%	98.57%	98.57%
16 knots	99.57%	99.57%	99.57%	96.99%	96.99%	96.99%	99.73%	99.73%	99.73%
20 knots	99.88%	99.88%	99.88%	98.88%	98.88%	98.88%	99.94%	99.94%	99.94%

Notes:
IFR = Instrument Flight Rules
VFR = Visual Flight Rules
Period of Record = 2013-2022
Number of Observations = 157,193
Station = 912120 Guam International Airport
Source: Airport Data and Information Portal (ADIP)



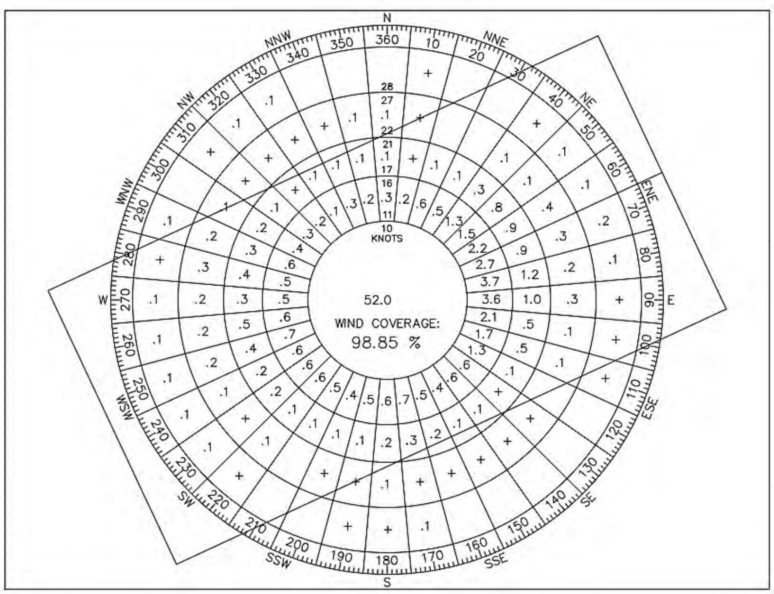
Source: FAA Airport Data and Information Portal (ADIP) Windrose

Figure 2-44. All Weather Wind Rose



Source: FAA Airport Data and Information Portal (ADIP) Windrose

Figure 2-45. VFR Wind Rose



Source: FAA Airport Data and Information Portal (ADIP) Windrose

Figure 2-46. IFR Wind Rose

2.9 Environmental Features

This section describes the existing environmental conditions at the Airport that are essential in the identification and evaluation of development alternatives and strategies for project implementation. The inventory of existing environmental conditions that could affect future development include:

- Air Quality
- Biotic Resources
- Coastal Resources
- U.S. Department of Transportation (DOT) Section 4(f) Resources
- Hazardous Materials
- Cultural Resources
- Land Use
- Water Resources

2.9.1 Air Quality

Airports, including aircraft, GS , and motor vehicle operations, contribute emissions of air pollutants to the atmosphere, and the levels of those emissions have the potential to increase or decrease as a result of airport improvements and changes. missions from aircraft and airport-related ground activities generally extend several miles from an airport. The air quality impact is thus a regional issue as well as a local issue. For this reason, the existing regional air quality must be considered along with that of the immediate airport vicinity.

2.9.1.1 National Ambient Air Quality Standards

The Clean Air Act is the comprehensive federal law that regulates air emissions from mobile and stationary sources. Among other things, this law requires the U.S. P A to set National Ambient Air Quality Standards (NAAQS) and to work with state governments and territories to improve air quality by reducing emissions in areas where the standards are not being met.

The P A has set NAAQS for six “criteria” pollutants: ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, and lead. The P A designates an area as “attainment” or “nonattainment.” Geographic areas where air quality is cleaner than the national standard are referred to as attainment areas. Areas that don’t meet the national standard are referred to as nonattainment areas.

According to the P A, the area surrounding the Airport is in attainment for all criteria pollutants except for two relatively small areas associated with the Piti (Cabras) and Tanguisson electric power generating stations, which are designated nonattainment for sulfur dioxide (SO2). The Piti generating station is located 7.6 miles west-southwest of the Airport, and the Tanguisson generating station is located 3.25 miles north-northeast of the Airport. Both nonattainment areas have radii of 2.2 miles from the plants; therefore, the nonattainment areas do not extend to the Airport.

The general conformity requirements of the Clean Air Act do not apply to a federal action located in an attainment area; therefore, the requirements do not apply to projects or actions at the Airport.

2.9.2 Biotic Resources

This section discusses the various wildlife, and plant habitats at the Airport including threatened or endangered species in the vicinity of the Airport, nearby wildlife refuges and designated natural areas, and wildlife hazards.

2.9.2.1 Cover ypes and a bitats

The Airport is predominantly developed with pavement and buildings. The remaining land use and cover patterns consist of upland vegetation or open land covered with meadow grasses around the airfield and turf grasses in landscaped areas. A few isolated forested areas lie around Airport property. The trees are also actively managed to avoid potential obstructions and should be in accordance with the Airport Wildlife Management Plan. Additionally, the grasses are actively managed and mowed on a regular basis.

2.9.2.2 hreatened and Endangered Species

Under Section 7 of the n dangered Species Act, the U.S. Fish & Wildlife Service (USFWS) and National Marine Fisheries Service (NMFS) have jurisdiction over federally listed threatened, endangered, and candidate species. The USFWS's Information for Planning and Consultation (IPaC) was used as a screening tool to search for any known records of threatened or endangered species in the vicinity of the Airport. The IPaC screening indicates that there are 22 listed species that could occur in the vicinity of the Airport. See **Table 2-9**.

able 2-9 hreatened and Endangered Species

Species	Scientific Name	Status
Mammals		
Mariana Fruit Bat	*Pteropus mariannus*	Threatened
Birds		
Guam Micronesian Kingfisher	*Halcyon cinnamomina*	ndangered
Guam Rail	*Rallus owstoni*	ndangered
Reptiles		
Green Sea Turtle	*Chelonia mydas*	ndangered
Slevin's Skin	*Emoia Slevini*	ndangered
Snails		
Fragile Tree Snail	*Samoana fragilis*	ndangered
Guam Tree Snail	*Partula radiolata*	ndangered
Humped Tree Snail	*Partula gibba*	ndangered
Insects		
Mariana ight-spot Butterfly	*Hypolimnas octocula marianensis*	ndangered
Mariana Wandering Butterfly	*Vagrans egistina*	ndangered
Flowering Plants		
Aplokating-palaoan	*Psychotria malaspinae*	ndangered
Berenghenas Halomtano	*Solanum guamense*	ndangered
Cebello Halumtano	*Bulbophyllum guamense*	Threatened
Dendrobium guamense		Threatened
ugenia bryanii		ndangered
Maesa walkeri		Threatened
Nervilia jacksoniae		Threatened
Tabernaemontana rotensis		Threatened
Tinospora homosepala		ndangered
Tuberolabium guamense		Threatened
Ufa-halomtano	*Heritiera longipetiolata*	ndangered
Conifers and Cycads		
Fadang	*Cycas micronesica*	Threatened

Source: U.S. Fish & Wildlife Service, Information for Planning and Consultation Report

Under the n dangered Species Act, critical habitat is a USFWS term used to designate a habitat area essential to the conservation of a listed species, whether or not the area is actually occupied by the species at the time it is designated. There are no critical habitats at the Airport.

2.9.2.3 Other Species

Though not a protected species, the brown tree snake (*Boiga irregularis*) is an observed species on and around the Airport. This snake is an invasive species that has decimated populations of native land birds on the island of Guam. Due to their nocturnal and tree-dwelling habits, these snakes are extremely difficult to detect, especially when they are present at low densities in an area. The Airport has an ongoing program to trap and remove this species from Airport property by setting up live traps along the existing perimeter fence.

Additionally, the U.S. Department of the Interior's Office of Insular Affairs (OIA) provided $4.1 million in funding for a Brown Tree Snake Control program in FY2021, with another $3.5 million allocated for FY2022. These grants are administered through the Technical Assistance Program to control and mitigate this species on the island of Guam.[19]

2.9.3 Coastal Resources

The entire island of Guam has been designated as a "coastal zone" in the context of the Coastal Zone Management Act (CZMA). Therefore, all the territory's land and sea areas, and all its land use-related planning and regulatory agency programs and laws fall within the concern of the program.

The Guam Coastal Management Program (GCMP) was established in 1979 through a cooperative agreement between NOAA and the Bureau of Planning, Office of the Governor. It draws its authorities from the CZMA of 1972 and 5 Guam Code Annotated (GCA) Ch.1, Article 2, *Centralized Planning* under the renamed Bureau of Statistics and Plans, Office of the Governor. The GCMP is responsible for the land use and natural resource planning duties of the Bureau. The common interest and function of GCMP is to integrate its policy-making efforts with public and private interests engaged in physical, social, and economic development planning for the island through a process and mechanism in which duly adopted policies of Guam are linked and considered with all elements of decision-making among governmental and nongovernmental coastal uses. GCMP's goal is to create a responsible and balanced use of Guam's coastal resources through improving management and policy systems, optimizing planning, creating awareness, and improving the administration and enforcement of natural resource-related laws and regulations.[20]

2.9.4 U S Department of ransportation f

The U.S. DOT Act of 1966 included a special provision, Section 4(f), which protects use of publicly owned parks, recreation areas, and wildlife and waterfowl refuge areas of national, state, or local significance, and public and private historical sites.

A "use" of Section 4(f) property may be a direct use (property is permanently incorporated into the transportation project), a temporary use (property is temporarily occupied in a way that is adverse to the property's purpose), or a constructive use (the project's proximity impacts substantially impair the protected activities, features, or attributes of property).

The Guam National Wildlife Refuge (NWR) is located 11 miles north of the Airport. The Guam NWR is composed of three units: the AAFB Overlay Unit (Air Force Overlay Unit), the Navy Overlay Unit, and the Ritidian Unit. The Ritidian Unit, known to the Native Chamorro people as Puntan Litekyan, is located on the northern tip of Guam and encompasses 1,217 acres, including 385 terrestrial acres and 832 acres of submerged areas offshore.

The Ritidian Unit was established in 1993, in response to the 1984 listing of six species as endangered, and was designated as a critical habitat in 2004 for three of these species: the Mariana fruit bat, the Guam Micronesian kingfisher, and the Mariana crow.

Additionally, there are six historical parks on the island of Guam:

1. Asan Beach - With gun encasements, caves, and pill boxes, plus 445 water acres of reefs and relics.

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[19] U.S. Department of the Interior.
[20] The Guam Coastal Management Program, Bureau of Statics and Plans.

2. Asan - Heavy vegetation all around the village conceals caves, pillboxes, a bridge, foxholes, and a 75mm mountain gun.
3. Piti - Covered in lush growth, the hillside has three Japanese coastal defense guns in good condition.
4. Mount Chacho/Mount Tenjo - A Pre-World War II American gun encasement is one of several important relics found in this remote, hilly area.
5. Mount Alifan - Thirteen caves and tunnels plus bomb and shell craters are among the more than 30 sites along the winding trails.
6. Agat - This area is predominantly under water with sunken relics and unspoiled reefs.

2.9.5 aza rdous Materials

Hazardous waste, which is mapped out for the Airport, is considered any waste that can be dangerous or potentially harmful to human health or the environment. The Hazardous Waste program originated in 1965 with the federal Solid Waste Disposal Act. In 1976, the United States passed the Resource Conservation and Recovery Act, commonly known as RCRA, which splits Hazardous Waste and Solid Waste into two distinct areas. This law gave the U.S. PA greater ability to regulate hazardous waste from “cradle-to-grave.”

The U.S. PA National n vironmental Policy Act (N PA) Assist tool was used to identify the presence/absence of P A-regulated facilities on or near the Airport. Four brownfield sites were identified on the south side of the airfield (see **Figure 2-48**):

1. Former Aircraft Graveyard located at the corner of Admiral Sherman Boulevard and Neptune Avenue. This 0.1-acre site was an historic scrap metal dumpsite. The site has been cleaned up and is ready for industrial or commercial use.
2. Tiyan Typhoon Transition Site located at Mariner Avenue west of Corsair Road. This 4-acre site contained a few hundred waste tires and debris as a result of typhoon recovery efforts. A Phase 1 n vironmental Assessment (A) of the site was completed at the site before the debris was removed to prepare for a Phase II n vironmental Assessment. The Phase II assessment was conducted, and a draft report is being reviewed.
3. GS Maintenance Facility along Neptune Avenue between Corsair and Fury Roads. This site consists of two buildings separated by a concrete apron where various vehicle parts, machinery, and equipment were stored and parked. The apron slopes toward the center to create a slight V-shaped, concrete-lined trench that collects surface drainage from the apron. The trench discharges to an unlined culvert at the fence line of the southwest side of the apron. The 0.22-acre site has been cleaned up.
4. VSG Interceptor Facility along Neptune Avenue between Corsair and Fury Roads. This site is a stormwater interceptor trench from a previously removed oil/water separator. The 0.13-acre site has been cleaned up.

2.9.6 Cultural Resources

Historic properties affected by proposed airport development projects or actions are federally regulated under the National Historic Preservation Act (NHPA), the Archaeological Resources Protection Act (ARPA), and other applicable laws and regulations intended to protect historic properties. Section 106 of the NHPA requires federal agencies to take into account the effects of their actions on historic properties and include an opportunity for consultation with all interested parties. Historic properties include any prehistoric or historic district or site that is listed or eligible for listing in the National Register of Historic Places (NRHP).

Several previous cultural resource surveys have been conducted at the Airport dating back to the transfer of land from the U.S. Department of the Navy to the Government of Guam and GIAA in 2000. These studies identified resources eligible for listing on the NRHP. To be determined eligible for listing on the NRHP, properties must be at least 50 years old, and then must meet at least one of four criteria of significance and retain sufficient historic integrity to convey that significance. The previous studies had identified several resources on Airport property, both historic architectural and archaeological, 50 years of age or older, but only one is listed on the NRHP: Site No. 66-01-1496 (formerly identified as Site 1562-T18). This is a Prehistoric Period archaeological site determined eligible for NRHP under Criterion D: a site that has yielded or may be likely to yield information important in prehistory or history. The site is located on the south side of the Airport. See **Figure 2-48** for the site location.

Prior to undertaking any Airport project, the FAA must determine if the project has the potential to affect historic properties and, if so, must make a determination about the effects of the project on historic properties. As the lead federal agency, the FAA would be responsible for consulting with the Guam State Historic Preservation Office (GSHPO), which oversees the NRHP program for Guam for federal actions that could affect historic or archaeological resources.

2.9.7 and Use and Zoning

The Airport covers approximately 1,654.19 acres and is located about 1 mile north of downtown Hagåtña, immediately adjacent to Tamuning, and south of Dededo, Guam, as mapped in **Figure 2-47**.

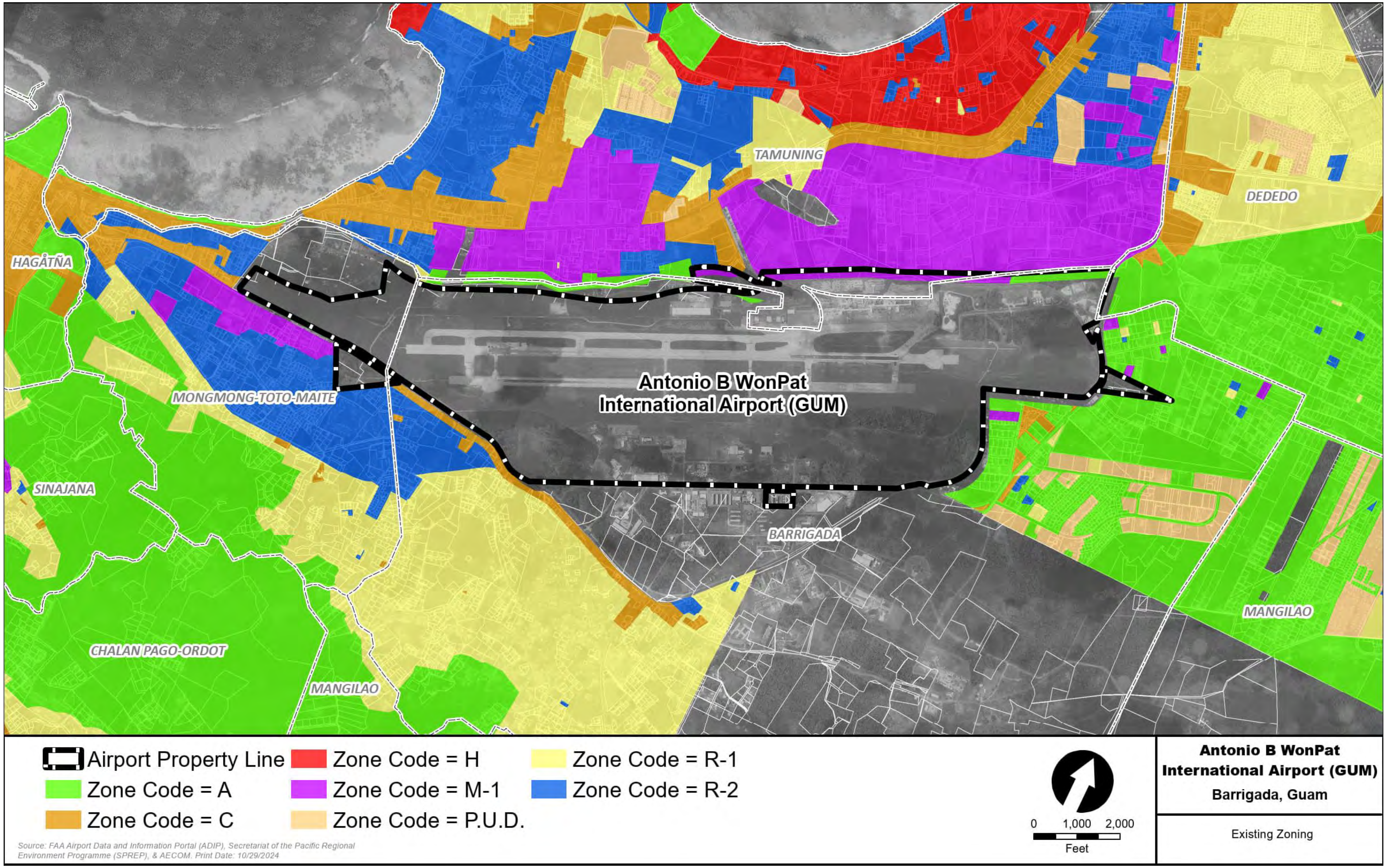
In Guam, the Department of Land Management (DLM) and Department of Public Works (DPW) have the authority to perform comprehensive planning and prepare zoning ordinances to guide development. The Guam Legislature also significantly impacts land use planning through "spot zoning." The DLM administers those parts of GCA Title 21, Division 2 that pertain to land zoning and use. Typically, an owner's building permit application would be reviewed and approved by the DLM with respect to conformance with existing zoning law. **Table 2-10** shows zones that are used in official zoning maps to categorize real property.

able 2-1 and Use Around the Airport

and Use Designation	ype of and Use
A	Agricultural
R-1	Single Family Dwelling
R-2	Multiple Family Dwelling
C	Commercial
P.U.D.	Planned Unit Development
H	Hotel/Resort
M-1	Limited Light Industrial
M-2	Industrial

Source: Airport Noise Exposure Map Update, February 2016

The majority of undeveloped land in Guam is zoned “A,” Agricultural. Similarly, the majority of developed properties are zoned R-1, Single Family Dwelling, excluding Federal and Military Reservations, which are not zoned. See **Figure 2-47**.



Sources: FAA Airport Data and Information Portal (ADIP), Secretariat of the Pacific Regional Environment Programme (SPREP)
AECOM

Figure 2-47. Existing Zoning

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2.9.8 Water Resources

The construction and operation of airport projects have the potential to affect the quality and quantity of an area's water resources, both surface and subsurface; therefore, federal, state, and local laws apply to any project or activity that has the potential to affect regulated water resources.

2.9.8.1 Surface Water

The surface water bodies nearest to the Airport include:

- A 1-acre freshwater marsh (wetland) located on the south side of the Airport, near Route 8
- Harmon Sink, a natural sinkhole with fluctuating water levels located north of the Airport near the Route 1/Route 10A intersection
- Agana and Tumon Bays along Guam's western coastline; both bays are ocean or coastal water bodies, and are used for fisheries, recreational activities, and waterborne transportation

The nearest surface water feature is an engineered, concrete-lined channel on the north side of Route 10A that conveys runoff to Harmon Sink. Areas drained by the concrete-lined channel include portions of the Tiyan cliff line at the eastern end of the project corridor and the northern portion of the Airport.

Stormwater runoff from a large portion of the Airport (largely the southern end) is collected through a system of unlined surface channels, stormwater basins, and dry injection wells.

2.9.8.2 Groundwater

The geology of the northern portion of Guam is dominated by shallow soils over coral limestone that formed over older volcanic deposits and was then uplifted by seismic activity. The Northern Guam Sole Source Aquifer encompasses the northern half of the island. This groundwater aquifer was designated as a "sole source" by the U.S. PA in accordance with Section 1424(e) of the Safe Drinking Water Act because it is the principal source of potable water on the island. The aquifer is recharged from rainfall that percolates through surface soils and the underlying cavernous limestone. The maximum elevation of the aquifer lens is approximately 6.5 feet AMSL.

2.9.8.3 Wetlands

Wetlands are transition areas where land is covered with shallow water most or all of the time. The prolonged presence of water creates conditions that favor the growth of specially adapted plants and promote the development of characteristic wetland (hydric) soils. Wetlands are valuable ecosystems, as they serve to accumulate, convert, store, and supply basic nutrients. Also, they tend to be highly productive areas that provide habitat for many species of plants, fish, and waterfowl. Additionally, wetlands serve to regulate the flow of runoff waters and to clean them of contaminants. Finally, wetlands provide a buffer against stormwaters and help reduce flooding.

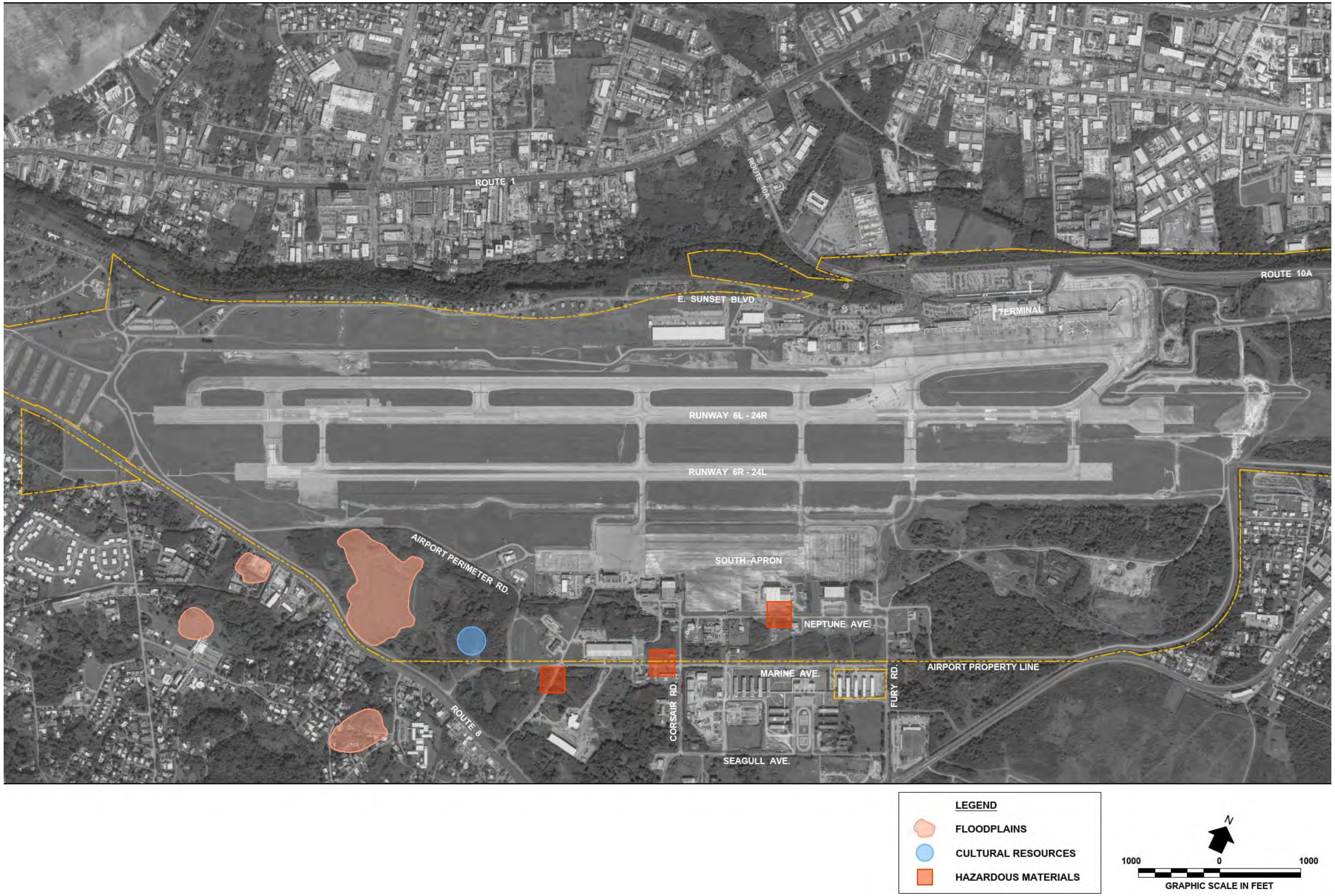
The USFWS National Wetlands Inventory Mapper indicates there are no wetlands, streams, or navigable waters located within or adjacent to the Airport.

2.9.8.4 Floodplains

Floodplains are defined by the Federal me rgency Management Agency (F MA) as any land area susceptible to being inundated by floodwaters from any source. Flood zones are geographic areas that F M A has defined according to varying levels of flood risk. These zones are identified on the official Flood Insurance Rate Map (FIRM), and each zone reflects the severity or type of flooding predicted to occur. Land area that has a 1 percent chance of flooding in any given year is identified as a Special Flood Hazard Area (SFHA).

An SFHA is an area where floodplain management regulations must be enforced. Floodplains are hydrologically important, environmentally sensitive, and ecologically productive areas that perform many natural and beneficial functions. These areas are mostly important for the natural storage and conveyance of floodwaters, the protection of water quality, and groundwater recharge. They also provide a unique and rich habitat for a wide variety of plants and animals. Consequently, development within floodplains potentially causes or contributes to decreases in water quality, loss of wildlife habitats, and an increase in severity and frequency of flood losses.

Based on a review of the F MA FIRM for the territory of Guam (2007), Map Numbers 6600010084D, 6600010125D and 6600010092D, the airfield is primarily mapped as an area of minimal flood hazard (Zone X). An isolated floodplain is located in the southwest quadrant of the Airport within the former NAS landfill, which has since been remediated. This area is mapped as having a 0.2 percent annual chance, or 500-year, flood. Most of the precipitation collected in the vicinity on pervious surfaces tends to infiltrate directly into the ground. However, some sheet flow could occur during extreme storm events, or along impervious surfaces, which include roadways, runways, or taxiways. See **Figure 2-48** for the floodplains on and around Airport property.



Source: AECOM

Figure 2-48. Airport Environmental Features

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2.10 Existing and Use

As discussed in the Land Use section of the n vironmental Features section, the majority of land surrounding the Airport is zoned as Agricultural, Limited Light Industrial, and Single and Multiple Family Dwellings. This section details the specific land uses and zoning adjacent to Airport property.

2.10.1 Former Naval Air Station Family o using Area

The narrow strip of property along the northwestern portion of Airport property has already been determined by GIAA to be used for revenue-producing facilities. Most of the former Navy facilities along . Sunset Boulevard have been demolished. This new area will allow for the future expansion of cargo or retail facilities. The Tiyan Parkway that connects Route 8 and Airport Road was completed in 2015, which allowed for the closing of Central Avenue and the extension of Runway 6L/24R.

2.10.2 East Portion – Airport Industrial Park

This area is east of the commercial passenger terminal and currently occupied by military fuel lines and the fuel farm. The fuel line bisects this area into the western and eastern sectors. This restricted easement prevents any type of development across the line, with the eastern sector being subdivided and leased out by GIAA and the western sector being less developed and proposed to be assigned for uses that require ready access to the aprons.

2.10.3 West Portion

The western tip of Airport property is proposed for new cargo and industrial buildings.

2.10.4 South Portion

The southern-most portion of the property is somewhat developed with existing aircraft, ground maintenance, administration, and storage buildings. Other buildings included in this area are the NOAA National Weather Service Station, the ARFF facility, and the FAA ATCT. Plans for this area include additional future buildings for maintenance and offices.

The area within the AOA will be specifically devoted to airside support facilities and airfield operations, while the areas outside the AOA and south of the airfield are reserved for future revenue-generating properties.

2.10.5 Existing Zoning Plan

The current state of development surrounding GIAA property is represented in the " xi sting Land Use Plan," indicating lower density land uses, primarily agriculture, and single-family detached housing to the east and west, adjacent to the ends of the runways.

The I Tano'-Ta Land Use Plan describes development opportunities in the form of Performance Standards and Density Districts. The May 1994 Base Reuse Master Plan describes potential compatibility conflicts and recommends revisions to these standards.[21] The purpose is to ensure that criteria for development in the surrounding areas address concerns regarding Airport activities such as noise and safety.

[21] I Tano'-Ta, The Land Use Plan for Guam, May 1994

2.11 Socioeconomic Conditions

According to the 2020 United States Census, the population of Guam was 153,836, which is the second highest of the five permanently inhabited territories of the United States.[22] This represents a 3.5 percent decrease from the 2010 Census population of 159,358. Additionally, the 2020 U.S. Small Business Administration (SBA) Office of Advocacy reported that the island netted 1,026 new jobs in 2017. At the time, the island was also the venue of 3,556 small business establishments and netted $1.1 billion in total exports. Also, in 2017, the top three specialty industries on the island consisted of accommodation and food services, retail trade, and construction. See **Figure 2-49** for employment numbers per municipality on the island of Guam.

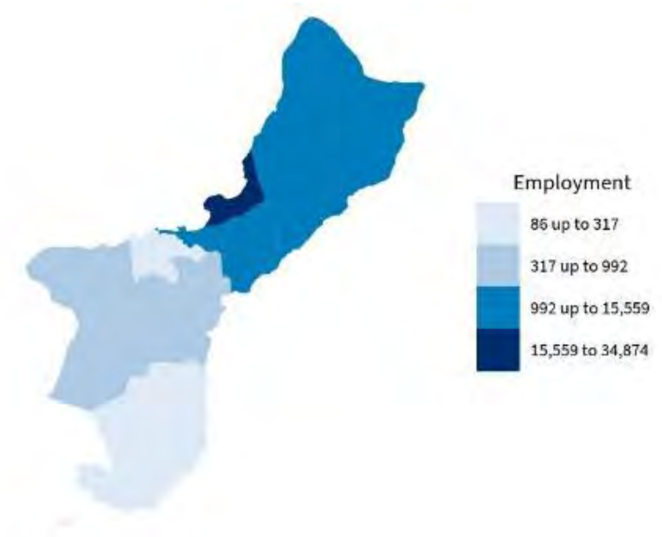

Figure 2-49. Guam Employment by Municipality, 2017

Source: County of Business Patterns, U.S. Census Bureau

As the only commercial service airport located on the island of Guam, the Airport serves as the main source of passenger travel between Guam and the rest of the world. According to the Guam FY2020 Annual Report, in FY2020 (October 1, 2019 – September 30, 2020), the Airport generated $27,596,210 in major revenue sources.[23] These revenue sources include landing fees, terminal lease, and concession and parking charges. The total revenue was a decrease of about 28.5 percent from FY2019, which was in-large part due to the COVID-19 pandemic. In comparison, the net total revenue between FY2018 and FY2019 for the same revenue sources, was just -0.86 percent. In terms of GIAA employment rates at the Airport, employment did not appear to be affected by the COVID-19 pandemic, as there were 202 full-time GIAA employees by the end of FY2020, just one less than the end of FY 2019. The majority of these employees work in Airport Police, ARFF, Properties & Facilities Maintenance, and Administration departments.

2.12 GIAA Current Facilities Inventory ist

able 2-11 GIAA Facilities Inventory ist

Code	Description	Built	Area Square Feet	Story
ADM	Administration Building	1978	2,934	1
ACCT	Accounting Building	1978	2,019	2
YCB	Yellow Cargo Building	1973	11,229	1
MF	Continental Maintenance Building +	1967	1,162	1
CG	Continental Office Building		7,200	1
DHL	DHL Cargo Building	2005	49,117	1=2
BUT	Maintenance (Butler) Building	1991	1,800	1
FST	Airport Fuel Storage Terminal	1980	1,824	1
CTB	Commuter Terminal Building	1976	47,011	1

22 Census Bureau Releases 2020 Census Population and Housing Unit Counts for Guam, census.gov.
23 Antonio B. Won Pat International Airport Authority, Guam (A Component Unit of the Government of Guam), Financial Statements, Required Supplementary Information, and Supplementary and Other Information, Years ended September 30, 2020 and 2019.

Code	Description	Built	Area Square Feet	Story
MTB	Main Terminal Building	1980	237,244	3B
	Airport Lighting Vault Building	2000	4,446	1
GWRF	GIAA Water Reservoir Facility and Water Line	2009		1 & UG
BHS	Baggage Handling System	2015		0
IAC	International Arrivals Corridor (Phase 1)			
	Terminal Ramp Lighting	2015		0
	Terminal Loading bridges	2015		0
TPL	Terminal Parking Lot			0
11-11	Small Arms	1958	578	UG
11-12	H Magazine	1958	578	UG
11-13	SP&P MAG 1FTX3	1958	578	UG
12-75A	K9 Kennel - GIAA AP	2004	2,283	1
12-3000	K9 Drug Detection Unit - C&Q		1,550	1
13-16	Bach. nlisted Quarters	1958	13,032	2
13-17	Bach. nlisted Quarters	1958	13,032	2
13-18	Bach. nlisted Quarters	1958	13,032	2
13-19	Bach. nlisted Quarters	1958	13,032	2
13-20	Bach. nlisted Quarters	1958	13,032	2
1617 & 1619	. Sunset Blvd.	1960	1,860	1
1621 & 1623	. Sunset Blvd.	1960	1,660	1
1625 & 1627	. Sunset Blvd.	1960	1,660	1
16-3230	lectric/Communication Maintenance Shop		907	1
16-3231	Transmitter Building		2,392	1
16-6103	Vehicle Maintenance Facility		9,300	1
17-75	Operations/Tower Facility		14,760	3
17-79	Regulator Building			1
17-80	Nose Dock	1960	40,200	1=3
17-82	NAPRA Flammable Storage		144	1
17-85	Radar Operational Facility		14,760	3
17-86	ROF Generator Building		294	1
17-87	PAR Generator Building	1988	247	1
17-100	VQ-1 Hangar	1962/2005	71,700	1=5
17-3120	Large Warehouse		51,206	2
17-3304	17-3305		7,900	1
17-3306	Survival quipment Maintenance	1965	5,875	1+5
17-3307	Photographic Building - GPD	1965	18,700	1
17-3309	ARFF Building	1965/2005	15,995	1=2
17-3310	ngine Maintenance Shop	1972	3,200	1=2
17-3400	VQ-1 Line Shack	1969	987	2
17-3404	HC-5 Hangar	1974	51,600	1=5
17-3410	Dist. Building, Shelter, lec.	1974	1,462	1
101 & 103	. Sunset Blvd.	1960	2,922	
105 & 107	. Sunset Blvd.	1960	1,496	

Code	Description	Built	Area Square Feet	Story
109 & 111	. Sunset Blvd.	1960	1,496	
17-3305	Aircraft Ground quipment Mx. Facility	1960	6,960	
17-3311	Avionics Shop/Corsair Road	1960	14,070	
-	Fuel Pipeline UG	1962		
-	Threshold Lighting	1967		
-	Precision Approach Radar Facility	1988		
-	Opt. Glide Path Ind. System	1961		
-	TACAN Hard Stand	1962		
-	Runway Lighting	1958		
-	Open Storage Area RI	1961	3,225	
-	Fencing			
-	Glide Slope Facilities & Antennas	2013	210	1
-	Glide Slope mergency Gen & Fuel Storage Tank	2013	210	1
-	Localizer Facilities & Antennas	2013	242	1
-	Localizer mergency Gen & Fuel Storage Tank	2013	242	1
-	MALSR Facilities	2012	144	1
	Customs and Quarantine Office at IACF	2009	25,000	2

Note: This schedule is presented solely to enable underwriters to view the distribution of values and determine a probable maximum loss. It is not to be used to establish sub-limits of coverage, nor is it presented as any form of valuation warranty.
Source: GIAA

3 Aviation Demands Forecast

Executive Summary

A C OM has been engaged by the A.B. Won Pat International Airport Authority, Guam (GIAA) to provide airport planning services associated with a Master Plan Update for the Antonio B. Won Pat International Airport (Airport). This chapter of the Master Plan presents a summary of historical aviation demand at the Airport and a forecast of unconstrained aviation demand through the 20-year planning horizon (the forecast period).

Forecast scenarios were developed for enplaned passengers, air cargo tonnage, aircraft operations, and based aircraft. The supporting analyses required in developing the forecasts are presented in the report and include an explanation of the forecast approach and methodology; the forecast results; and a comparison with other forecasts prepared for the Airport, including the Federal Aviation Administration (FAA) Terminal Area Forecast (TAF), the n planements Forecast prepared by InterVISTAS in August, 2022 (Forecast in the Report of the Airport Consultant), and the 2012 Airport Master Plan Forecast.

The recommended forecasts as summarized in **able ES 3-1** below provide the basis for determining the planning activity levels and future facility requirements in the Master Plan Update.

able ES 3-1 Summary of Aviation Demand Forecasts

Fiscal Year	otal Enplanements	otal Operations	otal Based Aircraft
Actual			
2019 [A]	1,885,108	72,699	36
2020	884,060	38,907	36
2021	135,566	20,363	37
Forecast			
2024	1,277,397	59,960	37
2029	1,960,402	83,655	38
2034	2,123,073	88,012	39
2039	2,312,858	92,643	40

Note: 2019 (pre-2019 Novel Coronavirus [COVID-19][24]-pandemic) is the base year for the forecast.
Source: AECOM Analysis

[24] 2019 Novel Coronavirus (COVID-19): Coronavirus disease 2019 is a contagious disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). The World Health Organization (WHO) declared the outbreak of COVID-19 a global pandemic in March 2020. The aviation activity level has dropped significantly since the pandemic.

3.1 Introduction

Forecasts of future aviation activity levels are the basis for effective decisions in airport master planning. The recommended forecasts provide the basis for determining the planning activity levels and future facility requirements in the Master Plan Update. It also provides a basis for the development of alternatives to meet the projected demand, environmental analyses, and economic and financial plans.

The forecast elements for this Master Plan include:

- n planed passengers
  - Domestic enplaned passengers
  - International enplaned passengers
- Air cargo
  - Cargo tonnage by air freighter aircraft
  - Cargo tonnage by small cargo aircraft
  - Cargo tonnage by passenger aircraft (lower deck, i.e., belly cargo)
- Aircraft operations
  - Air carrier (commercial passenger aircraft operations)
  - Air carrier (all-cargo aircraft operations)
  - Air taxi and general aviation (GA) operations
  - Military aircraft operations
  - Breakdowns between itinerant and local operations
- Based aircraft

a ch forecast includes unconstrained demand for the 20-year planning horizon (2019 through 2039) grouped into 5-year periods and utilizing actual 2019 (pre-COVID-19-pandemic) statistics as the baseline.

The historical and forecast annual statistics in this report are summarized by fiscal year (FY), which is the 12-month period beginning 1 October and ending 30 September the following year. The identification of a FY is the calendar year in which it ends (i.e., FY2019 began on 1 October 2018 and ended on 30 September 2019). The use of FY ensures consistency with the FAA TAF and for the purposes of this report, years associated with all forecasts will be designated as its FY unless stated otherwise.

3.2 Airport Service Region

Guam is known as the jewel of Micronesia and a tourism destination. It is an island located in the Pacific Ocean, is the largest island in Micronesia, and is located about 1,200 miles east of the Philippines and 3,300 miles west-southwest of Hawaii.[25]

The Airport is the only commercial service airport serving the U.S. Territory of Guam. The other airport on the island is a military airport, the Andersen Air Force Base (AAFB) (GUA).

The Airport enplaned over 1.8 million passengers in 2019 to become the 75th busiest airport (out of 3,304 airports) in the U.S. National Plan of Integrated Airport Systems (NPIAS) based on enplanements. The FAA classifies the Airport as a small hub airport because it serves between 0.05 and 0.25 percent of annual U.S. commercial enplanements.[26] The Airport was ranked as the 14th busiest small hub airport in 2019.

The nearest public airports are located in the Commonwealth of the Northern Mariana Islands (CNMI), including Saipan International Airport (GSN) on Saipan Island, Tinian International Airport (TNI) on Tinian Island, and Benjamin Taisacan Manglona International Airport (GRO) on Rota Island. These three airports

[25] Distances are measured in nautical miles (nm).
[26] In 2019, the base year of the Master Plan, the Airport was designated as a small, primary hub airport however, subsequently, the airport has been designated as a primary, non-hub airport in the 2023-2027 National Plan of Integrated Airport Systems (NPIAS).

range from 49 to 112 nautical miles (nm) (or 35 to 50 minutes travel time by air) from the Airport. Because travel by air is the primary mode of transportation for visitors and residents to/from Guam and the Northern Mariana Islands, GSN, GWT, and GRO are not considered competitors to the Airport.

Farther from the Northern Mariana Islands, there are other Pacific islands outside the U.S. Territory but within Micronesia, including the Republic of Palau, Federated States of Micronesia, and Republic of Marshall Islands (**Figure 3-1**). Guam is closer to many east Asian countries including Japan, Korea, Philippines, China, and Taiwan than these Micronesian islands (**Figure 3-2**). In addition, the Airport is the largest airport amongst these islands, with more nonstop destinations, more operating airlines, and higher flight frequencies, and therefore it acts like a gateway to Micronesia. Flights between islands bring passengers to the Airport for connection to their final destinations. Visitors may also visit multiple islands during their stay in the region.

For the purposes of the aviation demand forecast analysis, the primary catchment area served by the Airport (i.e., the Airport service region) is defined as the island of Guam. The secondary catchment area served by the Airport may extend to the Northern Mariana Islands and other Micronesian islands as shown in **Figure 3-1**.

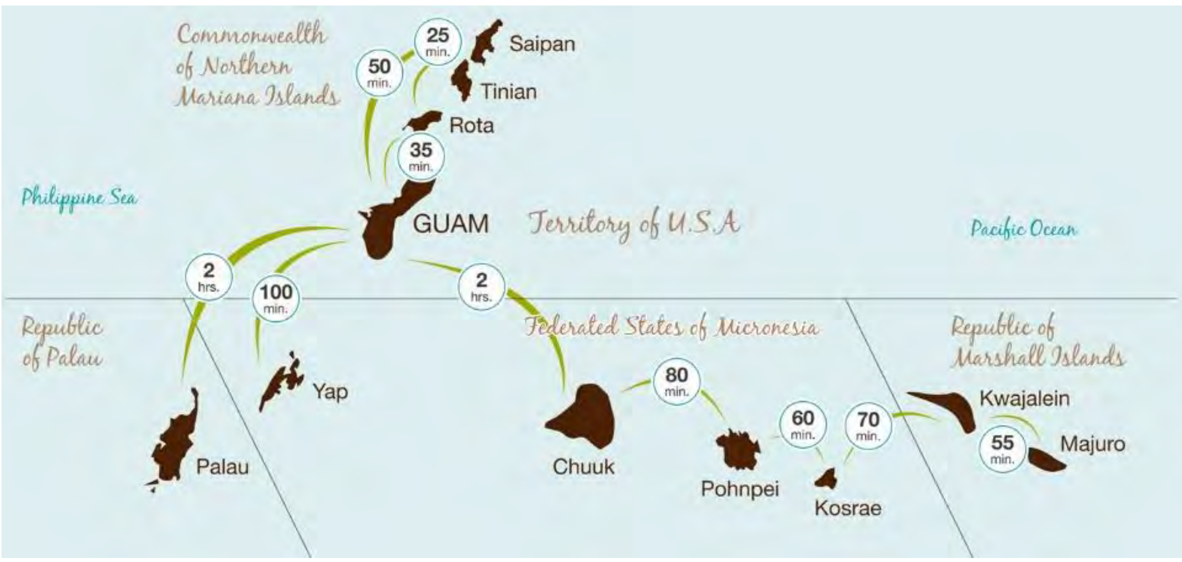

Figure 3-1. Flight Time Between Guam and Other Micronesian Islands in the Region

Source: Pacific Asia Travel Association Micronesia Chapter

Figure 3-2. Flight Time Between Guam and East Asia, Oceania, and U.S. Mainland/Hawaii

Sources:

1. *Base map - Guam Visitors Bureau (GVB), Gateway to Micronesia*
2. *AECOM edits*

Since Guam is a leisure destination, the majority of the international travel demand to/from Guam is driven by visitors. It is the economic basis of the top tourism markets, e.g., Japan, Korea, China, and Taiwan, that drives the principal demand for supporting the aviation activities at the Airport instead of the local economy of the primary or secondary catchment areas. **Section 3** focuses on describing the socioeconomic characteristics of the top tourism markets and supplements with the characteristics of the Airport service region. These socioeconomic characteristics were used to evaluate the long-term aviation activity trends at the Airport.

For the near-term aviation activity trends, the COVID-19 pandemic plays an important role. Hence, before discussing the analyses on the socioeconomic characteristics of different markets, **Section 3 3** describes the recent historical trends and impacts of COVID-19 to the economy and the aviation industry.

3.3 COVID-19 Pandemic

The COVID-19 pandemic created an unprecedented crisis in the U.S., leading to a declaration of national emergency on March 13, 2020. The U.S., like many countries, sought to curtail the spread of the virus by issuing domestic and international travel restrictions, including statewide stay-at-home orders and national social distancing measures. Despite these efforts to contain the spread of COVID-19, several waves of the virus hit the U.S. The first wave began in March 2020; the second wave, June 2020; the third wave, October 2020; the fourth wave, July 2021; and the fifth wave began in December 2021 due to the impacts of the Omicron variant.

Figure 3-3 and **Figure 3-** show the daily number of new COVID-19 cases and death cases in the U.S. and identify the different waves of impacts. Since the Omicron variant is more transmissible than the original virus and other variants, the trend for the fifth wave as shown in **Figure 3-3**, is exaggerated. Considering the Omicron variant also causes less severe disease, hence **Figure 3-** showing the death statistics is added.

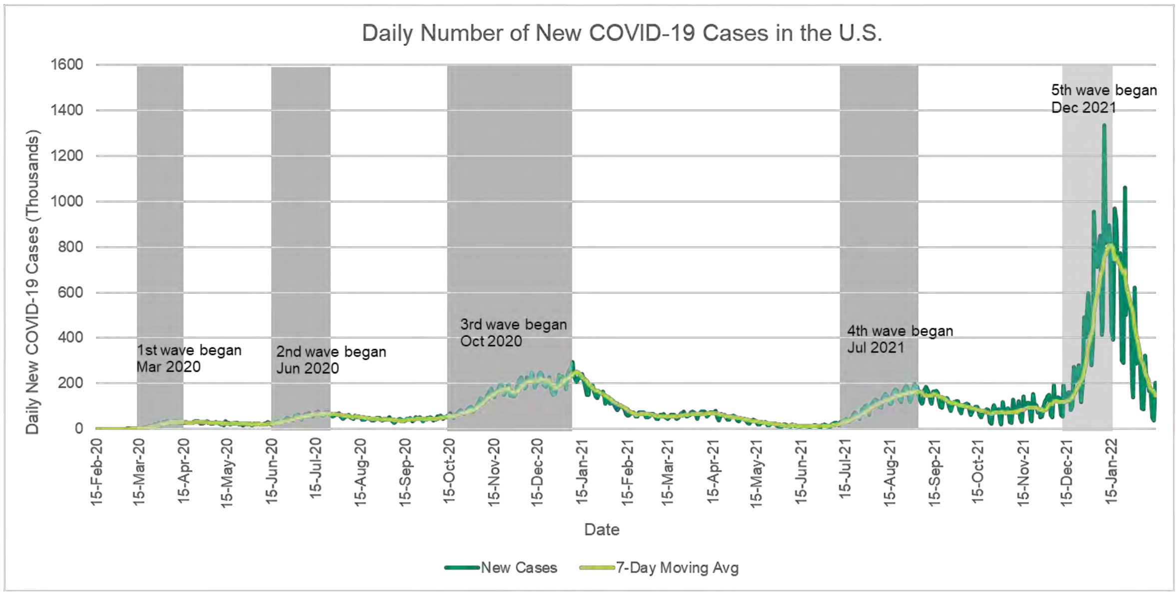

Figure 3-3. Daily Number of New COVID-19 Cases in the U.S.

Sources:
1. *Centers for Disease Control and Prevention (CDC), COVID Data Tracker (February 16, 2022)*
2. *AECOM analysis*

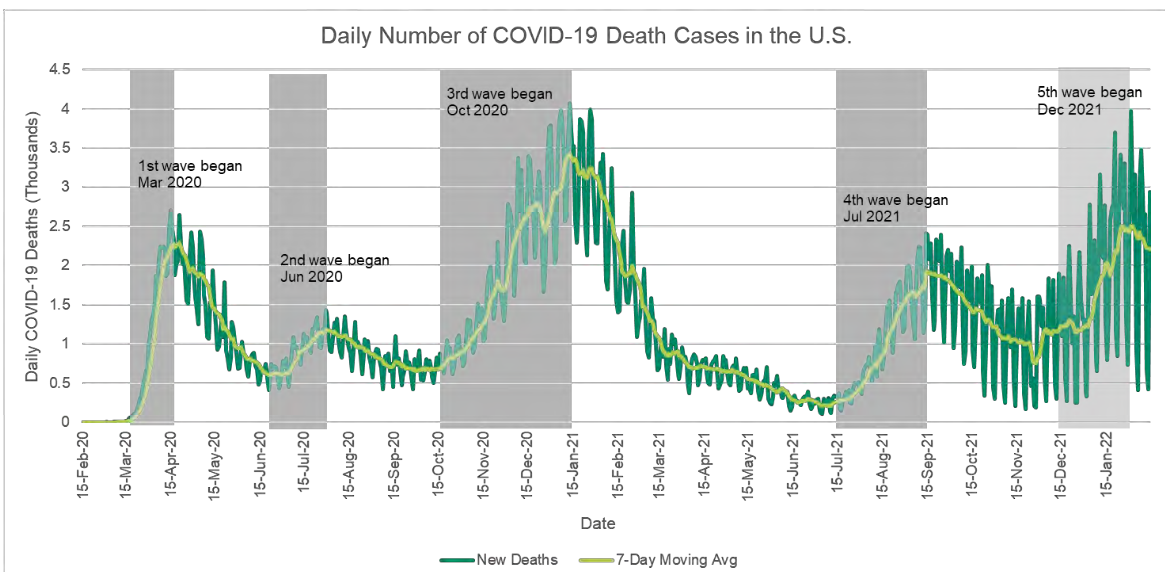

Figure 3-4. Daily Number of COVID-19 Death Cases in the U.S.

Sources:
1. *CDC, COVID Data Tracker (February 16, 2022)*
2. *AECOM analysis*

The number of daily new cases peaked in January 2022 in most states and territories, including Guam, due to the highly transmissible Omicron variant as shown in **Figure 3-** . The first three waves that the U.S. mainland experienced are not as distinct in the daily new cases and daily deaths statistics for Guam, as given in **Figure 3-** and **Figure 3-6**. This is mostly due to the smaller sample size in Guam as compared to the U.S. mainland, and it also takes time for the virus to make its way to distant islands away from the main continents.

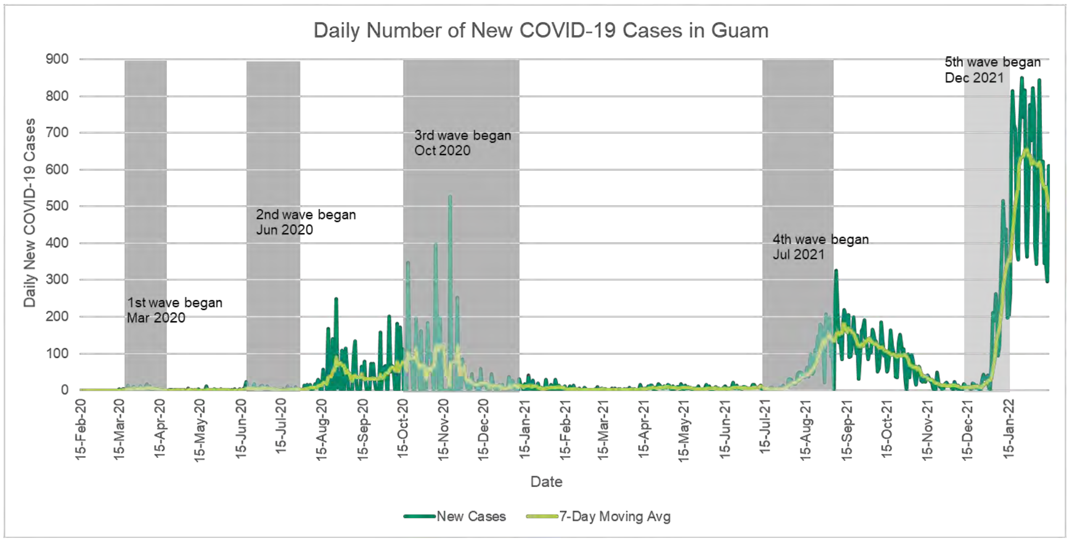

Figure 3-5. Daily Number of New COVID-19 Cases in Guam

Sources:
1. *CDC, COVID Data Tracker (February 16, 2022)*
2. *AECOM analysis*

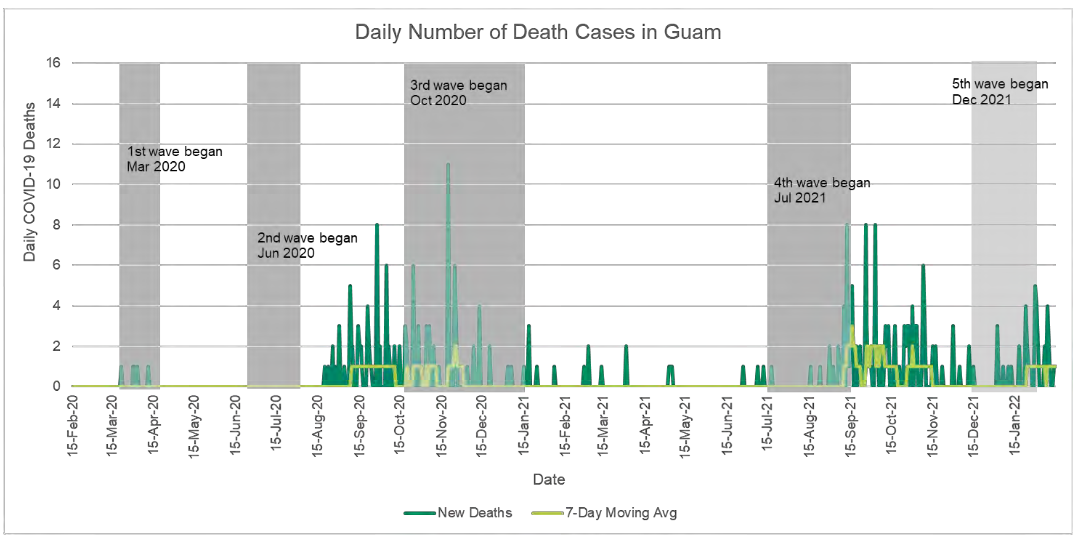

Figure 3-6. Daily Number of COVID-19 Death Cases in Guam

Sources:
1. *CDC, COVID Data Tracker (February 16, 2022)*
2. *AECOM analysis*

The pandemic devasted the U.S. economy and the airline industry worldwide. Because of travel restrictions and fears about the virus, many businesses were temporarily shut down and travel came to a near halt. **Figure 3-** and **Figure 3-** show the monthly visitors from the U.S. and outside the U.S. to Guam by air from January 2019 to November 2021. **Figure 3-9** and **Figure 3-1** show the monthly domestic and international enplanements at the Airport, which follow similar recovery patterns for monthly visitors in **Figure 3-** and **Figure 3-** , respectively.

In April 2020, the beginning of the pandemic, Guam lost 85.7 percent of its U.S. visitors and 99.7 percent of international visitors. Domestic enplanements at the Airport dropped 91.8 percent, and international enplanements dropped 99.6 percent. During the same period, the total travelers in the U.S. dropped by 95.3 percent based on the Transportation Security Administration (TSA) security screening statistics as shown in **Figure 3-11**.

Recovery is well under way for the domestic market. Guam experienced a strong recovery in July 2021, and domestic visitor statistics reached nearly 98 percent of their pre-pandemic level for the same month in 2019 (**Figure 3-**). For the same period, domestic enplanements at the Airport returned to 93 percent of their pre-pandemic level in July 2021 (**Figure 3-9**). Nevertheless, recovery of international visitors is stagnant (**Figure 3-** and **Figure 3-1**), and it is heavily impacted by the travel restrictions and quarantine policies of different countries. During the same period, total travelers in the U.S. recovered by approximately 80 percent (**Figure 3-11**).

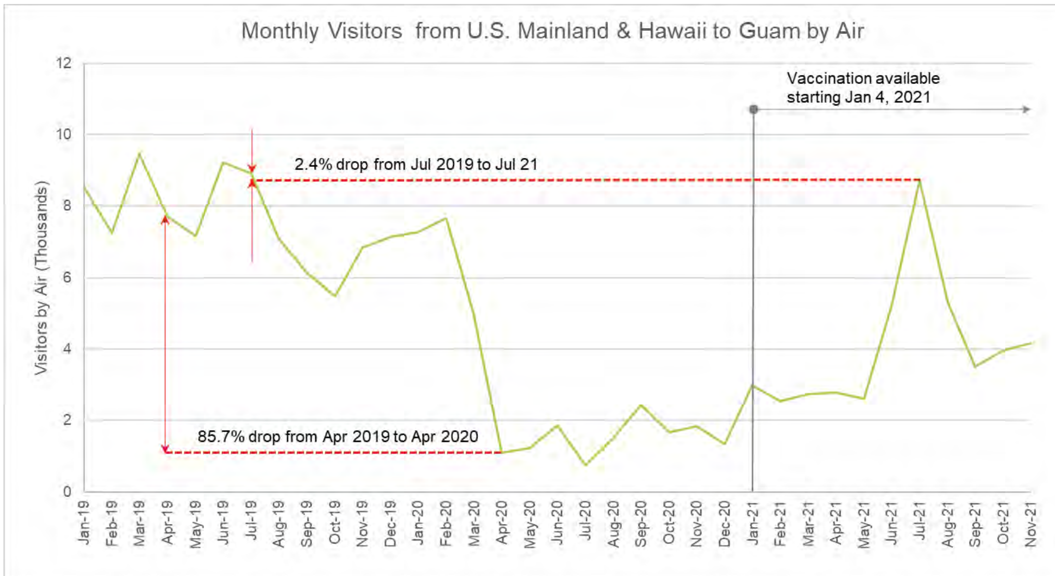

Figure 3-7. Monthly Visitors from U.S. Mainland and Hawaii to Guam by Air

Sources:
1. *Visitor statistics – GVB*
2. *First vaccination date – WHO*
3. *AECOM analysis*

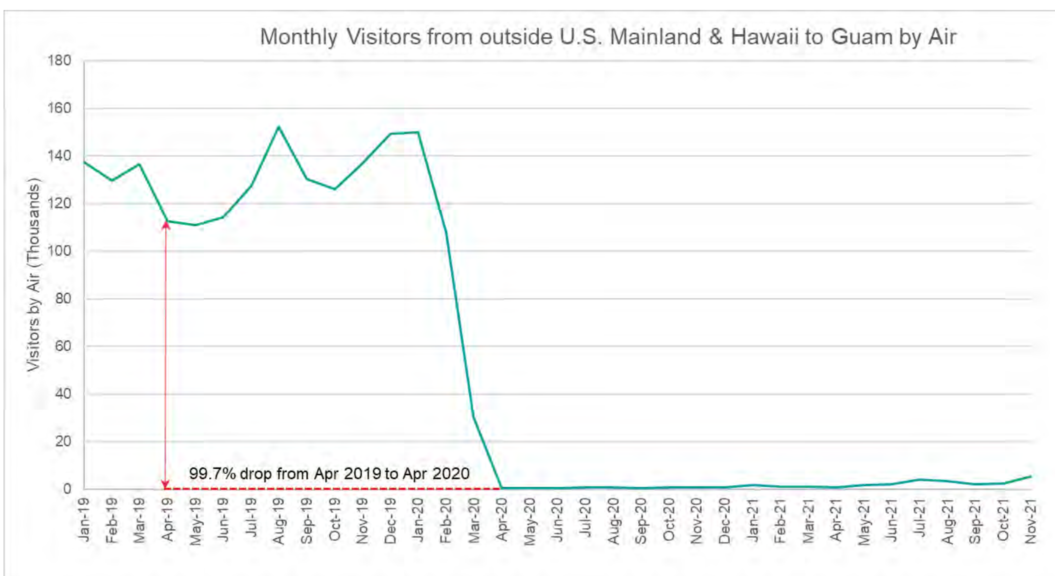

Figure 3-8. Monthly Visitors from Outside the U.S. Mainland and Hawaii to Guam by Air

Sources:
1. *GVB*
2. *AECOM analysis*

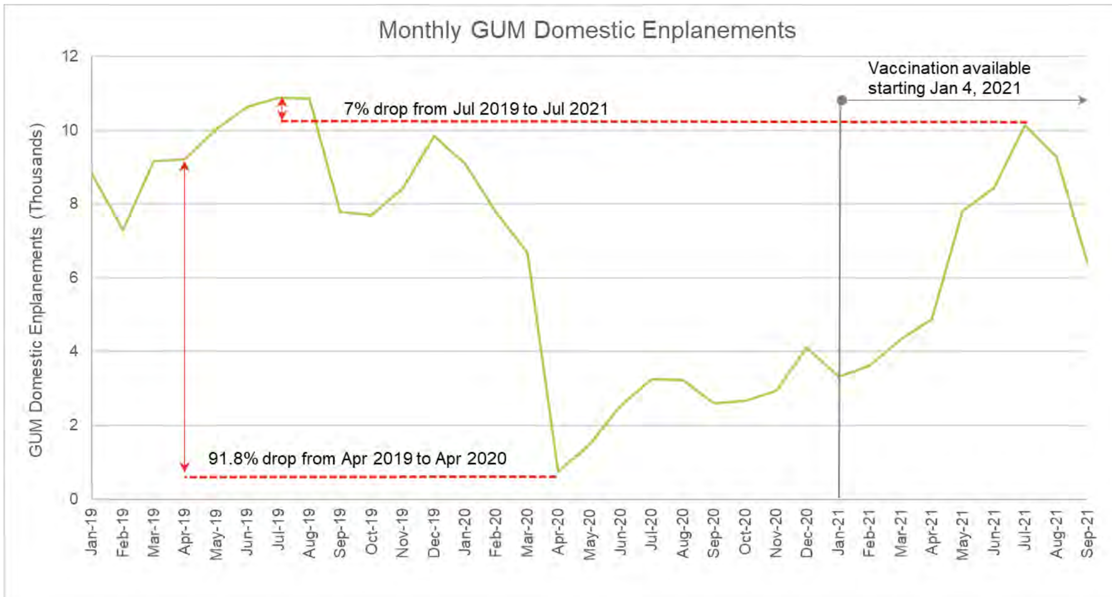

Figure 3-9. Monthly GUM Domestic Enplanements

Sources:
1. *GIAA*
2. *AECOM analysis*

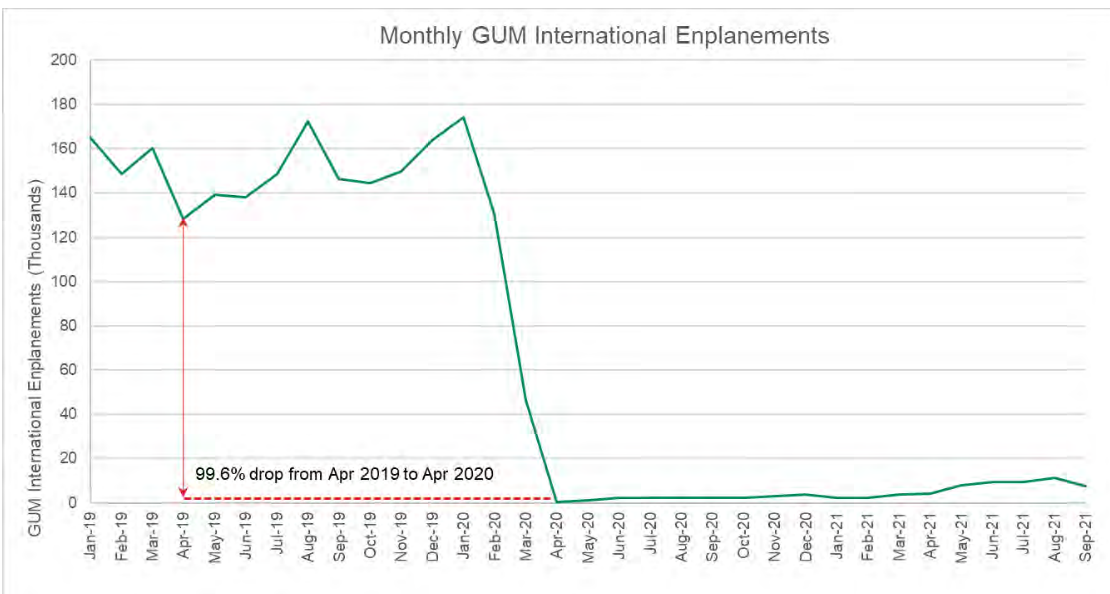

Figure 3-10. Monthly GUM International Enplanements

Sources:
1. *GIAA*
2. *AECOM analysis*

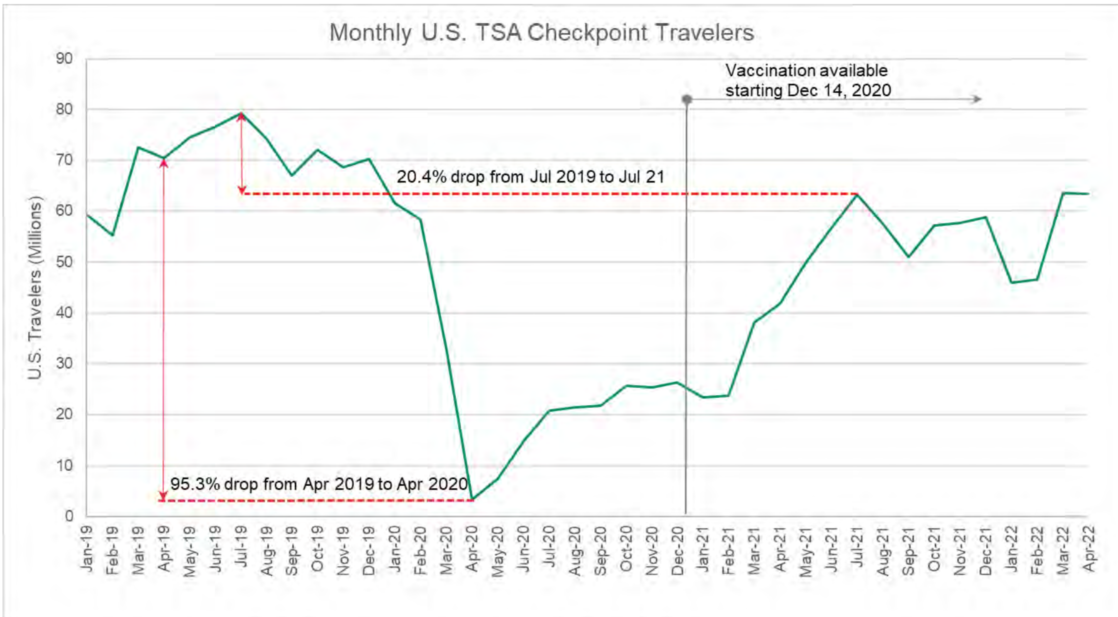

Figure 3-11. Monthly U.S. TSA Checkpoint Travelers

Sources:

1. *Traveler statistics – TSA*
2. *First vaccination date – WHO*
3. *AECOM analysis*

Sources: Traveler statistics – TSA; First vaccination date – WHO; AECOM analysis

Increased travel in July 2021 ties into the 4th wave, when the Delta variant began to emerge throughout the world. As the daily new cases surged, the traveler statistics began to decline again. A similar pattern was also observed during the 5th wave triggered by the Omicron variant. The recovery rate dropped in January 2022 after the growth in holiday season travel through November and December 2021.

As economic losses accumulated, pressures on local and state governments to ease travel restrictions and re-open the economy began to mount. In addition, vaccination was available beginning mid-December 2020 in the U.S. and early January 2021 in Guam.

Of Guam's population, 87.6 percent have had at least one dose of the vaccine and 79 percent are fully vaccinated as of mid-February 2022. The vaccination rates at the nearby Northern Mariana Islands including, Rota, Saipan, and Tinian, are similar to the Guam statistics. Both Guam and the Northern Mariana Islands have higher vaccination rates than the U.S. average (**able 3-1**). Out of the 50 states, D.C., territories, and federal entities, the Northern Mariana Islands has the highest percentage of its population fully vaccinated, and Guam has the 7th highest.

The vaccination rates in the top international markets for the Airport, including Japan, Korea, Taiwan, and China, are similar to Guam, with over 80 percent of the total population with at least one dose of vaccine and over 74 percent fully vaccinated. Only destinations such as the Philippines, Micronesia, and Marshall Islands have vaccination rates lower than the U.S. average.

Aided by increases in vaccination rates and the increase in pressures to lift travel restrictions for economic recovery, it is anticipated that the recovery in the aviation industry is under way. The forecast section will further discuss the impacts and considerations of the pandemic in different near-term scenarios.

able 3-1 Vaccination Rates in U S , Guam, Pacific Islands, and op International Markets

ocation	% of Population with at least one dose of vaccine	% of Population fully vaccinated
U S / erritories/Commonwealths		
U.S.	76.0%	64.5%
Guam	87.6%	79.0%
Northern Mariana Islands (CNMI)	86.6%	82.0%
International Markets		
Japan	80.1%	78.9%
Korea	87.2%	86.0%
Taiwan	80.7%	74.3%
China	86.7%	84.0%
Philippines	60.8%	54.4%
Micronesia (FSM)	55.8%	44.5%
Palau	93.4%	81.7%
Marshall Islands (RMI)	35.9%	30.4%

Notes:
CNMI = Commonwealth of the Northern Mariana Islands
FSM = Federated States of Micronesia
RMI = Republic of the Marshall Islands
Sources:
U.S./Territories/Commonwealths/Federal States – Centers for Disease Control (CDC) and Prevention, COVID Data Tracker (February 17, 2022)
Japan/Korea/China/Philippines – World Health Organization (WHO), Coronavirus Dashboard (February 17, 2022)
Taiwan – Our World in Data, Coronavirus Vaccinations (February 17, 2022)

3.4 Economic Basis for Aviation Demand

The economy of the top tourism markets and the region served by the Airport is an important determinant of long-term passenger demand at the Airport. The development and diversity of the economic base of these top tourism markets and the Airport service region is important to future passenger traffic growth. To identify the top tourism markets, the historical arrival statistics from the Guam Visitors Bureau (GVB) were analyzed and are included in **Section 3 1**. Then the socioeconomic characteristics, including historical and outlook in population, per capita personal income, and regional economy (in terms of Gross Domestic Product [GDP]), for each of the top tourism markets and for Guam are included in **Section 3 2**.

3.4.1 ourism Statistics

Figure 3-12 summarizes the number of air visitors arriving in Guam by country of origin. **Figure 3-13** shows the corresponding percentage of market share. Both figures show that Japan, Korea, Taiwan, and China (including Hong Kong) are the top four international markets for Guam.

The Japan market has been the largest tourism market in Guam for many years. However, Japan's sluggish economy, depreciated currency, and aging populations continue to affect visitor arrivals to Guam. Since 2018, Korea has surpassed Japan as the dominant market for Guam, until 2020 when the COVID-19 pandemic effects began.

With the travel restrictions and quarantine requirements in these top tourism markets during the pandemic, U.S. domestic travel emerged as the dominant market in 2021.

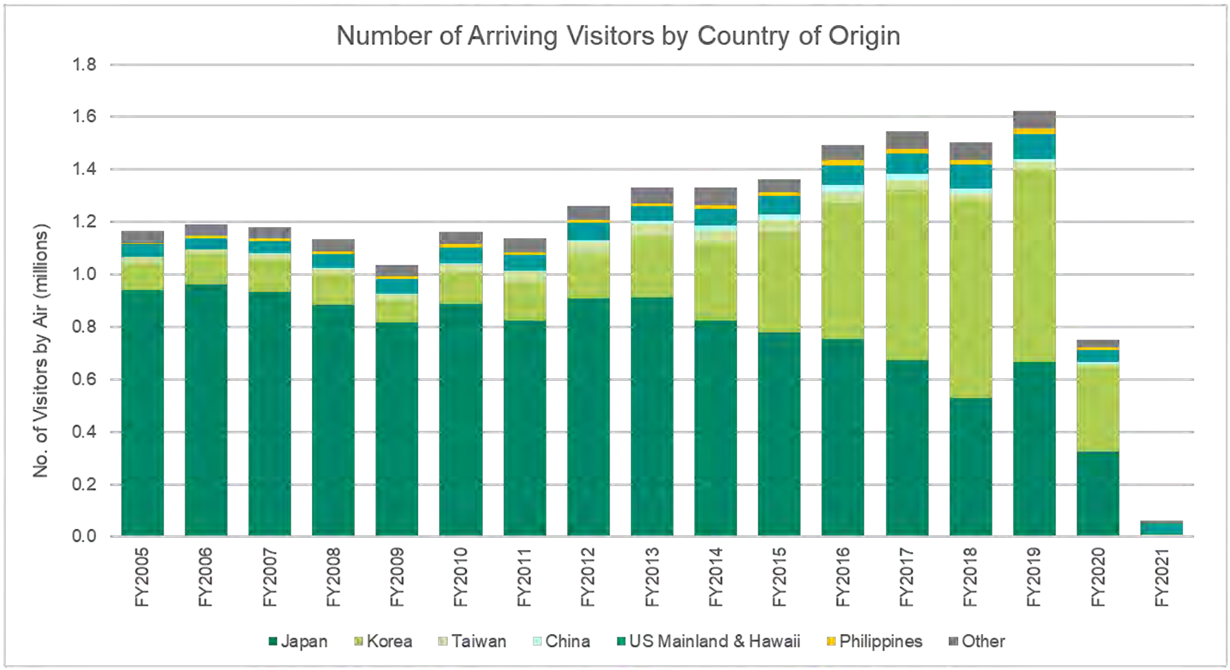

Figure 3-12. Number of Arriving Visitors by Country of Origin (FY2005 to FY2021)

Sources:

1. *Visitor statistics – GVB (January 2022)*
2. *AECOM analysis*

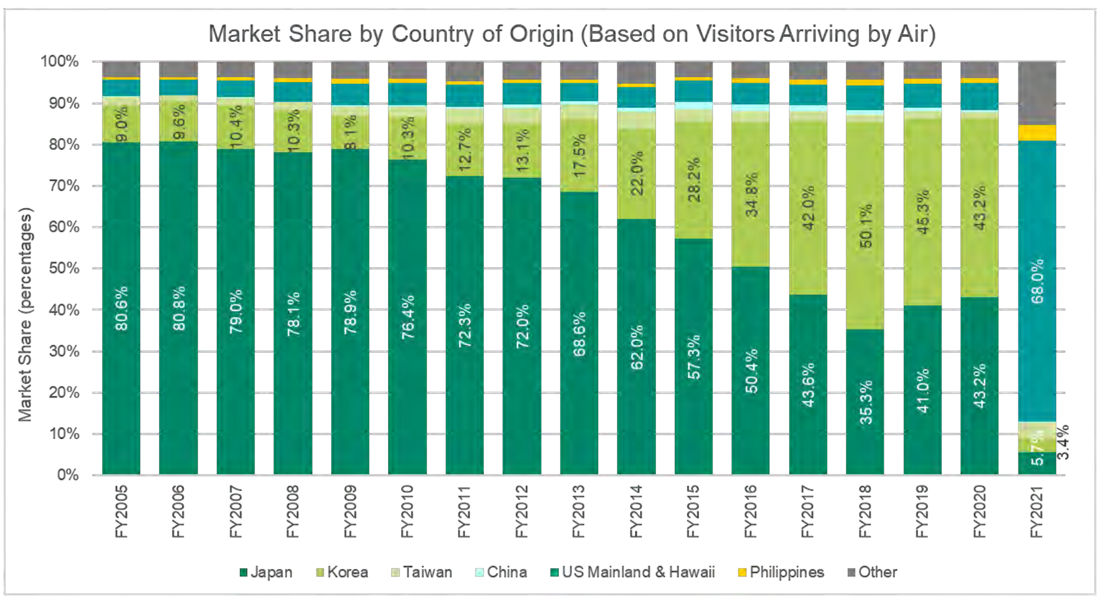

Figure 3-13. Market Share by Country of Origin (FY2005 to FY2021)

Sources:

1. *Visitor statistics –GVB (January 2022)*
2. *AECOM analysis*

The tourism statistics also provide an insight on the seasonal variations on air travel demands. **Figure 3-1** shows the seasonal variations based on monthly visitor statistics. Typically, the peak tourism seasons in Guam are December to March and June to August. Off-peak months with the lowest tourism demand are May, September, and October.

December to March is popular for Japanese and Korean visitors, as temperatures are a lot warmer in Guam during winter. June to August is the traditional peak season for many destinations because schools have summer breaks. August is the overall peak month throughout the year.

Figure 3-14. Seasonal Variations in Tourism Demands

Sources:

1. *Visitor statistics – GVB (January 2022)*
2. *AECOM analysis*

The tourism statistics were analyzed to determine the percentage of domestic (U.S. mainland, Hawaii, and CNMI) and international (other than U.S. mainland, Hawaii, and CNMI) visitors. **Figure 3-1** shows the percentage of domestic visitors varied between 5 and 8 percent over the past 15 years before the COVID-19 pandemic.

Less than 30 percent of the domestic visitors arrive from CNMI, as shown in **Figure 3-16,** and that statistic has decreased to less than 20 percent in recent years. The driver for the increase in domestic visitors is primarily from the U.S. mainland (via Hawaii).

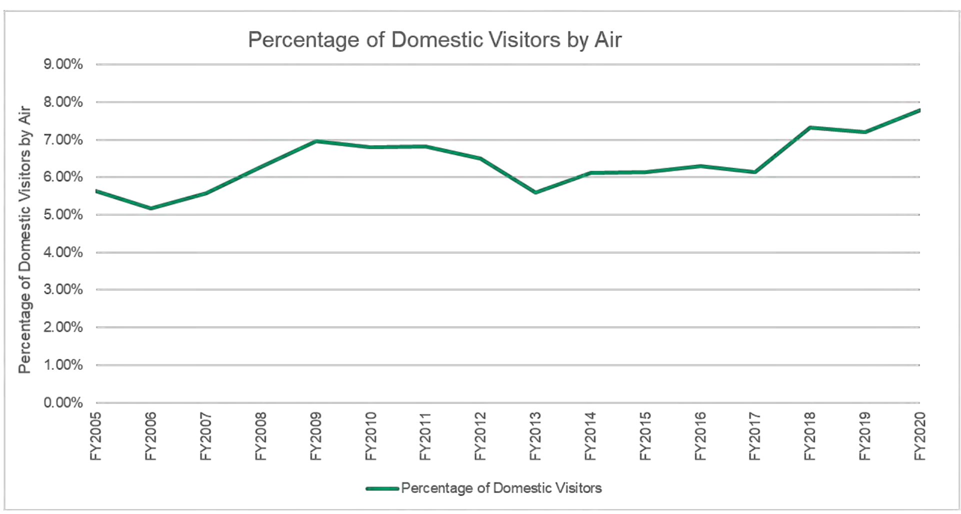

Figure 3-15. Percentage of Domestic Visitors by Air (FY2005 to FY2020)

Note: Percentage of domestic visitors was 73 percent in FY2021, as international travels were significantly reduced due to the COVID-19 pandemic, hence, the FY2021 data is excluded from the figure.

Sources:

1. *Visitor statistics – GVB (January 2022)*
2. *AECOM analysis*

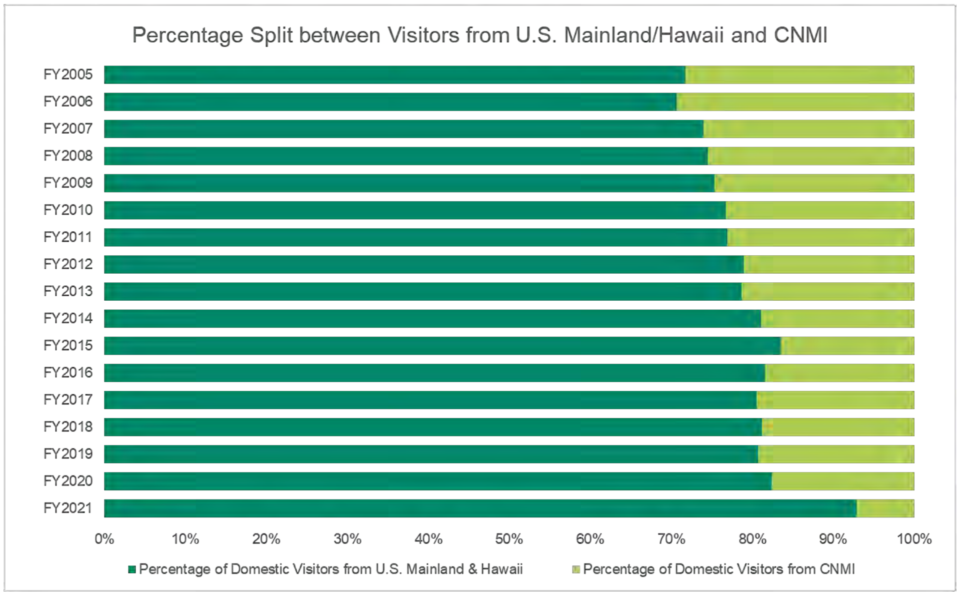

Figure 3-16. Percentage Split Between Visitors from U.S. Mainland/Hawaii and CNMI (FY2005 to FY2021)

Sources:
1. *Visitor statistics – GVB (January 2022)*
2. *AECOM analysis*

Visitor profiles of the top tourism markets provide additional insights on the correlation of socioeconomic characteristics to the air travel demands. Relevant analyses for the Japan, Korea, and Taiwan markets based on GVB's FY2020 Annual Report and xi t Survey Reports by country for the first quarter of 2020 are summarized below.

- Japanese visitors are mostly motivated by the short travel time to Guam (41 percent) and natural beauty (37 percent). Korean visitors' travel motivations are primarily for pleasure (66 precent) and relaxation (51 percent). Taiwanese visitors' top travel motivations are the natural beauty of Guam (47 percent) and for relaxation (41 percent).
- The average age of visitors is similar for these three markets and falls between 32 and 34 years.
- Average party size is 4.7 for Japanese visitors, 3.5 for Korean visitors, and 5.4 for Taiwanese visitors.
- The average length of stay is also similar and falls between three and five nights: three nights for Japanese visitors, four nights for Korean visitors, and five nights for Taiwanese visitors.
- Japan is a mature market with more repeat visitors as compared to Korea and Taiwan; 58 percent of Japanese visitors are first-time visitors versus 75 percent for Korean visitors and 76 percent for Taiwanese visitors.
- Peak months for Japanese visitors are March and August. January and July are the peak months for Korean visitors. February and July are the peak months for Taiwanese visitors.
- The income groups are very diverse. Guam appears to be popular with a wide range of visitors from different income groups.

For the domestic market, relevant analyses for the U.S. visitor profile based on GVB's xit Survey Report for the first quarter of FY2020 are summarized below. The travel motivations for domestic visitors are different from international visitors, hence the visitor profiles also vary.

- The top motivations for U.S. visitors are related to government/military (41 percent), visiting friends and relatives (35 percent), vacation (27 percent), and business (23 percent).
- The average age of visitors is 41.7 years.
- Average party size is 2.1 persons.
- Average length of stay is 12.6 nights.

- 39 percent of U.S. visitors are first-time visitors.
- Peak months for U.S. visitors are August and December.[27]
- The income group is also very diverse; 56 percent of the U.S. visitors have annual household income before taxes between $50,000 and $150,000, including 18 percent at $50,000 to $75,000, 14 percent at $75,000 to $100,000, and 24 percent at $100,000 to $150,000.[28]

3.4.2 Socioeconomics

The socioeconomic characteristics of the top tourism international markets, the domestic U.S. market, and the local Guam market are described in this section. The projections of the socioeconomic characteristics and economic outlook through the planning horizon are included where available.

3.4.2.1 Japan

Japan is one of the largest and most developed economies in the world. It has a well-educated, industrious workforce, and its large, affluent population makes it one of the world's biggest consumer markets. Japan's economy was the world's second largest (behind the U.S.) from the 1960s to 2010, when it was overtaken by China. Its GDP in 2019 was $4.6 trillion (in constant 2015 U.S. dollars [USD]), and its population of 126 million enjoys a high standard of living, with per capita GDP of over $36,000 in 2019.

3.4.2.1.1 Population of Japan

Figure 3-1 summarizes the historical and projected population, and annual population growth rates of Japan. The rapidly aging population, the decline in birth rates, and continued migration restrictions shrink Japan's population. The United Nations predict the population of Japan will reduce by 9.6 percent from 126 million in 2019 to 114 million in 2039.

Both the aging population and overall decline in total population will reduce the size of the workforce and tax revenues, while placing an increase on demands on health and welfare expenditure. These factors add pressure to Japan's economy.

Since the average age of visitors from Japan is the youngest (32 years) among the top markets, only 2 percent of the Japanese visitors are over 60 years old. Guam will continue to face its challenges in silver tourism with the aging demographics.

3.4.2.1.2 Economy of Japan

Japan is a world leader in manufacturing of electrical appliances and electronics, automobiles, ships, machine tools, high technology equipment, machinery, and chemicals. In recent years; however, Japan has ceded some economic advantage in manufacturing to China, Korea, and other manufacturing economies. Japanese firms have reacted to this trend by moving some of their manufacturing production to low-cost countries. Japan's services sector, especially financial services, now plays a more prominent role in the economy than manufacturing.

International trade contributes significantly to the Japanese economy. Key exports include automobiles, machinery, and manufactured products. Despite the depreciated yen as a result of stimulatory economic initiatives, export growth remains sluggish.

Japan's economy and depreciated currency continue to affect Japanese visitors to Guam. The multi-year increases in its sales tax and deficit spending by the government, combined with limited opportunities for foreign direct investment, has resulted in annual GDP growth measured at an average of less than 1 percent in the past five years (2015 to 2019). Over the last two decades (2000 to 2019), the annual GDP growth has also been stagnant and averaged at less than 1 percent. The historical GDP and GDP per capita growth rates are given in **Figure 3-1** .

However, Japan remains immensely strong in the world of trade and commerce and an economic powerhouse. Growth is projected to continue at a moderate rate after the recovery from the pandemic.

[27] This data is based on annual arrival statistics instead of the quarterly Exit Survey Report.
[28] Throughout this report, "$" means U.S. dollars unless otherwise stated.

The long-term economic outlook referencing the FAA Aerospace Forecast FY2021–2041 assumptions is given in **Figure 3-1** .

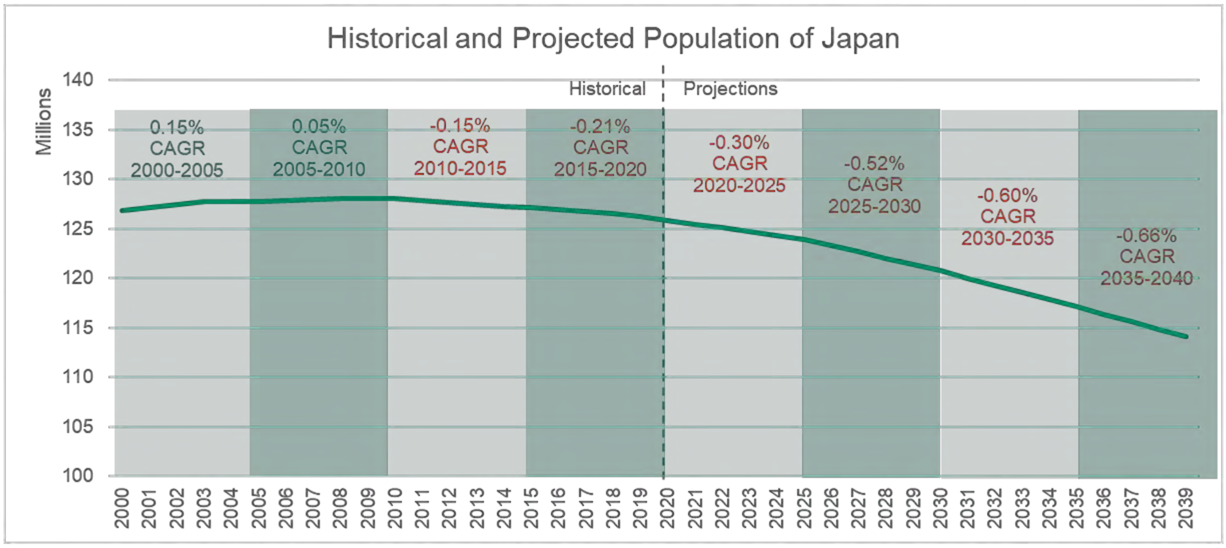

Figure 3-17. Historical and Projected Population of Japan

Sources:
1. *Historical population statistics – World Bank, World Development Indicators (January 2022)*
2. *Projected population statistics at 5-year intervals, median prediction – United Nations (November 2021)*
3. *Interpolation between 5-year internals and compound annual growth rate (CAGR) calculations – AECOM analysis*

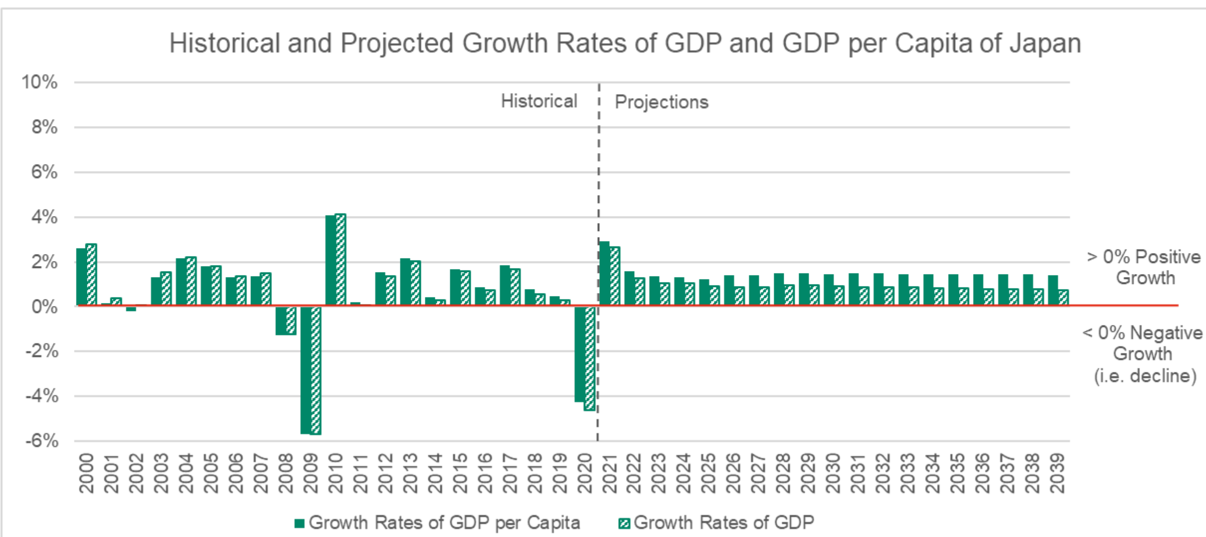

Figure 3-18. Historical and Projected Growth Rates of GDP and GDP per Capita of Japan

Sources:
1. *Historical GDP and GDP per capita (constant 2015 USD) statistics – World Bank, (January 2022)*
2. *Projected GDP, baseline scenario – Information Handling Services (HIS) Markit adopted in the FAA Aerospace Forecast FY2021–2041*
3. *Projected population statistics, median prediction – United Nations (November 2021)*
4. *Projected GDP per capita calculations based on projected GDP and population statistics – AECOM analysis*

3.4.2.2 o rea

Korea (i.e., Republic of Korea or South Korea), with a GDP of $1.6 trillion (in constant 2015 USD) in 2019, is the fourth-largest economy in Asia and the 13th largest in the world. It is an innovative, free-market economy with a highly educated and tech savvy workforce. It had a population of 51.7 million and per capita GDP of over $31 thousand in 2019.

3.4.2.2.1 Population of orea

Figure 3-19 summarizes the historical and projected population, and annual population growth rates of Korea. Korea shares the same problem with rising longevity and low fertility rate as Japan, but to a less severe extent. The United Nations predicts the population of Korea will reduce by 3.4 percent from 51.7 million in 2019 to just below 50 million in 2039.

3.4.2.2.2 Economy of orea

Advanced manufacturing and services dominate the economy of Korea and employ most of the population. Among its main manufactured products are mobile phones, consumer electronics, household appliances, cars, ships, and steel, all of which are exported around the globe. As an advanced manufacturing economy, Korea imports large quantities of natural resources such as coal, iron ore, and oil.

Korea's economic progress in the last half-century has in many ways mirrored Japan's that preceded it. In the recent decade, the economic growth in Korea has outpaced Japan. During the recent global financial crisis of 2008–2009, Korea was one of the few countries to avoid a recession.

Korea has had an average annual GDP growth of 2.8 percent over the past five years (2015 to 2019) and over 4 percent in the past two decades (2000 to 2019). The historical GDP and GDP per capita growth rates are given in **Figure 3-2** . Korea's GDP growth rate has outpaced Japan for the last two decades.

As described in **Section 3 1**, Korea surpassed Japan in 2018 as the most prominent market for Guam.

The long-term economic outlook referencing the FAA Aerospace Forecast FY2021–2041 assumptions and the forecast by the International Monetary Fund (IMF) (2021–2026) is given in **Figure 3-2** .

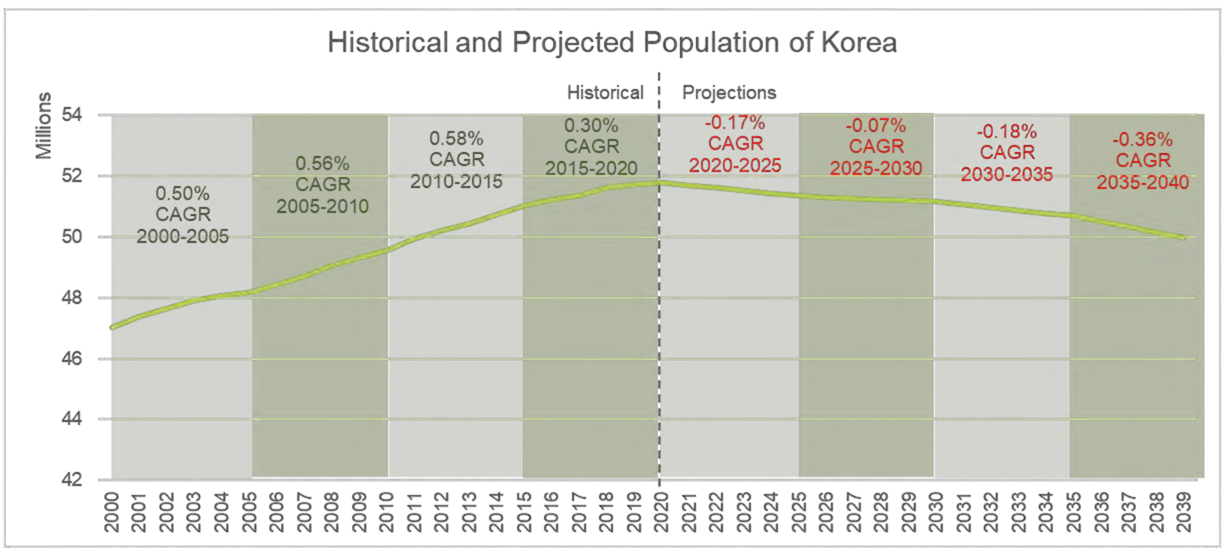

Figure 3-19. Historical and Projected Population of Korea

Sources:

1. *Historical population statistics – World Bank, World Development Indicators (January 2022)*
2. *Projected population statistics at 5-year intervals, median prediction – United Nations (November 2021)*
3. *Interpolation between 5-year internals and CAGR calculations – AECOM analysis*

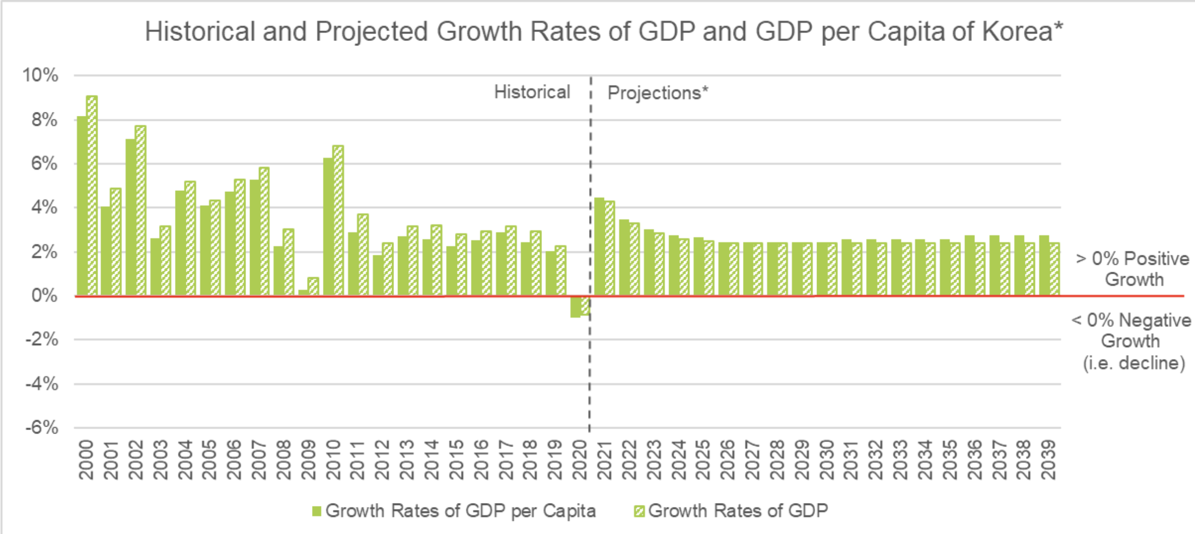

Figure 3-20. Historical and Projected Growth Rates of GDP and GDP per Capita of Korea

Note: Since the FAA Aerospace Forecast FY2021–2041 does not include country-specific data for Korea, projected GDP references the IMF forecast (2021–2026) for Korea and the global GDP growth, which is comparable to the historic trend of Korea.
Sources:

1. *Historical GDP and GDP per capita (constant 2015 USD) statistics – World Bank (January 2022)*
2. *Projected GDP growth rates – IMF (February 2022)*
3. *Projected GDP, baseline scenario – IHS Markit adopted in the FAA Aerospace Forecast FY2021–2041*
4. *Projected population statistics, median prediction – United Nations (November 2021)*
5. *Projected GDP per capita calculations based on projected GDP and population statistics – AECOM analysis*

3.4.2.3 aiwan

As one of the original four "Asian Tigers[29]," Taiwan's (i.e., Republic of China's) economic performance stunned the world in the second half of the 20th century. Today, with its highly developed economy, free-market environment, and advanced information technology (IT) industrial production chains, Taiwan continues to be a leading force contributing to Asia's economic prosperity.

3.4.2.3.1 Population of aiwan

Figure 3-21 summarizes the historical and projected population, and annual population growth rates of Taiwan. The United Nations predicts the population of Taiwan will increase slightly from 23.6 million in 2019 to 24 million in 2030. After 2030, the population is projected to decline slowly and return to 23.6 million in 2039.

3.4.2.3.2 Economy of aiwan

Despite its contentious relationship with China, Taiwan has thrived over the last four decades. It plays a central role in the supply chain of the global IT industry and is a hub that links developed Western economies and emerging Asian markets.

Due to pressure from China, the country is not a member of the United Nations, but it has nevertheless emerged as a reliable exporter. Taiwan's GDP per capita was nearly $26 thousand in 2019. Its GDP was over $620 billion in 2019, with an average annual GDP growth of 2.6 percent over the past five years (2015 to 2019) and 3.8 percent in the past two decades (2000 to 2019), making this nation of 23.6 million people one of the strongest economies in Asia. The historical GDP and GDP per capita growth rates based on the National Statistics of Taiwan are given in **Figure 3-22**. The long-term economic outlook referencing the FAA Aerospace Forecast FY2021–2041 assumptions and the forecast by the IMF (2021–2026) is also included in **Figure 3-22**.

[29] The Four Asian Tigers are the economies of South Korea, Taiwan, Singapore, and Hong Kong. Between the early 1960s and 1990s, fueled by exports and rapid industrialization, the Four Asian Tigers have consistently maintained high levels of economic growth, and have collectively joined the ranks of the world's wealthiest nations.

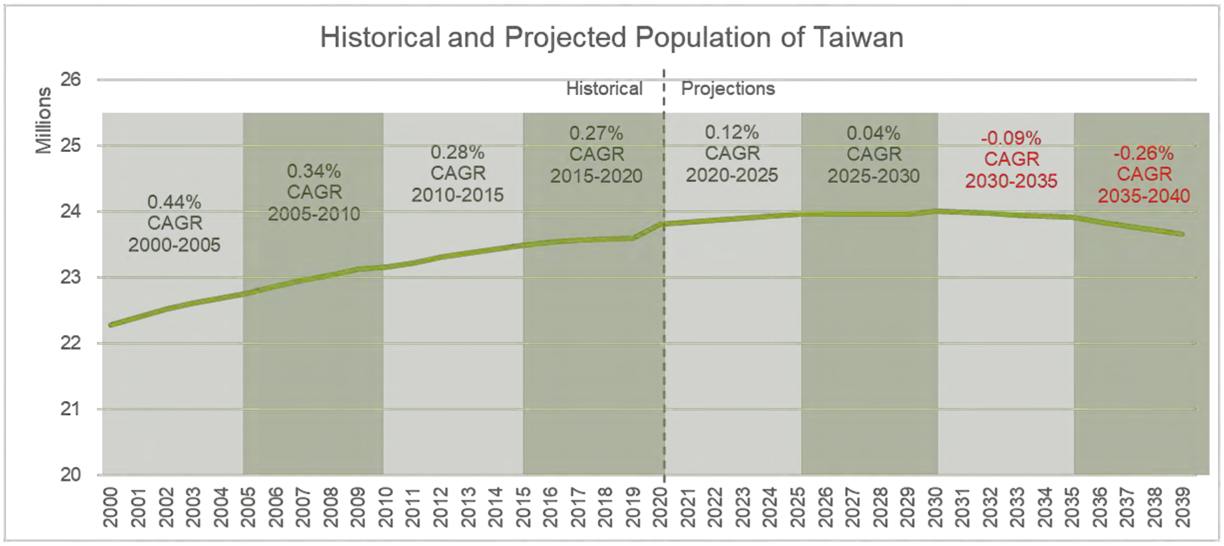

Figure 3-21. Historical and Projected Population of Taiwan

Sources:

1. *Historical population statistics – Taiwan Ministry of the Interior (February 2022)*
2. *Projected population statistics at 5-year intervals, median prediction – United Nations (November 2021)*
3. *Interpolation between 5-year internals and CAGR calculations – AECOM analysis*

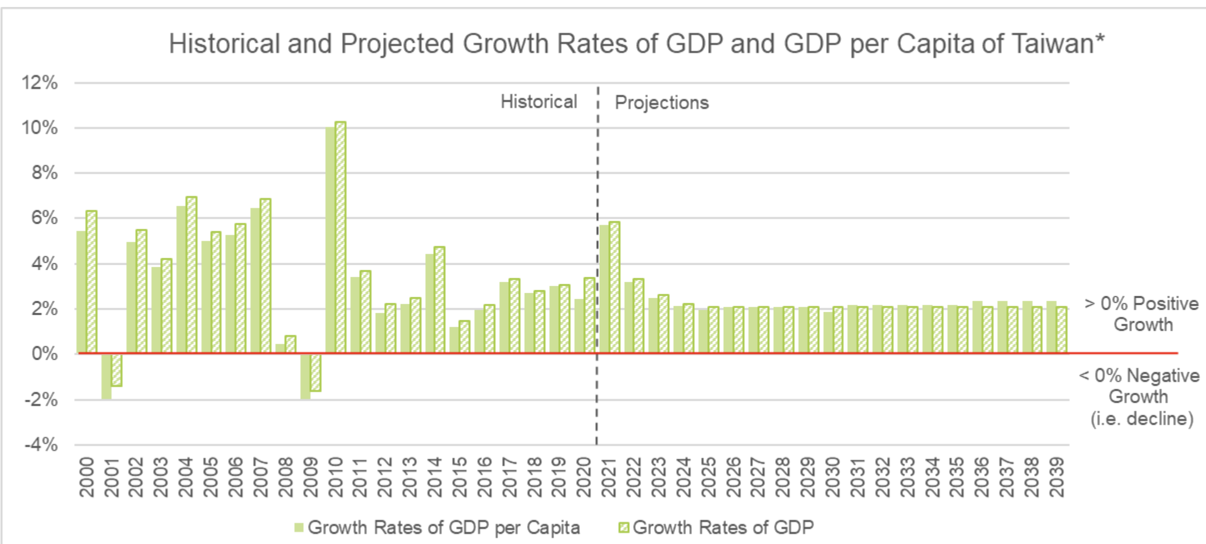

Figure 3-22. Historical and Projected Growth Rates of GDP and GDP per Capita of Taiwan

Note: Since the FAA Aerospace Forecast FY2021–2041 does not include country-specific data for Taiwan, projected GDP references the IMF forecast (2021–2026) for Taiwan and the global GDP growth, which is comparable to the historic trend of Taiwan.
Sources:

1. *Historical GDP and GDP per capita (chained dollars) statistics – Taiwan National Statistics (February 2022)*
2. *Projected GDP growth rates – IMF (February 2022)*
3. *Projected GDP, baseline scenario – IHS Markit adopted in the FAA Aerospace Forecast FY2021–2041*
4. *Projected population statistics, median prediction – United Nations (November 2021)*
5. *Projected GDP per capita calculations based on projected GDP and population statistics – AECOM analysis*

3.4.2.4 China

Forty years ago, after a long period of economic stagnation, China (i.e., People's Republic of China) was not among the world's top economies. Because of the social and economic transformation that began in the late 1970s, China's economy is currently the second largest in the world, behind only the United States. Its GDP in 2019 was $14.3 trillion (in constant 2015 USD), with a population of 1.4 billion and per capita GDP of over $10 thousand in 2019.

3.4.2.4.1 Population of China

The size of China's population has long been a controversial issue. After rapid population growth in the middle of the 20th century, the Chinese government sought to limit population growth by introducing the "one-child" policy. The scheme, which rewarded couples that agreed to have just one child with cash bonuses and better access to housing, proved to be so successful that the birth rate dropped significantly. As a result, there are concerns that China's low birth rate, combined with its aging population, will damage its future economic development. In addition, the one-child policy was met with a great deal of resistance, particularly in rural areas, and it also created an abnormal ratio of male to female births in China. The policy was ended in 2016.

China's population growth has slowed since the implementation of the one-child policy, and that slowing is projected to continue. The United Nations predicts the population to grow at increasingly slower rates until 2030, at which point the population should begin to decrease.

Figure 3-23 summarizes the historical and projected population, and annual population growth rates of China.

3.4.2.4.2 Economy of China

China's economy is the second-largest in the world. But after three decades of growth, China is now moving into a slower growth phase—an inevitable result of its transition from a developing economy to a more mature, developed economy. In the 1980s, 1990s, and early 2000s, China's annual GDP growth frequently exceeded 10 percent, but it gradually dropped to 6 percent in 2019.

The economy of China is managed by the Chinese Government through five-year plans that set goals, strategies, and targets. The current five-year plan focuses on increasing China's competitiveness through more efficient and increasingly advanced manufacturing on the east coast, attracting labor-intensive manufacturing to central provinces and increasing domestic demand.

The perception of China since the 1980s as a predominantly low-cost manufacturing hub, where it effectively served as an inexpensive producer for global brands, is changing as the economy grows. Average wages in China have been climbing to the point where China is changing from a low-cost hub to a dynamic and complex economy.

Rapidly rising income levels in China and mass migration from rural to urban areas have created an abundantly large class of urban consumers demanding improved housing, a cleaner environment, better education, health care, financial services, and overseas travel, which is the most relevant to the Guam's tourism market. From the sophisticated consumers of developed cities such as Beijing, Guangzhou, and Shanghai, to the growing middle classes in lesser-known inland cities, there are increasing opportunities in China.

Over the last decade, visitors from China to Guam increased until 2016/2017, when the geo-political issues started to impact the China market. During the historical peak periods in 2016/2017, not only did Air China and United Airlines have flights from Shanghai to Guam, but there were also charter flights (operated by Dynamic Air) from secondary cities such as Guangzhou, Chengdu, Dalian, Nanjing, Shenyang, and Zhengzhou.[30]

The historical GDP and GDP per capita growth rates are given in **Figure 3-2** . The long-term economic outlook referencing the FAA Aerospace Forecast FY2021–2041 assumptions is also included in **Figure 3-2** .

[30] FY2016, FY2017, FY2018, and FY2019 Financial Statements, A.B. Won Pat International Airport Authority, Guam (GIAA).

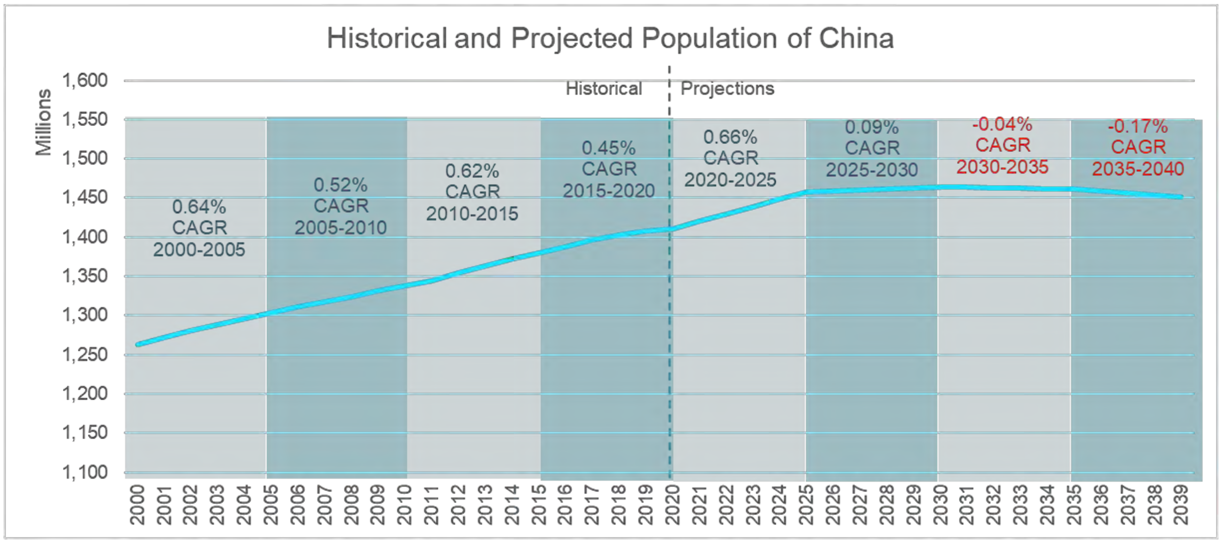

Figure 3-23. Historical and Projected Population of China

Sources:

1. *Historical population statistics – World Bank, World Development Indicators (January 2022)*
2. *Projected population statistics at 5-year intervals, median prediction – United Nations (November 2021)*
3. *Interpolation between 5-year internals and CAGR calculations – AECOM analysis*

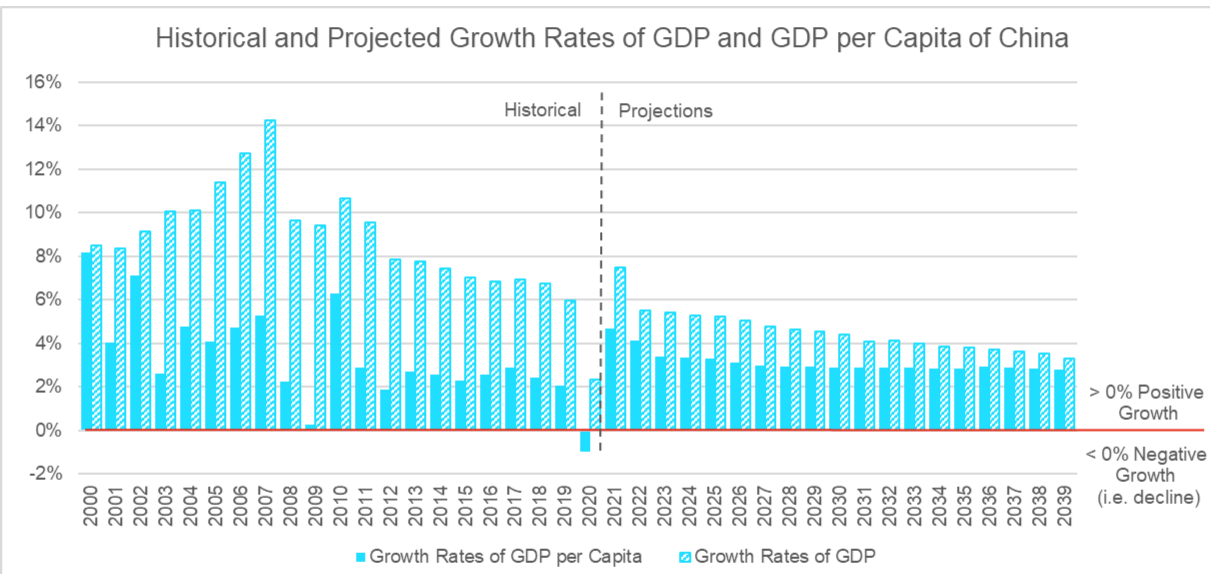

Figure 3-24. Historical and Projected Growth Rates of GDP and GDP per Capita of China

Sources:

1. *Historical GDP and GDP per capita (constant 2015 USD) statistics – World Bank (January 2022)*
2. *Projected GDP, baseline scenario – IHS Markit adopted in the FAA Aerospace Forecast FY2021–2041*
3. *Projected population statistics, median prediction – United Nations (November 2021)*
4. *Projected GDP per capita calculations based on projected GDP and population statistics – AECOM analysis*

3.4.2.5 United States

The U.S. has been the world's largest economy since the late 19th century. Several factors contribute to the U.S.'s powerful economy. The U.S. is known globally for cultivating a society that supports and encourages entrepreneurship, which encourages innovation and, in turn, leads to economic growth. The growing population in the U.S. has helped diversify the workforce. The U.S. is also one of the leading manufacturing industries in the world, coming second only to China. The USD is also the most widely used currency for global transactions.

The GDP for the U.S. is $20 trillion (in constant 2015 USD), with a population of over 328 million and per capita GDP of $60 thousand in 2019.

3.4.2.5.1 Population of the U S

Unlike China, the U.S. population is expected to continue growing throughout the century without decline. The population growth in the U.S. is mainly attributed to high rates of immigration, and the natural increase (the difference between number of births and deaths).

The U.S. population grew an average of 0.9 percent annually for the first decade of the 21st century and reduced to an annual average of 0.6 percent for the second decade. This is because of a decrease in the number of total births over the years. Additionally, more post-World War II baby boomers are reaching old age, which increases the number of deaths. Despite a decrease in the population growth rate in recent years, the population is still expected to grow continuously.

Figure 3-2 summarizes the historical and projected population, and annual population growth rates of the U.S. The United Nations predict the U.S. population will increase continuously from 328 million in 2019 to 365 million in 2039.

3.4.2.5.2 Economy of the U S 31

The U.S. economy is one of the world's wealthiest and most diversified, led by a highly productive, highly developed, and technologically advanced services sector, advanced manufacturing, and world-class research and development. Its economy is dominated by service-oriented companies in areas such as technology, financial services, healthcare, and retail.

ve n though the services sector is the main engine of the economy, the U.S. also has an important manufacturing base. The U.S. is one of the largest manufacturers in the world and a leader in higher-value industries such as automobiles, aerospace, machinery, telecommunications, and chemicals.

In the long-term, the U.S. economy is expected to maintain its powerhouse status through a combination of characteristics: It has access to an abundance of natural resources; it has a large, well-educated, and productive workforce; the well-established regulatory structure, legal system, and free-market environment facilitates economic growth; and the general population, including a diversity of immigrants, brings a mix of culture and ideas. co nomic growth in the U.S. is constantly being driven forward by ongoing innovation, research, and development as well as capital investment.

The U.S. economy has been growing moderately with an average annual GDP growth of 2.5 percent over the past five years (2015 to 2019) and 2.1 percent in the past two decades (2000 to 2019). It is anticipated that the long-term growth trend will maintain at similar levels.

The historical GDP and GDP per capita growth rates of the U.S. are given in **Figure 3-26**. The long-term economic outlook referencing the FAA Aerospace Forecast FY2021–2041 assumptions is also included in **Figure 3-26**.

[31] Multiple sources such as the FAA Aerospace Forecast FY2021–2041, the Congressional Budget Office's (CBO's) July 2021 report The Budget and c onomic Outlook: 2021 to 2031, and the World Bank's Focus c onomics (https://www.focus-economics.com/countries/united-states).

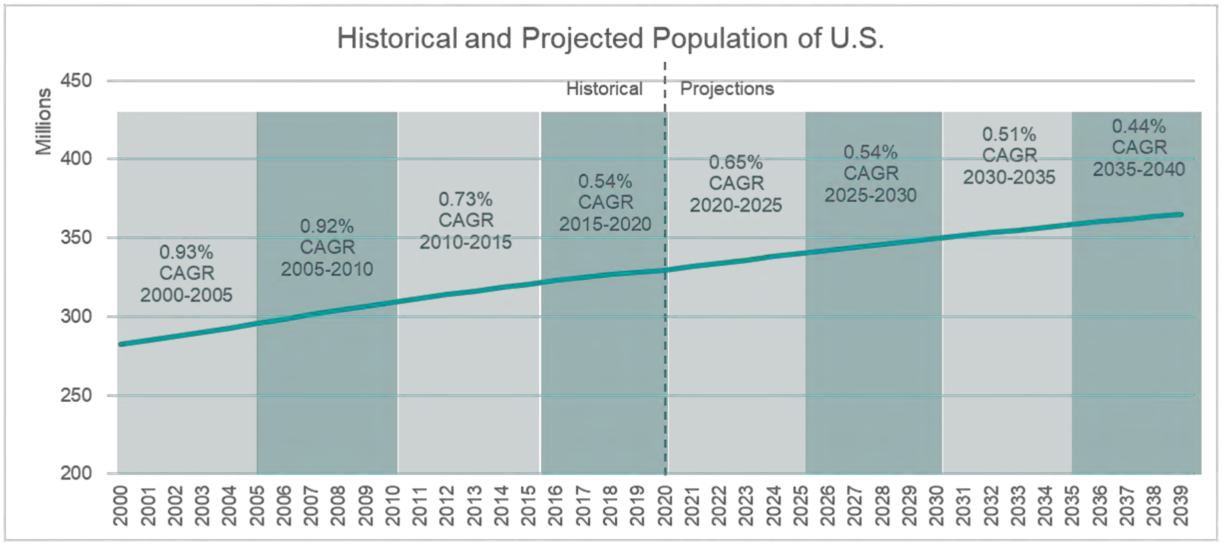

Figure 3-25. Historical and Projected Population of the U.S.

Sources:
1. *Historical population statistics – World Bank, World Development Indicators (January 2022)*
2. *Projected population statistics at 5-year intervals, median prediction – United Nations (November 2021)*
3. *Interpolation between 5-year internals – AECOM analysis*

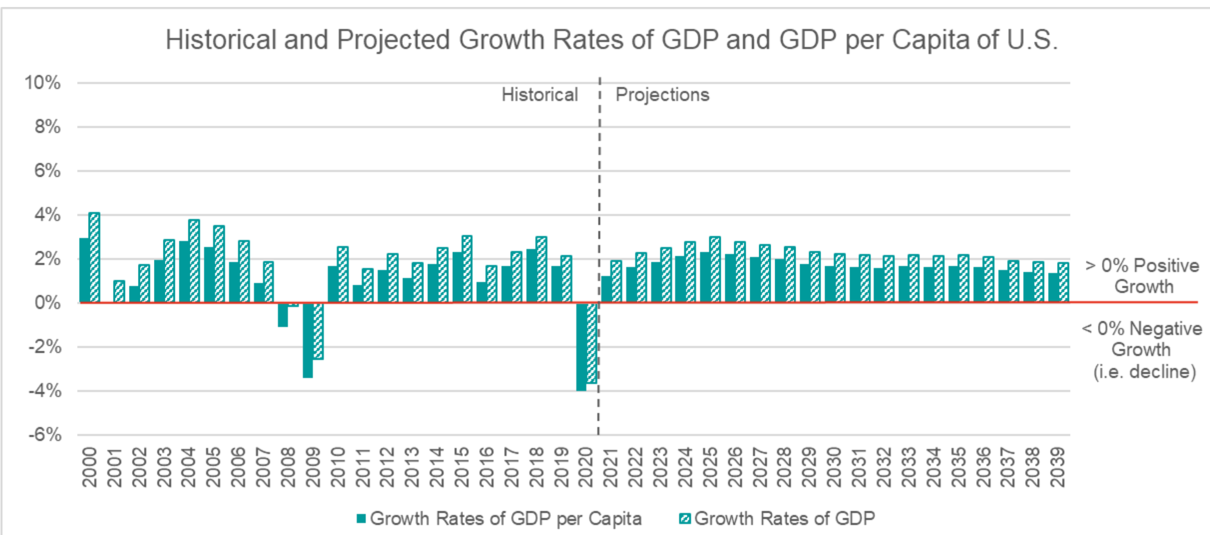

Figure 3-26. Historical and Projected Growth Rates of GDP and GDP per Capita of the U.S.

Sources:
1. *Historical GDP and GDP per capita (constant 2015 USD) statistics – World Bank (January 2022)*
2. *Projected GDP, baseline scenario – IHS Markit adopted in the FAA Aerospace Forecast FY2021–2041*
3. *Projected population statistics, median prediction – United Nations (November 2021)*
4. *Projected GDP per capita calculations based on projected GDP and population statistics – AECOM analysis*

3.4.2.6 Guam

Guam's economy is small and undiversified, but the island is endowed with natural resources and a multicultural workforce. It depends primarily on tourism, the U.S. Department of Defense (DoD) installations, and local businesses. Guam's economy is small in terms of both population and size, which will be discussed in the subsequent paragraphs.

Guam is the largest island in Micronesia and is located in the Western Pacific region. Being an island has its challenges, as it implies some level of geographic isolation and distance from larger markets. It also makes it vulnerable to natural disasters such as typhoons, earthquakes, and tsunamis that have significant and unpredictable impacts to the economy, in particular the tourism sector.

3.4.2.6.1 Population of Guam

According to the 2020 United States Census, the population of Guam was more than 153 thousand. According to the Bureau of Statistics and Plans, Guam, there are constantly between 10,600 and 13,600 active military personnel and their family members in Guam based on the available data from 2005 to 2017, which represents between 6.7 and 8.5 percent of Guam's total population. Military personnel and their dependents mostly travel to/from Guam by air and generate air service demands.

Figure 3-2 summarizes the historical and projected population, and annual population growth rates of Guam. The United Nations predicts the population of Guam will increase continuously from 153 thousand in 2019 to 187 thousand in 2039.

3.4.2.6.2 Economy of Guam

Guam's economy is heavily related to the military actions in the Pacific region, which brings not only the military population (including dependents), but also an increase in construction of infrastructure and military installations. For example, in late 1980s, Cold War military spending and closing of the U.S. bases in the Philippines increased Guam's military population significantly (23,800 in 1987), thereby adding to Guam's economic base.

Troops temporarily repositioned from the closed Philippine bases to Guam were relocated out of Guam at the end of the 1980s causing a decline in military population in the 1990s. The closure of the Naval Air Station (NAS) Agana in 1995 resulted in a reduction of the military population in Guam from over 20,000 in the 1980s to approximately 15,000 in the mid-1990s and remain between 10,600 and 13,600 in the 2000s and 2010s.[32, 33]

The agreement between the U.S. and Japan to reduce the presence of U.S. troops in Okinawa and relocate them to Guam, Hawaii, and other locations will also impact Guam's economy. Information from the local news indicates that the planned transfer of U.S. Marine Corps personnel from Okinawa to Guam may start in October 2024. Infrastructure projects to cope with the surge in population are under way.[34, 35]

Guam's undiversified economy is also highly impacted by tourism, hence the economy of those top tourism markets. Historically, Guam's Asia-oriented visitor base expanded and peaked in the mid-1990s, generating substantial increases in the construction of hotels and condominiums. However, the collapse of the Asian financial markets in 1997, compounded by the crash of Korean Air flight on approach to the Airport in August 1997, led to a decline in both the Japan and Korea markets. By 2000, the tourism industry appeared to recover, but the attacks of September 11 in 2001, the damage caused by Typhoon Pongsona in 2002, and the pandemic of sever acute respiratory syndrome (SARS) in 2003 hit Guam's tourism industry again.

Guam's economy continues to be volatile, and its performance is closely tied to overseas markets and occurrences of natural disasters. The aftermath of the Tohoku earthquake and tsunami that devasted northeastern Japan in March 2011, the global financial crisis that caused the Great Recession from December 2007 to June 2009, and COVID-19 in 2020 affected the tourism industry. Hotel occupancy rates along with related hotel occupancy taxes as well as employment and income for many island residents working in tourist-related activities all declined during those periods. Based on the GDP statistics from the U.S. Bureau of co nomic Analysis (B A) and the Guam population data from the World Bank, the GDP for Guam is over $5.6 billion (in chained 2012 USD), and per capita GDP was nearly $34,000 in 2019. The historical GDP and GDP per capita growth rates are given in **Figure 3-2** .

Authorities and organizations that provide GDP forecasts such as the IMF, the U.S. Congressional Budget Office (CBO), Organization for conomic Cooperation and Development (O C D), and the FAA Aerospace Forecast FY2021–2041 do not include the annual or quarterly forecasts for small economies like Guam, hence projected growth rates are not included in **Figure 3-2** . Nevertheless, the economic outlook for Guam FY2022 and FY2023 from the Department of Labor, Government of Guam, provide some insights

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[32] Department of Defense (DoD), Guam and Commonwealth of the Northern Mariana Islands (CNMI) Military Relocation, Final Environmental Impact Statement, July 2010. Chapter 16 Socioeconomics and General Services.

[33] Bureau of Statistics and Plans, 2020 Guam Statistical Yearbook, Chapter 8 Federal Programs.

[34] Marine Corps Times dated May 3, 2019. Website https://www.marinecorpstimes.com/news/your-marine-corps/2019/05/03/marine-corps-relocation-from-okinawa-to-guam-worthy-of-review-commandant-says/.

[35] Post Guam dated March 25, 2021. Website https://www.postguam.com/news/local/military-development-of-marine-corps-base-on-guam-on-track/article_17f1b0a0-8d03-11eb-9c09-f7aebad6ea29.html.

on the near-term recovery. Further discussions on the near-term recovery outlook in the aviation demand forecasts are given in **Section 3 6 1 1**.

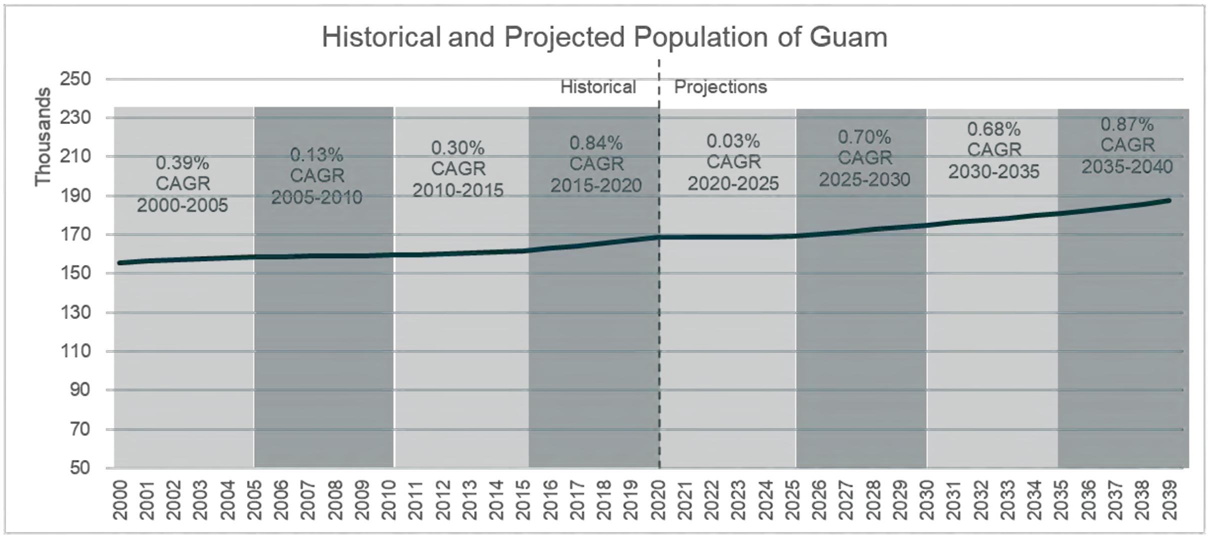

Figure 3-27. Historical and Projected Population of Guam

Sources:

1. *Historical population statistics – World Bank, World Development Indicators (January 2022)*
2. *Projected population statistics at 5-year intervals, median prediction – United Nations (November 2021)*
3. *Interpolation between 5-year internals – AECOM analysis*

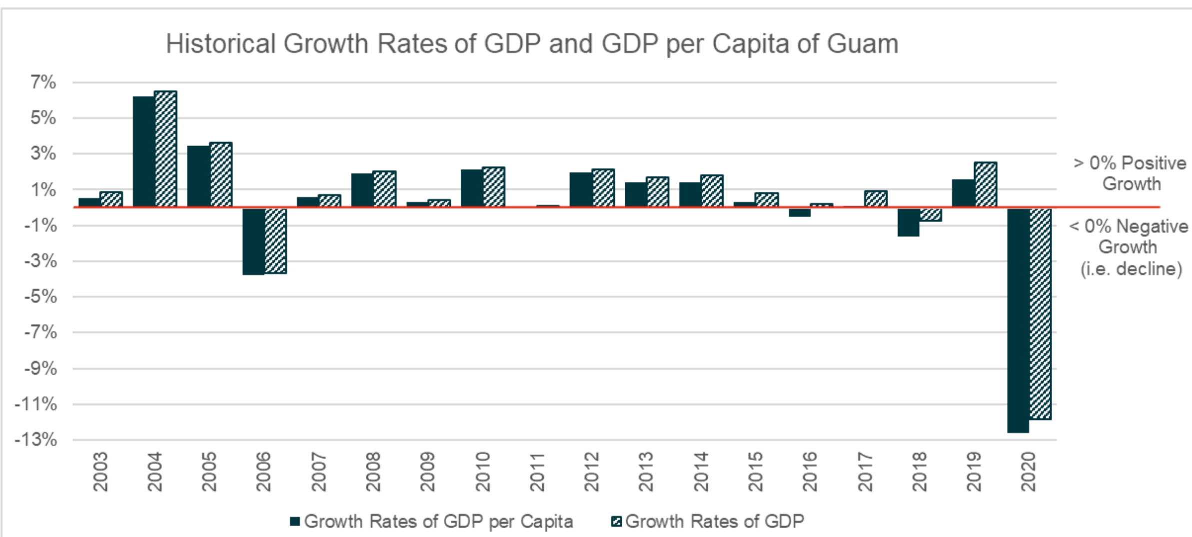

Figure 3-28. Historical Growth Rates of GDP and GDP per Capita of Guam

Sources:

1. *Historical GDP (chained 2012 USD) statistics – U.S. BEA (December 2021)*
2. *Historical population statistics – World Bank, World Development Indicators (January 2022)*
3. *Historical GDP per capita calculations based on GDP and population statistics – AECOM analysis*

3.4.3 Near- erm Economic Outlook

This section discusses the near-term outlook for the U.S., Guam, and worldwide economies.

3.4.3.1 U S Economy

The COVID-19 pandemic caused severe economic disruptions beginning March 2020 as households, government agencies, and businesses adopted a variety of mandatory and voluntary restrictions for social distancing to control the spread of the coronavirus. The impact was focused on particular sectors of the economy, including travel and hospitality, and unemployment was concentrated among lower-wage workers.

Two years after the declaration of the global COVID-19 pandemic, the U.S. economy is on track for recovery. Vaccination is expected to reduce the number of new COVID-19 cases and both travel restrictions and social distancing requirements are expected to decline. Based on the national real GDP released by the B A , real GDP returned to pre-pandemic level (2019 Q4) in mid-2021 (2021 Q2), which is consistent with the projections from the CBO released in February 2021 and the FAA’s domestic baseline forecast assumptions in the FAA Aerospace Forecast FY2021–2041 released in March 2022.

Based on the economic outlook from the CBO, the economy is projected to continue to strengthen during the next five years. Additionally, labor market conditions continue to improve. As the economy expands, people are rejoining the labor force who had left it during the pandemic. The unemployment rate is projected to gradually decline through 2026, and the number of people employed will return to its pre-pandemic level in 2024. Inflation, as measured by the price index for personal consumption expenditures, is expected to rise gradually over the next few years as the Federal Reserve maintains low interest rates.[36]

While the impact of the pandemic on the economy waned, geopolitical tensions increased due to the Russian aggressions in Ukraine that started in February 2022. The Ukraine crisis is likely to increase inflation in the short term, but it is not likely to derail the recovery of the U.S. economy. The impacts are primarily from two main sources. First, the rise in oil price as sanctions on Russian oil companies have reduced crude oil supplies. However, how much the oil price is going to increase is still uncertain. Some economists have the opinion that oil is a global, fungible commodity and Russia can still sell its oil to countries such as China and India, which did not join the sanctions on Russia. The second source of impact is related to u rope’s heavy dependence on Russian natural gas. As the U.S. is a major trading partner of the u ropean Union (U), slow economic growth in the U will reduce demand from the U.S. as well as depreciating the euro against the dollar and will make U.S. products less competitive. Nevertheless, the combined impact of these two main sources may slow down the economic growth but may not be large enough to generate another recession in the U.S. based on the analysis from Deloitte’s global economics team.[37]

3.4.3.2 Guam Economy

The near-term economic outlook for Guam references the co nomic Outlook for FY2023, Department of Labor, Government of Guam.

Guam has three primary funding sources: tourism, federal expenditures, and construction capital investment. The Government of Guam expects partial rebound in tourism beginning in 2022 and continuing into 2023. However, the pace of recovery is still unknown, and the GVB has not issued its tourist arrival projections yet. Federal expenditures are likely to remain above normal levels due to COVID-19 stimulus and relief funding. However, the composition of the expenditures is expected to shift from pandemic relief to increased defense and infrastructure expenditures. Construction is projected to increase substantially with the support of private, Government of Guam, and federal projects already contracted. The growth in construction is indicated by an increase in employment, temporary worker demand, and gross receipt taxes paid for construction in FY2021. The total value of building permits for both civilian projects and DoD construction contracts also increased substantially in 2021. Building permits and DoD construction contracts are solid indicators of development plans backed by financial commitments to commence construction in the near term.[38]

In summary, Guam’s economy is subject to many uncertainties, which widens the range of possible economic scenarios. The government’s economist expects the economic expansion and partial recovery experienced in 2021 to continue in FYs 2022 and 2023. Despite the uncertainties, key economic sectors and funding sources have been, and are expected to remain, stable and increase in the near-term.[39]

[36] Congressional Budget Office, The Budget and Economic Outlook: 2021 to 2031, February 2021.
[37] Deloitte, United States Economic Forecast, March 2022.
[38] Department of Labor, Government of Guam, Economic Outlook for Guam FY2023.
[39] Department of Labor, Government of Guam, Economic Outlook for Guam FY2023.

3.4.3.3 World Economy and Economy of Major Markets

The near-term global economic outlook references the IMF's World co nomic Outlook, April 2022, and the economic outlook in the FAA Aerospace Forecast FY2021–2041. Focuses of the outlook are on the major markets, i.e., Asia, Japan, and Korea, for the tourism industry of Guam.

The IMF summarizes five major considerations in relation to the near-term global economic outlook:

- co nomic damage from the conflict in Ukraine will contribute to a slowdown in global growth in 2022. The economic contraction is more significant in Ukraine and Russia, and may spill over worldwide through commodity markets, trade, financial linkages, labor supply, and humanitarian impacts. u rope is likely to be impacted more than others.
- The Ukraine crisis and related sanctions have tightened global financial conditions. Inflation has risen, and many central banks have tightened monetary policy. One exception is China, where inflation remains low, and their central bank cut its policy rate to support the recovery.
- Fiscal condition in many countries has been eroded by higher COVID-related spending and lower tax revenue in 2020 and 2021. Governments around the world are increasingly challenged by the rising borrowing costs, and central banks increase interest rates to fight inflation.
- Slowing growth in China's economy has wider ramifications for Asia. The combination of more transmissible variants and a zero-COVID strategy entail the prospect of more frequent lockdowns, with consequential effects on private consumption in China.
- Worker shortages and mobility restrictions compounded supply chain disruptions and bottlenecks early in 2022, constraining activity and adding to inflation. Restrictions have begun to ease as the peak of the Omicron wave passes and global weekly COVID deaths decline. The risk of infection leading to severe illness or death appears lower for the Omicron variant than for others—especially for the vaccinated and boosted. IMF assumes that the health and economic impacts of the virus will start to fade in the second quarter of 2022 and that hospitalizations and deaths will be brought to low levels in most countries by the end of the year.

The outlook for Asian economies, which affect Guam's economy, mainly through tourism and through secondary effects on intertwined activities among various countries, as provided in items extracted from the IMF World co nomic Outlook, April 2022, are summarized in **able 3-2**. The projections for real GDP growth rate are lower, while the projections for consumer prices are higher than previous projections released in October 2021. The recovery of GDP in Japan lags other Asian countries and the U.S.[40]

International travel and tourism have been heavily impacted globally by COVID-19. Guam has a large component of its economy related to international tourism. Therefore, the economic effects of the pandemic are more severe in Guam than in most developed economies.[41]

able 3-2 Near- erm Economic Outlook

	Annual Percent Change in Real GDP				Annual Percent Change in Average Consumer Prices			
	2 2	2 21	2 22	2 23	2 2	2 21	2 22	2 23
Markets	istorical		Projections		istorical		Projections	
United States	-3.4%	5.7%	3.7%	2.3%	1.2%	4.7%	7.7%	2.9%
Japan	-4.6%	1.6%	2.4%	2.3%	0.0%	-0.3%	1.0%	0.8%
Korea	-0.9%	4.0%	2.5%	2.9%	0.5%	2.5%	4.0%	2.4%
Taiwan	3.1%	6.3%	3.2%	2.9%	-0.2%	1.8%	2.3%	2.2%
China	2.3%	8.1%	4.4%	5.1%	2.4%	0.9%	2.1%	1.8%

Sources:
2020 data: International Monetary Fund, World Economic Outlook (October 2021)
2021 to 2023 data: International Monetary Fund, World Economic Outlook (April 2022)

[40] International Monetary Fund, World Economic Outlook, April 2022, and October 2021.
[41] Department of Labor, Government of Guam, Economic Outlook for Guam FY2023.

3.4.4 Aviation Fuel Prices

Fluctuations and overall trends in the cost of aviation fuel is an important factor affecting the aviation industry because it directly impacts an airline's operating cost and thus airfares and passenger demand. Fuel prices are particularly sensitive to worldwide economic uncertainty and political instability. Beginning in 2003, fuel prices increased as a result of the Iraq War, political instability in some oil-producing countries, the rapidly growing economies of China, India, and other developing countries, and other factors. By mid-2008, average fuel prices were three times higher than they were in 2003. In the second half of 2008 when the recession was approaching its peak, fuel demand decreased worldwide and prices followed. However, with the initial recovery stage in 2009, prices returned to a relatively steady cost between $3 and $3.5 per gallon until mid-2014. With surging oil production and declining demand, fuel costs dropped and has stayed between $1 and $2.5 per gallon since 2015, as depicted in **Figure 3-29**.

The decrease in aviation demand during the COVID-19 pandemic also reduced the aviation fuel demand. Fuel costs dropped to between $1 and $1.2 per gallon in summer 2020, which is the lowest since 2004. However, the supply has not kept up with the demand as the economy is recovering from the pandemic, and the fuel costs have risen again.

Nevertheless, the geopolitical factor is the most crucial and imminent concern as the economy enters the post-pandemic era in 2022. The Russian aggressions in Ukraine that started in the last week of February 2022 put the oil market on edge. Potential interruptions of Russian oil shipments and sanctions on Russian companies could impact u rope first and then the global energy supply chain. The impact highly depends on the duration of this ongoing crisis, how long the reserve can last for different countries, and whether other Organization of the Petroleum xp orting Countries (OP C) can increase production. There are many uncertainties on the Russian-Ukraine crisis as this technical report is prepared.

Analysts hold different views regarding how oil and aviation fuel prices may change in the future. Reference case forecasts project fuel prices out into the future based on current market conditions, exchange rates, technology advancement in oil extraction, and other possible factors that may affect the supply and demand of crude oil.[42] Projections are uncertain because many of the events that shape energy markets as well as future developments in technologies, demographics, and resources cannot be foreseen with certainty. In order to consider future uncertainties, organizations such as the U.S. n ergy Information Administration (IA) develop multiple scenarios such as the high and low oil price forecasts in addition to a baseline reference case. The long-term annual projections of jet fuel by the IA's latest Annual n ergy Outlook 2022 (A O2022), including the reference case and the high and low oil price cases, are illustrated in **Figure 3-3** .

The projected average annual growth rates of jet fuel price by the IA from 2021 to 2050 are -1 percent, 1 percent, and 2.9 percent for the low, reference, and high oil price cases, respectively.[43] The FAA Aerospace Forecast FY2021–2041 projects U.S. mainline air carrier jet fuel prices to increase 0.2 percent per annum from 2021 to 2041 (using the increased actual price in 2021 instead of the estimated price), which is on the low side but falls within the projections by the IA's reference and low oil price cases.

[42] U.S. Energy Information Administration, Annual Energy Outlook 2022.
[43] U.S. Energy Information Administration, Annual Energy Outlook 2022.

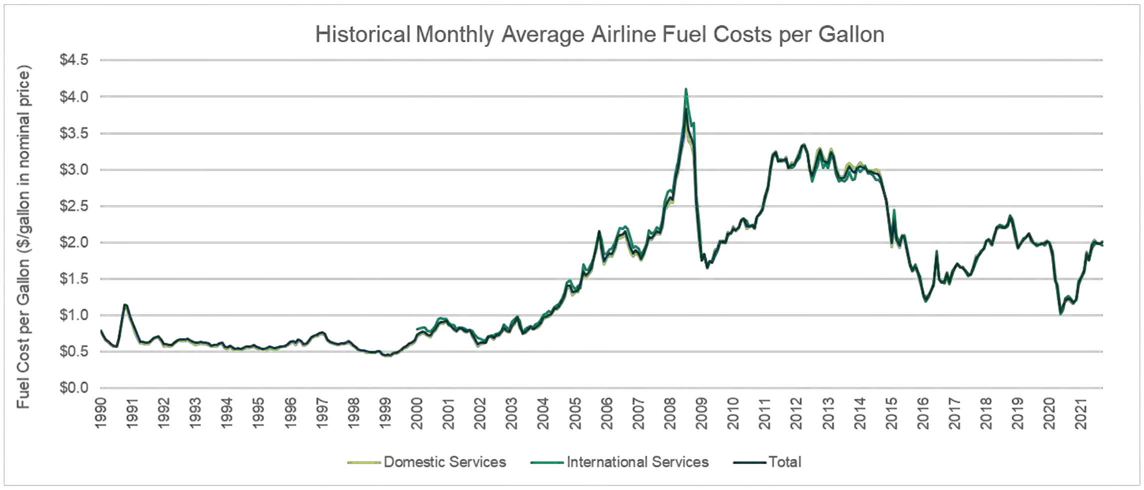

Figure 3-29. Historical Monthly Average Airline Fuel Costs per Gallon (Nominal dollars)

Sources:

A. *Fuel consumption and cost – U.S. Bureau of Transportation Statistics (BTS) Form 41 Schedule P12A (March 2022)*
B. *Fuel cost per gallon calculations – AECOM analysis*

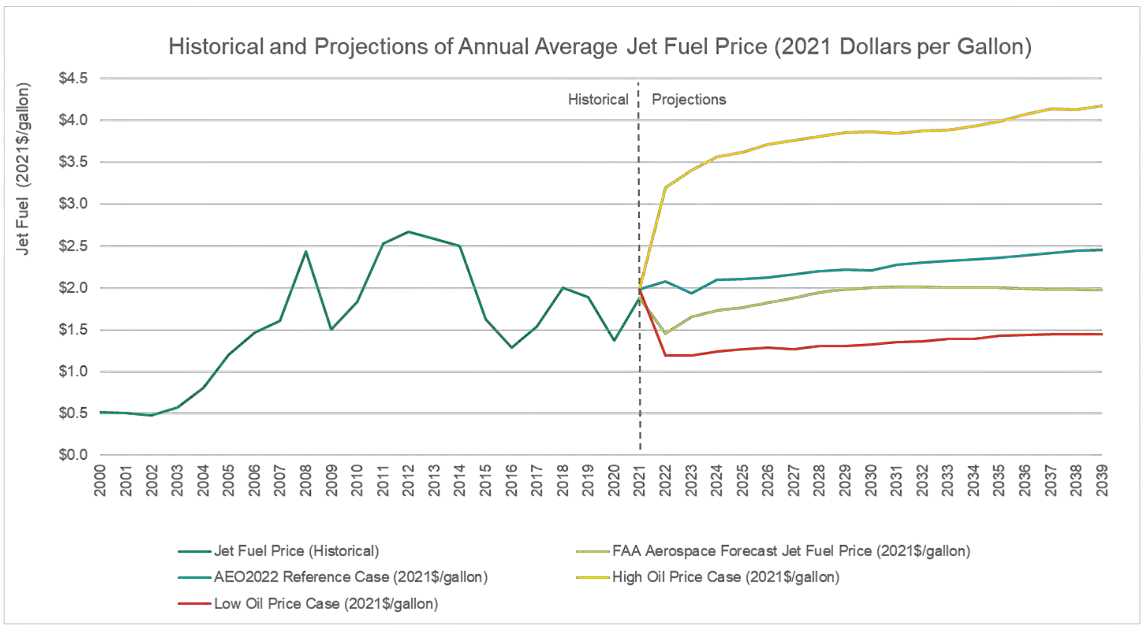

Figure 3-30. Historical and Projections of Annual Average Jet Fuel Price per Gallon (2021 dollars)

Sources:

A. *Historical jet fuel cost – U.S. BTS Form 41 Schedule P12A (March 2022)*
B. *Consumer price index (CPI) for all urban consumers – U.S. Bureau of Labor Statistics (March 2022)*
C. *Projected jet fuel price – U.S. Energy Information Administration, Annual Energy Outlook 2022 (March 3, 2022)*
D. *FAA Aerospace Forecasts FY2021–2041*
E. *Conversions to 2021 dollars – AECOM analysis*

3.4.5 Summary of Economic Basis for Aviation Demand

The various economic, demographic, and geographical characteristics discussed above collectively portray Guam as the gateway to Micronesia and a leisure destination capable of producing continuous demand for air transportation services. The historical trends and projections for key economic variables for the major tourism markets, the U.S., and Guam as summarized in this section were used in the development of the aviation demand forecasts. However, the results of these analyses do not necessarily provide a direct correlation between growth of an individual economic variable and the forecast elements. Instead, the trends in economic variables are compared with the trends in aviation demand to uncover relationships between the two and identify reasonable indicators of growth in future aviation activity. The reason for this comparison is that innumerable outside influences can affect the ultimate reality of forecasting. ve nts such as economic recessions, financial crises, new technology, widespread health issues, terrorist attacks, and so forth cannot be predicted with any certainty or likelihood, and therefore, the results of the economic analyses serve as a guideline and indicator for projecting future aviation demand rather than a precise predictor.

3.5 is torical Aviation Demand

This section describes historical aviation demand at the Airport, including an analysis of commercial air carrier service providers; enplaned passengers, load factors, and seats per departure; airline shares of passengers; airline service; airline yields; air cargo tonnage; and aircraft operations.

3.5.1 Air Service Development

This section discusses the historic and current passenger service airlines at the Airport.

3.5.1.1 Passenger Airlines Serving the Airport

In 2019, 11 operating signatory air carriers provided scheduled service at the Airport, including United Airlines (United, UA), Korean Air (K), Japan Airlines (JL), Philippine Airlines (PR), China Airlines (CI), Jin Air (LJ), Jeju Air (7C), T'way Air (TW), Air Busan (BX), Air Seoul (RS), and Cebu Pacific (5J). In addition, Star Marianas Air provides commuter services to the CNMI from Guam under Part 135 certification and use aircraft with nine passenger seats or less. **able 3-3** below lists the passenger airlines that served the Airport in 2019 and early 2020 (pre-pandemic).

able 3-3 Air Carriers for Passenger Services at the Airport

Carriers	ype1
Scheduled Passenger Services Include seasonal on-demand charter	
United Airlines (UA)	U.S. Air Carrier (Network Carrier)
Korean Air (K)	Foreign (Korea) Air Carrier (Network Carrier)
Japan Airlines (JL)	Foreign (Japan) Air Carrier (Network Carrier)
Philippine Airlines (PR)	Foreign (Philippine) Air Carrier (Network Carrier)
China Airlines (CI)	Foreign (Taiwan) Air Carrier (Network Carrier)
Jeju Air (7C)	Foreign (Korea) Air Carrier (Low-cost Carrier)
T'way Air (TW)	Foreign (Korea) Air Carrier (Low-cost Carrier)
Air Busan (BX)	Foreign (Korea) Air Carrier (Low-cost Carrier)
Jin Air (LJ)	Foreign (Korea) Air Carrier (Low-cost Carrier)
Air Seoul (RS)	Foreign (Korea) Air Carrier (Low-cost Carrier)
Cebu Pacific (5J)	Foreign (Philippine) Air Carrier (Low-cost Carrier)
On-demand and Scheduled chart service by Part 13 Air Carriers	
Star Marianas Air	Part 135 Commuter Air Carrier

Note: U.S. and foreign air carriers are grouped into two broad groups: network carriers and low-cost carriers, based on their differences in operation and business models. In recent years, the differences between these carriers narrowed. Low-cost carriers in the U.S. are expanding into international markets such as Latin America and the Caribbean and compete against network carriers. Carriers may be grouped into three groups as the industry evolves: traditional network legacy carriers (American, United, Delta), ultra-low-cost carriers (Frontier, Allegiant), and something in between (Southwest, JetBlue, Alaska/Virgin America). The list of foreign low-cost carriers is based on International Civil Aviation Organization (ICAO) classification. For master planning purposes, the traditional grouping into two broad groups is still applicable in this analysis.
Sources:
Flight schedules for 2019 and 2020 via GIAA
GIAA FY2019 and FY2020 Financial Statements

Figure 3-31 presents the historical market share of passenger airlines serving the Airport. Over 90 percent of the market was served by U.S., Korean, and Japanese air carriers before the COVID-19 pandemic.

U.S. carriers include United and Delta Air Lines (Delta, DL). United operates at the Airport as its hub airport in the Pacific region and offers nonstop flights to and from four cities in Japan regularly (Tokyo, Osaka, Nagoya, and Fukuoka) as well as to and from Manila, Philippines. Within Micronesia, United also offers connections to and from destinations such as Koror in Palau, Chuuk, Kosrae, Pohnpei and Yap in the Federated States of Micronesia, and Majuro in the Marshall Islands. Delta used to offer flights to and from Japan (Tokyo, Osaka, and Nagoya), but the service was discontinued in January 2018 when Delta eliminated its Tokyo Narita hub. In 2019, approximately 47 percent of the market share was served by United, which remains the largest carrier at the Airport. As the aviation market was hit by the pandemic, international travel was severely impacted by traffic restrictions. Most of the foreign air carriers canceled their services at the Airport; hence, over 90 percent of the market was served by United in 2021.

Korean air carriers, including both network carriers (Korean Air Lines) and low-cost carriers (Jeju Air, T'way Air, Air Busan, Jin Air, and Air Seoul), are the second largest group of air carriers at the Airport, which are then followed by the Japanese air carrier (Japan Airlines). Korean air carriers offer flights to and from Korea (Seoul and Busan) and Japan (mainly Tokyo and Osaka, occasionally Nagoya, Fukuoka, and Okayama, etc.). Japan Airlines offers nonstop flights to and from Tokyo only.

Philippine and Taiwanese air carriers are the fourth and fifth largest passenger air carriers serving the Airport. Philippine air carriers include network carrier Philippine Airlines and low-cost carrier Cebu Pacific. They provide nonstop destinations to and from Manila. Philippine Airlines also offer connections from Los Angeles and San Francisco to Manila through Guam (i.e., LAX-GUM-MNL and SFO-GUM-MNL). Taiwanese air carriers include both China Airlines and ve rgreen Airways (V A Airways), which provide nonstop destinations to and from Taipei. However, V A Airways ceased operations at the Airport in February 2017, and China Airlines became the only air carrier offering flights to and from Taipei until the pandemic. After ceasing operations at the Airport for four years, V A Airways returned in July 2021 as air services recovered from the pandemic.

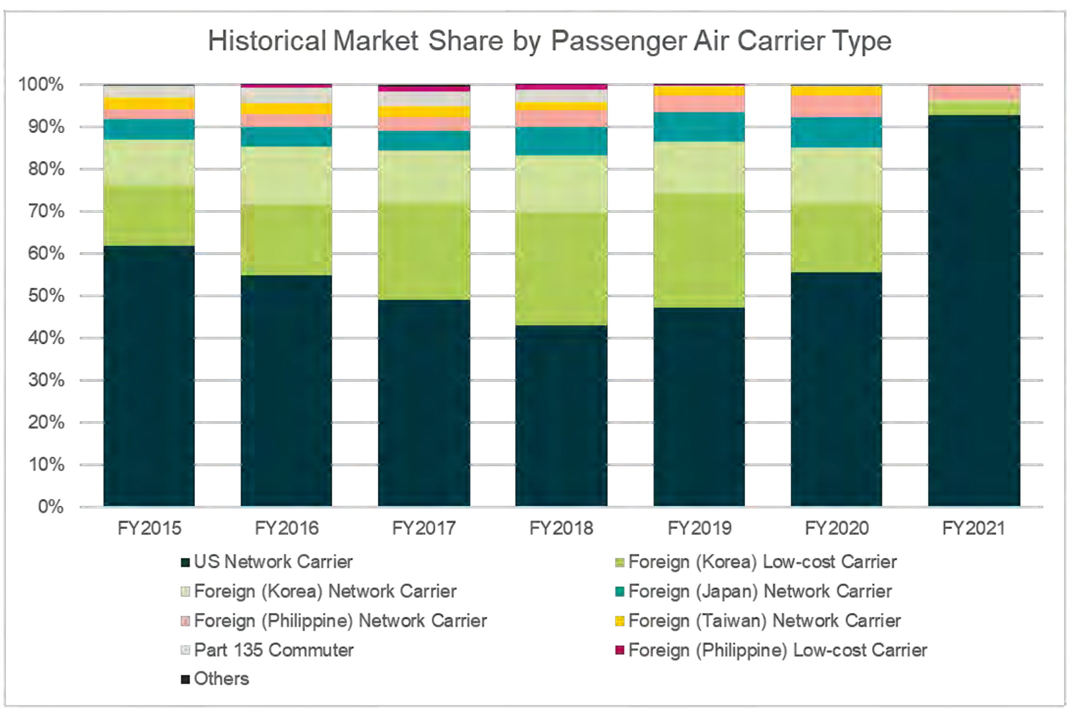

Figure 3-31. Historical Market Share by Passenger Air Carrier Type

Note: U.S. Network Carrier includes United Airlines (all years) and Delta Air Lines (FY2015 to FY2017 only)
Sources:

1. *Passengers by air carrier – U.S. BTS T-100 data*
2. *AECOM analysis*

3.5.1.2 Nonstop Services from Guam

Figure 3-32 shows 18 nonstop destinations served by the Airport during the peak month, August, in 2019. These destinations include 15 international destinations, two domestic destinations in CNMI, and domestic connections to the markets in the U.S. mainland through Honolulu, Hawaii.

able 3- summarizes the total seat capacity for the nonstop destinations during an average week of the peak month, August 2019 (pre-pandemic), and comparison with August 2020 and 2021 (impacted by the pandemic). United was the first airline that returned to service and continues to offer domestic services between Guam and the U.S. mainland through Honolulu. United also maintains air services to Narita, Japan, as part of its Asia-Pacific network, and provides services to Saipan in CNMI; Koror in Palau; and Chuuk, Yap, and Pohnpei in the Federated States of Micronesia. After more than one year into the pandemic, foreign air carriers started to increase their capacity at the Airport. More Korean air carriers returned their nonstop services to and from Incheon, Korea, in summer 2021. Philippine Airlines and V A Airways also returned services to and from Manila and Taipei, respectively.

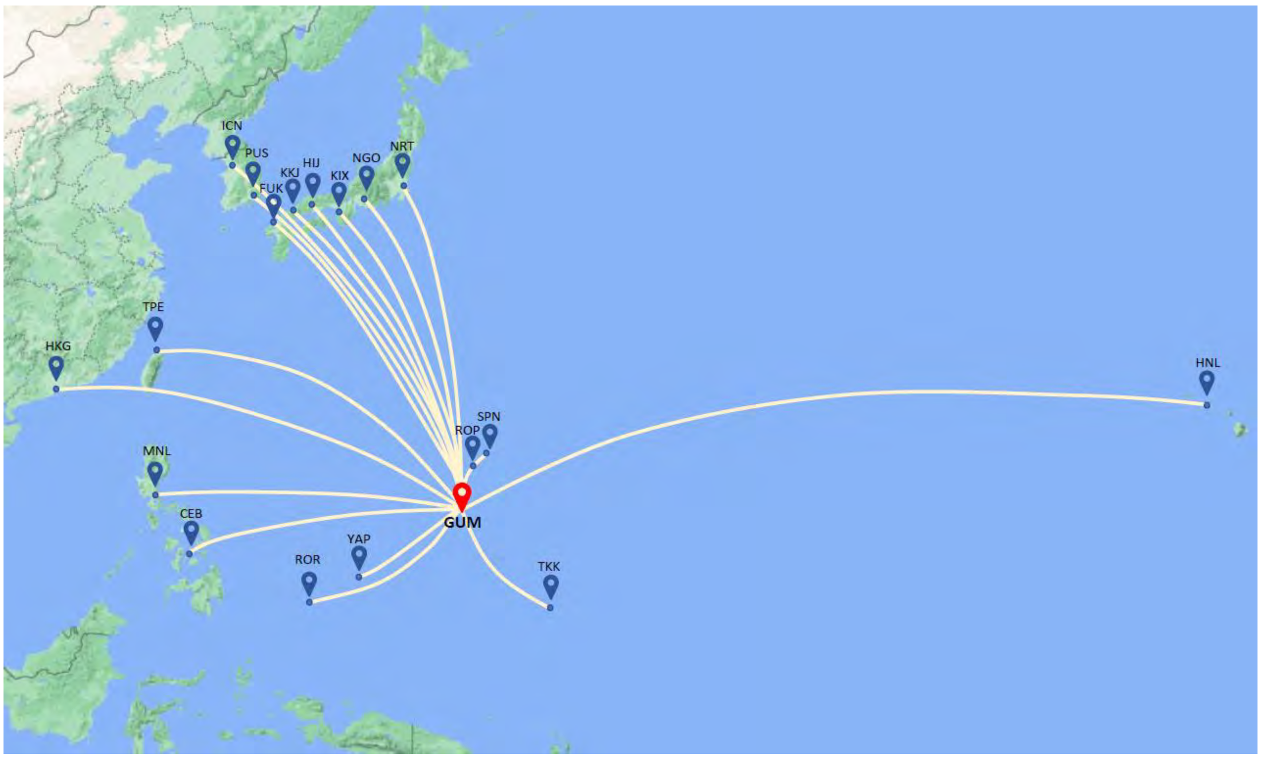

Figure 3-32. Nonstop Destinations in August 2019

Notes: Abbreviations for airports are given in ***Table 3-4.***
Sources:

1. *GIAA*
2. *Flight schedules for August 2019*
3. *AECOM analysis*

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able 3- Nonstop Destinations and Scheduled Departure Seats in August 2 19, 2 2 , and 2 21

Destination Airports	City, Country	Airlines in August 2 19	Weekly Scheduled Departure Seats in August 2 19	Airlines in August 2 2	Weekly Scheduled Departure Seats in August 2 2	Airlines in August 2 21	Weekly Scheduled Departure Seats in August 2 21
ICN	Seoul, Korea	7C, K , LJ, RS, TW	13,545	LJ	189	7C, K , LJ, RS, TW	1,458
NRT	Tokyo, Japan	7C, BX, JL, TW, UA	11,718	UA	1,512	UA	1,162
MNL	Manila, Philippines	5J, PR, UA	7,393	-	-	PR, UA	1,228
KIX	Kansai, Japan	7C, CI, TW, UA	4,318	-	-	-	-
NGO	Nagoya, Japan	7C, TW, UA	4,241	-	-	-	-
PUS	Pusan, Korea	7C, BX, LJ	3,644	-	-	-	-
HNL	Honolulu, Hawaii, U.S.	UA	2,394	UA	1,162	UA	2,394
FUK	Fukuoka, Japan	7C, TW, UA	1,500	-	-	-	-
SPN	Saipan, CNMI, U.S.	UA	1,414	UA	378	UA	1,162
HIJ	Hiroshima, Japan	CI	1,106	-	-	-	-
KKJ	Fukuoka, Japan	BX	1,040	-	-	-	-
ROR	Koror, Palau	UA	836	UA	126	UA	166
TP	Taipei, Taiwan	CI	790	-	-	BR	920
C B	Mactan, Philippines	PR	762	-	-	-	-
TKK	Chuuk, FSM	UA	750	UA	166	UA	332
HKG	Hong Kong, China	UA	504	-	-	-	-
YAP	Yap, FSM	UA	332	UA	126	UA	166
ROP	Rota, CNMI, U.S.	Star Marianas Air	56	-	-	-	-
PNI	Pohnpei, FSM	-	-	UA	126	UA	166
			August 2 19		**August 2 2**		**August 2 21**
Weekly Scheduled Departure Seat			**6,3 3**		**3,**		**9,1**

Notes:
CNMI = Commonwealth of the Northern Mariana Islands
FSM = Federated States of Micronesia
*See **Table 3-2** for airline carriers by airline code.*
Sources:
GIAA
Flight schedules for August 2019, 2020, and 2021
AECOM analysis

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3.5.1.3 Air Service Recovery Incentive Program

Both the GVB and GIAA launched recovery incentive programs to support and strengthen air services to Guam. The programs include both scheduled air service and on-demand charter flights.

GVB's recovery incentive program targets the Japan, Korea, and Taiwan markets while remaining open to other new markets. l igible and approved charter flight programs will receive incentives in the form of monetary support ($100) per seat sold. For the scheduled, regular air service, eligible and approved airlines will be provided with a subsidy of a fixed amount per sellable seat on each inbound flight to the Airport. Applications for GVB's air service recovery incentive program remain open until end of July 2022. However, the duration of these programs is subject to the availability of GVB funding.[44]

As of April 2022, five airlines (Air Busan, Jin Air, T'way, Philippine Airlines, and Korean Air) have applied for GVB's recovery incentive program. GVB expects the monthly total air seat capacity to increase from 37,000 in April 2022 to more than 107,000 in June 2022 as more international travel restrictions are lifted in Guam's major tourism markets of Korea, Japan, Taiwan, and the Philippines.[45]

Remaining budget from the air service recovery program could potentially be reallocated to the GVB program that provides free COVID-19 testing to eligible tourists before they return to their home countries. It means monetary savings for tourists visiting Guam.[46]

GIAA is launching an Airline Recovery Assistance and Incentivizing Service (RAIS) Program from May 1, 2022, through September 30, 2022. The objective of the Airline RAIS Program is to incentivize and stimulate air service travel demand in anticipation of Guam's plan to safely reopen with requirement of pre-arrival COVID testing. These targeted economic recovery incentives are intended to attract and encourage air service from all destinations in the Asia-Pacific region. The Airline RAIS Program applies to passenger air service with a minimum of one flight per week per destination. Airlines under the RAIS Program will receive discounts (up to 25 percent) on their rates and charges, such as Airfield Use (Landing) Fee, Loading Bridge Use, Immigration Inspection, Arrival Fees, and Departure Fees.[47]

3.5.2 Enplaned Passengers

n planed passengers represent one of the largest drivers in the master planning process for any commercial service airport. **able 3-** and **Figure 3-33** present enplaned passengers at the Airport for the period from 2005 through 2021. During this period, enplaned passenger levels varied with peaks of 1.8 million in 2017 and just below 1.9 million in 2019 before the COVID-19 pandemic.

As is typical for most commercial service airports, the trend of historical enplaned passengers generally follows the economic growth. The significance of the tourism industry in Guam and its geographical location as an island also make Guam vulnerable to natural disasters. The financial turmoil in late 2007, the Tohoku earthquake and tsunami which caused the Fukushima Daiichi nuclear disaster in 2011, the typhoon Mangkhut that passed through Guam in 2018 causing multiple cancellations of flights, and the COVID-19 recession in 2020 all correlate to a reduction in enplaned passengers at the Airport. In between these distinct incidents, there were also impacts on the historical enplanements due to the economic and geopolitical factors of the top tourism markets like Japan, Korea, Taiwan, and China. For example, tensions with North Korea with missile threats in Guam in 2018, increasing tensions between China and Taiwan in Taiwan's airspace in 2021, the ongoing trade war between the U.S. and China that started in 2018, and the Russian aggressions in Ukraine that started in February 2022 are unfavorable factors impacting the aviation demands in Guam. The previous, **Section 3** , also includes the discussions about the economy of these top tourism markets and the potential relationship with the visitor demands in Guam. The impacts on visitor demands are directly correlated to the aviation demands at the Airport.

44 GVB website, https://www.guamvisitorsbureau.com/marketing/markets/air-service-development#.
45 The Guam Daily Post dated April 4, 2022, https://www.postguam.com/news/local/5-airlines-apply-for-guam-subsidy/article_5a92e384-b4ad-11ec-9c12-2ba3ea57d313.html.
46 The Guam Daily Post dated April 4, 2022, https://www.postguam.com/news/local/5-airlines-apply-for-guam-subsidy/article_5a92e384-b4ad-11ec-9c12-2ba3ea57d313.html.
47 GIAA website, https://www.guamairport.com/corporate/airline-incentive-programs/airline-recovery-assistance-and-incentivizing-service-program.

Regardless of the historical events, enplanements rebounded after each financial downturn, recession, natural disaster, or pandemic. n planements increased at an average annual growth rate of 1.6 percent from 2005 to 2019. In the 5 years preceding the COVID-19 pandemic, enplanements increased at an average annual growth rate of 2.2 percent.

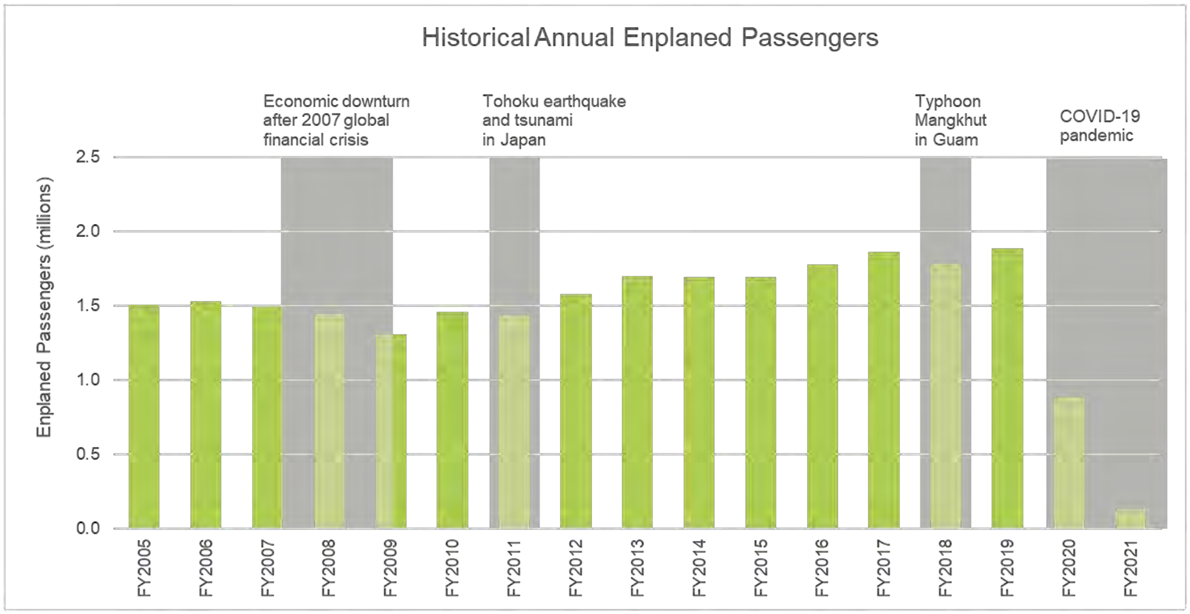

Figure 3-33. Historical Annual Enplaned Passengers

Source: Enplanement statistics – GIAA

able 3- istorical Annual Enplaned Passengers

Fiscal Year	Enplaned Passengers	YOY % Change
2005	1,503,304	N/A
2006	1,526,931	1.6%
2007	1,491,188	-2.3%
2008	1,442,810	-3.2%
2009	1,305,209	-9.5%
2010	1,456,875	11.6%
2011	1,439,424	-1.2%
2012	1,574,491	9.4%
2013	1,697,986	7.8%
2014	1,690,900	-0.4%
2015	1,692,943	0.1%
2016	1,774,590	4.8%
2017	1,858,379	4.7%
2018	1,780,572	-4.2%
2019	1,885,108	5.9%
2020	884,060	-53.1%
2021	135,566	-84.7%

Period	CAGR	
2005 to 2019 (14-year)	1.6%	
2009 to 2019 (10-year)	3.7%	
2014 to 2019 (5-year)	2.2%	

Note:
N/A = Not available
CAGR = Compound annual growth rate
YOY = Year-over-year
Sources:
Enplanement statistics – GIAA
YOY and CAGR calculations – AECOM analysis

3.5.2.1 Domestic vs International Passengers

The percentage of international passengers at the Airport is estimated by the analyses of the historical international visitor statistics from GVB. Between 92 and 94 percent of total visitors by air were international visitors from 2005 to 2019. Since most of the visitors in 2020 visited Guam before the COVID-19 pandemic starting March 2020, the percentage of international visitors in 2020 is similar to the historical trend at 92 percent. The impact of the COVID-19 pandemic is revealed in 2021. With the travel restrictions and quarantine requirements, the percentage of international visitors dropped significantly to below 27 percent in 2021.

able 3-6 presents the split between domestic and international visitors to Guam from 2005 to 2021. The percentage of domestic and international passengers at the Airport are assumed to mirror these percentages.

able 3-6 istorical Annual Domestic and International Visitors by Air

Fiscal Year	Domestic Visitors by Air U S Mainland/ awaii and CNMI	International Visitors by Air	% Domestic Visitors by Air	% International Visitors by Air	YOY % Change on Share of International Visitors by Air
2005	65,772	1,099,377	5.6%	94.4%	N/A
2006	61,571	1,128,320	5.2%	94.8%	0.5%
2007	65,689	1,114,538	5.6%	94.4%	-0.4%
2008	71,234	1,061,778	6.3%	93.7%	-0.8%
2009	72,172	963,622	7.0%	93.0%	-0.7%
2010	79,020	1,083,808	6.8%	93.2%	0.2%
2011	77,568	1,060,855	6.8%	93.2%	0.0%
2012	82,038	1,179,597	6.5%	93.5%	0.3%
2013	74,451	1,256,036	5.6%	94.4%	1.0%
2014	81,617	1,250,340	6.1%	93.9%	-0.6%
2015	83,502	1,277,586	6.1%	93.9%	0.0%
2016	94,117	1,398,132	6.3%	93.7%	-0.2%
2017	94,783	1,450,190	6.1%	93.9%	0.2%
2018	110,065	1,391,849	7.3%	92.7%	-1.3%
2019	116,707	1,504,247	7.2%	92.8%	0.1%
2020	58,581	693,281	7.8%	92.2%	-0.6%
2021	44,417	16,266	73.2%	26.8%	-70.9%

Fiscal Year	Domestic Visitors by Air U S Mainland/ awaii and CNMI	International Visitors by Air	% Domestic Visitors by Air	% International Visitors by Air	YOY % Change on Share of International Visitors by Air
Period	**CAGR**	**CAGR**	**CAGR**	**CAGR**	
2005 to 2019 (14-year)	4.2%	2.3%	1.8%	-0.1%	
2009 to 2019 (10-year)	4.9%	4.6%	0.3%	0.0%	
2014 to 2019 (5-year)	7.4%	3.8%	3.3%	-0.2%	

Notes:
N/A = Not available
CAGR = Compound annual growth rate
YOY = Year-over-year
Sources:
Visitor statistics – GVB
Percentage shares, YOY, and CAGR calculations – AECOM analysis

3.5.2.2 U S Mainland/ a waii vs CNMI Passengers

Within domestic visitors, the percentage of visitors from CNMI is summarized in **able 3-** . Because flying between Guam and CNMI, including Rota, Tinian, and Saipan, is within the range of smaller aircraft operated by Part 135 commuter operators such as Star Marianas Air, the characteristics are different from the demands from the U.S. mainland through Hawaii. In addition, there are U.S. Customs and Border Protection (CBP) processing requirements for visitors from U.S. Territories, such as Guam, to the U.S. mainland/Hawaii because of differences in visa validity. “Domestic” travel from Guam to the U.S. mainland/Hawaii is not exactly the same as domestic travel within the U.S. Hence, the share of CNMI passengers is estimated from the share of domestic passengers.

able 3- shows that the average historical growth in domestic visitors from the U.S. mainland/Hawaii is at 5.1 percent per annum, which is much higher than the growth in domestic visitors from CNMI at 1.4 percent per annum from 2005 to 2019. The number of visitors from the U.S. mainland/Hawaii in 2019 is twice the number of visitors in 2005.

able 3- istorical Annual U S Mainland/ awaii and CNMI Visitors by Air

Fiscal Year	Domestic U S Mainland/ awaii Visitors by Air	Domestic CNMI Visitors by Air	% U S Mainland/ awaii Visitors by Air	% CNMI Visitors by Air	YOY % Change on share of CNMI Visitors by Air
2005	47,150	18,622	71.7%	28.3%	N/A
2006	43,501	18,070	70.7%	29.3%	3.7%
2007	48,590	17,099	74.0%	26.0%	-11.3%
2008	53,038	18,196	74.5%	25.5%	-1.9%
2009	54,386	17,786	75.4%	24.6%	-3.5%
2010	60,651	18,369	76.8%	23.2%	-5.7%
2011	59,636	17,932	76.9%	23.1%	-0.6%
2012	64,766	17,272	78.9%	21.1%	-8.9%
2013	58,546	15,905	78.6%	21.4%	1.5%
2014	66,151	15,466	81.1%	18.9%	-11.3%
2015	69,745	13,757	83.5%	16.5%	-13.1%
2016	76,727	17,390	81.5%	18.5%	12.2%
2017	76,291	18,492	80.5%	19.5%	5.6%
2018	89,363	20,702	81.2%	18.8%	-3.6%

Fiscal Year	Domestic U S Mainland/ awaii Visitors by Air	Domestic CNMI Visitors by Air	% U S Mainland/ awaii Visitors by Air	% CNMI Visitors by Air	YOY % Change on share of CNMI Visitors by Air
2019	94,141	22,566	80.7%	19.3%	2.8%
2020	48,263	10,318	82.4%	17.6%	-8.9%
2021	41,239	3,178	92.8%	7.2%	-59.4%
Period	**CAGR**	**CAGR**	**CAGR**	**CAGR**	
2005 to 2019 (14-year)	5.1%	1.4%	0.8%	-2.7%	
2009 to 2019 (10-year)	5.6%	2.4%	0.7%	-2.4%	
2014 to 2019 (5-year)	7.3%	7.8%	-0.1%	0.4%	

Notes:
CNMI = Commonwealth of the Northern Mariana Islands
N/A = Not available
CAGR = Compound annual growth rate
YOY = Year-over-year
Sources:
Visitor statistics – GVB
Percentage shares, YOY, and CAGR calculations – AECOM analysis

3.5.2.3 Originating/ erminating vs Connecting Passengers

The Airport is primarily an origin and destination (O&D) airport with between 87 and 91 percent of the Airport's enplaned passengers being O&D passengers and 9 to 13 percent of passengers connecting through Guam to their final destinations. **able 3-** and **able 3-9** summarize the approximate number of originating, terminating, and connecting passengers at the Airport. The share of O&D passengers has been increasing through the years and reached the highest at 91 percent in 2019. The historical growth in enplanements is driven by the increase in visitors flying to Guam as their destination instead of going to other islands in Micronesia.

able 3- istorical Annual Originating and Connecting Passengers

Fiscal Year	Originating Passengers	Connecting Passengers	% Originating Passengers	% Connecting Passengers	YOY % Change on Share of Connecting Passengers
2005	1,303,975	199,329	86.7%	13.3%	N/A
2006	1,337,630	189,301	87.6%	12.4%	-6.5%
2007	1,308,607	182,581	87.8%	12.2%	-1.2%
2008	1,253,769	189,041	86.9%	13.1%	7.0%
2009	1,158,752	146,457	88.8%	11.2%	-14.4%
2010	1,273,445	183,430	87.4%	12.6%	12.2%
2011	1,264,243	175,181	87.8%	12.2%	-3.3%
2012	1,407,163	167,328	89.4%	10.6%	-12.7%
2013	1,498,419	199,567	88.2%	11.8%	10.6%
2014	1,480,349	210,551	87.5%	12.5%	5.9%
2015	1,476,574	216,369	87.2%	12.8%	2.6%
2016	1,559,141	215,449	87.9%	12.1%	-5.0%
2017	1,660,548	197,831	89.4%	10.6%	-12.3%
2018	1,596,054	184,518	89.6%	10.4%	-2.7%
2019	1,720,562	164,546	91.3%	8.7%	-15.8%

Fiscal Year	Originating Passengers	Connecting Passengers	% Originating Passengers	% Connecting Passengers	YOY % Change on Share of Connecting Passengers
2020	783,532	100,528	88.6%	11.4%	30.3%
2021	101,696	33,870	75.0%	25.0%	119.7%
Period	**CAGR**	**CAGR**	**CAGR**	**CAGR**	
2005 to 2019 (14-year)	2.0%	-1.4%	0.4%	-2.9%	
2009 to 2019 (10-year)	4.0%	1.2%	0.3%	-2.5%	
2014 to 2019 (5-year)	3.1%	-4.8%	0.8%	-6.9%	

Notes:
N/A = Not available
CAGR = Compound annual growth rate
YOY = Year-over-year
Sources:
Passenger statistics – GIAA Financial Reports
Percentage shares, YOY, and CAGR calculations – AECOM analysis

able 3-9 istorical Annual erminating and Connecting Passengers

Fiscal Year	erminating Passengers	Connecting Passengers	% erminating Passengers	% Connecting Passengers	YOY % Change on Share of erminating Passengers
2005	1,301,073	199,329	86.7%	13.3%	n/a
2006	1,335,577	189,301	87.6%	12.4%	-6.6%
2007	1,308,112	182,581	87.8%	12.2%	-1.3%
2008	1,261,234	189,041	87.0%	13.0%	6.4%
2009	1,163,670	146,457	88.8%	11.2%	-14.2%
2010	1,296,795	183,430	87.6%	12.4%	10.9%
2011	1,284,203	175,181	88.0%	12.0%	-3.1%
2012	1,412,502	167,328	89.4%	10.6%	-11.8%
2013	1,485,648	199,567	88.2%	11.8%	11.8%
2014	1,489,971	210,551	87.6%	12.4%	4.6%
2015	1,492,347	216,369	87.3%	12.7%	2.3%
2016	1,579,609	215,449	88.0%	12.0%	-5.2%
2017	1,703,240	197,831	89.6%	10.4%	-13.3%
2018	1,625,932	184,518	89.8%	10.2%	-2.1%
2019	1,715,346	164,546	91.2%	8.8%	-14.1%
2020	794,593	100,528	88.8%	11.2%	28.3%
2021	88,037	33,870	72.2%	27.8%	147.4%

Fiscal Year	erminating Passengers	Connecting Passengers	% erminating Passengers	% Connecting Passengers	YOY % Change on Share of erminating Passengers
Period	CAGR	CAGR	CAGR	CAGR	
2005 to 2019 (14-year)	2.0%	-1.4%	0.4%	-2.9%	
2009 to 2019 (10-year)	4.0%	1.2%	0.3%	-2.4%	
2014 to 2019 (5-year)	2.9%	-4.8%	0.8%	-6.7%	

Notes:
N/A = Not available
CAGR = Compound annual growth rate
YOY = Year-over-year
Sources:
Passenger statistics – GIAA Financial Reports
Percentage shares, YOY, and CAGR calculations – AECOM analysis

3.5.3 oad Factors

n planed passenger trends typically do not tell the complete story regarding airline service. It is also important to understand the historical trend of average load factors and seat capacity to understand airport utilization dynamics. The number of aircraft operations and the average size of aircraft serving an airport do not necessarily increase or decrease with the numbers of enplaned passengers. Thus, this section describes the Airport load factors, the subsequent section discusses Airport seat capacity, and fleet mix.

able 3-1 presents historical data on load factors for 2003 through 2021. Graphic presentations of monthly and annual trends are shown in **Figure 3-3** and **Figure 3-3** . **Figure 3-3** includes the national trend on load factors for domestic, international, and the combined total for all U.S. air carriers per the FAA Aerospace Forecast FY2021–2041.

The load factors for both domestic and international departures from the Airport vary seasonally with peaks in summers and winters, and troughs during off-seasons fall between the peak seasons as illustrated in **Figure 3-3** . As soon as the travel restrictions were enforced due to the COVID-19 pandemic, load factors dropped to a record low at below 10 percent in April 2020. Airlines reduced capacity with flight cancelations to recover the load factors (and operating costs) in subsequent months.

Regardless of monthly variations, the overall annual load factor for international flights, hence the overall Airport average load factor, increased gradually throughout the past decade. The average load factor for international departures at the Airport increased from 71 percent in 2004 to 80 percent in 2019, as summarized in **able 3-1** . However, the average load factor for domestic departures decreased from 86 percent to 74 percent during the same period.

The comparison of the historical trend at the Airport and the national systemwide trend is given in **Figure 3-3** . The average load factors at the Airport are generally lower than the nationwide average for both domestic and international flights.

able 3-1 istorical Annual oad Factors for Departures

Fiscal Year	Domestic oad Factor	International oad Factor	Airport otal oad Factor
2004	86.5%	71.1%	73.2%
2005	87.6%	73.2%	75.0%
2006	86.8%	74.1%	75.5%
2007	87.2%	74.5%	75.8%
2008	85.4%	73.7%	74.9%
2009	79.1%	69.8%	70.9%

Fiscal Year	Domestic oad Factor	International oad Factor	Airport otal oad Factor
2010	84.4%	72.0%	73.4%
2011	87.2%	75.6%	77.0%
2012	71.8%	76.7%	76.1%
2013	74.3%	76.0%	75.8%
2014	75.7%	76.2%	76.1%
2015	71.7%	76.5%	75.8%
2016	74.0%	77.3%	76.8%
2017	74.9%	79.3%	78.7%
2018	77.2%	80.3%	79.8%
2019	74.3%	79.9%	79.0%
2020	41.8%	71.3%	62.2%
2021	46.2%	27.8%	40.5%
Period	**CAGR**	**CAGR**	**CAGR**
2004 to 2019 (15-year)	-1.0%	0.8%	0.5%
2009 to 2019 (10-year)	-0.6%	1.4%	1.1%
2014 to 2019 (5-year)	-0.4%	1.0%	0.7%

Notes:
CAGR – Compound annual growth rate
Sources:
T-100 Segment database – U.S. Department of Transportation (DOT) BTS
Load factors by fiscal year based on revenue passenger miles, available seat miles, and CAGR calculations – AECOM analysis

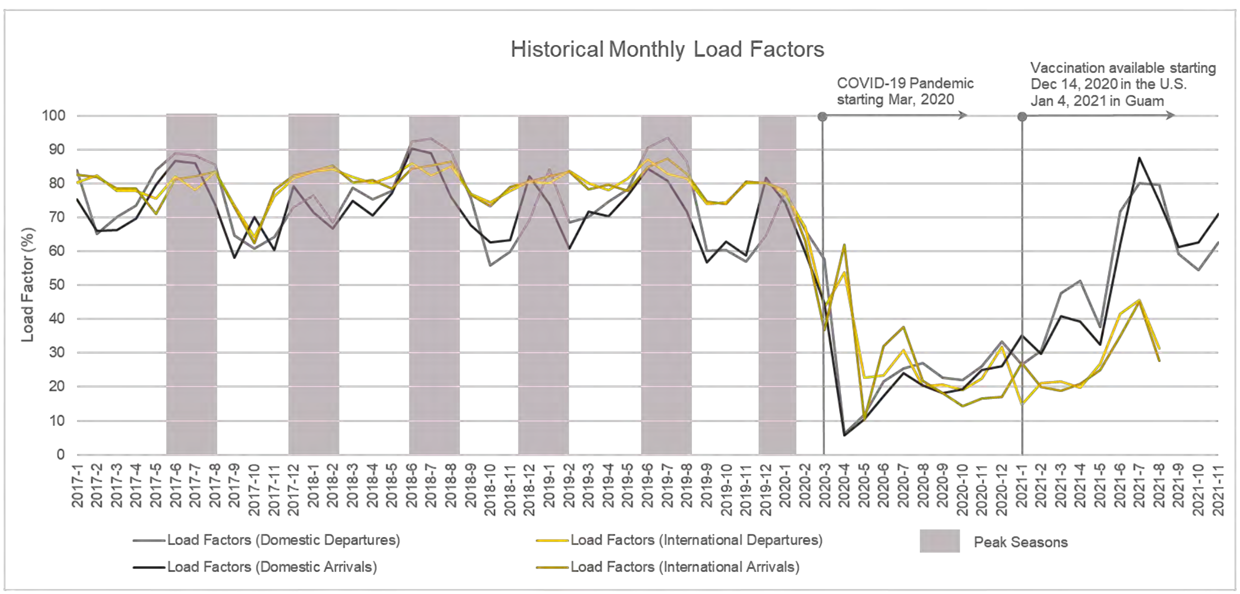

Figure 3-34. Historical Monthly Load Factors

Sources:

1. *T-100 Segment database – U.S. DOT BTS*
2. *First vaccination date – WHO*
3. *AECOM analysis*

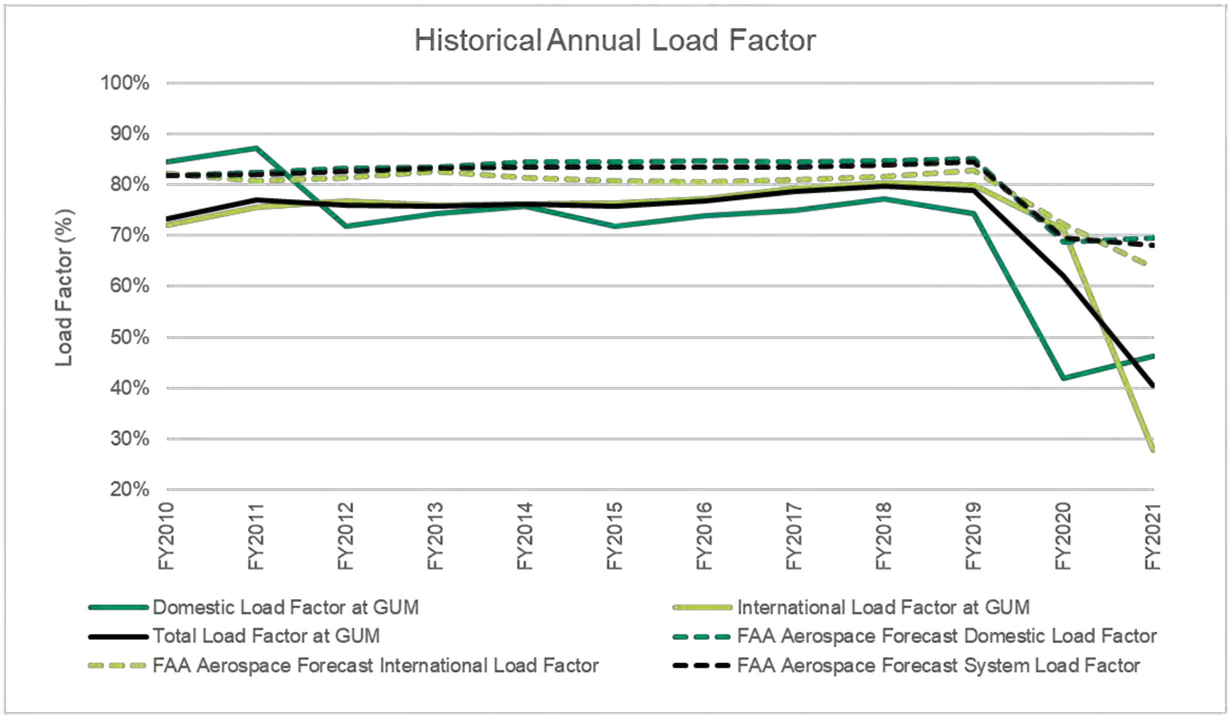

Figure 3-35. Historical Annual Load Factors

Note: U.S. Systemwide load factors in FY2020 and FY2021 are estimates and projections, respectively.
Sources:

1. *Airport statistics from T-100 Segment database – U.S. DOT BTS*
2. *U.S. Systemwide load factor statistics – FAA Aerospace Forecast FY2021–2041*
3. *Load factors by fiscal calculations – AECOM analysis*

3.5.4 Aircraft Fleet Mix and Average Seats per Departure

Figure 3-36 summarizes the major changes in passenger aircraft fleet mix based on the number of annual departures at the Airport since 2015. During this time frame, the most popular passenger aircraft at the Airport are the narrowbody aircraft Boeing (B) B737-800 and B737-700. They are mostly flown by United, Jeju Air, Jin Air, China Airlines, and Korean Air. Airbus (A) A321 and A320 aircraft are also common at the Airport. Air Busan, Air Seoul, Philippine Airlines, and V A Airways operate their A321s, while Cebu Pacific operates an A320.

The most popular widebody aircraft is the B777-200 followed by the A330-200. United, Jin Air, Korean Air, Japan Airlines, and Philippine Airlines are the typical airlines that include some widebody aircraft in their fleet serving Guam.

Because of its location, Guam is served by mainline aircraft (long-range aircraft with 90 seats or more) for destinations farther than CNMI. None of the air carriers operate regional jets (short- to medium-range aircraft with less than 90 seats, including 50-seaters like mb raer Regional Jet [R J] R J-135/140/145 and Canadair Regional Jet [CRJ] CRJ-100/200 and larger jets with 70 to 90 seats like R J-170/175 and CRJ-700/900) at the Airport. Only commuter air carriers such as Star Marianas Air operate a short-range 8-seat Piper (PA) PA-31 for inter-island connections between Guam and Rota (or Saipan) in CNMI.

The average seat capacity per aircraft at the Airport increased from 176 in 2015 to 196 seats per departure in 2019 (pre-pandemic), as shown in **Figure 3-3** . The average seat capacity for international flights is slightly higher than domestic flights. The average seat capacity for international departures increased from 181 in 2015 to 202 seats per departure in 2019. The average seat capacity for domestic departures increased from 172 in 2015 to 190 seats per departure in 2019.

When the aviation demands were heavily impacted by the COVID-19 pandemic, airlines reduced frequency and used smaller aircraft to match capacity with the reduced demand. Average seat capacity per aircraft at the Airport reduced from 196 in 2019 to 174 seats per departure in 2021. During the same period, average seat capacity for international flights decreased from 202 to 175 seats per departure, while domestic flights decreased from 190 to 173 seats per departure. As the load factors recover from the pandemic (**Figure 3-3**), airlines will gradually increase capacity by a combination of increasing frequency and resuming use of their larger aircraft. It is anticipated that the average seats per departure will eventually return to the historical pre-pandemic trend.

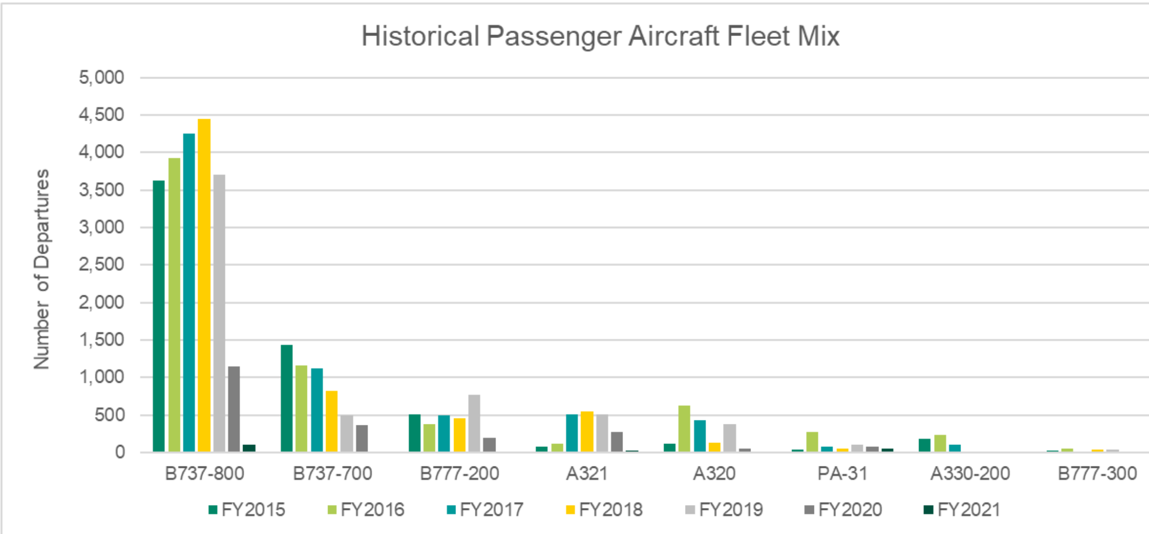

Figure 3-36. Historical Passenger Aircraft Fleet Mix

Note: Aircraft models with at least 10 departures in FY2019 are included.
Sources:

1. *Airport statistics from T-100 Segment database – U.S. DOT BTS*
2. *Summary by aircraft model – AECOM analysis*

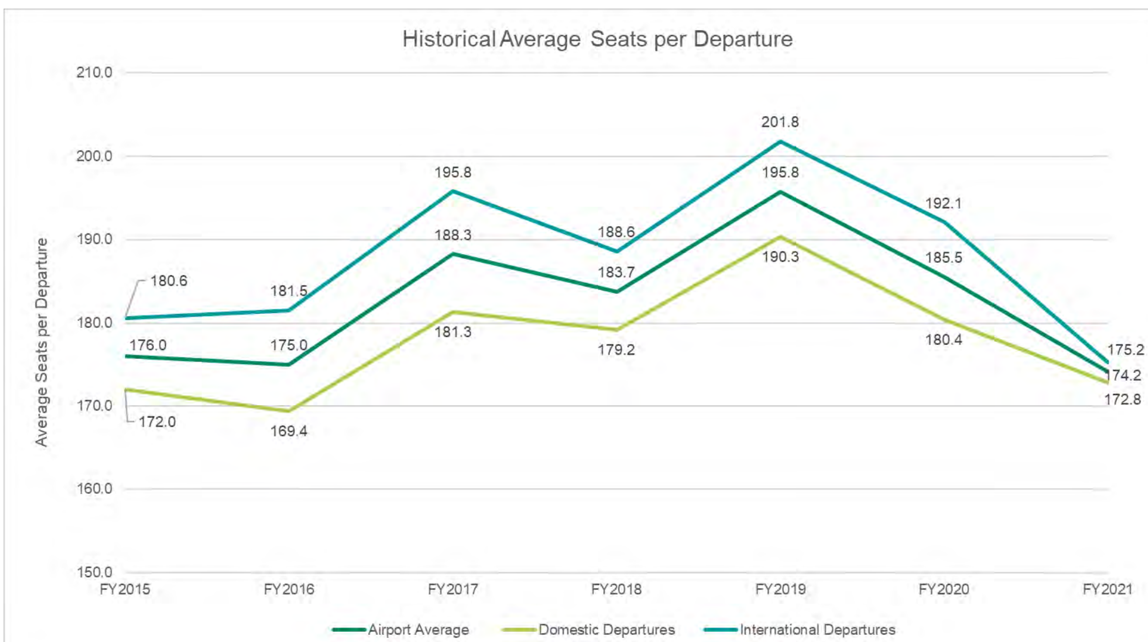

Figure 3-37. Historical Average Seats per Departure

Note: Operations by Part 135 Commuter such as Star Marianas Air, which operates with an 8-seat Piper PA-31, are excluded.
Source:

1. *Airport statistics from T-100 Segment database – U.S. DOT BTS*
2. *Average seats by departure calculations – AECOM analysis*

3.5.5 Airline Yield

Lower airfares attract passengers. A common measure of airfares per unit trip length is by airline yield. Yield is a measure of airline revenue, normalized for distance. It is measured in cents per revenue-passenger-mile and is calculated by dividing fare revenue by trip length. The information is based on data from the U.S. DOT BTS Airline Origin and Destination Survey (DB1B database), which collects ticket fare and miles flown for each domestic itinerary reported. The sample size of the Airline Origin and Destination Survey is approximately 10 percent of all air tickets.

Figure 3-3 summarizes airline yields for domestic itineraries to/from the Airport and the national average airline yields from 2015 through 2021. **Figure 3-3** also graphically presents the YOY changes on yields for both the Airport and the national average. Historical variations in yields for the Airport and domestic yields for the U.S. increase and decrease at a similar pattern. The drops in 2009 and 2016 airline yield are consistent with the drop in oil prices.

Figure 3-39 presents the changes in yields for the top U.S. carriers at the Airport.

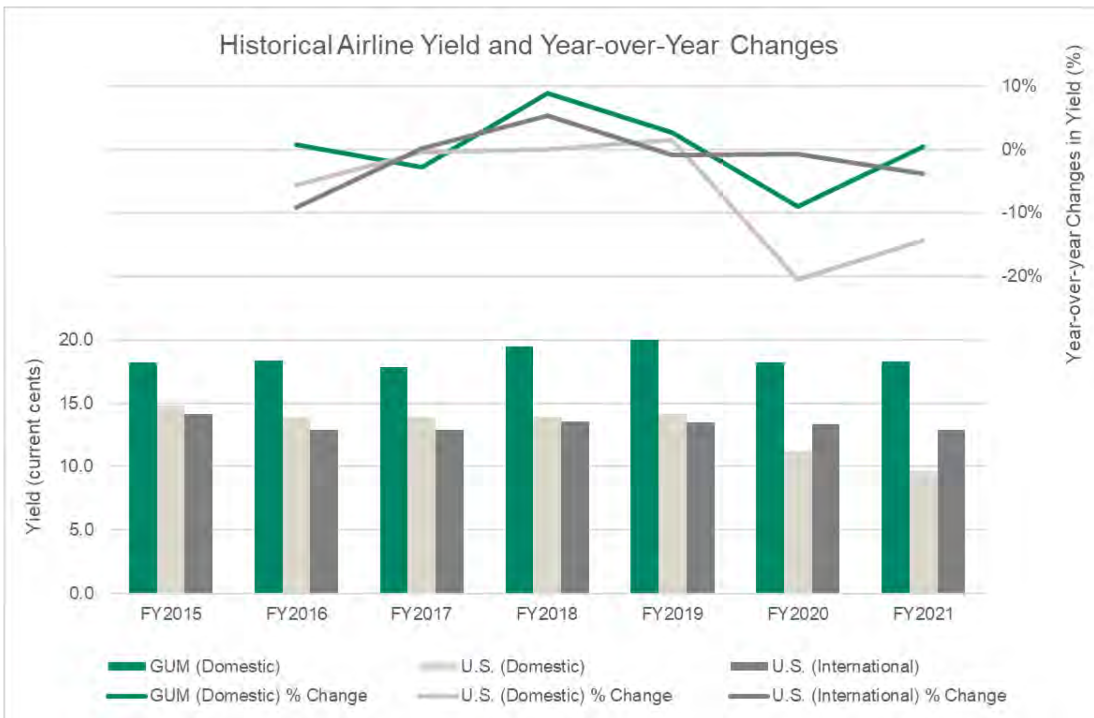

Figure 3-38. Historical Domestic and International Airline Yield and Year-over-Year Changes

Note: DB1B Market database provides information for domestic itinerary from the Origin and Destination Survey, which is a 10 percent sample of airline tickets from reporting carriers.
Source:

1. *Airport statistics from DB1B Market database – U.S. DOT BTS*
2. *U.S. statistics – FAA Aerospace Forecast FY2021–2041*
3. *Airport domestic airline yield and percentage change calculations – AECOM analysis*

Figure 3-39. Historical Domestic Airline Yield by Carriers

Note: DB1B Market database provides information for domestic itinerary from the Origin and Destination Survey, which is a 10 percent sample of airline tickets from reporting carriers.
Sources:

1. *Airport statistics from DB1B Market database – U.S. DOT BTS*
2. *Airport domestic airline yield by carriers – AECOM analysis*

3.5.6 Air Cargo

Historical annual air cargo (air freight and mail) tonnage throughput from 2017 to 2021 is summarized in **Figure 3-** . Freight throughput increased significantly from 6,700 tons in 2017 to the peak of 18,000 tons in 2020 and 15,500 tons in 2021 for outbound; volume was maintained between 6,900 and 9,400 tons for inbound freight throughput. Air mail also increased significantly from 2,000 tons in 2017 to 6,800 tons in 2021 for outbound and increased from 5,300 tons to 13,400 tons during the same period for inbound. The surge in demand in 2020 and 2021 is mostly related to the urgent need for supplies during the COVID-19 pandemic. Monthly air cargo tonnage given in **Figure 3- 1** also shows the sudden increase in outbound freight at the beginning of the pandemic.

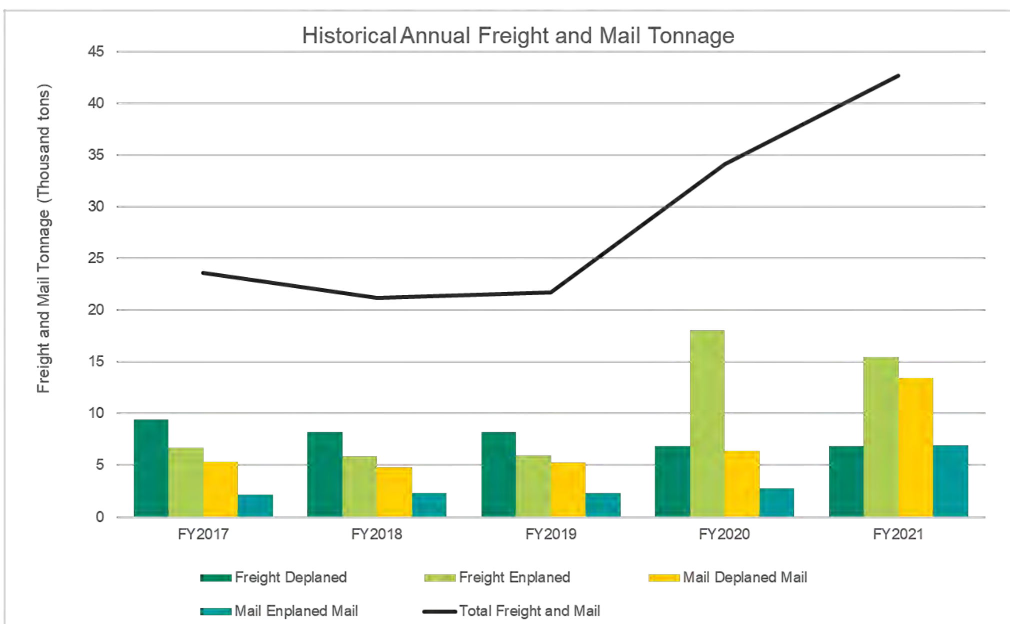

Figure 3-40. Historical Annual Freight and Mail Tonnage

Source: GIAA

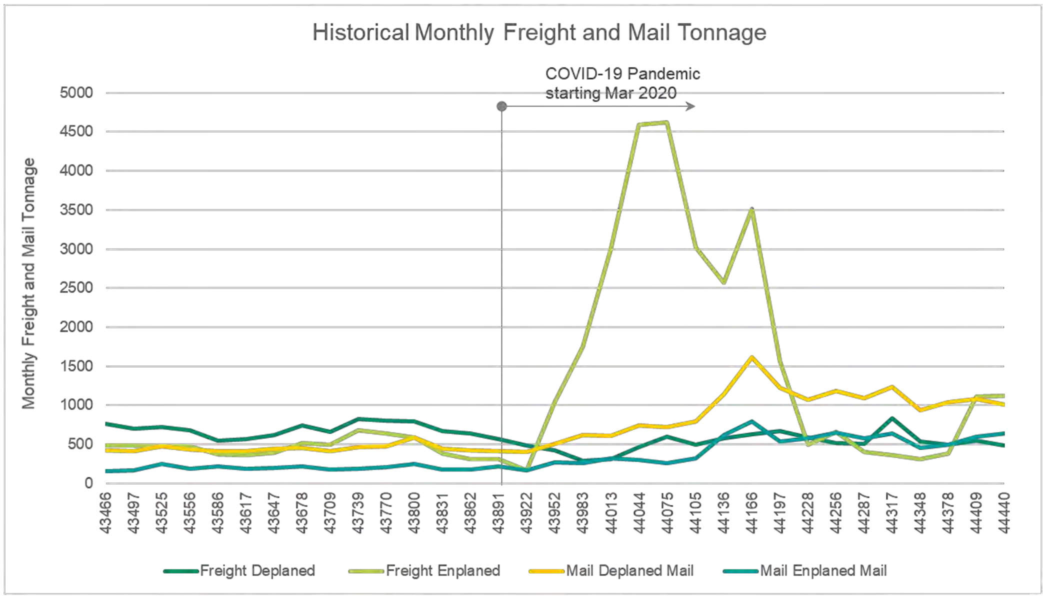

Figure 3-41. Historical Monthly Freight and Mail Tonnage

Source: GIAA

In order to analyze a longer historical trend of the air cargo demand than the period shown in **Figure 3-** , the all-cargo data from the FAA were collected for the calendar years from 2009 to 2020, as summarized in **Figure 3- 2** and **able 3-11**. The landing weight of all-cargo aircraft at the Airport increased at an average rate of 15 percent per annum over the 10-year period from 2009 through 2019 and over 9 percent per annum over the 5-year period from 2014 through 2019. The national ranking of the Airport's all-cargo aircraft landing weight has been going up since 2017, which indicates the growth in cargo demand at the Airport outperformed other airports nationwide. There is also a surge in all-cargo aircraft landing weight in 2020 during the COVID-19 pandemic, which is similar to the trend described on the cargo tonnage and driven by the need for supplies to the Pacific Islands.

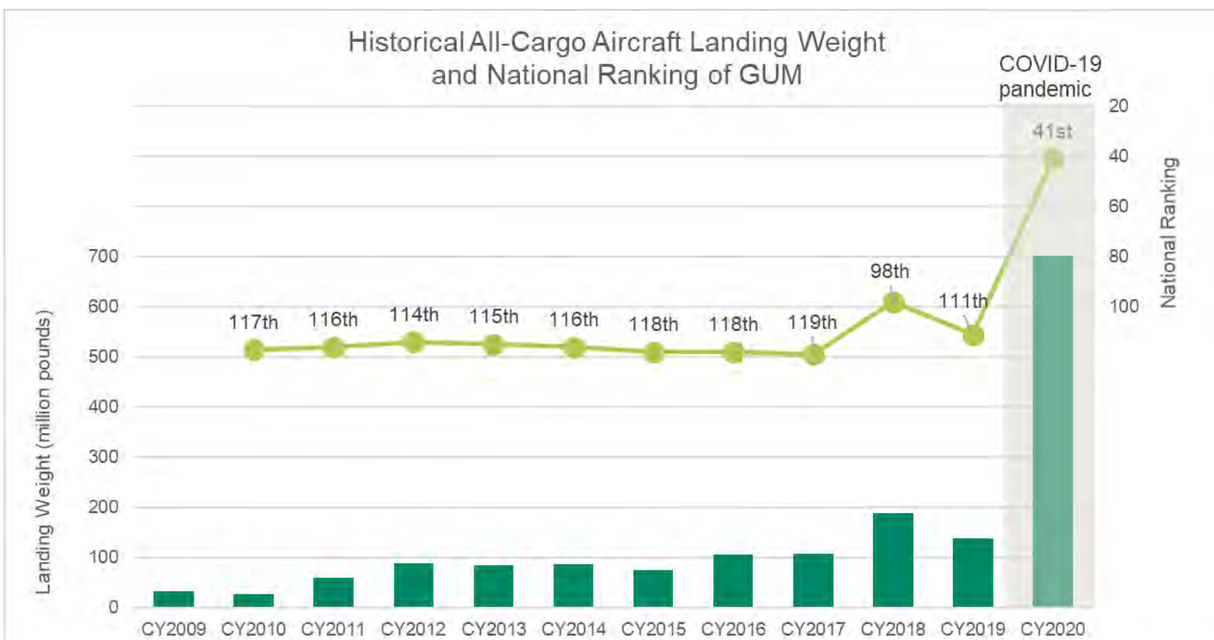

Figure 3-42. Historical All-Cargo Aircraft Landing Weight and National Ranking of GUM

Source: Landing weight and national ranking – FAA All-Cargo Data

able 3-11 istorical All-Cargo Aircraft anding Weight

Calendar Year	All-Cargo anding Weight Pounds	YOY % Change
2009	33,909,200	N/A
2010	27,108,400	-20.1%
2011	61,117,700	125.5%
2012	89,287,000	46.1%
2013	84,912,300	-4.9%
2014	87,446,300	3.0%
2015	76,717,500	-12.3%
2016	106,768,850	39.2%
2017	108,440,100	1.6%
2018	189,833,874	75.1%
2019	138,511,079	-27.0%
2020	702,512,030	407.2%
Period	**CAGR**	
2009 to 2019 (10-year)	15.1%	
2014 to 2019 (5-year)	9.6%	

Notes:
N/A = Not available
CAGR = Compound annual growth rate
YOY = Year-over-year
Sources:
Landing weight – FAA All-Cargo Data
YOY and CAGR calculations – AECOM analysis

Figure 3- 3 illustrates the changes in exports and imports via Guam in terms of value, geography, and type of commodities. Although the statistics include transportation by both air and ship, the combined statistics provide valuable insights on the characteristics and historic trend of the cargo industry in Guam. An average of 30 percent of the imports (by value) were delivered by air based on available historical statistics in 2017 through 2019.

This historical inbound air cargo throughput was much higher than the outbound throughput before the COVID-19 pandemic, as shown in **Figure 3-** . A similar pattern is shown in the imports and exports statistics, as the value of monthly imports are much higher than the monthly exports. As an island in the Pacific Ocean with limited natural resources and productivity, Guam depends heavily on imports of supplies. High value, time- or temperature-sensitive goods and perishables are mostly delivered by air through the Airport. Bulky, heavy, and less time-critical deliveries are usually transported in container ships through the Port of Guam.

The majority of the imports are from the U.S., followed by Italy, China, Singapore, Korea, Japan, and Taiwan. The top commodities imported to Guam include food, alcoholic beverages, clothing, leather products, motor vehicles, watches, electrical appliances, perfumes and cosmetics, jewelry, and pharmaceutical products.

The FSM, Marshall Islands, and Palau are the top, the fourth, and the fifth country of destinations for exports from Guam, respectively. These three countries together represent 48 to 67 percent of the exports from Guam from 2017 through 2021. Other popular export destinations include Japan, Hong Kong, Korea, and Taiwan. The top commodities exported to these countries are tobacco products, beer, motor vehicles, fish (live, chilled, or frozen), perfumes and cosmetics, and watches. As Guam does not manufacture most of these products, the majority of these exports are transshipments redistributed to Micronesia.

Guam had a well-established fishery transshipment industry in the mid-1980s and 1990s. With the adoption of the xcl usive conomic Zone (Z), which extends 200 nm from the coast, established in

1982,[48] many Pacific Islands took actions toward the landing of fish caught in their Zs by imposing licensing conditions with bilateral or multilateral access agreements between different nations. The FSM, with the most marine resources in its Z s amongst the countries in the Micronesia region, adopted the land-fish-locally policy. An emerging pattern of air transshipment through both Guam (i.e., GUM) and Saipan (i.e., GSN) for sashimi-grade tuna bound for Japanese market accompanied imposition of the land-fish-locally policy. Smaller cargo jets transported these sashimi-grade tuna to Guam and Saipan, where shipments were consolidated for transshipment onto large cargo aircraft to Japan. Guam also developed secondary transshipment operations by processing the rejected fish that did not meet Japanese sashimi market standard and air freighting them to other destinations such as u rope via Korea.[49, 50] After the Asian financial crisis in 1997 and the drop of the Japanese yen against the U.S. dollar, the operating cost, fuel cost, port cost, and air freight cost for foreign-flagged vessels fishing in the Micronesia region went up and resulted in a significant decline in the fishery industry. xp orts of fish (live, chilled, or frozen) from Guam continues to decline through the COVID-19 pandemic as shown in **Figure 3- 3** .

Despite the decline of the fishery transshipment in Guam, there are potential opportunities for Guam in the transshipment industry resulting from the increasing need to address supply chain issues in a post-COVID era. Guam's geographically and politically strategic location within the Asia Pacific represents a vital component to not only U.S. military logistics and operations but it also provides easy access to manufacturing hubs in the Asia-Pacific supply chain. The Port of Guam at Apra Harbor has convenient access to the Airport and has the capacity to handle more shipments in comparison with other ports in the Pacific.[51] The Government of Guam set up a Transshipment Task Force in June 2021 to develop Guam into a transshipment hub by addressing issues such as federal and local regulations, tax policy, workforce development, incentive programs, infrastructure, finance, and outreach. With the strong support of both the government and local community, and the desperate need for a diversified economy for Guam to recover from the pandemic, the outlook for transshipment demands and the consequential impacts on air freight demands are encouragingly positive.

48 The United Nations Convention on the Law of the Sea signed in 1982.
49 Hamnett and Pintz, The Contribution of Tuna Fishing and Transshipment to the Economies of American Samoa, the Commonwealth of Northern Mariana Islands, and Guam. 1996.
50 South Pacific Commission Port Sampling Workshop, Summary Report of the Tuna Transshipment Industry in Guam. 1994.
51 Wang, Bhojwani, Tumaneng, and Ji, Transshipment on Guam. 2021.

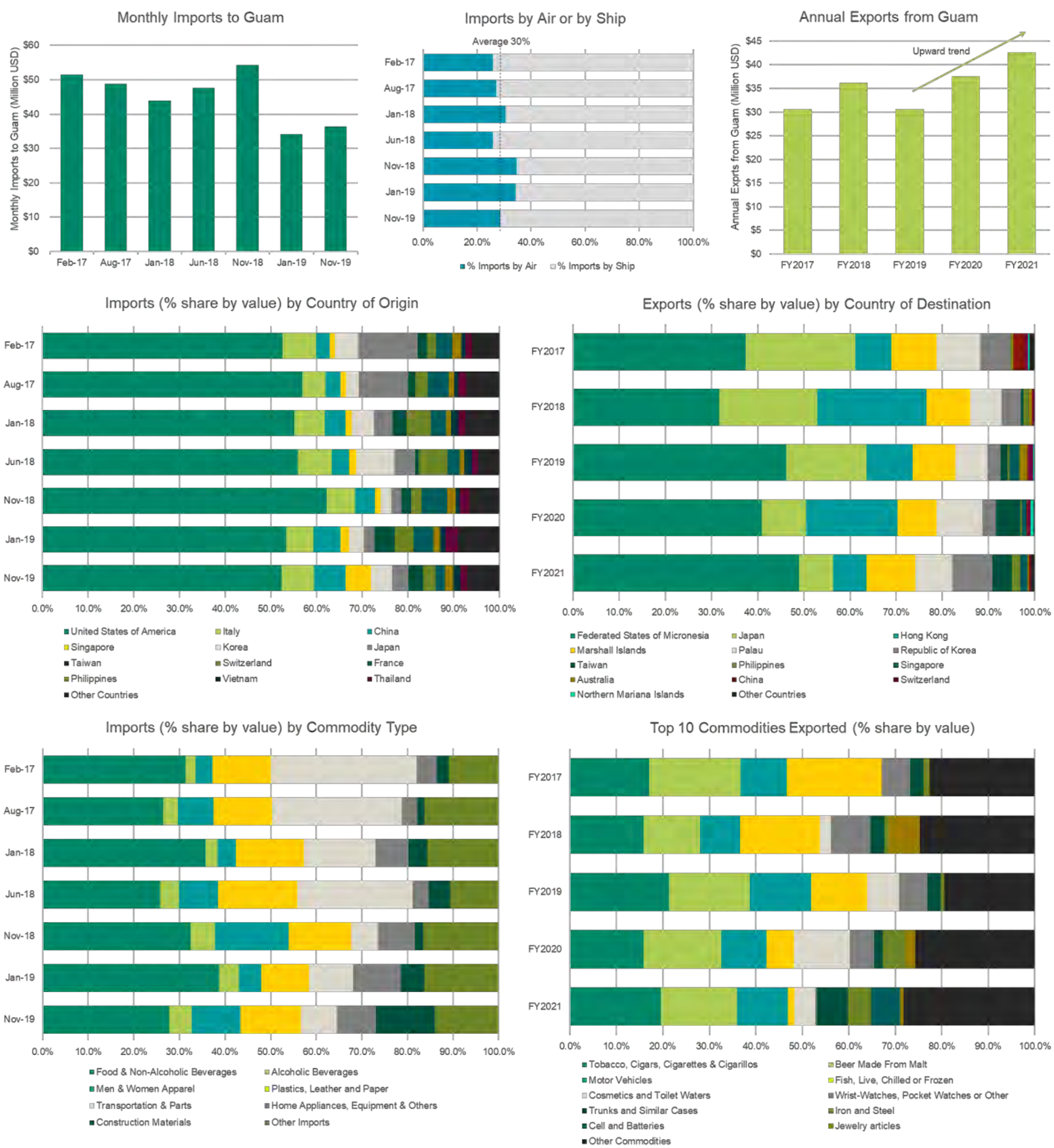

Figure 3-43. Historical Imports and Exports through Guam

Sources:

1. *Bureau of Statistics and Plans, Government of Guam*
2. *AECOM analysis*

Air cargo services are provided by five basic types of carriers:

- Combination carriers – passenger airlines offering cargo services. They use either passenger aircraft designed with additional freight capacity, or in some cases, air freighters. They may limit their services to express packages, mail, and palletized freight on scheduled passenger services or may operate their own cargo service with dedicated air freighters. With the surge in demand for Personal Protective q uipment (PP) and medical supplies during the COVID-19 pandemic, some passenger airlines operated cargo-only flights on passenger aircraft or increased their belly cargo capacity by removing some passenger seats. United Airlines, Japan Airlines, Korean Airlines, and

Philippine Airlines are the most common combination carriers at the Airport. During the pandemic, both United and Korean Airlines operated regularly scheduled dedicated freighter service. Other examples of passenger airlines that had occasional on-demand cargo services at the Airport in the past 3 years include, V A Airways, Jeju Air, Air China, China Southern, China a stern, Hainan Airlines, Hawaiian Airlines, Lion Airlines, and Uzbekistan Airways.

- Integrated carriers offering door-to-door services by combining air and land transport (also known as integrated express operators or integrators). The largest air freight carriers are the integrated carriers Fed x and UPS. Both Fed x and UPS operate weekly flights to/from the Airport. They maintained the same weekly operations during the pandemic. UPS typically flies from Honolulu to Guam and continues to Hong Kong (HNL-GUM-HKG). Fed x typically flies the route from Anchorage to Guam and then Shanghai (ANC-GUM-PVG). Fed x also has occasional destinations at Osaka (KIX), Seoul (ICN), or Tokyo (NRT) instead of Shanghai (PVG).
- All-cargo airlines offering chartered and/or scheduled services. They operate scheduled services for contract shippers and provide charter operations for other airlines. They typically utilize freight forwarders to arrange most of their shipments. The largest all-cargo carrier at the Airport is Asia Pacific Airlines (APA) with their headquarters in Tamuning, Guam. APA operates cargo charter services from bases in Guam and Honolulu with its hub operation at the Airport. Its primary operation is the shipment of U.S. mail and freight throughout Micronesia. The second and third largest all-cargo carriers at the Airport are Air Transport International (ATN) and Polar Air Cargo (PAC). ATN operated freighter service primarily from Hong Kong to Sydney through Guam (HKG-GUM-SYD) during the pandemic (from July 2020 to January 2021). PAC operated freighters primarily from Hong Kong or Seoul to Sydney through Guam (HKG-GUM-SYD or ICN-GUM-SYD). Other common all-cargo airlines operating at the Airport include Atlas Air Cargo, Volga-Dnepr Airlines, Omni Air International, Antonov Airlines, Kalitta Air, Lynden Air Cargo, Cargo Aircraft Management, and National Airlines.
- Part 135 commuter air carriers offering charter or scheduled cargo only or passenger and cargo services. They operate with small aircraft with a maximum payload capacity of 7,500 pounds and a maximum passenger-seating configuration of 9 seats, or in any rotorcraft. They cannot operate in any turbojet aircraft. Micronesian Air Cargo Services (MACS, also operated as Skydive Guam) and Star Marianas Air are the top Part 135 operators at the Airport. MACS plays an important role in the U.S. Postal Service (USPS) operations in the region and delivers air mail to/from CNMI regularly. MACS also provides on-demand air cargo delivery between Guam, Rota, Saipan, and Tinian. Star Marianas Air offered daily scheduled flights to/from Rota, CNMI, before the COVID-19 pandemic and other non-scheduled charter services to Rota, Saipan, and Tinian, CNMI. Star Marianas Air typically ships cargo and rarely provides passenger service. Arctic Air (or Arctic Circle Air) is another Part 135 air carrier with headquarters in Saipan and is owned by Marianas Harvest. Their business plan is to establish a reliable supply of fresh produce from CNMI to Guam, but they also provide charter services for passengers and air cargo.
- Leasing companies providing air freighters on dry or wet lease or a combination lease arrangement. The historical statistics of cargo operations typically show the lessees as the air carrier instead of the lessors. They are included in the above-listed categories of air cargo carriers.

Figure 3- summarizes the historical share of air cargo tonnage carried by air freighters, small aircraft operated by Part 135 commuter air carriers, or as belly cargo in passenger aircraft. During the COVID-19 pandemic, passenger demands dropped significantly. Many passenger aircraft were used as cargo aircraft without passengers temporarily. Hence, the percentage of belly cargo on passenger aircraft was negligible, while the percentage of air freighters increased significantly in 2020 and 2021. It is anticipated that the percentage share between different types of aircraft will return to levels similar to those in 2019 after the pandemic. For the current forecasting effort, the share of air cargo on air freighters (excluding belly cargo) will be used to estimate the number of cargo aircraft operations, and the share of air cargo on small aircraft operated by Part 135 commuter air carriers will be used to estimate the number of air taxi operations for cargo delivery.

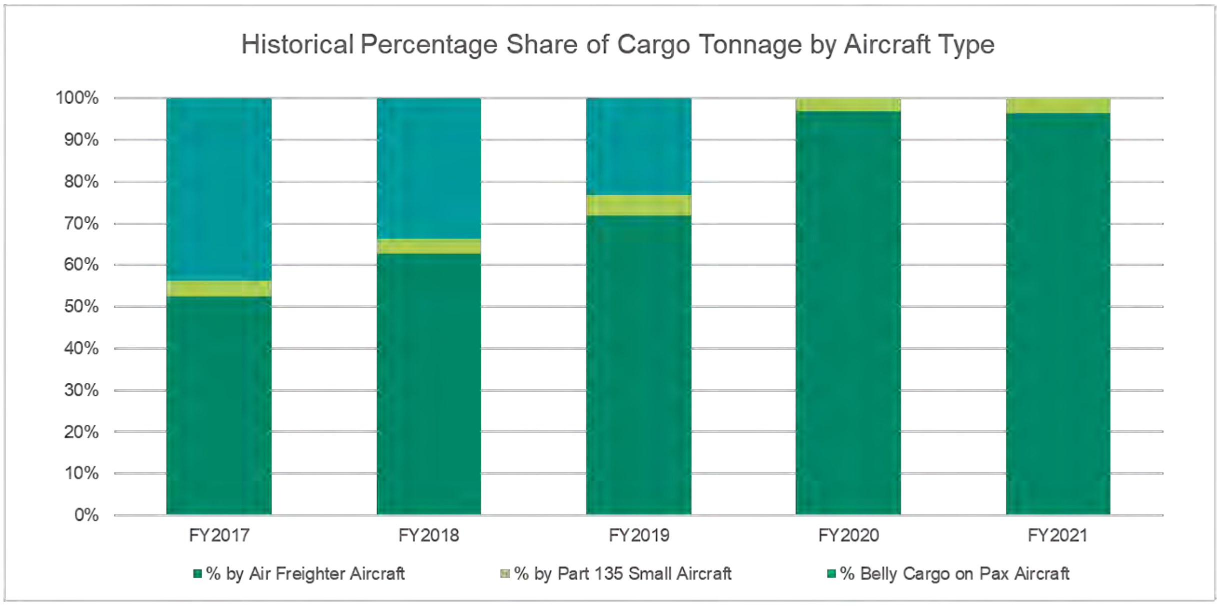

Figure 3-44. Historical Percentage Share of Cargo Tonnage by Aircraft Type

Sources:

1. *Cargo tonnage and operations – GIAA*
2. *Airport statistics from T-100 database – U.S. DOT BTS*
3. *Percentage share estimates – AECOM analysis*

able 3-12 summarizes the fleet mix by the top cargo carriers at the Airport. **Figure 3-** depicts the air freighter fleet mix by number of operations in 2018 through 2021. **Figure 3- 6** shows the small cargo aircraft fleet mix by Part 135 commuter air carriers.

APA retired its B727 fleet in 2020 and only flies B757-200s. UPS is gradually changing its fleet from the older B747-400F to the newer B747-8F aircraft. Fed x typically flies the McDonnell Douglas (MD) MD-11 to/from Guam. As discussed above, United Airlines and Korean Airlines provided regularly scheduled dedicated freighter service during the pandemic. United flies mostly the B777-300 R , B787-9, and B737-800 for cargo delivery. Korean Airlines flies mostly the A330 and B787-9.

The most common small aircraft model used for cargo delivery at the Airport is the Cessna (C) C208 Caravan in MACS's fleet, followed by the Piper PA-32 and PA-31 operated by Star Marianas.

able 3-12 istorical Regular Cargo Aircraft Fleet Mix at the Airport

op Integrated/All-Cargo/Combination Carriers	Fleet [B]	Maximum Payload Cargo Capacity, if available [C]
APA	B757-200 Freighter	79,000 lbs
	B727 Freighter (Retired)	53,000 lbs
UPS	B747-400 Freighter	273,000 lbs
	B747-8 Freighter	292,400 lbs
FedEx	MD-11 Freighter	180,000 lbs
United Cargo	B777-300 R	154,000 lbs (Cargo capacity 153,040 lbs)
	B787-9	116,000 lbs (Cargo capacity 104,460 lbs)
	B737-800	20,200 lbs (Cargo capacity 15,580 lbs)
Korean Cargo	A330-200 or 300	100,500 to 151,000 lbs
	B787-9	116,000 lbs
Polar Cargo	B767-300 Freighter	120,000 lbs
Part 13 Commuter Carriers	**Fleet**	**Maximum Payload**
MACS	Cessna C208 Caravan (C208)	2,800 lbs
	Cessna C208 X Grand Caravan (C208 X)	3,200 lbs
	mbraer MB110 (MB110)	3,400 lbs
Star Marianas	Piper PA-31-350 Navajo Chieftain (PA31)	2,500 lbs
	Piper PA-32 Cherokee Six (PA32)	1,500 lbs
Arctic Air	Britten-Norman BN-2 Islander (BNT2)	2,000 lbs

Notes:
APA = Asia Pacific Airlines
UPS = United Parcel Service
MACS = Micronesian Air Cargo Services
lbs = pounds
Only fleet with over 10 departures in the past 5 years are included.
Maximum payloads are approximate estimates from similar aircraft models or from carriers' website.
Sources:
Aircraft operations statistics – FAA Air Traffic Activity Data System (ATADS)
YOY and CAGR calculations – AECOM analysis

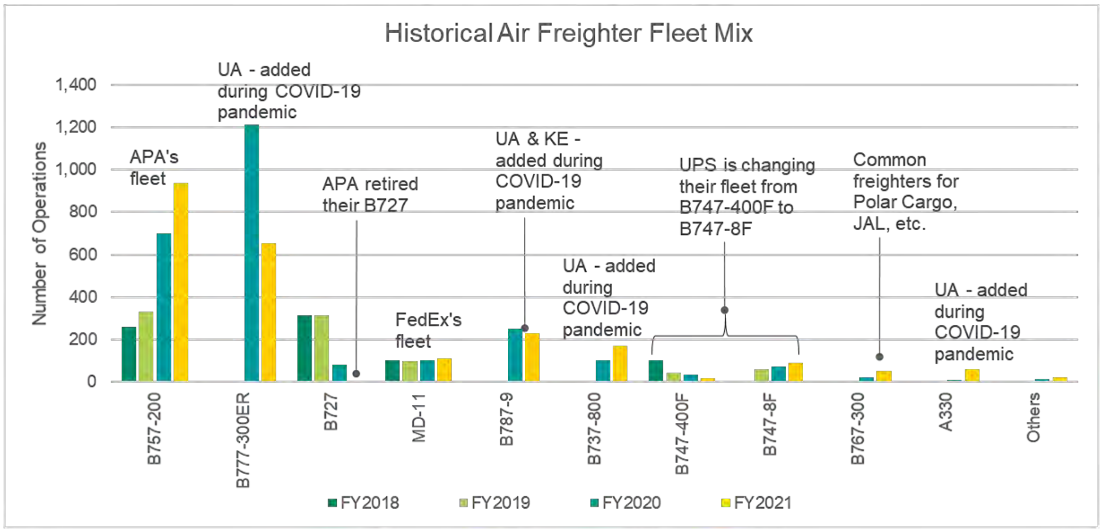

Figure 3-45. Historical Air Freighter Fleet Mix

Source: Cargo aircraft operations – GIAA

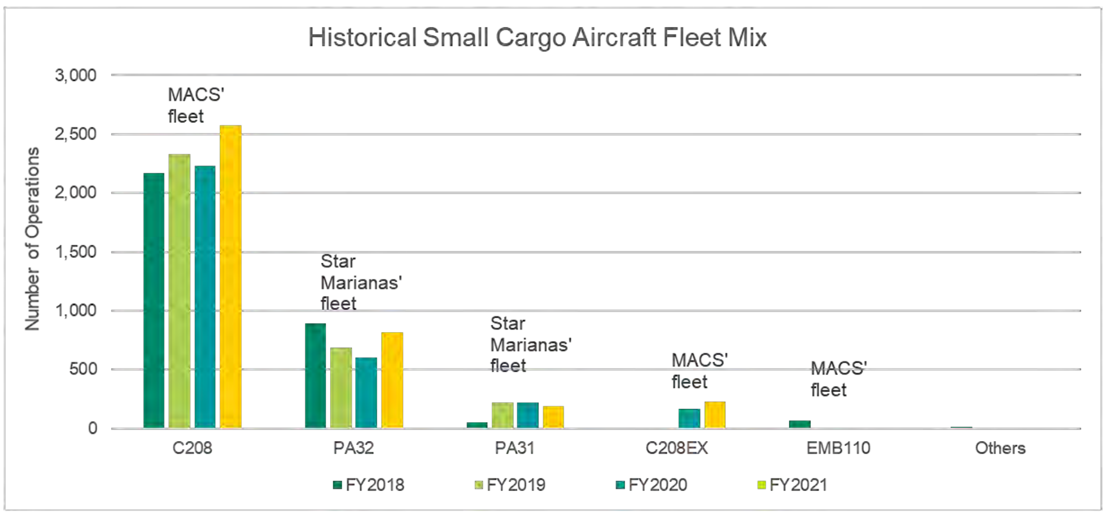

Figure 3-46. Historical Small Cargo Aircraft Fleet Mix

Source: Cargo aircraft operations – GIAA

3.5.7 Aircraft Operations

Figure 3- and **able 3-13** present the historical aircraft operations at the Airport for the period from 2005 through 2021. Historical total aircraft operations data are based on the FAA Air Traffic Activity Data System (ATADS). During this period, total operations peaked at over 76,000 in 2017 and just below 73,000 in 2019 before the COVID-19 pandemic.

The trend of historical aircraft operations is similar to enplanements and generally follows historical events and the economy as discussed in previous **Section 3 2**.

After the economic downturn ended in mid-2009, total enplanements increased at 3.7 percent per annum from 2009 to 2019 and 2.2 percent per annum from 2014 to 2019; total operations increased at a slower rate of 2 percent and 0.7 percent per annum during the same period, respectively. This is consistent with an industry-wide trend, with airlines generally increasing aircraft size (i.e., upgauging), flying less frequently, and resulting in higher load factors.

able 3-1 summarizes the historical aircraft operations by type of operations based on cargo statistics from both GIAA and FAA ATADS. The operations from air carrier (passenger and cargo), air taxi, GA, and military aircraft follow the FAA ATADS. The split between passenger air carrier and cargo carrier operations is based on GIAA cargo statistics.

Cargo aircraft operations increased significantly during the COVID-19 pandemic. Cargo aircraft operations increased by over 200 percent from 2019 to 2020, while passenger aircraft operations was reduced by 47 percent. A similar trend happened globally as air cargo demands were driven by urgent delivery of PP , medical supplies, and booming e-commerce.

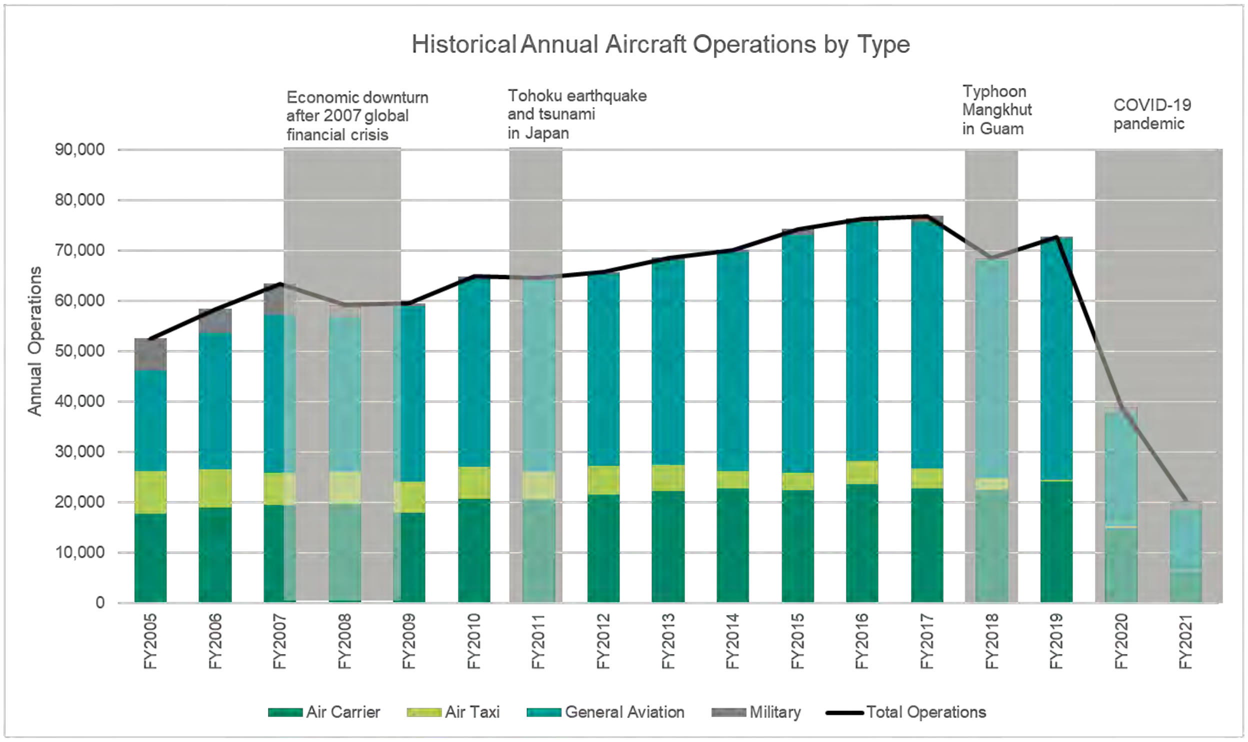

Figure 3-47. Historical Annual Aircraft Operations by Type

Source: Aircraft operations statistics – FAA ATADS

able 3-13 istorical Annual Aircraft Operations

Fiscal Year	Aircraft Operations	YOY % Change
2005	52,549	N/A
2006	58,411	11.2%
2007	63,328	8.4%
2008	59,135	-6.6%
2009	59,525	0.7%
2010	64,855	9.0%
2011	64,492	-0.6%
2012	65,708	1.9%
2013	68,547	4.3%
2014	70,108	2.3%
2015	74,214	5.9%
2016	76,253	2.7%
2017	76,777	0.7%
2018	68,476	-10.8%
2019	72,699	6.2%
2020	38,907	-46.5%
2021	20,363	-47.7%

Period	CAGR	
2005 to 2019 (14-year)	2.3%	
2009 to 2019 (10-year)	2.0%	
2014 to 2019 (5-year)	0.7%	

Notes:
N/A = Not available
CAGR = Compound annual growth rate
YOY = Year-over-year
Sources:
Aircraft operations statistics – FAA ATADS
YOY and CAGR calculations – AECOM analysis

able 3-1 istorical Annual Aircraft Operations by ype

Fiscal Year	Air Carrier		otal Air Carrier	Air axi	General Aviation	Military	otal Operations
	Passenger Aircraft	Freighter Cargo Aircraft					
2018	21,555	781	22,336	2,519	43,236	385	68,476
2019	23,289	849	24,138	370	47,777	414	72,699
2020	12,197	2,602	14,799	575	22,171	1,362	38,907
2021	3,988	2,345	6,333	197	11,906	1,927	20,363

Note: Skydive Guam (Mac-Cargo) and Star Marianas operate small turbine or piston aircraft for cargo delivery to/from the Airport. These operations are categorized under air taxi/GA instead of air carrier under the FAA ATADS. Hence, the number of freighter (cargo aircraft) operations in ***Table 3-14*** *exclude cargo operations by Skydive Guam (Mac-Cargo) and Star Marianas.*
Sources:
Aircraft operations statistics – FAA ATADS
Cargo aircraft statistics – GIAA
Breakdown of air carrier operations of cargo aircraft statistics from calendar year to fiscal year – AECOM analysis

3.5.8 Based Aircraft

Historical based aircraft records were obtained from the FAA Terminal Area Forecast (TAF) (2022 model, released in February 2023), and Form 5010-1 (April 2022). **able 3-1** and **Figure 3-** provide information on aircraft based at the Airport since 2005, including the number of single-engine, multi-engine, jet, and helicopter aircraft.

The number of based aircraft has decreased from the peak of 83 before and during the 2007/2008 economic downturn to 37 in 2021. Most of the decline occurred in the multi-engine and jet categories. The number of single-engine aircraft dropped after the economic downturn, but it has returned to an upward trend since 2017/2018.

While COVID-19 has had an overall negative impact on the aviation industry, general aviation was not as severely impacted as commercial passenger airlines. There are indications nationwide that charter activity, recreational flying, and flight training are returning to pre-COVID-19 levels. A new flight school, Aire Services, started service in April 2021. The upward trend in the number of single-engine based aircraft is indicative of increased demand for flight training and recreational flying.

able 3-1 istorical Based Aircraft by ype

	Number of Based Aircraft					Percentage of otal Based Aircraft			
Fiscal Year	**Single**	**Multi**	**Jet**	**elicopters**	**otal**	**Single**	**Multi**	**Jet**	**elicopters**
2005	10	16	32	1	59	16.9%	27.1%	54.2%	1.7%
2006	18	8	47	1	74	24.3%	10.8%	63.5%	1.4%
2007	20	10	52	1	83	24.1%	12.0%	62.7%	1.2%
2008	20	10	52	1	83	24.1%	12.0%	62.7%	1.2%
2009	20	10	52	1	83	24.1%	12.0%	62.7%	1.2%
2010	20	10	52	1	83	24.1%	12.0%	62.7%	1.2%
2011	19	13	24	1	57	33.3%	22.8%	42.1%	1.8%
2012	12	9	21	0	42	28.6%	21.4%	50.0%	0.0%
2013	13	9	16	0	38	34.2%	23.7%	42.1%	0.0%
2014	21	7	15	0	43	48.8%	16.3%	34.9%	0.0%
2015	15	2	16	0	33	45.5%	6.1%	48.5%	0.0%
2016	14	8	16	0	38	36.8%	21.1%	42.1%	0.0%
2017	19	6	15	0	40	47.5%	15.0%	37.5%	0.0%
2018	18	5	12	0	35	51.4%	14.3%	34.3%	0.0%
2019	22	4	10	0	36	61.1%	11.1%	27.8%	0.0%
2020	22	4	10	0	36	61.1%	11.1%	27.8%	0.0%
2021	23	4	10	0	37	62.2%	10.8%	27.0%	0.0%
Period	**CAGR**								
2005 to 2019 (14-year)	5.8%	-9.4%	-8.0%	N/A	-3.5%				
2009 to 2019 (10-year)	1.0%	-8.8%	- 15.2%	N/A	-8.0%				
2014 to 2019 (5-year)	0.9%	-10.6%	-7.8%	N/A	-3.5%				

Notes:
N/A = Not available
CAGR = Compound annual growth rate
Sources:
Based aircraft by type – FAA TAF 2022 (February 2023)
Form 5010-1 (April 2022)
Percentage share by type and CAGR calculations – AECOM analysis

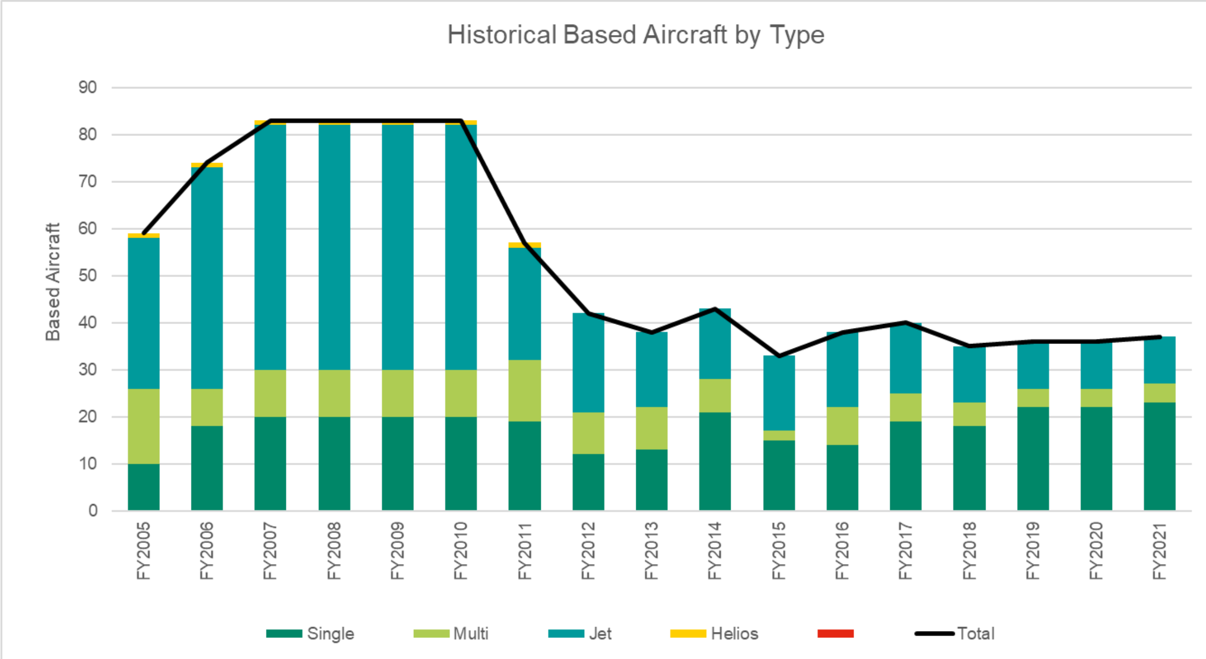

Figure 3-48. Historical Based Aircraft by Type

Sources:

1. *Based aircraft by type – FAA TAF*
2. *2022 model released in February 2023. Form 5010-1 (April 2022)*

3.6 Aviation Demand Forecasts

Forecasts of aviation demand were developed for the following categories:

- n planed passengers
  - Domestic enplaned passengers
  - International enplaned passengers
- Air cargo
  - Cargo tonnage by air freighter aircraft
  - Cargo tonnage by small cargo aircraft
  - Cargo tonnage by passenger aircraft (lower deck, i.e., belly cargo)
- Aircraft operations
  - Air carrier (commercial passenger aircraft operations)
  - Air carrier (all-cargo aircraft operations)
  - Air taxi and GA operations
  - Military aircraft operations
  - Breakdowns between itinerant and local operations
- Based aircraft

a ch forecast includes expected demand for the 20-year planning horizon (2019 to 2039) grouped into 5-year periods and uses actual 2019 (pre-COVID-19-pandemic) statistics as the baseline.

The overall forecast approach is illustrated in **Figure 3- 9** . n planements and air cargo demands are first developed by analyzing key socioeconomic drivers, historical trends, and industry outlook. Adjustments are made for the short-term forecast in response to the impact of the COVID-19 pandemic. Using the enplanement and air cargo forecasts, projections for aircraft operations are derived based on assumptions for aircraft fleet mix, enplanement load factors, average seats per departure, share of cargo on different cargo carriers, and cargo volume per operation. Further explanations are given in subsequent paragraphs.

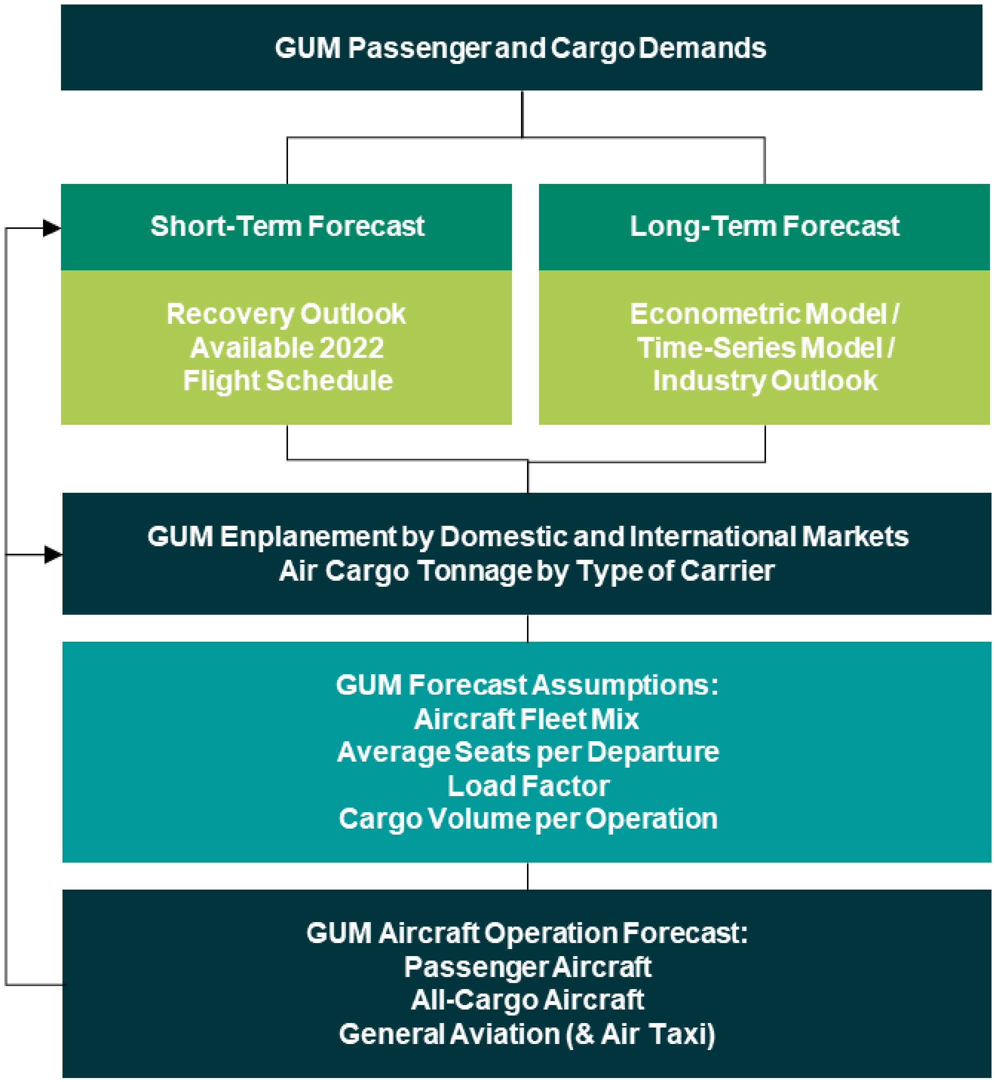

Figure 3-49. Overall Forecast Approach

Source: AECOM

3.6.1 Enplaned Passengers Forecast

As discussed in **Section 3 3**, the COVID-19 pandemic had significant impacts on air travel. Like many other airports around the world, the Airport experienced an unprecedented drop in passenger levels in April 2020. While a recovery is genuinely expected, the key question is when the aviation demands will return to pre-COVID-19 level.

Unlike previous experience in recovering from crises, international travel has been much slower to recover than domestic travel. Travel restrictions and quarantine requirements for travels to and from different countries discourage international travels. Although leisure and VFR (Visiting Friends and Relatives) travel has recovered faster than business travel, and leisure travelers have demonstrated a preference for outdoor-oriented leisure destinations in small and less dense cities to stay isolated while on vacation, most of the visitors to Guam are international travelers. The passenger traffic recovery at the Airport is still not as fast as other leisure destination airports. In addition, the primary markets for Guam's tourism are in the Asia-Pacific, which is the slowest region to remove international travel restrictions.

Airlines have responded to the decrease in passenger demands by reducing capacity through retirement of older aircraft, postponing the delivery of new aircraft orders, and grounding or storing larger aircraft. Airlines have also reduced their workforce by creating incentives for voluntary retirement and extended leave. As air travel demands began to return, airlines have gradually restored capacity and deployed flights to match demand.

Unlike the experience following the Great Recession, this time households have emerged, on average, with relatively healthy finances from the deep but brief recession induced by the economic lock-down and stay-at-home orders implemented to contain the spread of COVID-19. Pent-up demand for travel is backed up by capacity to spend.

The Russia-Ukraine conflict is ongoing, and the timeline and consequences for aviation are uncertain. Although it is expected to have some downside risks and impact on airline costs as a result of fluctuations in fuel prices or due to rerouting to avoid Russian airspace, the air transport industry is generally resilient against historical shocks. According to the International Air Transport Association (IATA), this Russian-Ukraine conflict is unlikely to impact the long-term growth of air transport.[52]

The forecast analysis consisted of two main elements: a short-term forecast, and a long-term forecast. The short-term forecast focuses on the coming 3 to 5 years and references the recovery outlook for the post-COVID era from the industry and known factors such as local air service incentive programs from the GVB and GIAA. The long-term forecast projects the enplanement demands in the 20-year planning horizon based on macroscopic socioeconomic conditions and historical trends at the airport. Forecast development also acknowledges the elevated uncertainty in the development of the pandemic and the implications for the outlook for the aviation industry and the overall economy. A range of scenarios from a high (optimistic) scenario, to baseline (moderate), to a low (pessimistic) scenario were considered. Because domestic and international demands have been recovering at different paces, forecasts for the two traffic segments were developed separately in the forecast models and then added to arrive at the total enplanement forecasts.

3.6.1.1 Short- erm Enplanement Forecast

The following factors were considered in developing the short-term enplanement forecast:

- Short-term forecast development considered the progress made so far in traffic recovery and what the latest airline flight schedules (early 2022) indicate the enplanement level may be for 2022.
- The near-term recovery trend considered current development in aviation industry, the business environment, trends in COVID-19 infection and vaccination rates, various travel sentiment surveys, and travel restrictions, especially for international travel.
- Recovery trends based on the TSA checkpoint screening throughput indicate strong domestic recovery, especially after the vaccine was available in the U.S. Total traveler throughput in April 2022 has already returned to 90 percent of the throughput in April 2019.
- Travel sentiment surveys conducted by different agencies indicate the travel industry is gradually moving forward. Comparison between 2020 and 2022 surveys shows an increase in confidence to travel again. The younger generation such as the millennials and generation Z[53] passengers are more eager to return to travel and they are also slightly less concerned about catching the coronavirus while traveling. When the vaccine is available for children and teens, more families are willing to travel again.[54]
- IATA's long-term forecast released in March 2022 includes the following highlights:[55]
  - Overall traveler numbers are expected to improve to 94 percent of 2019 levels in 2023, and 103 percent in 2024.
  - International traveler numbers are expected to improve to 82 percent of 2019 levels in 2023, 92 percent in 2024, and 101 percent in 2025.

[52] IATA, Press Release No. 10, Air Passenger Numbers to Recover in 2024, March 2022.
[53] Millennials, also known as generation Y, were born between the early 1980s and mid-1990s. Generation Z refers to the generational cohort following millennials, born between the late 1990s and early 2010s.
[54] Travel sentiment surveys from OAG, PwC, Indagare, and Oliver Wyman.
[55] IATA, Press Release No. 10, Air Passenger Numbers to Recover in 2024, March 2022.

- Domestic traveler numbers are expected to improve to 93 percent of 2019 levels in 2022, and 103 percent in 2023.
- Asia-Pacific: The slow removal of international travel restrictions, and the likelihood of renewed domestic restrictions during COVID outbreaks, are likely to slow down the recovery in traffic to/from/within Asia-Pacific, the weakest outcome of the main regions in IATA's analysis. The 2019 levels are expected to be recovered in 2025 due to slower growth on international traffic in the region.
- North America: After a resilient 2021, traffic to/from/within North America will continue to perform strongly as the U.S. domestic market returns to pre-crisis trends, and with ongoing improvements in international travel. In 2022, passenger numbers are expected to reach 94 percent of 2019 levels, and full recovery is expected in 2023, ahead of other regions.

- Boeing's Commercial Market Outlook 2021–2040 include the following highlights:
  - Global GDP is forecast to return to pre-crisis level by mid-decade (2025).
  - Domestic markets and short-haul networks will lead the recovery. Domestic traffic is expected to return to 2019 levels in 2022.
  - International and long-haul markets are projected to return to 2019 levels in 2024 globally.
  - Traffic flow to/from Asia-Pacific and North America is expected to grow at an average annual rate of 3.5 percent from 2019 through 2040.
- FAA's Aerospace Forecast FY2021–2041 includes the following outlook:
  - Domestic U.S. mainline carriers' enplanement growth is forecast to recover strong in 2022 and 2023 and return to 2019 levels in early 2024. With the recovery complete, domestic enplanements will resume growth driven by economic fundamentals and average 2.3 percent over the remaining forecast period.
  - International U.S. mainline carriers' enplanement forecasts follow a similar path with strong growth early in the recovery and then slowing as enplanements return to 2019 levels in 2025. From then through 2041, international mainline enplanements are expected to grow at an average rate of 3.3 percent.
  - The Pacific region has had relative success in controlling COVID-19 transmission. Travel restrictions will be slow to lift. Although the region is forecast to have the strongest economic growth of any region over the next 20 years, led by China, enplanements growth over the forecast period are restrained in part because U.S. carriers continue to have most of their service in the region to Japan as opposed to faster-growing countries. Total passengers (including both U.S. and Foreign Flag carriers) in the Pacific region are projected to have a relatively slow return to 2019 passenger levels in 2027.
- Air service incentive programs from the GVB and GIAA will facilitate the recovery in the near-term.

For the Airport's short-term enplanement forecasts, domestic enplanements are expected to return to 2019 levels later in 2022 for the optimistic scenario, in 2023 for the moderate scenario, and in 2024 for the pessimistic scenario.

The majority of the international markets are impacted by the economic activity of Japan and Korea. The sluggish Japanese economic growth with aging population and the slow lifting in travel requirements such as quarantine and testing requirements in many Asian countries deter the recovery in Guam as compared to other global international markets. Hence, the Airport's international enplanements are expected to return to 2019 levels around 2026 for the optimistic scenario and 2028 for the moderate scenario. The timeline for the recovery of the pessimistic scenario for international enplanements is beyond the short-term forecast period and is driven by the long-term econometric model discussed in **Section 3 6 1 2**.

The recovery of total enplanements was projected by combining the outcome from the long-term forecast analyses and adjusting for the short-term recovery forecasts for domestic and international markets. Total enplanements are expected to reach over 1.8 million (2019 levels) around 2026 in the optimistic scenario, 2028 in the moderate scenario, and 2030 in the pessimistic scenario. The outcome is also summarized in the recommended enplanement forecast given in **Section 3 6 1 3**.

3.6.1.2 ong- erm Enplanement Forecast

The long-term forecast projects the enplanement demands in the 20-year planning horizon based on key socioeconomic forecasts and historical trends at the Airport. The projections for the international enplanements are focused on the ability of the primary international markets' socioeconomic base to generate increasing passenger demands in the long-term. The projections for the domestic enplanements considered the economy of U.S. and Guam.

3.6.1.2.1 Econometric Models

co nometric models using regression analysis were developed to project passenger demands in relation to socioeconomic factors, including GDP, per capita GDP, population, and jet fuel price as described in **Section 3 2**. The correlation may be single (pair-wise) or multiple correlations. Correlation analysis was first conducted to identify relevant independent variables for the regression models. Then the significance of the variables was tested to avoid multicollinearity. The following independent variables were used to develop the econometric models after testing for significance. The corresponding adjusted coefficients of determination (R2) for the econometric models are given in brackets. Dummy variables are included to consider unusual events, that do not correlate with underlying socioeconomic trends where applicable. The unusual events are descripted in **Section 3 2** and highlighted in **Figure 3-33**, which include economic downturns after the 2007 global financial crisis, Tohoku earthquake, typhoon Mangkhut and the COVID-19 pandemic. Autoregressive[56] variables are considered when there is a high tendency to correlate on historical trend.

- Domestic enplanements:
  - U.S. GDP (Adjusted R2 = 0.89)
  - U.S. and Guam GDP (Adjusted R2 = 0.85)
- International enplanements:
  - Japan and Korea per capita GDP (Adjusted R2 = 0.95)

The high adjusted coefficients of determination (over 0.85) signify a high percent of variation in the dependent variables (i.e., enplanements) that are explained by the independent variables (i.e., the socioeconomic parameters). **able 3-16** summarizes the forecast enplanements for the econometric models.

The forecast for U.S. GDP is based on the long-term economic outlook for the U.S. from the FAA Aerospace Forecast FY2021–2041 assumptions as described in **Section 3 2** . The average U.S. GDP annual growth rates assume 2.3 percent for the period through 2039 and is adopted for the high scenario. The growth in Guam is estimated to be slower than the U.S. and assumes an average annual growth rate of 1.8 percent, which is adopted for the low scenario.

The forecast for Japan and Korea per capita GDP is based on the population projections from the United Nations and the projected GDP from the FAA Aerospace Forecast FY2021–2041 and IMF assumptions as described in **Sections 3 2 1** and **3 2 2** for Japan and Korea, respectively. Since there has been a shift of Japan's market share to Korea in recent years, the projections also factored into the changes in relative weighting (i.e., significance) between these two markets. The high scenario assumes a slower loss in weighting for the Japanese market than the low scenario.

Adjustments were made to each of the econometric models considering the optimistic, moderate, and pessimistic recovery timelines as discussed in the last section for the short-term enplanement forecast. **able 3-16** summarizes the forecast enplanements for the econometric models.

3.6.1.2.2 ime-Series rend Model

A time-series model was also developed to analyze the historical trends and to project the future aviation demands based on current or past trends. Aviation demand is typically cyclical in response to changing economic conditions as discussed earlier in **Section 3 2**, thus, the historical period analysis considered

[56] Autoregressive (AR) is a stochastic process used in statistical models in which future values are estimated based on a weighted sum of past values, i.e., past values have an effect on current values.

the historical peaks and troughs. The time-series model was developed for the period from 2005 to 2020 and was used to estimate the long-term enplanements in 20 years.

Similar to the econometric models, adjustments were made to include the optimistic, moderate, and pessimistic recovery timelines for the short-term enplanement forecasts. **able 3-16** summarizes the forecast enplanements for the time-series model.

3.6.1.3 Recommended Enplanement Forecast

To account for the inherent uncertainty of aviation demand forecasting, a range of enplaned passenger forecasts was developed considering various socioeconomic and historical conditions. Together these forecast scenarios represent a reasonable range of potential demand. The outcomes of the short-term enplanement forecasts combined with the long-term forecasts from the econometric models and time-series model are summarized in **able 3-16** as the baseline (moderate), high (optimistic), and low (pessimistic) scenarios, each representing varying levels of enplaned passenger activity that may occur based on economic conditions and recovery pace. The consolidated scenarios are presented in **Figure 3-** and **able 3-1** .

Comparisons of the recommended baseline enplanement forecast with the FAA TAF, the enplanement forecast from the Report of the Airport Consultant (August 2022), and the 2012 Airport Master Plan Update Forecast are included in **Figure 3-** and **able 3-1** .

The FAA's TAF is prepared annually for each commercial service airport in the U.S. Variations from the FAA TAF, while expected due to local growth in demand, need to be reviewed and approved by the FAA. Forecasts are considered consistent with the FAA TAF if the variations are less than 10 percent within the 5-year forecast period, and less than 15 percent in the 10-year forecast period. The baseline enplanement forecast for this Master Plan Update differs from the latest FAA TAF (issued February 2023) by less than 15 percent in the 10-year planning horizon (1.1 percent). However, the difference is over 10 percent in the near-term 5-year planning horizon (46.2 percent).

The difference with the FAA TAF is because of the discrepancies in historical enplanements recorded by GIAA versus those reported in the FAA TAF. As shown in **able 3-1** , the historical enplanements in 2019 (base year) are 47.7 percent higher than the FAA TAF. The latest historical enplanements in 2022 is 418,234, which is also higher than the latest FAA TAF by 20 percent at 332,678.

The recommended baseline enplanement forecast in 5-year planning horizon (2024) projects approximately 68 percent recovery from 2019. The latest FAA TAF also projects 68 percent recovery by 2024, however, it is based on the lower historical enplanements at 1,276,443 instead of the record by GIAA at 1,885,108 enplanements. If the historical enplanements in the FAA TAF are updated to reflect the actual historical statistics from GIAA, the corresponding near-term forecasts from the FAA TAF are expected to increase proportionally and narrow the gap between the FAA TAF and this Master Plan Update forecast.

able 3-16 Enplanement Forecast Models

Fiscal Year	Econometric Models			ime-Series Models		
	Econometric Model, Optimistic Recovery	Econometric Model, Optimistic Recovery	Econometri c Model, Pessimistic Recovery	ime-Series from 2 to 2 2 , Optimistic Recovery	ime-Series from 2 to 2 2 , Moderate Recovery	ime-Series from 2 to 2 2 , Pessimistic Recovery
istorical						
2019 (Base Year)	1,885,108	1,885,108	1,885,108	1,885,108	1,885,108	1,885,108
2020	884,060	884,060	884,060	884,060	884,060	884,060
2021	135,566	135,566	135,566	135,566	135,566	135,566
Forecast						
2024	1,461,419	1,288,617	1,115,816	1,536,243	1,242,911	1,018,551
2029	2,086,980	1,957,224	1,827,467	2,132,702	1,984,577	1,788,103
2034	2,262,705	2,113,789	1,964,872	2,281,274	2,277,982	2,215,441
2039	2,475,820	2,312,858	2,149,896	2,429,846	2,429,846	2,429,846
Period	**CAGR**					
2019 to 2024 (5-year)	-5.0%	-7.3%	-10.0%	-4.0%	-8.0%	-11.6%
2019 to 2029 (10-year)	1.0%	0.4%	-0.3%	1.2%	0.5%	-0.5%
2019 to 2039 (20-year)	1.4%	1.0%	0.7%	1.3%	1.3%	1.3%

Notes:
CAGR = Compound annual growth rate
Sources:
Historical statistics – GIAA
Projections – AECOM analysis

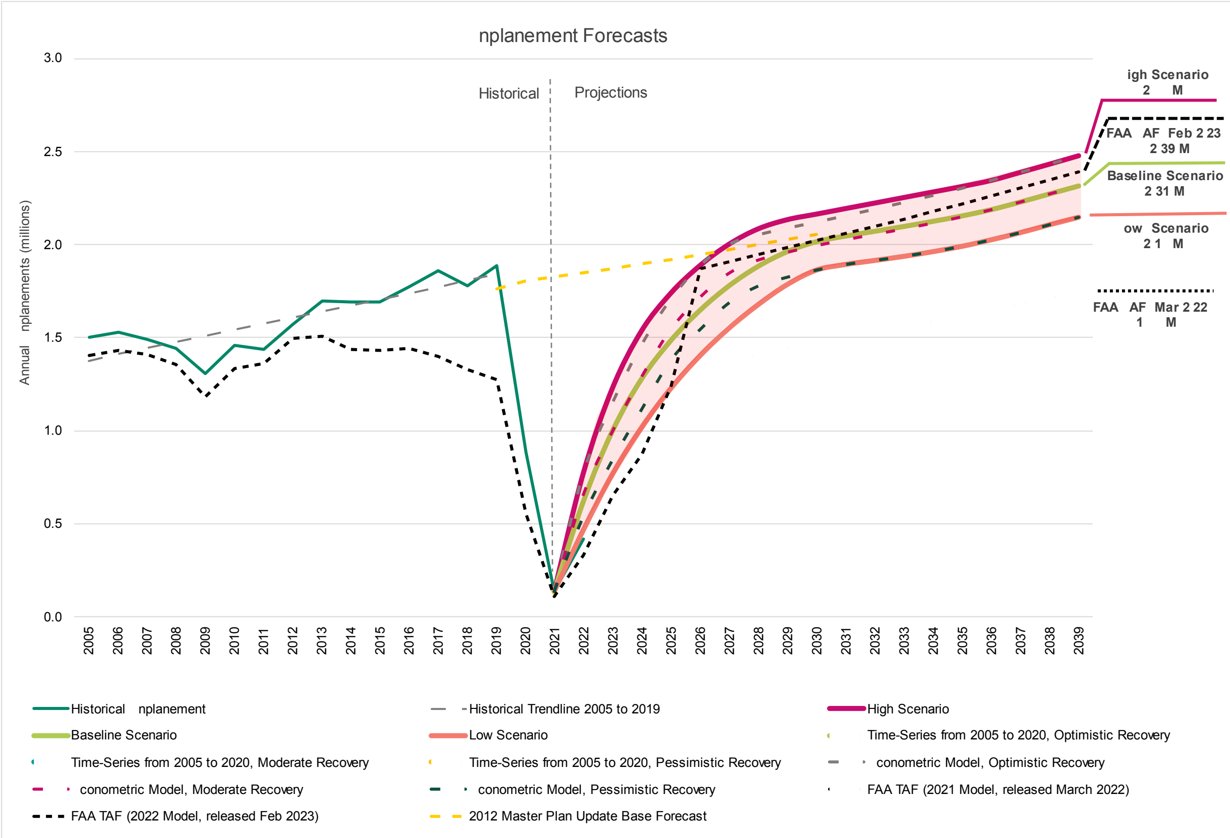

Figure 3-50. Enplanement Forecasts

Source: AECOM Analysis

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able 3-1 Enplanement Forecasts and Comparison with Other Forecasts

Fiscal Year	High Scenario	Baseline Scenario	Low Scenario	FAA TAF (2022 Model, released February 2023)	% Difference between Baseline and FAA TAF	FAA TAF (2021 Model, released March 2022)	% Difference between Baseline and FAA TAF	Report of the Airport Consultant - Low Range Enplanement Forecast by InterVISTAS (August 2022)	% Difference between Baseline and InterVISTAS' Low Range Forecast (August 2022)	Report of the Airport Consultant - High Range Enplanement Forecast by InterVISTAS (August 2022)	% Difference between Baseline and InterVISTAS' High Range Forecast (August 2022)	2012 Master Plan Update Base Forecast	% Difference between Baseline and 2012 Master Plan Update Base Forecast
	Historical			Historical		Historical		Historical/ Forecast		Historical/ Forecast		Forecast	
2019 (Base Year)	1,885,108	1,885,108	1,885,108	1,276,443	47.7%	1,276,443	47.7%	1,885,108	0.0%	1,885,108	0.0%	1,760,947	7.1%
2020	884,060	884,060	884,060	555,576	59.1%	555,576	59.1%	884,060	0.0%	884,060	0.0%	1,804,341	-51.0%
2021	135,566	135,566	135,566	101,779	33.2%	101,779	33.2%	135,566	0.0%	135,566	0.0%	1,827,052	-92.6%
	Forecast			Forecast		Forecast		Forecast		Forecast		Forecast	
2024	1,536,243	1,277,397	1,018,551	873,733	46.2%	1,269,750	0.6%	1,300,000	-1.7%	1,600,000	-20.2%	1,897,566	-32.7%
2029	2,132,702	1,960,402	1,788,103	1,982,619	-1.1%	1,443,446	35.8%	N/A	N/A	N/A	N/A	2,027,337	-3.3%
2034	2,281,274	2,123,073	1,964,872	2,178,600	-2.5%	1,591,016	33.4%	N/A	N/A	N/A	N/A	N/A	N/A
2039	2,475,820	2,312,858	2,149,896	2,391,019	-3.3%	1,738,251	33.1%	N/A	N/A	N/A	N/A	N/A	N/A
Period	CAGR			CAGR		CAGR		CAGR		CAGR		CAGR	
2019 to 2024 (5-year)	-4.0%	-7.5%	-11.6%	-7.3%		-0.1%		-5.8%		0.2%		1.5%	
2019 to 2029 (10-year)	1.2%	0.4%	-0.5%	4.5%		1.2%		N/A		N/A		1.4%	
2019 to 2039 (20-year)	1.4%	1.0%	0.7%	3.2%		1.6%		N/A		N/A		N/A	

Notes:
FAA = Federal Aviation Administration
TAF = Terminal Area Forecast
N/A = Not available
CAGR = Compound annual growth rate
Sources:
FAA TAF (March 2022 and February 2023)
2012 Airport Master Plan Update Forecast
Report of the Airport Consultant by InterVISTAS (August 2022)
AECOM analysis

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3.6.1.4 Domestic and International Enplanement Forecasts

The domestic and international enplanement forecasts for the three scenarios are summarized in **able 3-1** . The average annual growth rates for domestic enplanements outpace international enplanements, which is consistent with the historical trend on growth of domestic visitors described in **Section 3 2 1.** The long-term growth in the U.S. population and GDP will continue to drive the strong domestic demands.

able 3-1 Domestic and International Enplanement Forecasts

Fiscal Year	igh Scenario		Baseline Scenario		ow Scenario	
	Domestic Enplanements	International Enplanements	Domestic Enplanements	International Enplanements	Domestic Enplanements	International Enplanements
istorical						
2019 (Base Year)	109,693	1,775,415	109,693	1,775,415	109,693	1,775,415
2020	63,417	820,643	63,417	820,643	63,417	820,643
2021	67,948	67,618	67,948	67,618	67,948	67,618
Forecast						
2024	150,688	1,385,555	128,830	1,148,567	106,413	912,137
2029	195,499	1,937,203	182,129	1,778,273	168,647	1,619,455
2034	233,522	2,047,751	216,413	1,906,660	199,313	1,765,560
2039	271,989	2,203,831	249,040	2,063,818	226,091	1,923,805
Period	**CAGR**					
2019 to 2024 (5-year)	6.6%	-4.8%	3.3%	-8.3%	-0.6%	-12.5%
2019 to 2029 (10-year)	5.9%	0.9%	5.2%	0.0%	4.4%	-0.9%
2019 to 2039 (20-year)	4.6%	1.1%	4.2%	0.8%	3.7%	0.4%

Note:
CAGR – Compound annual growth rate
Source:
Historical statistics – GIAA
Projections – AECOM analysis

3.6.1.5 Mainline and Regional Enplanement Forecast

Mainline carriers (air carriers) are defined as those providing service via aircraft with 90 or more seats. Regionals are defined as those providing service via aircraft with 89 or fewer seats and whose routes serve mainly as feeders to the mainline carriers. n planement forecasts are divided into passengers traveling with mainline or regional carriers for the calculation of passenger aircraft operations based on different seat capacities.

In addition, breakdowns into mainline and regional enplanements and aircraft operations are required for the FAA's standard summary table for the approval of the forecast in the event there is any inconsistency with the FAA TAF.

As described in **Section 3** , none of the U.S. or foreign air carriers operate regional jets at the Airport. Only Part 135 commuter air carriers such as Star Marianas Air operate short-range 8-seat Piper PA-31 for inter-island connections between Guam and Rota (or Saipan) in CNMI. The operations for Part 135 commuter air carriers are included in the general aviation/air taxi category instead of air carriers.

In summary, the total enplanements given in **able 3-1** are classified as passengers for mainline carriers for the calculation of mainline aircraft operations.

3.6.2 Air Cargo Forecast

The objective of the air cargo forecast is to provide a reasonable order of magnitude projection of cargo activity that can be expected to occur over the 20-year planning horizon. Due to the cyclical nature of the economy, the focus of the forecasts is not to predict year-to-year fluctuations, but to establish a trend that represents long-term growth potential. The air cargo industry is undergoing some transformations, as carriers adjust operations, and new carriers expand their distribution networks in the growing e-commerce marketplace. The Airport experienced similar fluctuations in air cargo demand in the past as discussed in **Section 3 6**. Nevertheless, the air cargo throughput is expected to grow with the economy in the long-term.

Various air cargo growth forecasts were analyzed to identify a reasonable expectation for air cargo volume in the future:

- Time-Series Models: Two time-series models were developed for the cargo forecast. The first one is based on the FAA's all-cargo aircraft landing weight from 2009 to 2020 and applied a similar historical trend to project the total air cargo tonnage at the Airport. The second time series model is based on the recent available historical total air cargo tonnage from GIAA for the period between 2017 and 2020. Dummy variables were adopted in both models to deter the impacts of the COVID-19 pandemic in 2020. The adjusted R^2 for the time-series models were 0.98 and 0.96, respectively.
- The FAA Aerospace Forecast FY2021–2041: The FAA projects the U.S. air cargo revenue ton miles (RTMs) for the Pacific region to increase at 8.6 percent from 2020 to 2021, at an average annual rate of 4.7 percent for the 10-year period from 2021 to 2031, and at 4 percent for the 20-year period from 2021 to 2041. This model references the projected year-to-year growth rate from the FAA Aerospace Forecast for the Pacific region.
- Boeing's World Air Cargo Forecast 2020–2039: Boeing biannually develops a detailed analysis and forecast on the air cargo industry for worldwide regions and markets. The latest forecast includes high, base, and low cases from 2020 to 2039. The high, base, and low cases forecast the air cargo tonnage on the trans-Pacific route between North America and a st Asia to grow at an average annual rate of 5.2 percent, 4.3 percent, and 3.4 percent over the 20-year period from 2020 to 2039, respectively. Three growth models were developed referencing Boeing's World Air Cargo Forecast 20-year growth rates for the air trade across the Pacific for the high, base, and low cases.

able 3-19 summarizes the air cargo forecasts for these six models, which are then consolidated to the baseline, high (optimistic), and low (pessimistic) scenarios representing varying levels of air cargo throughput estimates for the 20-year planning horizon. The consolidated scenarios are presented in **able 3-2** and **Figure 3- 1** .

A comparison between the air cargo forecast and the projections from the 2012 Master Plan Update is also included in **able 3-2** and **Figure 3- 1** . The 2012 Master Plan Update air cargo forecast is within the range of our projections in the long-term.

For the purpose of estimating cargo aircraft operations in the next section, the air cargo volumes carried by air freighter aircraft, small cargo aircraft under Part 135 commuter air carriers, or the lower deck of passenger aircraft (i.e., belly cargo) are estimated in **able 3-21**.

able 3-19 Air Cargo Forecast Models

Fiscal Year	ime-Series Models		Industry References			
	ime-Series Model on FAA's GUM All-Cargo anding Weight 2 9 to 2 2 tons	ime-Series Model on GUM Cargo onnage 2 1 to 2 2 tons	FAA Aerospace Forecast tons	Boeing's igh Case tons	Boeing's Base Case tons	Boeing's ow Case tons
istorical						
2019 (Base Year)	21,724	21,724	21,724	21,724	21,724	21,724
2020	34,147	34,147	34,147	34,147	34,147	34,147
2021	42,704	42,704	42,704	42,704	42,704	42,704
Forecast						
2024	26,944	21,724	44,010	27,991	26,814	25,676
2029	34,652	23,762	54,633	36,065	33,096	30,349
2034	42,360	25,992	65,533	46,470	40,850	35,871
2039	50,068	28,431	77,106	59,875	50,422	42,398
Period	**CAGR**					
2019 to 2024 (5-year)	4.4%	0.0%	15.2%	5.2%	4.3%	3.4%
2019 to 2029 (10-year)	4.8%	0.9%	9.7%	5.2%	4.3%	3.4%
2019 to 2039 (20-year)	4.3%	1.4%	6.5%	5.2%	4.3%	3.4%

Note:
CAGR = Compound annual growth rate
Source: AECOM analysis

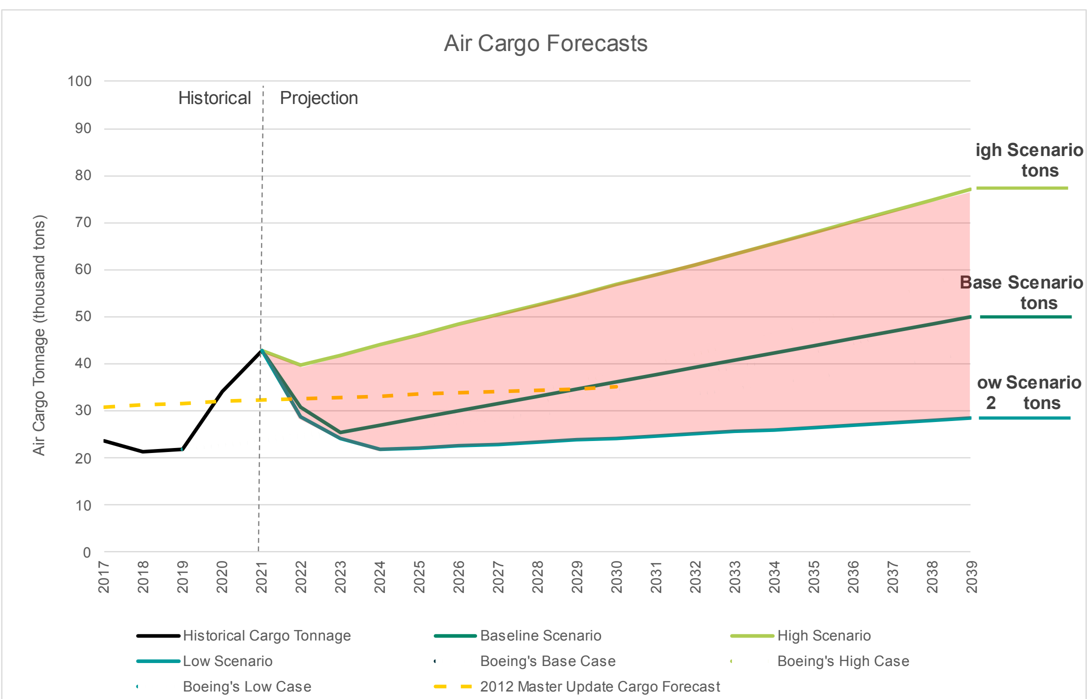

Figure 3-51. Air Cargo Forecasts

Source: AECOM Analysis

able 3-2 Air Cargo Forecasts and Comparison with Previous Master Plan Forecasts

Fiscal Year	High Scenario (tons)	Baseline Scenario (tons)	Low Scenario (tons)	2012 Master Plan Update Forecast (tons)	% Difference between Baseline and 2012 Master Plan Update Base Forecast
	Historical			**Forecast**	
2019 (Base Year)	21,724	21,724	21,724	31,644	-31.3%
2020	34,147	34,147	34,147	31,977	6.8%
2021	42,704	42,704	42,704	32,268	32.3%
	Forecast			**Forecast**	
2024	44,010	26,944	21,724	33,158	-18.7%
2029	54,633	34,652	23,762	34,714	-0.2%
2034	65,533	42,360	25,992	N/A	N/A
2039	77,106	50,068	28,431	N/A	N/A
Period	**CAGR**			**CAGR**	
2019 to 2024 (5-year)	15.2%	4.4%	0.0%	0.9%	N/A
2019 to 2029 (10-year)	9.7%	4.8%	0.9%	0.9%	N/A
2019 to 2039 (20-year)	6.5%	4.3%	1.4%	N/A	N/A

Note:
CAGR = Compound annual growth rate
Source:
2012 Airport Master Plan Update Forecast
AECOM analysis

able 3-21 Air Cargo Forecasts by ype of Carrier

Fiscal Year	High Scenario			Baseline Scenario			Low Scenario		
	Air Freighter Aircraft (tons)	Small Cargo Aircraft (tons)	Belly Cargo on Pax Aircraft (tons)	Air Freighter Aircraft (tons)	Small Cargo Aircraft (tons)	Belly Cargo on Pax Aircraft (tons)	Air Freighter Aircraft (tons)	Small Cargo Aircraft (tons)	Belly Cargo on Pax Aircraft (tons)
Estimate from Historical									
2019 (Base Year)	15,249	1,098	5,377	15,249	1,098	5,377	15,249	1,098	5,377
Forecast									
2024	31,247	2,200	10,562	18,995	1,212	6,736	15,207	869	5,648
2029	38,789	2,732	13,112	24,430	1,559	8,663	16,634	950	6,178
2034	46,528	3,277	15,728	29,864	1,906	10,590	18,194	1,040	6,758
2039	54,746	3,855	18,506	35,298	2,253	12,517	19,902	1,137	7,392
Period	**CAGR**								
2019 to 2024 (5-year)	15.4%	14.9%	14.5%	4.5%	2.0%	4.6%	-0.1%	-4.6%	1.0%
2019 to 2029 (10-year)	9.8%	9.5%	9.3%	4.8%	3.6%	4.9%	0.9%	-1.4%	1.4%
2019 to 2039 (20-year)	6.6%	6.5%	6.4%	4.3%	3.7%	4.3%	1.3%	0.2%	1.6%

Note:
CAGR = Compound annual growth rate
Pax = Passenger
Source: AECOM analysis

3.6.3 Aircraft Operations Forecast

Aircraft operations were projected for the four major categories of users: commercial passenger airlines, commercial all-cargo carriers, GA, and military.

Commercial air carrier operations include those certified under Federal Aviation Regulations (FAR) Part 121 or 129 to conduct scheduled services on specific routes. Commercial air carrier operations typically include the activities by both mainline aircraft and regional jets. However, in the case of Guam, there are only mainline aircraft operations as discussed in **Section 3** .

Passengers and/or cargo commuter air carriers like Star Marianas, Arctic Circle Air, and MACS, who operate scheduled and/or on-demand services under Part 135 certification are included as GA/air taxi operations. The fleet of Part 135 carriers typically consists of small aircraft with a maximum seating configuration of 30 seats for on-demand certificate holders or nine seats for commuter certificate holders.

Air taxi operators typically hold Part 135 certification and provide on-demand services for compensation or hire. The air taxi operations were analyzed together with the GA activities. The approach and methodologies are detailed in the following sections.

3.6.3.1 Commercial Airline Operations

Commercial airline operations were estimated utilizing the enplaned passenger forecasts for this Master Plan Update. The projected number of commercial operations was determined by evaluating three main factors: total passengers, average aircraft size (seat capacity), and average load factor. The number of operations was derived by total passengers divided by the multiple of average seat capacity and average load factor. Total passengers include both enplaned and deplaned passengers.

Passenger aircraft operations were further divided into domestic and international air carrier operations based on the forecast enplanements for each group as well as differences in average aircraft size (seat capacity) and average load factor.

The aircraft sizes (seat capacity) for the fleet mix are grouped into categories, and their future trends are described in **able 3-22**. The future trends reference industry trends, the age of the existing fleet for the major airlines, and their outstanding orders for new aircraft. The average retirement age for commercial passenger aircraft is assumed to be 25 years.

The historical average seat capacity for domestic and international markets were first estimated (**Section 3**), and then projected to the future for the high, baseline, and low scenarios. Historical average load factors for domestic and international markets (**Section 3 3**) were also referenced for the projection of future load factors. Airlines are expected to gradually increase the average seat capacity by either increasing the size of aircraft and/or updating the seating configurations for both new and existing aircraft. Load factors are also expected to increase over time. Both of these trends allow airlines to accommodate more passengers without increasing the number of flights and improve their operational efficiency. Average seat capacity for the domestic market is projected to increase to the range of 185 to 195 seats per departure over the 20-year planning horizon. Average seat capacity for the international market is projected to increase to the range of 195 to 205 seats per departure over the same period. Average load factor for the domestic market is estimated to return to between 78 and 82 percent, while the average load factor for the international market is expected to return to between 80 and 84 percent during the same period. **able 3-23** and **able 3-2** summarize the assumptions on average seats per departure and enplaning load factors, respectively.

The projected passenger aircraft operations for the three scenarios are summarized in **able 3-2** .

able 3-22 Aircraft Size Categories and Future   rends

Aircraft Size Categories	Seat Capacity	Typical Aircraft Models at the Airport (2019)	Notes and Future Trends
Widebody (WB) (Twin-aisle airplanes)	240 to 393 seats	B777-200 (United) B777-200 R (Jin Air) B777 (Japan Airlines, Korean Air) A330-300 (Philippine Airlines, Korean Air) A340-300 (Philippine Airlines)	• United typically flew its B777-200 with over 340 seats to/from Honolulu daily and two flights a day to/from Narita before the pandemic. The older B777-200 is expected to be replaced by the newer B777-300 R with 350 seats. • Jin Air's B777-200 Rs are relatively new at less than 20 years. It is likely to continue service at the Airport when international demands are recovered. Jin Air's B777-200 R configuration fits 393 seats. • Philippine Airlines retired their A340 in 2021. They anticipate return of their A330-300 for their international routes in the Pacific region together with some of their A321s. • Korean Air flies both B777 and A330-300 to/from the Airport. Older B777s may be replaced by their new orders of B787s in the long-term. • Japan Airlines is planning to retire their B777s and replace them with A350s in 2023. Seat capacity will increase from 244 to 391 seats.
Narrowbody (NB) (Single-aisle airplanes)	120 to 200 seats	A321 (Air Busan, Air Seoul, Philippine Airlines) A320 (Cebu Pacific) B737 (T'way Air, China Airlines) B737-800 (Jeju Air, Jin Air, United) B737-700 (United)	• The average age of Air Busan's A321-200 fleet is 14 years old. Similar to Philippine Airlines, new orders of A321 neo will gradually replace the older A321-200s in the existing fleet. • The average age of Air Seoul's A321-200 is 11 years old. No new orders are in its plan. • Philippine Airlines operates A321-200 (ceo) and A321 neo. New orders of A321 neos will gradually replace the older A321s. • Cebu Pacific's entire fleet is less than 10 years old. A320-200s, A320 neos, and potentially A321-200 and A321 neos may be included in future itineraries. • T'way Air's B737 fleet is still relatively new. Individual older B737-800 aircraft are likely to be replaced by new orders of B737 Max 8s. • China Airlines is gradually retiring and placing its B737-800s with A321 neos. Seat capacity will increase from 158 to 180 seats. • Jeju Air operates an all B737 fleet with an existing B737-800 fleet and future orders for B737 Max 8s. • Jin Air retired some of its older B737-800s, which were former Korean Air aircraft. • United typically flies its B737-700 and B737-800 between the islands in Micronesia and other international destinations in Asia. The older B737s with 126 to 166 seats are going to be replaced by the B737 Max 8 or 9 with approximately 179 seats.
Regional Jets	Less than 90 seats	N/A	• No commercial airlines fly regional jets to/from the Airport in their regular flight schedules

Notes:
WB = Widebody aircraft
NB = Narrowbody aircraft
N/A = Not available

able 3-23 Assumed Average Seats per Departure

Scenarios	Markets	Historical			Projected Trend			
		2019 Base Year	2020	2021	2024	2029	2034	2039
High Scenario	Domestic	190.3	180.4	175.2	178	180	182	185
	International	201.8	172.8	172.8	178	186	190	195
Baseline Scenario	Domestic	190.3	180.4	175.2	180	185	187	190
	International	201.8	172.8	172.8	185	196	198	200
Low Scenario	Domestic	190.3	180.4	175.2	185	190	192	195
	International	201.8	172.8	172.8	195	200	202	205

Note: Higher seats per departure yield lower number of operations and vice vera.

able 3-2 Assumed Average Enplaning oad Factors

Scenarios	Markets	Historical			Projected Trend			
		2019 Base Year	2020	2021	2024	2029	2034	2039
High Scenario	Domestic	74.3%	41.8%	46.2%	75%	77%	77.5%	78%
	International	79.9%	71.3%	27.8%	65%	78%	79%	80%
Baseline Scenario	Domestic	74.3%	41.8%	46.2%	75%	78%	79%	80%
	International	79.9%	71.3%	27.8%	65%	80%	81%	82%
Low Scenario	Domestic	74.3%	41.8%	46.2%	75%	79%	80.5%	82%
	International	79.9%	71.3%	27.8%	70%	82%	83%	84%

Note: Higher load factors yield lower number of operations and vice versa.

able 3-2 Passenger Aircraft Operations Forecasts

Fiscal Year	High Scenario			Baseline Scenario			Low Scenario		
	Domestic Pax Aircraft	Int'l Pax Aircraft	Total Pax Aircraft	Domestic Pax Aircraft	Int'l Pax Aircraft	Total Pax Aircraft	Domestic Pax Aircraft	Int'l Pax Aircraft	Total Pax Aircraft
Estimate from Historical									
2019 (Base Year)	1,531	21,758	23,289	1,531	21,758	23,289	1,531	21,758	23,289
2020	1,500	10,697	12,197	1,500	10,697	12,197	1,500	10,697	12,197
2021	1,516	2,472	3,988	1,516	2,472	3,988	1,516	2,472	3,988
Forecast									
2024	2,257	23,951	26,208	1,909	19,103	21,012	1,534	13,365	14,899
2029	2,821	26,705	29,526	2,524	22,682	25,206	2,247	19,749	21,997
2034	3,303	27,223	30,526	2,923	23,780	26,702	2,573	21,012	23,585
2039	3,770	28,254	32,024	3,277	25,169	28,445	2,828	22,344	25,172
Period	**CAGR**								
2019 to 2024 (5-year)	8.1%	1.9%	2.4%	4.5%	-2.6%	-2.0%	0.0%	-9.3%	-8.5%
2019 to 2029 (10-year)	6.3%	2.1%	2.4%	5.1%	0.4%	0.8%	3.9%	-1.0%	-0.6%
2019 to 2039 (20-year)	4.6%	1.3%	1.6%	3.9%	0.7%	1.0%	3.1%	0.1%	0.4%

Notes:
Int'l – International
Pax – Passenger
CAGR – Compound annual growth rate

3.6.3.2 All-Cargo Operations

As previously described in **Section 3 6**, the largest all-cargo carrier at the Airport, APA, has retired its smaller B727 freighter and only flies the larger B757-200 freighter. UPS is also gradually changing its fleet from the older B747-400F to the newer B747-8F with greater cargo capacity. It is anticipated that the average cargo volume per cargo aircraft operation will increase from the existing ratio of just below 18 tons per operation to the range between 19 and 21 tons per operation over the planning period.

For air cargo delivered by small cargo aircraft such as the Cessna C208 Caravan in MACS's fleet, or the Piper PA-32 and PA-31 operated by Star Marianas, a similar fleet is expected over the planning horizon. While the cargo capacity for each small cargo aircraft will stay the same as the existing fleet, each flight will carry more cargo to optimize each delivery. The projections assume the average cargo volume per operation will gradually increase from the existing ratio of just below 700 pounds per operation to the range between 700 and 1,500 pounds per operation.

The forecast all-cargo aircraft operations by air freighter and small cargo aircraft are summarized in **able 3-26**. The forecast air freighter operations are combined with the passenger aircraft operations to obtain the total air carrier operations. The small cargo aircraft operations are included in the general aviation and air taxi operations.

able 3-26 All-Cargo Aircraft Forecasts by ype of Carrier

Fiscal Year	High Scenario		Baseline Scenario		Low Scenario	
	Air Freighter Aircraft Operations	Small Cargo Aircraft Operations	Air Freighter Aircraft Operations	Small Cargo Aircraft Operations	Air Freighter Aircraft Operations	Small Cargo Aircraft Operations
Estimate from Historical						
2019 (Base Year)	849	3,238	849	3,238	849	3,238
2020	2,602	3,211	2,602	3,211	2,602	3,211
2021	2,345	3,805	2,345	3,805	2,345	3,805
Forecast						
2024	1,715	4,527	1,050	3,566	838	3,216
2029	2,099	4,967	1,306	3,907	873	3,261
2034	2,483	5,281	1,544	4,068	910	3,308
2039	2,881	5,508	1,765	4,096	948	3,355
Period	**CAGR**					
2019 to 2024 (5-year)	15.1%	6.9%	4.3%	1.9%	-0.3%	-0.1%
2019 to 2029 (10-year)	9.5%	4.4%	4.4%	1.9%	0.3%	0.1%
2019 to 2039 (20-year)	6.3%	2.7%	3.7%	1.2%	0.6%	0.2%

Note:
CAGR = Compound annual growth rate
Source:
Historical all-cargo aircraft operations – GIAA
Conversions of cargo aircraft statistics from calendar year to fiscal year and forecasts – AECOM analysis

3.6.3.3 GA and Air axi Operations

The forecast for GA and air taxi[57] operations is based on the estimated number of landings per based aircraft by benchmarking the type of aircraft, ownership, and usage at the Airport with the national statistics. The based aircraft forecast is given in the subsequent section, which is used in this section to estimate the general aviation and air taxi operations forecast. The methodology is illustrated in **Figure 3- 2** , and the assumptions in the model are listed below.

Figure 3-52. General Aviation Operations Methodology Illustration

Source: AECOM

- The number of landings by type of active aircraft for different usage referencing the FAA GA and Part 135 Activity Survey 2019 is given in **able 3-2** and are adjusted to reflect the characteristics of the Airport. It is generally assumed that based aircraft owned by individuals tend to fly mostly for personal use, while corporation-owned aircraft are used mostly for business. Based aircraft operated by the flight school are used for instructional purposes.
- **able 3-2** summarizes the number of based aircraft by type, ownership, and average aircraft age. Most of the based aircraft are owned by corporations or operated for business purposes. The top four general aviation businesses with based aircraft and their number of landings in the base year 2019 and during the pandemic in 2020 and 2021 are summarized in **able 3-29**. Comparison between the national average number of landings for different usage in **able 3-2** and the characteristics of the Airport in
- **able 3-2** and **able 3-29** shows that the number of landings per based aircraft is much higher than the national average. The unique island characteristics drive strong demands for delivery of mail and cargo between islands. Competitive cost for flight training at Guam as compared to Australia/New Zealand/U.S. mainland attracts Asian student pilots. The tourism industry drives demand in aerial sightseeing and skydiving. The turbine engine aircraft at the Airport are relatively new, and they are expected to be the driver of aviation activity referencing the national trend. In summary, the average number of landings per based aircraft assumed 600 in the forecast model. The number of operations include both landings and takeoffs. Hence, the model assumes each based aircraft generates 1,200 operations.
- Based on the GA operations in 2019, the model assumes 87 percent of the total operations flown by a based GA aircraft in each year are either departures or arrivals, which include 48 percent local operations (e.g., instructional, sightseeing, and skydiving) and 39 percent itinerant operations (including small cargo aircraft delivery estimated previously in **able 3-26**).
- The proportion of transient GA aircraft operations is estimated to be approximately 38 percent of the total itinerant GA operations based on 2019 estimates.

[57] Air taxi operators are air carriers that transport persons, property, and mail using small aircraft under 30 seats or a maximum payload capacity of 7,500 lbs. Air taxi operators typically hold FAR Part 135 certification and provide on-demand services (for compensation or hire).

- The proportion of air taxi aircraft operations is estimated to be approximately 0.8 percent of the total general aviation and air taxi operations based on 2019 statistics. These are mostly operations similar to Star Mariana Air (Part 135 air carrier) with based aircraft in Saipan and Tinian and other air charter companies providing on-demand services (for compensation or hire).

able 3-2 National Average Number of andings per Aircraft for Different Usage

ype of Aircraft	Overall Average	Business without a paid flight crew	Business with a paid flight crew	Instructional	Sightseeing	Part 13 Air axi
Single- ngine Piston	155	64	88	231	100	168
Multi- ngine Piston	168	106	185	448	N/A	1,253
Single- ngine Turboprop	430	101	189	254	N/A	273
Multi- ngine Turboprop	230	122	154	537	N/A	409
Jet Aircraft	174	260	360	303	N/A	673
All Aircraft	176	75	147	246	100	290

Note:
N/A = Not available
Source:
FAA General Aviation and Part 135 Activity Survey 2019
AECOM analysis

able 3-2 ype of Based Aircraft Ownership, Average Age, and Characteristics

Type of Aircraft	Type of Ownership	Number of Based Aircraft (FY2019)	Average Age of Based Aircraft	Notes
Single-Engine Piston	Corporation	7	44	• 4 owned by Aire Services (previously Sky Guam Aviation or Micronesian Aviation) and 3 owned by Trend Vector Aviation International. Both of them provide flight training.
	LLC	2	46	• Owned by Silver Fox Aviation LLC and leased to Sky Guam Aviation. Since Sky Guam Aviation ceased operation during the pandemic in August 2021, these two aircraft are likely to be transferred to other operators on the island, such as Aire Services.
	Individual/ Partnership	8	49	• Although these are individually owned aircraft, six of them are either owned by the President of Aire Services or operate for Aire Services (previously Sky Guam Aviation or Micronesian Aviation). The remaining two aircraft are also for business use based on an interview with the stakeholder.
Single-Engine Turboprop	Corporation	7	14	• Owned and operated by Skydive Guam / Skydive Saipan / MACS.
Multi-Engine Piston	Individual	4	53	• Individually owned aircraft are available for rental. E.g., the Piper PA-23 is available for rental via Aire Services. Two of them are owned by the President of Aire Services, which are likely to be available for operation by Aire Services.
Multi-Engine Turboprop	Corporation	1	24	• Owned by Pacific Mission Aviation (PMA). PMA provides free medical care, sea searches, rescue, and disaster relief; transports medical and food supplies; and provides logistical help to the islands.
	Individual	1	45	• Individually owned aircraft, anticipate primarily for personal use.
Not on the FBO list		6	N/A	
Total Based Aircraft at the Airport in FY2019		**36**	**N/A**	

Type of Aircraft	Type of Ownership	Number of Based Aircraft (FY2019)	Average Age of Based Aircraft	Notes

Notes:
N/A = Not available
FBO = Fixed base operator
MACS = Micronesian Air Cargo Services
Sources:
Based aircraft registration N-numbers – GIAA
AECOM analysis

able 3-29 Number of andings per Based Aircraft for op General Aviation Businesses at the Airport

Top Aviation Business	No. of Based Aircraft	Number of Arrivals			Number of Landings per Based Aircraft		
		FY2019	FY2020	FY2021	FY2019	FY2020	FY2021
Sky Guam Aviation [1]	7	5,310	2,276	101	759	325	14
Micronesian Aviation System [1]	4	3,092	1,064	18	773	266	5
Skydive Guam (includes MACS)	7	2,653	1,755	1,520	379	251	217
Trend Vector Aviation	3	2,501	1,212	472	834	404	157
Total for Top 4 General Aviation Business at the Airport	**21**	**13,556**	**6,307**	**2,111**	**646**	**300**	**101**

Note: Sky Guam Aviation and Micronesian Aviation System ceased operation during the pandemic in August 2021. Aire Services started its service at the Airport in April 2021 and purchased the based aircraft of the other two companies.
Sources:
Airline statistics – GIAA
AECOM analysis

- A time-series model based on the historical trend of GA and air taxi operations from 2009 through 2020 was developed and used to project the long-term GA and air taxi operations over the 20-year planning horizon. A dummy variable was adopted to reflect the impacts of the COVID-19 pandemic in 2020. The adjusted R^2 for the time-series model is 0.88.
- Three scenarios were developed using the average landings per based aircraft approach and the time-series model with the following adjustment for the short-term recovery outlook in the post-COVID era:
    - High Scenario: The long-term forecast for the high scenario assumes the upper bound of the two models, which is the outcome of the time-series model. The short-term forecast assumes optimistic recovery to 2019 levels between 2024 and 2025, which is consistent with the recovery projections from the FAA Aerospace Forecast FY2021–2041 for total active general aviation and air taxi hours flown.
    - Baseline Scenario: The long-term forecast for the baseline scenario assumes the midpoint between the upper bound and lower bound of the two models. The short-term forecast assumes moderate recovery to 2019 levels in between 2025 and 2026, which is consistent with the recovery projections from the FAA TAF (issued Mach 2022).
    - Low Scenario: The long-term forecast for the low scenario assumes the lower bound of the two models, which is the outcome of the model based on average landings per based aircraft. The short-term forecast assumes pessimistic recovery to 2019 levels between 2026 and 2027.

The forecast annual total GA and air taxi operations based on the based aircraft forecast and the historical trend for the baseline, low, and high scenarios are given in **able 3-3** and **Figure 3- 3** .

able 3-3 General Aviation and Air axi Operation Forecasts

Fiscal Year	High Scenario				Baseline Scenario				Low Scenario			
	Air Taxi	General Aviation		Total	Air Taxi	General Aviation		Total	Air Taxi	General Aviation		Total
		Itinerant	Local			Itinerant	Local			Itinerant	Local	
Historical												
2019 (Base Year)	370	26,908	20,869	48,147	370	26,908	20,869	48,147	370	26,908	20,869	48,147
2020	575	12,295	9,876	22,746	575	12,295	9,876	22,746	575	12,295	9,876	22,746
2021	197	5,121	6,785	12,103	197	5,121	6,785	12,103	197	5,121	6,785	12,103
Forecast												
2024	335	24,351	18,886	43,572	276	20,104	15,592	35,972	218	15,856	12,297	28,371
2029	457	33,211	25,757	59,425	424	30,858	23,933	55,216	392	28,506	22,108	51,006
2034	489	35,569	27,586	63,645	444	32,324	25,070	57,838	400	29,079	22,553	52,032
2039	522	37,927	29,415	67,864	465	33,815	26,226	60,506	408	29,703	23,036	53,147

Source: AECOM analysis

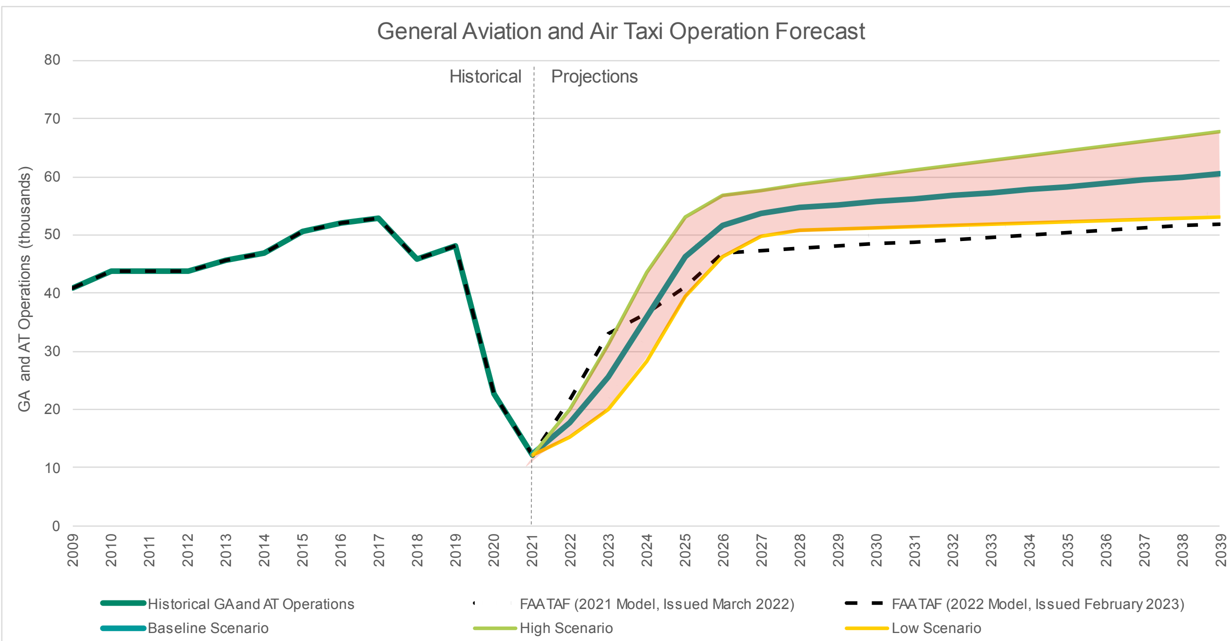

Figure 3-53. General Aviation and Air Taxi Operation Forecasts

Source: AECOM Analysis

3.6.3.4 Military Operations

Historical operation records indicate that other than operations from the U.S. armed forces (Marine Corps, Navy, and Coast Guard), there were occasional operations from foreign armed forces. Foreign armed forces include aircraft from Royal Canada Air Force/Canadian Armed Forces, Japan Air Self-Defense Force, New Zealand Air Force, Philippine Air Force, Royal Air Force, Royal Australian Air Force, and Republic of Korea Air Force, etc. There were occasional joint forces between alliances for bilateral or trilateral exercises in the Pacific region and at AAFB that attracted air traffic for transportation of personnel and supplies. C130, A330, KC30A, and B727 aircraft are the common aircraft models. For the purpose of Master Plan forecasts, the military activities at the Airport over the planning horizon assume maintaining annual aircraft operations at the 2021 level (i.e., 1,927 annual military operations) as summarized in **able 3-1** and **Figure 3-** .

3.6.3.5 otal Aircraft Operations

The total aircraft operations forecast, including commercial passenger air carrier, all-cargo carrier, air taxi, general aviation, and military aircraft operations, for the 20-year planning period are summarized in **able 3-31** and **Figure 3-** . A comparison of the projected total operations with the FAA TAF is also included in **able 3-31**. The forecasted total operations for the baseline scenario differ from the latest FAA TAF (issued February 2023) by less than 10 percent in the 5-year forecast period (9.4 percent). However, the difference is over 15 percent in the 10-year planning horizon (16.2 percent).

The latest FAA TAF forecast enplanements per air carrier departure are approximately 60 to 90 enplanements per departure, which are significantly lower than historical actual enplanements per departure. The Master Plan Update forecast assumes mainline aircraft with an average of over 180 seats per departure based on the actual Airport market.

able 3-31 otal Aircraft Operation Forecasts and Comparison with FAA AF

Fiscal Year	High Scenario	Baseline Scenario	Low Scenario	FAA TAF (2022 Model, released February 2023)	% Difference between Baseline and FAA TAF	FAA TAF (2021 Model, released March 2022)	% Difference between Baseline and FAA TAF
	Historical			Historical		Historical	
2019 (Base Year)	72,699	72,699	72,699	72,699	0.0%	72,699	0.0%
2020	38,907	38,907	38,907	38,907	0.0%	38,907	0.0%
2021	20,363	20,363	20,363	20,363	0.0%	20,363	0.0%
	Forecast			Forecast		Forecast	
2024	73,422	59,960	46,035	66,179	-9.4%	59,145	1.4%
2029	92,978	83,655	75,803	99,886	-16.2%	78,629	6.4%
2034	98,581	88,012	78,454	106,244	-17.2%	82,962	6.1%
2039	104,697	92,643	81,194	112,914	-18.0%	87,472	5.9%
Period	CAGR			CAGR		CAGR	
2019 to 2024 (5-year)	0.2%	-3.8%	-8.7%	-1.9%		-4.0%	
2019 to 2029 (10-year)	2.5%	1.4%	0.4%	3.2%		0.8%	
2019 to 2039 (20-year)	1.8%	1.2%	0.6%	2.2%		0.9%	

Notes:
FAA = Federal Aviation Administration
TAF = Terminal Area Forecast
CAGR = Compound annual growth rate
Sources:
FAA TAF (2021 Model, issued March 2022 and 2022 Model, issued February 2023)
AECOM analysis

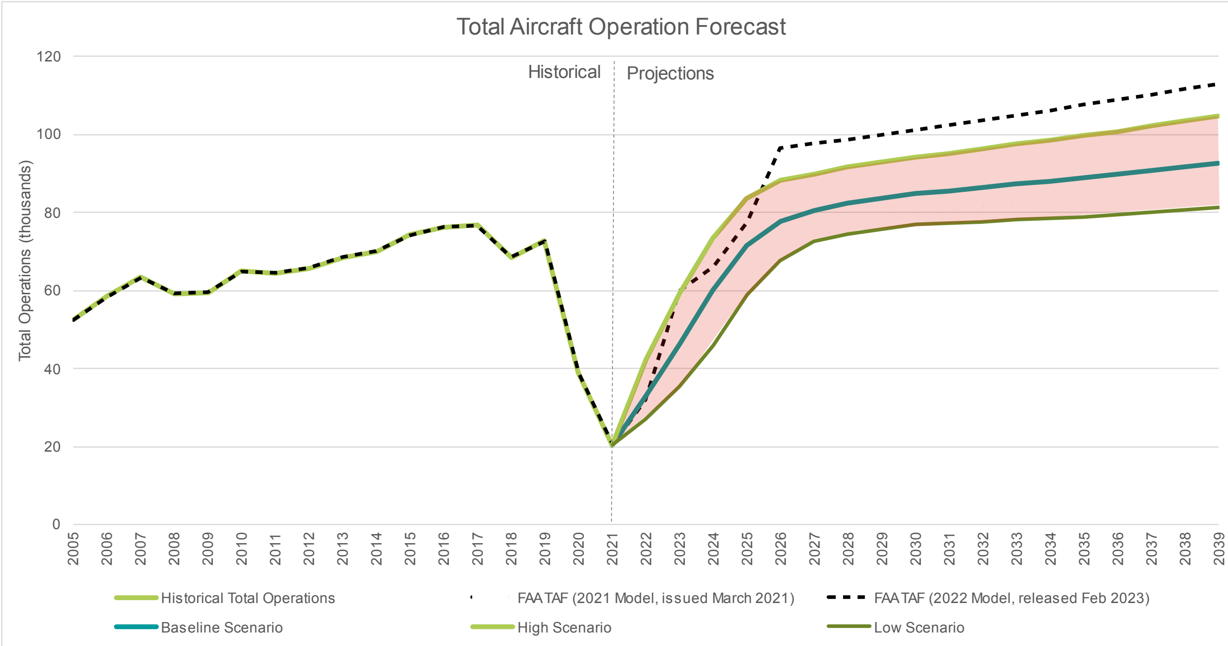

Figure 3-54. Total Operation Forecasts

Source: AECOM Analysis

3.6.4 Based Aircraft Forecast

Three methodologies were used to project the number of based aircraft at the Airport during the planning period.

3.6.4.1 Forecast Methodology

The forecast for based aircraft considers the historical trends and includes both top-down and bottom-up approaches:

- The top-down approach estimates the total regional demand for based aircraft in Guam and CNMI. The future based aircraft fleet is then allocated to each airport in the competitive area to derive future based aircraft.
- The bottom-up approach projects the based aircraft by type of aircraft based on growth rates predicted nationally by the FAA. Different growth rates are applied for fixed-wing single-engine piston aircraft, multi -engine piston aircraft, turboprop, and jet aircraft.
- The historical trend at the Airport is included in a time-series model for the past decade.

The results of the different approaches are compared and consolidated into a recommended baseline scenario, a high scenario, and a low scenario. Findings are then compared with the FAA TAF based aircraft forecasts.

3.6.4.2 Based Aircraft Projections for the Region

The decision by an aircraft owner on where to base the aircraft depends on many factors, such as the proximity of the airport to the owner's residence or business, the facilities, and services available at each airport. Based aircraft owned by individuals for personal use are mostly based on the same island as the owner. Owners of business aircraft for services between the islands in the region have the choice of their home base in Guam, GSN, or TNI. Since there is no FBO or aircraft maintenance support services in GRO, there is no historical based aircraft at GRO.

For example, Star Marianas Air operates from TNI and provides passenger and cargo services for the islands of Saipan, Tinian, Rota, and Guam. Their fleet of eight Piper PA-32-300 Cherokee Six and five

Piper PA-31-350 Navajo Chieftains aircraft are primary based in TNI. They also park their aircraft overnight at GSN for the first morning departures from GSN to TNI and from GSN to GRO.

Another example is Skydive Guam, which also operate as Skydive Saipan and MACS with a fleet of five Cessna C-208s, three Pac Aerospace Crop P-750s, and one Cessna 172S Skyhawk. Of the nine-aircraft fleet, seven of them are based in Guam according to the FBO record (April 2022), and the remaining two aircraft are based at GSN. They provide flight operations for tandem skydiving under the brand name of Skydive Guam and Skydive Saipan, respectively. They also provide regular and on-demand air cargo services for the islands of Guam, Rota, Saipan, and Tinian under MACS.

This historical based aircraft and market share in GUM, GSN and TNI are summarized in **Figure 3-** .

The forecast regional demand for based aircraft in Guam and CNMI was estimated by a time-series model from 2013 to 2022 based on the historical trend shown in **Figure 3-** . The model projects that the total number of based aircraft in the region will increase to 78 aircraft at an average annual growth rate of 0.64 percent over the 20-year planning period. The share of based aircraft is estimated from this projection and described in the next section.

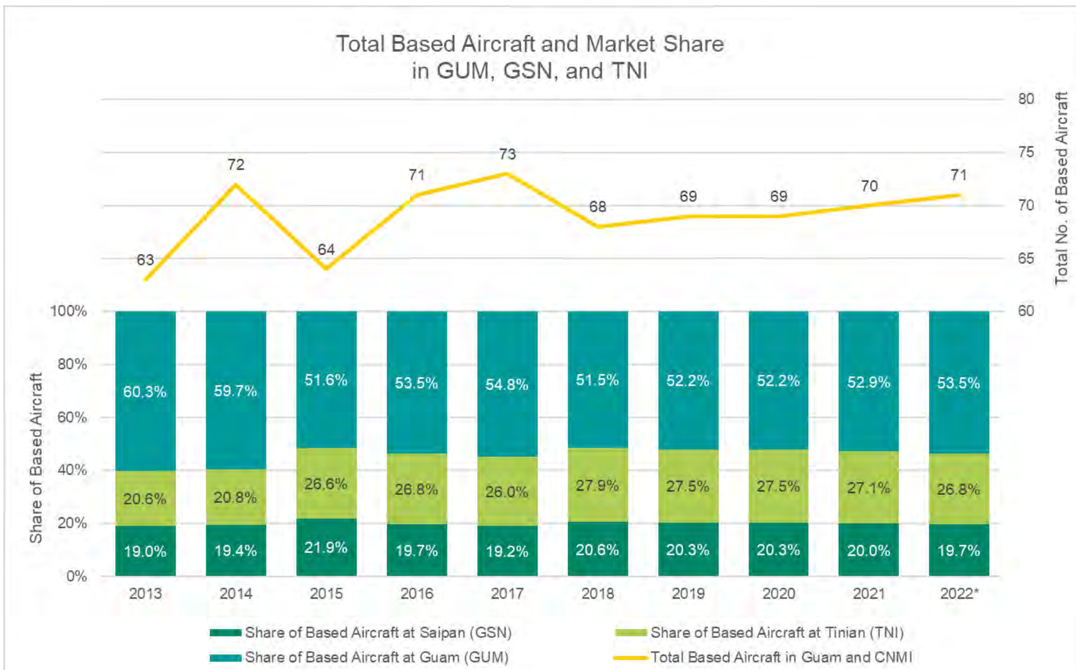

Figure 3-55. Historical Based Aircraft and Market Share in GUM, GSN, and TNI

Note: The number of based aircraft for the Airport in 2022 was updated with the Form 5010-1 information from GIAA.
Sources:
1. *Historical based aircraft – FAA, TAF, and GIAA*
2. *Calculation of market share – AECOM*

3.6.4.3 Based Aircraft Projections for the Airport

The three forecast methodologies are described below.

3.6.4.3.1 op-Down Approach

The forecast of based aircraft was obtained by distributing the total demand of the region based on the following two cases:

- xi sting-share case: It assumes the relative attractiveness of Guam to other airports in the region will stay constant throughput the planning horizon. The share of based aircraft at the Airport stayed at the existing share of 53 percent.
- Increasing-share case: It assumes there will be improvements in the facilities, support businesses, and services at the Airport as compared to other airports in the region and will attract more based

aircraft. The share of based aircraft will gradually increase to 60 percent, which is the historical share in 2013 and 2014.

able 3-32 summarizes the distribution to the Airport for these two cases.

3.6.4.3.2 Bottom-Up Approach

The bottom-up approach projects the based aircraft by type based on growth rates predicted nationally by the FAA. **able 3-33** summarizes the projected average annual growth rates for different types of aircraft by the FAA Aerospace Forecast FY2021–2041. **able 3-32** summarizes the forecast of based aircraft numbers using the bottom-up approach.

3.6.4.3.3 ime-Series Model

A time-series model was developed for the based aircraft using the historical trend from 2013 to 2022. The number of based aircraft in 2022 was updated to 38 aircraft based on GIAA's submission for the Airport Master Record, Form 5010-1, in May 2022.

able 3-32 summarizes the forecast of based aircraft using the time-series model.

able 3-32 Summary of the op-Down, Bottom-Up, and ime-Series Based Aircraft Projections

Fiscal Year	op-Down Approach: Existing-Share Case	op-Down Approach: Increasing-Share Case	Bottom Up Approach: Growth by Aircraft ype	ime-Series Model
istorical				
2019 (Base Year)	36	36	36	36
2020	36	36	36	36
2021	37	37	37	37
Forecast				
2024	38	39	37	36
2029	40	42	38	35
2034	41	44	39	34
2039	42	47	40	32
Period	**CAGR**			
2019 to 2024 (5-year)	1.3%	1.6%	0.7%	-0.1%
2019 to 2029 (10-year)	1.0%	1.4%	0.5%	-0.4%
2019 to 2039 (20-year)	0.8%	1.3%	0.5%	-0.5%

Note:
CAGR = Compound annual growth rate

able 3-33 Projected Based Aircraft Growth Rate by ype

Period	Fixed-Wing Piston			Fixed-Wing urbine			otal GA and Air axi Fleet
	Single-Engine	Multi-Engine	otal Piston	urboprop	urbojet	otal urbine	
istorical							
Historical CAGR (2010 to 2021)	-0.86%	-2.46%	-1.02%	0.86%	2.87%	2.01%	-0.86%
Historical CAGR (2020 to 2021)	-0.92%	-0.61%	-0.89%	-0.34%	2.46%	1.34%	0.43%
Forecast							
Forecast CAGR (2019 to 2029)	-0.95%	-0.54%	-0.91%	0.03%	2.55%	1.59%	-0.19%
Forecast CAGR (2019 to 2039)	-0.92%	-0.44%	-0.88%	0.39%	2.32%	1.61%	-0.07%

Notes:
GA = General aviation
CAGR = Compound annual growth rate
Source:
FAA Aerospace Forecast FY2021–2041, Table 28
Calculations of CAGR from 2019 to 2029 and from 2019 to 2039 – AECOM

By comparing the outcomes of the top-down, bottom-up, and time-series models, it is anticipated that the number of based aircraft will be between the optimistic estimate of 47 and the conservative estimate of 32 aircraft. The baseline scenario is projected to reach 40 based aircraft over the 20-year planning horizon.

Figure 3- 6 and **able 3-3** summarize the baseline, low, and high scenarios for forecast based aircraft and the comparison with FAA TAF.

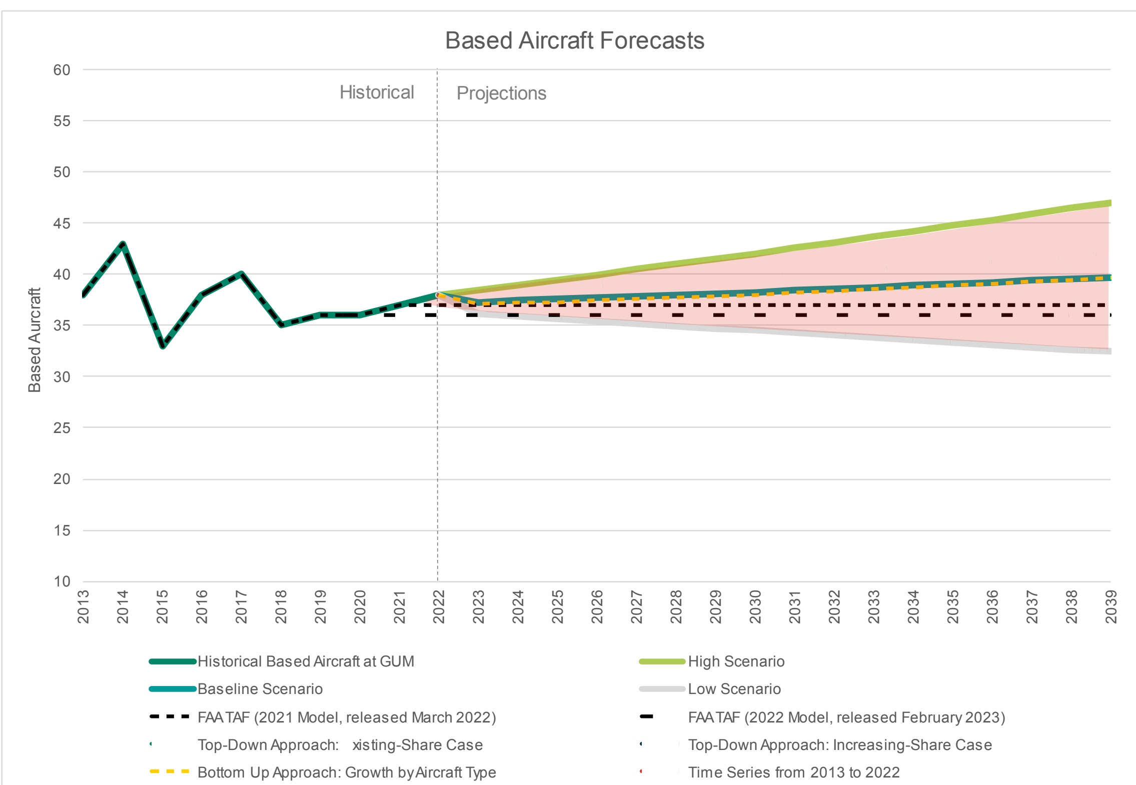

Figure 3-56. Based Aircraft Forecast

Source: AECOM Analysis

able 3-3 Based Aircraft Forecast and Comparison with FAA AF

Fiscal Year	High Scenario	Baseline Scenario	Low Scenario	FAA TAF (2022 Model, released February 2023)	% Difference between Baseline and FAA TAF	FAA TAF (2021 Model, released March 2022)	% Difference between Baseline and FAA TAF
		Historical		Historical		Historical	
2019 (Base Year)	36	36	36	36	0.0%	36	0.0%
2020	36	36	36	36	0.0%	36	0.0%
2021	37	37	37	36	2.8%	37	0.0%
		Forecast		Forecast		Forecast	
2024	39	37	36	36	4.0%	37	1.2%
2029	42	38	35	36	5.9%	37	3.1%
2034	44	39	34	36	8.1%	37	5.1%
2039	47	40	32	36	10.4%	37	7.4%
Period		CAGR		CAGR		CAGR	
2019 to 2024 (5-year)	1.6%	0.8%	-0.1%	0.0%		0.5%	
2019 to 2029 (10-year)	1.4%	0.6%	-0.4%	0.0%		0.3%	
2019 to 2039 (20-year)	1.3%	0.5%	-0.5%	0.0%		0.1%	

Note:
CAGR = Compound annual growth rate
Source:
FAA TAF (2021 Model, issued March 2022, and 2022 Model, issued February 2023)
AECOM analysis

3.6.5 Peak Activity Forecast

The passenger and aircraft traffic demand patterns at an airport are subject to seasonal, monthly, daily, and even hourly variations. These variations result in peak periods when the most demand is placed upon the facilities. Peaking characteristics identify the expected peak periods throughout the planning horizon for facility planning purposes. The objective of developing peak activity forecasts is to provide a design level that sizes facilities so they are neither underutilized nor overcrowded too often.

The peak activity forecasts in this section include:

- nplanements
- Commercial passenger carrier operations
- Total aircraft operations

3.6.5.1 "Average Day of the Peak Month" and "Peak o ur"

FAA guidance recommends using the peak hour of the average day in the peak month (ADPM) for the purposes of physical facility planning. The peak hour determination for enplanements and aircraft operations are based on monthly and hourly historic data from the Airport statistics from GIAA and FAA ATADS.

3.6.5.2 ADPM Peak o ur Enplanements

Figure 3- depicts the historical monthly enplanements for the past 5 fiscal years between 2017 and 2021. The peaks occurred during August in the summer except during the COVID-19 pandemic. Approximately 9.5 percent of the annual enplanements were recorded in the peak month, as shown in **able 3-3** , based on the three years before the pandemic. The ADPM peak hour analysis is based on the commercial airline flight schedules in August 2019.

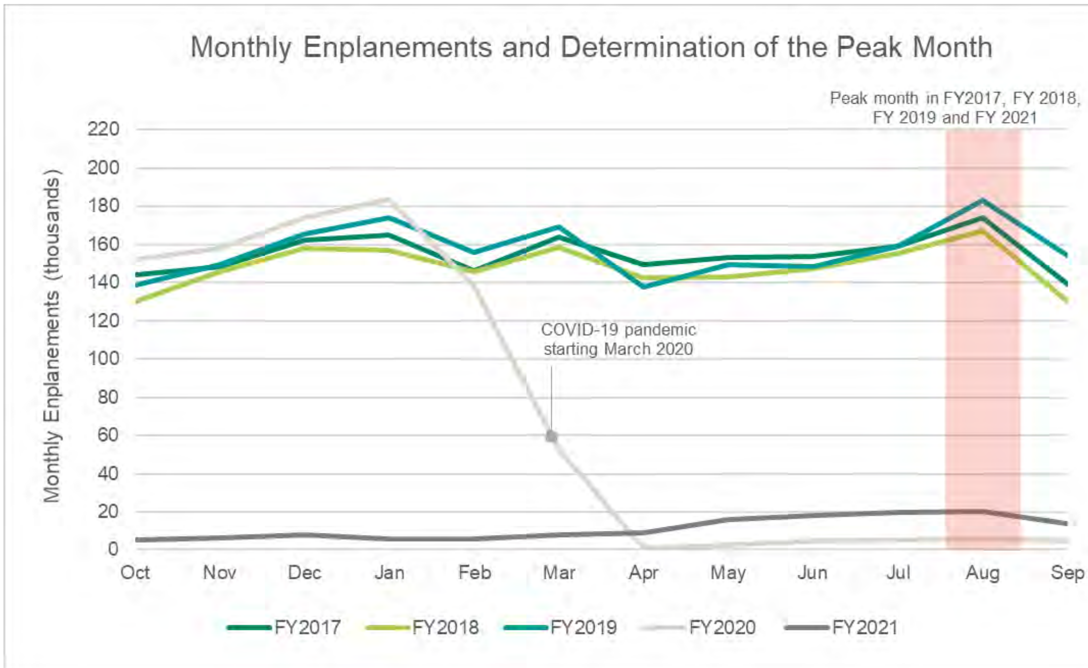

Figure 3-57. Monthly Enplanements and Determination of the Peak Month

Source: Monthly statistics for FY2017 to FY2021 – GIAA

able 3-3 Percentage of Enplanements in the Peak Month

Fiscal Year	Annual otal Enplanements	Monthly Average Enplanements	Peak Month Enplanements	Peak Month	Percentage of Peak Month Enplanements over Annual Enplanements
2017	1,858,379	154,865	173,825	August	9.4%
2018	1,780,572	148,381	167,180	August	9.4%
2019	1,885,108	157,092	183,096	August	9.7%
				Average Peak Month Factor	**9 %**

Sources:
Monthly statistics for FY2017 to FY2019 – GIAA
Percentage of enplanements in the peak month – AECOM analysis

able 3-36 presents the daily scheduled departure and arrivals seats in the peak month August 2019. For planning purposes, we recommend selecting a weekday in the peak month representing the average activities that is not the highest day over the weekends. Hence, Monday, August 19, 2019, was selected as the design day (i.e., ADPM) for the peak hour demand analysis.

able 3-36 Daily Scheduled Operations and Scheduled Seats in the Peak Month

Day of Week	Daily Scheduled Operations		Daily Scheduled Seats		Percentage Difference from Average Operations	Percentage Difference from Average Seats	Total Percentage Difference
	Arrivals	Departures	Arriving	Departing			
Sunday	39	40	8,061	8,187	2.5%	1.9%	4.4%
Monday	**39**	**39**	**8,031**	**8,031**	**2.2%**	**0.4%**	**2.6%**
Tuesday	39	38	7,833	7,707	4.7%	6.9%	11.6%
Wednesday	40	41	8,099	8,225	5.4%	2.8%	8.2%
Thursday	40	39	8,087	7,921	2.5%	2.1%	4.6%
Friday	37	38	7,651	7,857	9.8%	7.3%	17.1%
Saturday	42	41	8,581	8,415	10.5%	11.2%	21.7%
Average	39	39	8,049	8,049			

*Note: **Monday** was selected as the design day for planning purposes.*
Sources:
Flight schedules – GIAA
Daily scheduled operations and daily scheduled seats calculations – AECOM analysis

The peak hour demand analysis is based on the flight schedule for the design day in the base year 2019. **Figure 3-** and **Figure 3- 9** show the daily distribution of enplaned and deplaned passengers, respectively. **able 3-3** summarizes the peak hour demands in the base year and the projected peak hour demand based on the forecast annual enplanements, peak month ratio (9.5 percent), and the peak hour ratio (22.4 percent for enplanements and 22.8 percent for deplanements). Based on the historical trends, it is anticipated that the peak hour enplanements will increase from 1,477 to 1,812 and the peak hour deplanements will increase from 1,483 to 1,820 during the 20-year planning horizon.

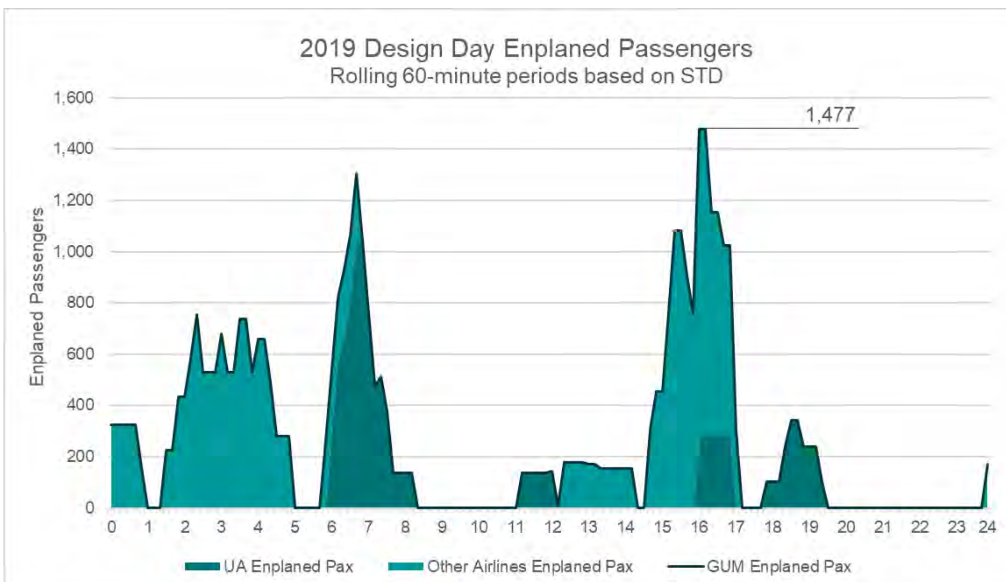

Figure 3-58. 2019 Design Day Enplaned Passengers

Note:
- A. *Abbreviations*
  STD = Scheduled time of departure
  PAX = Passenger

Sources:
1. *Flight schedules for August 2019 – GIAA*
2. *Load factor in August 2019 – U.S. DOT T-100 database*
3. *Rolling-60 minutes enplaned passengers – AECOM analysis*

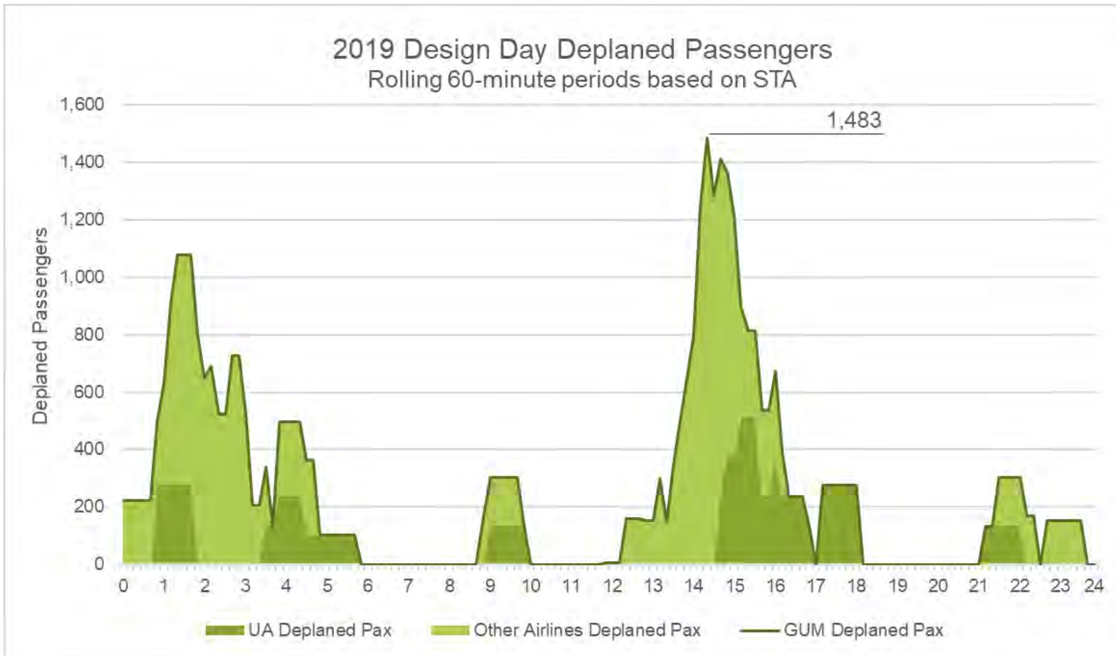

Figure 3-59. 2019 Design Day Deplaned Passengers

Note:

A. *Abbreviations*
STA = Scheduled time of arrival
Pax = Passenger

Sources:

1. *Flight schedules for August 2019 – GIAA*
2. *Load factor in August 2019 – U.S. DOT T-100 database*
3. *Rolling-60 minutes enplaned passengers – AECOM analysis*

able 3-3 Peak our Enplanement and Deplanement Forecast

Fiscal Year	Annual Enplanements[A]	Peak Month Enplanements	Design Day Enplanements	Peak our Enplanements	Peak our Deplanements
istorical					
2019	1,885,108	183,096	6,585	1,477	1,483
Forecast					
2024	1,277,397	121,353	4,462	1,001	1,005
2029	1,960,402	186,238	6,848	1,536	1,542
2034	2,123,073	201,692	7,417	1,663	1,670
2039	2,312,858	219,722	8,080	1,812	1,820

Note:
Annual enplanement forecasts for the baseline scenario.

3.6.5.3 ADPM Peak o ur Commercial Passenger Air Carrier Operations

Figure 3-6 shows the daily distribution of scheduled departures, arrivals, and total operations throughout the same design day as passenger enplanements (i.e., August 19, 2019).

able 3-3 summarizes the peak hour demands in the base year and the projected peak hour demand based on the forecast annual passenger aircraft operations, peak month ratio (9 percent), and the peak hour ratio (17.9 percent for departures, 20.5 percent for arrivals, 15.4 percent for combined operations).

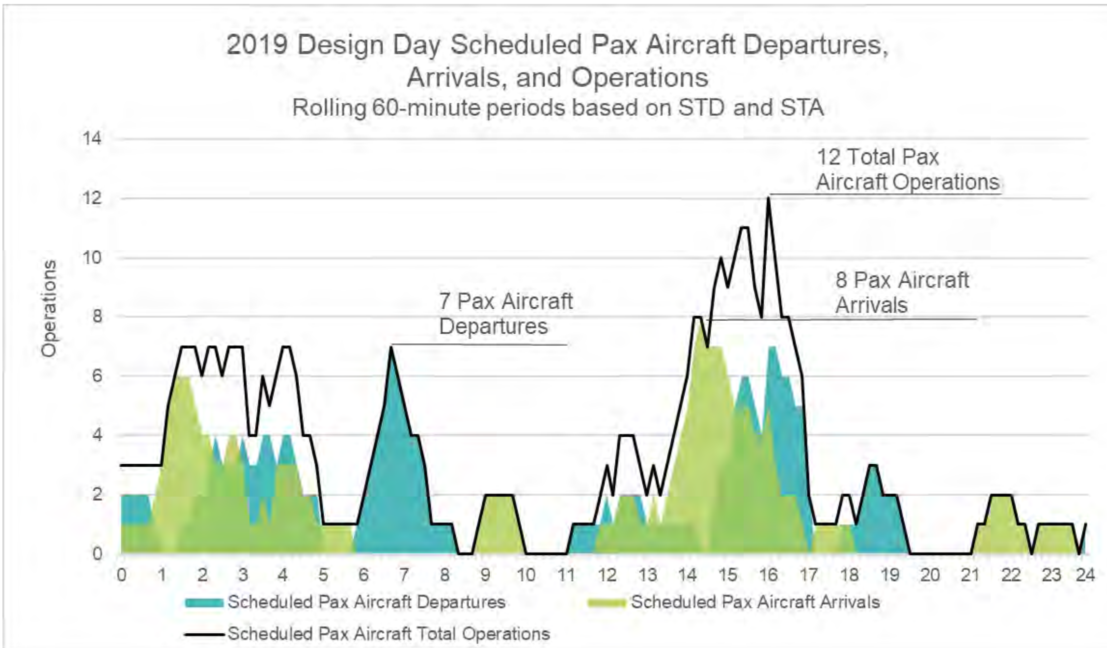

Figure 3-60. 2019 Design Day Scheduled Passenger Aircraft Operations

Note:

A. *Abbreviations*
STD = Scheduled time of departure
STA = Scheduled time of arrival
Pax = Passenger

Sources:

1. *Flight schedules for August 2019 – GIAA*
2. *Rolling-60 minutes enplaned passengers – AECOM analysis*

able 3-3 Peak our Commercial Passenger Air Carrier Operation Forecasts

Fiscal Year	Annual Operations[A]	Peak Month Operations	Design Day Departures	Design Day Arrivals	Peak our Departures	Peak our Arrivals	Peak our Operations
istorical							
2019	23,289	2,062	39	39	7	8	12
Forecast							
2024	21,012	1,860	35	35	6	7	11
2029	25,206	2,232	42	42	8	9	13
2034	26,702	2,364	45	45	8	9	14
2039	28,445	2,518	48	48	9	10	15

Note:
Annual commercial passenger air carrier operation forecasts for the baseline scenario.

3.6.5.4 ADPM Peak o ur otal Aircraft Operations

able 3-39 summaries the historical monthly total aircraft operations for the five FYs between 2015 and 2019 before the COVID-19 pandemic. Peak operations occurred in different months in different years and do not follow a regular pattern. The peak month accounts for an average of 9.6 percent of the annual total aircraft operations as shown in **able 3-** . In FY2019, the peak month for total aircraft operations was October 2018. To determine the peak hour operations for non-scheduled operations (e.g., GA and cargo aircraft operations), flight data from the GIAA were adopted for analysis.

The recorded monthly total aircraft operations from the GIAA flight data for the peak month in FY2019 was 5,166 operations, which represents over 76 percent of the total 6,759 operations from the FAA ATADS. The missing data are general aviation operations, which do not require a landing fee. The average daily and peak hour estimates were increased proportionally during the daytime to compensate for the missing general aviation operations.

Figure 3-61 presents the daily total aircraft operations in the peak month in FY2019, i.e., October 2018. An average day on Thursday October 11, 2018, was selected for peak hour analysis.

The findings of the peak hour total operations analysis are given in **Figure 3-62** through **Figure 3-6** . The number of departures, arrivals, and total operations throughout the day are shown in separate graphs. The aircraft operations obtained from the GIAA flight data are included in each graph. The white space between the operations from the GIAA flight data and yellow lines in **Figure 3-62** and **Figure 3-63** represent the estimated missing non-scheduled general aviation arrival and departure operations.

Peak hour total departures were estimated to be 14 operations, peak hour total arrivals were 16 operations, and peak hour total aircraft operations were 25 operations based on the estimates on the design day in base year 2019. **able 3- 1** summarizes the peak hour demands in the base year and the projected peak hour demand based on the forecast annual total aircraft operations.

able 3-39 Monthly otal Operations

Fiscal Year	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Peak Month
2015	5,512	6,252	6,275	5,392	6,920	5,446	5,107	6,510	5,764	7,024	**, 2**	6588	Aug
2016	5,751	5,558	5,967	6,597	6,868	6,805	5,580	**,**	6,906	6,512	6,821	5840	May
2017	6,066	6,303	6,371	7,307	6,031	5,961	5,844	**, 9**	6,160	6,780	6,571	5793	May
2018	4,979	5,037	5,612	6,008	5,849	6,443	5,457	5,561	5,905	**6,69**	5,960	4971	Jul
2019	**6, 9**	6,210	6,505	6,103	6,109	5,878	6,138	6,512	5,691	5,276	5,652	5866	Oct

Source: Monthly operation statistics – FAA ATADS

able 3- Percentage of otal Operations in the Peak Month

Fiscal Year	Annual otal Operations	Monthly Average Operations	Peak Month Operations	Peak Month	Percentage of Peak Month Operations over Annual Operations
2015	74,214	6,185	7,424	Aug	10.0%
2016	76,253	6,354	7,048	May	9.2%
2017	76,777	6,398	7,590	May	9.9%
2018	68,476	5,706	6,694	Jul	9.8%
2019	72,699	6,058	6,759	Oct	9.3%
				Average Peak Month Factor	**9 6%**

Sources:
Monthly statistics for FY2017 to FY2019 – GIAA
Percentage of enplanements in the peak month – AECOM analysis

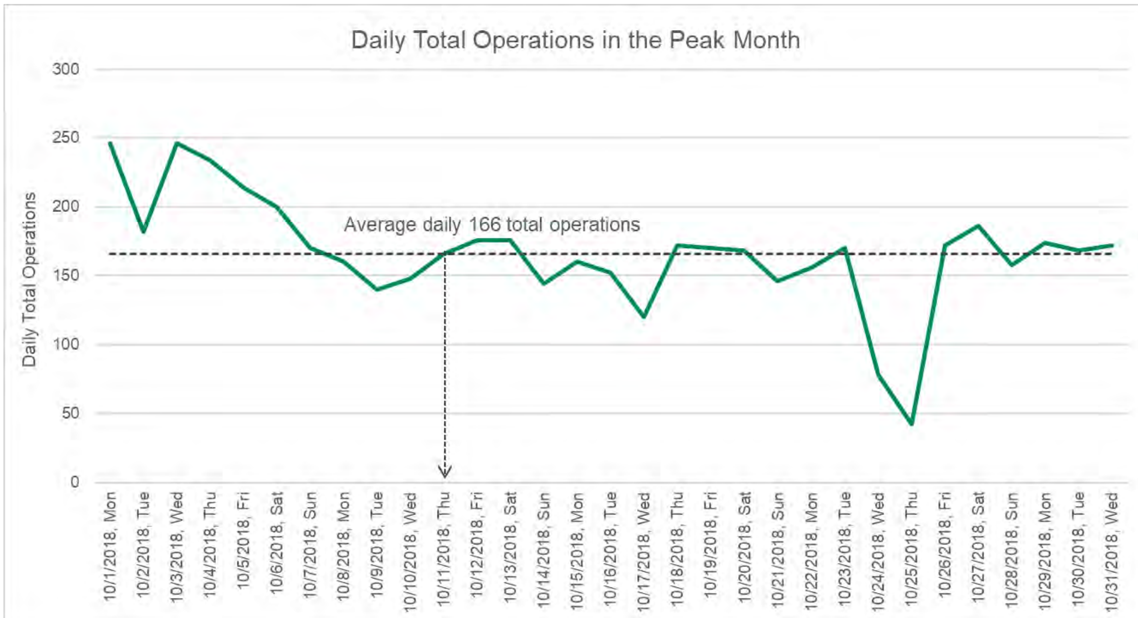

Figure 3-61. Daily Total Operations in the Peak Month

Sources:
1. *Flight data – GIAA*
2. *Average daily total operations and selection of design day – AECOM analysis*

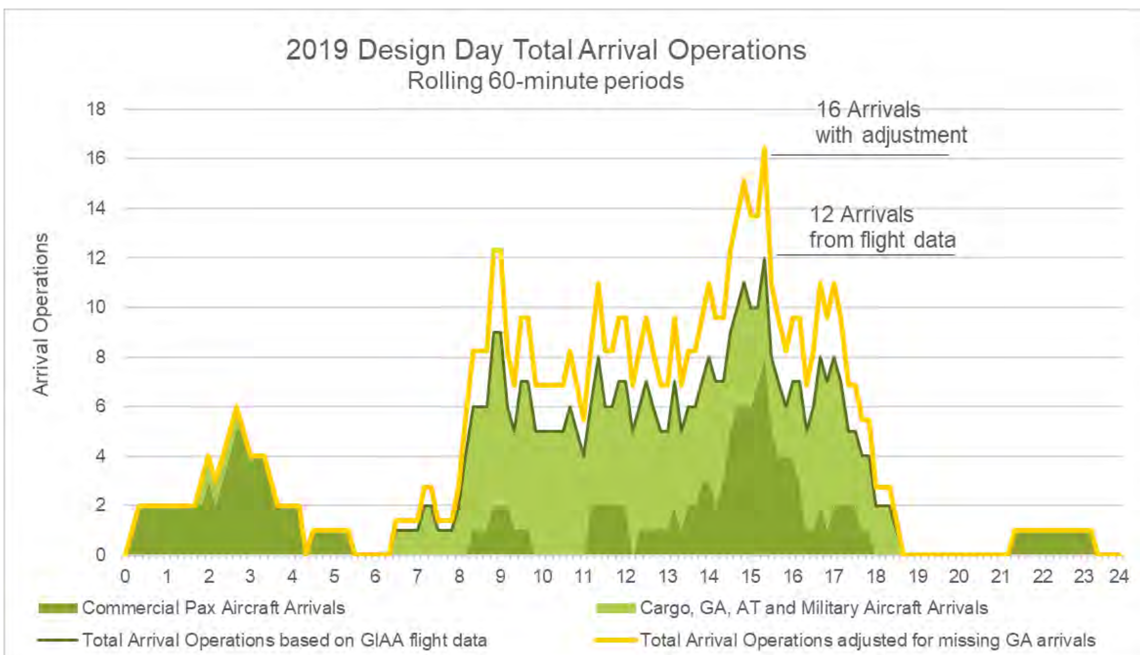

Figure 3-62. 2019 Design Day Total Arrival Operations

Note:

A. *Abbreviations*
GA = General aviation
AT = Air taxi
Pax = Passenger

Sources:
1. *Flight data – GIAA*
2. *Rolling 60-minutes arrivals and adjustment for missing GA arrivals – AECOM analysis*

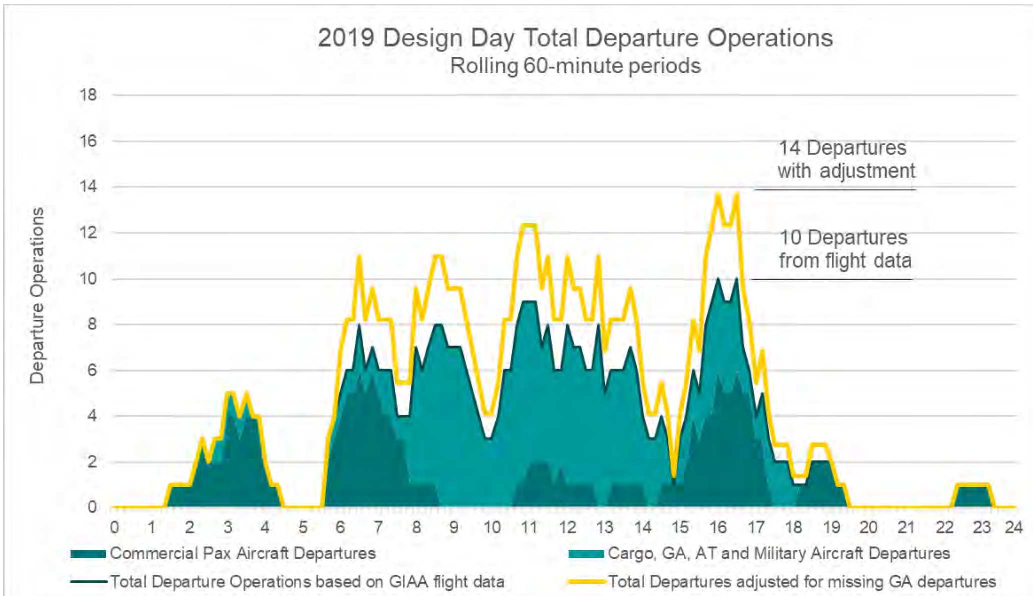

Figure 3-63. 2019 Design Day Total Departure Operations

Note:

A. Abbreviations
GA = General aviation
AT = Air taxi
Pax = Passenger

Sources:

1. *Flight data – GIAA*
2. *Rolling 60-minutes arrivals and adjustment for missing GA arrivals – AECOM analysis*

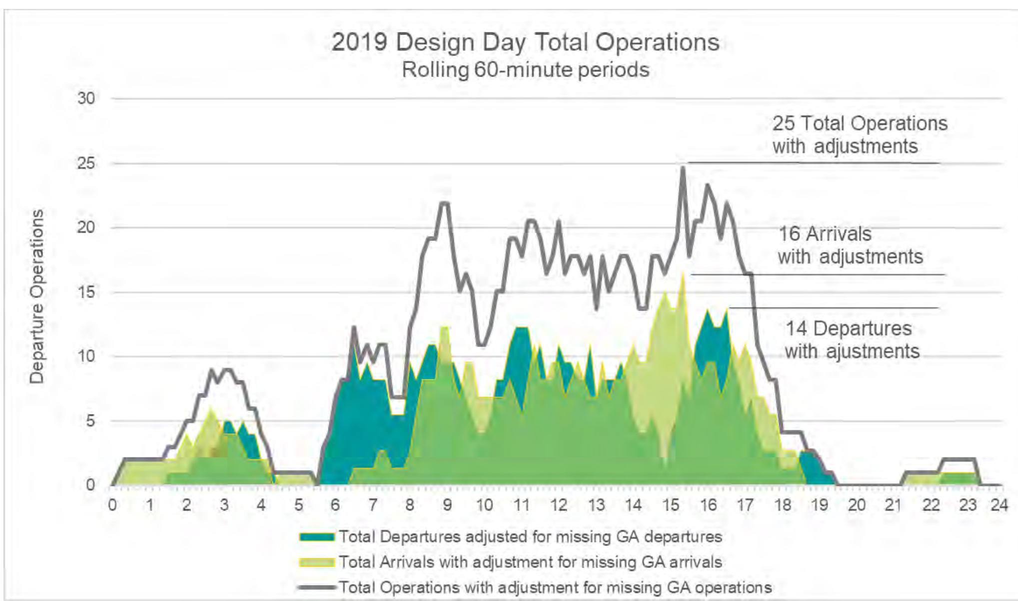

Figure 3-64. 2019 Design Day Total Operations

Note:

A. Abbreviations
GA = General aviation

Sources:

1. *Flight data – GIAA*
2. *Rolling 60-minutes total operations and adjustment for missing GA operations – AECOM analysis*

able 3- 1 Peak our otal Aircraft Operation Forecasts

Fiscal Year	Annual Operations[A]	Peak Month Operations	Design Day Daily Operations	Peak our Departures	Peak our Arrivals	Peak our Operations
istorical						
2019	72,699	6,759	218	14	16	25
Forecast						
2024	59,960	5,756	186	12	13	21
2029	83,655	8,031	259	16	18	29
2034	88,012	8,449	273	17	19	30
2039	92,643	8,894	287	18	20	32

Note:
Annual total operation forecasts for the baseline scenario.

3.7 Summary of Aviation Demand Forecasts

able 3- 2 summarizes the recommended baseline unconstrained forecasts for enplanements, aircraft operations, and based aircraft for the Airport over the 20-year planning horizon.

able 3- 2 Summary of Aviation Demand Forecasts for the 2 -Year Planning orizon

		Operations					Based Aircraft			
Year	**otal Enplanements**	**Air Carrier**	**Air axi**	**General Aviation**	**Military**	**otal Operations**	**Single-Engine**	**Multi-Engine**	**Jet**	**otal Based Aircraft**
istorical										
2019 (Base Year)	1,885,108	24,138	370	47,777	414	72,699	22	4	10	36
2020	884,060	14,799	575	22,171	1,362	38,907	22	4	10	36
2021	135,566	6,333	197	11,906	1,927	20,363	23	4	10	37
Forecast										
2024	1,277,397	22,062	276	35,695	1,927	59,960	22	4	11	37
2029	1,960,402	26,513	424	54,791	1,927	83,655	22	4	12	38
2034	2,123,073	28,246	444	57,394	1,927	88,012	21	4	14	39
2039	2,312,858	30,210	465	60,041	1,927	92,643	21	4	15	40
Period	**CAGR**									
2019 to 2024 (5-year)	-7.5%	-1.8%	-5.7%	-5.7%	36.0%	-3.8%	0.0%	0.0%	1.9%	0.5%
2019 to 2029 (10-year)	0.4%	0.9%	1.4%	1.4%	16.6%	1.4%	0.0%	0.0%	1.8%	0.5%
2019 to 2039 (20-year)	1.0%	1.1%	1.1%	1.1%	8.0%	1.2%	-0.2%	0.0%	2.0%	0.5%

Note:
CAGR = Compound annual growth rate

able 3- 3 summarizes the forecast levels and growth rates, and **able 3-** summarizes the comparison with the FAA TAF. These tables adopt the format required by the FAA.

able 3- 3 Summary of Forecast evels and Growth Rates

A Forecast evels and Growth Rates

Base Year: 2 19

						Average Annual Compound Growth Rates			
	Base Yr evel	**Base Year +1 Year**	**Base Year + Years**	**Base Year +1 Years**	**Base Year +1 Years**	**Base Year to +1**	**Base Year to +**	**Base Year to +1**	**Base Year to +1**
	2 19	**2 2**	**2 2**	**2 29**	**2 3**	**2 19 to 2 2**	**2 19 to 2 2**	**2 19 to 2 29**	**2 19 to 2 3**
Passenger Enplanements									
Air Carrier (Mainline)[A]	1,885,108	884,060	1,277,397	1,960,402	2,123,073	-53.1%	-7.5%	0.4%	0.8%
Commuter (Regional)[B]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
otal	**1, ,1**	**, 6**	**1,2 ,39**	**1,96 , 2**	**2,123, 3**	**- 3 1%**	**- %**	**%**	**%**
Operations									
Itinerant									
Air Carrier (Mainline)[A]	23,289	12,197	21,012	25,206	26,702	-47.6%	-2.0%	0.8%	0.9%
Commuter (Regional)[B]	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Cargo Carrier	849	2,602	1,050	1,306	1,544	206.5%	4.3%	4.4%	4.1%
Total Commercial Operations	*24,138*	*14,799*	*22,062*	*26,513*	*28,246*	*-38.7%*	*-1.8%*	*0.9%*	*1.1%*
Air Taxi	370	575	276	424	444	55.4%	-5.7%	1.4%	1.2%
General Aviation	26,908	12,295	20,104	30,858	32,324	-54.3%	-5.7%	1.4%	1.2%
Military	379	963	927	927	927	154.1%	19.6%	9.4%	6.1%
Local									
General Aviation	20,869	9,876	15,592	23,933	25,070	-52.7%	-5.7%	1.4%	1.2%
Military	35	399	1,000	1,000	1,000	1040.0%	95.5%	39.8%	25.0%
otal Operations	**2,699**	**3 ,9**	**9,96**	**3,6**	**, 12**	**- 6 %**	**-3 %**	**1 %**	**1 3%**
Peak Hour Operations	25	N/A	21	29	30	N/A	-3.4%	1.5%	1.2%
Cargo/Mail (nplaned + Deplaned Tons)	21,724	34,147	26,944	34,652	42,360	57.2%	4.4%	4.8%	4.6%
Based Aircraft									
Single- ngine (Non-jet)	22	22	22	22	21	0.0%	0.0%	0.0%	-0.3%

	Base Yr evel	Base Year +1 Year	Base Year + Years	Base Year +1 Years	Base Year +1 Years	Average Annual Compound Growth Rates			
						Base Year to +1	Base Year to +	Base Year to +1	Base Year to +1
	2 19	2 2	2 2	2 29	2 3	2 19 to 2 2	2 19 to 2 2	2 19 to 2 29	2 19 to 2 3
Multi- ngine (Non-jet)	4	4	4	4	4	0.0%	0.0%	0.0%	0.0%
Jet ngine	10	10	11	12	14	0.0%	1.9%	1.8%	2.3%
Helicopter	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Military	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
otal	**36**	**36**	**3**	**3**	**39**	**%**	**%**	**%**	**%**

Notes:
A. Mainline aircraft refers to aircraft with over 90 seats, including small narrowbody (B737 classics, MD-80s, A319, E190), medium narrowbody (B737 MAX8, MD-90, A320), large narrowbody (B757, B737 MAX9, A321 neo), and small widebody (B787-8, A330). Regional aircraft refer to aircraft with less than 90 seats, e.g., ERJ135/140/145/175, Q400, CRJ-200/700/900, and turboprops.
B. There is no commercial regional aircraft flying to/from the Airport regularly based on the 2019 to 2021 flight schedules.

B Operational Factors

	Base Yr evel	Base Yr +1yr	Base Yr + yrs	Base Yr +1 yrs	Base Yr +1 yrs
	2 19	2 2	2 2	2 29	2 3
Average Aircraft Size Seats					
Air Carrier (Mainline) [C]	196	185	184	195	197
Commuter (Regional) [C]	N/A	N/A	N/A	N/A	N/A
Average Enplaning oad Factor					
Air Carrier (Mainline) [D]	79.0%	62.2%	65.9%	79.8%	80.8%
Commuter (Regional) [D]	N/A	N/A	N/A	N/A	N/A
GA Operations Per Based Aircraft	1,327	616	965	1,442	1,472

Notes:
[C] *The average aircraft sizes (seats per departure) for 2019 and 2020 are estimated from the U.S. DOT T-100 Segment database and supplemented with the 2019 and 2020 flight schedules.*
[D] *The load factor in 2019 is based on the U.S. DOT T-100 Segment database.*
N/A – Not available

able 3- Comparison Between Airport Planning and FAA AF Forecasts

	Fiscal Year	Airport Forecast	FAA AF 2 22 Model, issued February 2 23	% Difference	FAA AF 2 21 Model, issued March 2 22	% Difference
Passenger Enplanements						
Base year	2019	1,885,108	1,276,443	47.7%	1,276,443	47.7%
Base year + 5 years	2024	1,277,397	873,733	46.2%	1,269,750	0.6%
Base year + 10 years	2029	1,960,402	1,982,619	-1.1%	1,443,446	35.8%
Base year + 15 years	2034	2,123,073	2,178,600	-2.5%	1,591,016	33.4%
Commercial Operations						
Base year	2019	24,138	24,138	0.0%	24,138	0.0%
Base year + 5 years	2024	22,062	28,180	-21.7%	24,443	-9.7%
Base year + 10 years	2029	26,513	50,355	-47.3%	27,071	-2.1%
Base year + 15 years	2034	28,246	54,819	-48.5%	29,413	-4.0%
otal Operations						
Base year	2019	72,699	72,699	0.0%	72,699	0.0%

Base year + 5 years	2024	59,960	66,179	-9.4%	59,145	1.4%
Base year + 10 years	2029	83,655	99,886	-16.2%	78,629	6.4%
Base year + 15 years	2034	88,012	106,244	-17.2%	82,962	6.1%

Notes:
FAA = Federal Aviation Administration
TAF = Terminal Area Forecast

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4 Facility Requirements

Executive Summary

The Facility Requirements chapter of the Antonio B. Won Pat International Airport (Airport) Master Plan assesses the Airport's ability to accommodate the existing conditions and future demand. The process includes comparing the information presented in **Chapter 2**: *Inventory of Existing Conditions* with current airport design standards established by the Federal Aviation Administration (FAA) and industry guidelines prepared by the Transportation Research Board (TRB) Airport Cooperative Research Program (ACRP), and the International Air Transport Association (IATA). These documents, and the projections included in **Chapter 3:** *Aviation Demand Forecasts,* are used to establish the future requirements for the airfield, commercial passenger terminal, landside and ground access, and general aviation (GA), cargo, and support facilities. The results of which are presented herein including any deficiencies or recommendations for preparing the Airport for the future demand.

Facilities requirements were prepared for three planning activity levels (PAL) corresponding to the baseline, 5 (2024), 10 (2029), and 20 (2039) year projections. The historical and forecast annual statistics in this report are summarized in fiscal years (FY) which is the 12-month period beginning 1 October and ending 30 September the following year unless stated otherwise.

This chapter is organized into four sections including:

- Airfield facilities
- Commercial passenger terminal facilities
- Landside facilities and ground access
- GA, cargo, and support facilities

The airfield has sufficient capacity to handle the long-term demand; however, there are several instances where the airfield does not meet current design standards. These include, but are not limited to, objects located within Runway Object Free Area (ROFAs), a lack of taxiway shoulders on the majority of taxiways, non-standard taxiway filets for all taxiway intersections, non-standard taxilane centerline separations, and problematic taxiway geometry. For a complete summary of the airfield facility requirements, see **Section 2 9**.

While the commercial passenger terminal facility has sufficient gates to handle the future passenger projections, there are opportunities within the commercial passenger terminal to improve its efficiency. Areas of concern include lack of queueing space at the Security Screening Checkpoint (SSCP), insufficient holdroom space throughout the concourse level of the facility, a shortage of restrooms, the absence of restrooms by the sterile corridor and Customs and Border Protection (CBP) areas, the diversity of concession areas, and the process for clearing outbound U.S. mainland passengers through CBP inspection at Gate 7. A complete summary of the commercial passenger terminal facility can be found in **Section 3 11**.

Currently, there are no outstanding existing landside facility and ground access issues within the 20-year planning period; however, further data collection and analysis for internal and surrounding traffic intersections is recommended.

A number of opportunities were identified within the GA, cargo, and support facilities analysis to prepare the Airport for the next 20 years. These include additional space for a jet and aircraft maintenance in the Nose Dock hangar, vehicle parking at the GA terminal, replacement for the outdated light aircraft commuter terminal, a new cargo facility with associated truck stalls and vehicle parking, a new widebody hangar, and additional fuel tanks. A summary of the GA, cargo, and support facilities can be found in **Section 9**.

Findings in this chapter, which include existing Airport deficiencies and future Airport needs, are evaluated in **Chapter** : *Alternatives Development and Evaluation*.

4.1 Introduction

This chapter identifies facility requirements for the airfield, terminal, landside, GA, cargo, and support facilities at the Airport throughout the 20-year planning period. The facility requirements were determined first by analyzing the impacts of forecast demand on the capacity of existing facilities to accommodate expected activity. After summarizing the facility requirements for the airfield, terminal, landside, and GA/cargo/support facilities, improvements were identified for the following elements:

- Airfield facilities
- Commercial passenger terminal facilities
- Landside facilities and ground access
- GA, cargo, and support facilities

4.1.1 Summary of Demand Forecasts

The timing of facility improvements is driven by when future aviation activity levels will be reached, not a predicted set point in time. The actual timing of development may vary from the Master Plan forecast years depending on the actual progression of future activity. As a result, PALs are encouraged to be used by the FAA in evaluating the need for additional facilities. The FAA's guidance on master plans says, "... planners should identify what demand levels will trigger the need for expansion or improvement of a specific facility. In this way, the airport sponsor can monitor growth trends and expand the airport as demand warrants."

As summarized in **able -1**, the PALs used in this Master Plan correspond to the 5-year increments presented in **Chapter 3**: *Aviation Demand Forecasts*. These PALs represent activity-based milestones that can be used to make future facility improvement decisions, focusing on the specific volumes of activity that trigger the facility improvement requirement. It is important to note that the Master Plan forecasts make certain assumptions about the characteristics of airlines and aircraft serving the Airport, etc. By monitoring future aviation activity continually, A.B Won Pat International Airport Authority, Guam (GIAA) can detect changes in these assumptions and adjust capital improvement schedules as appropriate.

able -1 Summary of Aviation Demands for the Planning Activity evels

PA	Annual Enplanements[A]	Annual Operations[A]	Annual Cargo onnage tons [A]	Based Aircraft[A]
istorical				
FY2019 (Base Year)	1,885,108	72,699	21,724	36
Forecast				
PAL 1 (FY2024 / Base Year +5 years)	1,277,397	59,960	26,944	37
PAL 2 (FY2029 / Base Year +10 years)	1,960,402	83,655	34,652	38
PAL 3 (FY2034 / Base Year +15 years)	2,123,073	88,012	42,360	39
PAL 4 (FY2039 / Base Year +20 years)	2,312,858	92,643	50,068	40

Notes:

A. Forecasts for the baseline scenario.

B. Abbreviation
PAL = Planning Activity Level
FY = Fiscal year

Source: ***Chapter 3****: Aviation Demand Forecasts*

4.2 Airfield Facilities

Potential issues associated with existing airfield facilities were determined by applying FAA, industry, and site-specific planning standards. This section includes an assessment of runway use and configurations, a wind and weather analysis, and an airfield demand and capacity analysis. Airfield geometry, airfield safety areas, and Navigational Aids (NAVAIDs) were also evaluated based on the critical aircraft using the airfield. This section also determines whether there are any deficiencies at the Airport, which will serve as a starting point for any future airfield alternatives.

4.2.1 FAA Design Standards

The design standards provided in FAA Advisory Circular (AC) 150/5300-13B, *Airport Design,* were used to evaluate the existing Airport facilities. This AC includes best practices that the FAA recommends for establishing an acceptable level of safety, efficiency, and capacity when designing and implementing development projects at civilian airports.

Other ACs that follow the same design standards as the *Airport Design* AC and are part of this analysis include:

- FAA AC 150/5060-5, Change 1 and 2, *Airport Capacity and Delay.* This AC explains how to compute airfield capacity and delay for an airport. This helps planners and designers get an accurate understanding of the existing operations performed at the airport and helps evaluate the future capacity based on proposed operations and airport improvement projects.
- FAA AC 150/5000-17, *Critical Aircraft and Regular Use Determination*. This AC defines an airport's critical aircraft, or the most demanding aircraft that makes regular use of an airport. s tablishing the critical aircraft is the foundation for planning, design, development, and financial decisions for future airport development. Defining the critical aircraft at an airport outlines the dimensional requirements needed for the safety of passengers and airport operations at federally obligated airports.
- FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*. This AC provides guidelines to determine required runway lengths. This AC can be used to determine whether existing runways are suitable for the aircraft operating at the airport.

4.2.2 Airfield Capacity Analysis

FAA AC 150/5060-5, Change 1 and 2, *Airport Capacity and Delay*, defines capacity as a "measure of the maximum number of aircraft operations which can be accommodated at the airport." This is typically measured by aircraft movements per hour or per year. Airfield capacity is determined by several factors, including the number of runways, runway orientation, runway exits, and the taxiway system. The airfield demand/capacity analysis evaluates the existing runway system and makes recommendations to help accommodate the future needs of the Airport based on the demand forecast. s sential information needed to establish airfield capacity include:

- Number of runways
- Runway configuration
- Runway separation distance
- Arrival/Departure separation
- Length of common approach
- The number of touch-and-go operations
- Runway exit availability
- Visual Meteorological Conditions (VMC)
- Instrument Meteorological Conditions (IMC)
- Aircraft fleet mix

This airfield capacity analysis used a methodology provided by the ACRP, which is a program established by the U.S. TRB. ACRP Report 79, *Evaluating Airfield Capacity*, provides an Airfield Capacity Spreadsheet Model, which was created using the calculations from FAA AC 150/5060-5, Change 1 and 2, *Airport Capacity and Delay*. It is used to determine the existing and future hourly and annual capacity of an airfield. The model uses the parameters listed above.

4.2.3 Airfield Configuration and Usage

The Airport's runway configuration consists of dual parallel runways (6L/24R and 6R/24L) oriented in a northeast-southwest direction. The separation between these runways is 700 feet, which meets the FAA required spacing between two parallel runways for simultaneous landings and takeoffs during VMC. According to the standard operating conditions identified by the FAA and Air Traffic Control (ATC) procedures, the separation for arriving and departing aircraft is 2 nautical miles (nm). Additionally, the length of a common approach at the Airport is 5.4 nm, which is documented in the Instrument Approach Procedures (IAPs). The length of the approach and the separation for both VMC and IMC conditions were used in the capacity calculations.

4.2.3.1 ouch-and-Go Operations

A touch-and-go operation is when an arriving aircraft lands on a runway and immediately takes off again without stopping or taxiing. Airports are typically at zero percent for these operations unless there is a flight school or a military base. The Airport currently witnesses a few military operations per year and has a flight school operating out of the south apron area. With the notion of these operations taking place at the Airport throughout the year, the assumption for touch-and-go operations is 5 percent.

4.2.3.2 axiway ayout and Exit Factor

Taxiway K is a full-length parallel taxiway along the northwest side of Runway 6L/24R. The presence of a parallel taxiway and associated exit taxiways allow aircraft to enter/exit the runway quickly which reduces runway occupancy time. See **Figure -1** and **Figure -2** for the existing runway separation and existing FAA Airport diagram.

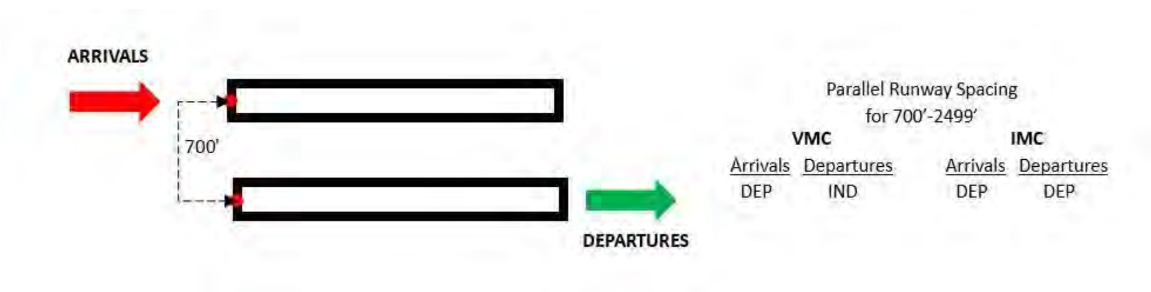

Figure 4-1. Runway Configuration and Separation

Note:

A. *Abbreviations*
   DEP = Dependent
   IND = Independent

Sources:

1. *FAA JO 7110.65 Air Traffic Control (ATC)*
2. *Airport Capacity Model Spreadsheet – ACRP Report 79, Evaluating Airfield Capacity*

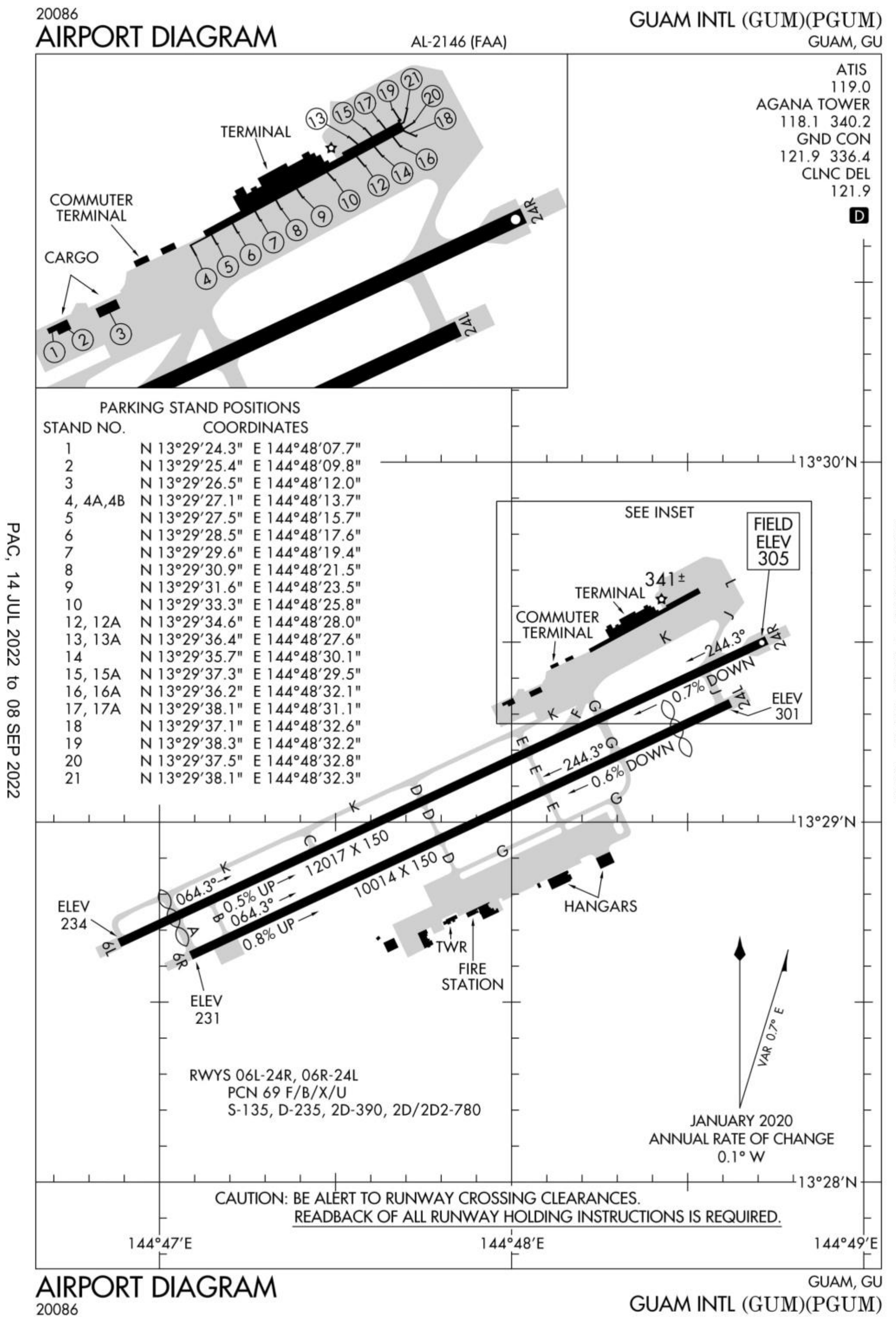

Figure 4-2. Airport Diagram

Source: AirNav.com (August 2, 2022)

4.2.4 Weather and Wind Analysis

As discussed in **Chapter 2:** *Inventory of Existing Conditions*, direction of wind, amount of precipitation, and other factors can affect airport operations and can cause delays and other issues that can impede procedures for airlines, air cargo, and other airport processes.

a sterly winds are prominent at the Airport due to the easterly trade winds that travel along the equator throughout the year in the Pacific region. According to the National Oceanic and Atmospheric Administration (NOAA), these trade winds are created by the circulation of warm, moist air rising from the equatorial region between the latitudes of 30 degrees north and south of the equator, while the cooler air that is closer to the poles sinks and moves back toward the equator. Because of the a rth's rotation, this creates an east-to-west wind flow. These trade winds produce warm, moist air and low pressure at the surface, which brings clouds and heavy precipitation. The average wind speed for the easterly trade winds is about 15 meters per second (35 miles per hour). Due to these winds having moderate velocities and traveling mostly in one direction, the Airport can primarily operate in an easterly flow without switching approach and departure directions.

For determining the capacity at the airfield, it is important to understand the percentage of VMC and IMC at the Airport. According to the NOAA Integrated Surface database from 2011 to 2020, the total number of recorded wind observations at the Airport was 141,213. Approximately 93 percent (131,759) of the observations occurred during VMC, and 7 percent (9,454) occurred during IMC. These percentages were used in the airfield capacity analysis.

4.2.5 Aircraft Fleet Mix

Aircraft fleet mix refers to the types of aircraft operating at an airport. Aircraft fleet mix is important because it affects the separation required between aircraft during their final approach onto a runway. This can affect airfield capacity because of the size, weight, and number of aircraft coming into and out of the Airport. **able -2** presents the aircraft classifications established by their Maximum Takeoff Weight (MTOW) and number of engines. The MTOW includes the aircraft's weight, plus fuel, passengers, and cargo. These aircraft are then separated into the seven aircraft classifications found in the ACRP Report 79 spreadsheet model and represents the operational proportions of aircraft categories using the Airport.

able -2 Aircraft Classifications

FAA Aircraft Category	Aircraft Classification	Maximum akeoff Weight lbs
A	Small – Single (S)	12,500 or less
B	Small – Twin (T)	12,500 or less
C	Small +	12,500 – 41,000
C	Large – Turbo Prop (TP)	41,000 – 255,000
C	Large – Jet	41,000 – 300,000
C	Large – 757	220,000 – 270,000
D	Heavy	More than 300,000

Note:
Abbreviations
A. *FAA = Federal Aviation Administration*
B. *lbs. = Pounds*
Sources:
1. *Airport Capacity Model Spreadsheet*
2. *ACRP Report 79, Evaluating Airfield Capacity*

To express types of aircraft used at an airport, the FAA uses the term "mix index," which is determined by the equation C+3D. The C represents the percentage of Class C aircraft, and the D represents the percentage of Class D aircraft. The percentages of the total of Class C and Class D aircraft from the data determine the fleet mix index number used to calculate the airfield's capacity. In **able -3**, operations are broken down by the type of aircraft according to the 2019 air carrier flight schedule. These operations show that small single-engine planes and large jets are the most common size aircraft operating at the Airport.

able -3 Aircraft Fleet Mix – Air Carrier Flight Schedule FY2 19

ype of Aircraft	FAA Aircraft Category	Operations FY2 19	Percentage of Aircraft
Small – S	A	39,414[A]	54.22%
Small – T	B	2,642[A]	3.63%
Small +	C	5,279[A]	7.26%
Large – Turbo Prop	C	482	0.66%
Large – Jet	C	19,328	26.59%
Large – 757	C	338	0.46%
Heavy	D	5,184	7.13%
Helicopter	-	32	0.04%
	otal Annual Operations	**2,699**	

Notes:

A. *This number includes an adjustment to account for missing GA operations. The Airport Operations FY2019 information doesn't include all GA operations when compared to FAA Operations Network (OPSNET) FY2019 data.*

B. *Abbreviations*
FAA = Federal Aviation Administration
FY = Fiscal year

Sources:

1. *Antonio B. Won Pat International Airport Operations FY2019*
2. *FAA OPSNET – GUM FY2019*

Using the information provided in **able -3**, the fleet mix index number can be calculated based on the percentages of Class C and Class D aircraft at the Airport. This includes the 72,699 total annual operations from FY2019, where the percentage of Class C aircraft is 52.5 percent and the percentage for Class D aircraft is 9.32 percent. **able -** depicts the fleet mix index number (80.46), which is another variable used to determine the airfield capacity.

able - Aircraft Fleet Mix Index Number

Class otal %	Fleet Mix Index
Class C	52.5% (C)
Class D	9.32% (D)
Fleet Mix Index Number C+3D	**6**

Source: Antonio B. Won Pat International Airport Operations FY2019

4.2.5.1 o urly Capacity

To calculate the capacity of hourly operations, runway configuration, touch-and-go operations, weather analysis, and runway exit factors are all incorporated. Using the dual parallel runway configuration, the hourly capacity during VMC and IMC operations is calculated. The capacity of VMC and IMC hourly operations for the Airport is displayed in **able -** .

able - ourly Airfield Capacity

PA	VMC Conditions		IMC Conditions		otal Peak our Operations
	Airfield Capacity	ourly Aircraft Operations	Airfield Capacity	ourly Aircraft Operations	
FY2019 (Base Year)	87	14	69	11	25
PAL 1 (FY2024)	87	12	69	9	21
PAL 2 (FY2029)	87	16	69	13	29
PAL 3 (FY2034)	87	17	69	13	30
PAL 4 (FY2039)	87	18	69	14	32

Note:

A. *Abbreviations*
PAL = Planning Activity Level
FY = Fiscal year
IMC = Instrument Meteorological Conditions
VMC = Visual Meteorological Conditions

Sources:

1. *Antonio B. Won Pat International Airport Operations FY2019*
2. *Airport Capacity Model Spreadsheet – ACRP – Report 79 (2022)*

The hourly capacity for the airfield was calculated at 87 operations per hour for VMC and 69 operations per hour for IMC. The current and forecasted peak hour operations information is found in the **Chapter 3:** *Aviation Demand Forecast*, where the peak hour operations are based on the peak hour of the Average Day in the Peak Month (ADPM). The peak hour operations for 2019 are 25 per hour, and the forecasted demand for 2039 peak hour operations are 32 per hour. The Airport's current and forecasted demand are operating lower than the calculated hourly capacity, and the airfield hourly capacity is sufficient for the current and future demand at the Airport.

4.2.5.2 Annual Capacity/Annual Service Volume

The FAA uses the term "Annual Service Volume (ASV)" to describe an airport's annual capacity. ASV provides an estimate of an airport's annual capacity assuming certain prevailing conditions. This includes the diverse situations that an airport would encounter throughout the year. ASV accounts for the acceptable delays that would be seen at any airport such as tolerable or acceptable delays under 5 minutes. A significant delay is one that is over 10 minutes, and 20 minutes or more would cause significant congestion. It is important to determine the airfield capacity while in the planning period to identify any limitations, improve any decision making, and be sure the Airport can function to the level of operations that may be experienced.

The total annual operations, average peak month daily demand, and average peak hourly demand information found in **Chapter 3:** *Aviation Demand Forecast* (see **able 3- 1**) were used. The calculated ASV for the existing and forecasted operations presented in **able** confirms that the airport is operating under the capacity available for both existing and forecasted operations.

able -6 Annual Service Volume vs Forecasted Annual Aircraft Operations

PA	Annual Service Volume	Annual Aircraft Operations
FY2019 (Base Year)	225,800	72,699
PAL 1 (FY2024)	222,800	59,960
PAL 2 (FY2029)	223,300	83,655
PAL 3 (FY2034)	227,900	88,012
PAL 4 (FY2039)	225,600	92,643

Note:
PAL = Planning Activity Level
FY = Fiscal year
Sources:

1. *Antonio B. Won Pat International Airport Operations FY2019*
2. *Airport Capacity Model Spreadsheet – ACRP – Report 79: Evaluating Airfield Capacity*

Based on the findings in able, the Airport's existing ASV is 225,800 annual operations based on the 2019 characteristic, while the forecast ASV for 2039 is 225,600 annual operations. With 2019 at 72,699 operations and 2039 at 92,643 operations, the Airport is operating below the airfield's capacity. The Airport in 2019 was operating at a total of 32 percent of the ASV and is projected to be operating at a total of 41 percent of the ASV by 2039.

The FAA recommends that when operations reach 60 percent of the ASV, planning for runway and airfield enhancements should be initiated. Implementation of those enhancements should begin once annual operations reach 80 percent of the ASV. **Figure -3** illustrates the existing airfield capacity and these thresholds compared to the historical and forecasted Airport operations.

Figure 4-3. Airfield Capacity vs Projected Operations

Sources:
1. *Antonio B. Won Pat International Airport Operations FY2019*
2. *OPSNET - GUM FY2009-FY2022*
3. *Chapter 3, Aviation Forecast Demand, Table 3-41*

The existing airfield has sufficient capacity to accommodate the projected demand for the planning horizon.

4.2.6 Critical Aircraft

va luating existing airfield facilities and planning for improvements require the identification of a critical aircraft. According to FAA AC 150/5000-17, *Critical Aircraft and Regular Use Determination*, an airport's critical aircraft is the most demanding aircraft type, or grouping of aircraft with similar characteristics, that make regular use of an airport. Regular use is 500 annual operations, including both itinerant and local operations but excluding touch-and-go operations.[58] The AC recommends an operations count by aircraft make and model for the most recent 12-month period be used to determine the critical aircraft. Due to the severe drop in aircraft operations in 2020 and 2021 because of the 2019 Novel Coronavirus (COVID-19) pandemic, 2019 operations were used to determine the Airport's critical aircraft using operations data from the FAA's Traffic Flow Management System Counts (TFMSC).

The FAA defines two parameters to determine an airport's critical aircraft: Airport Reference Code (ARC) and Taxiway Design Group (TDG). The ARC is determined by combining the Aircraft Approach Category (AAC) and the Airplane Design Group (ADG). The AAC (defined by a letter) relates to aircraft approach speed, while the ADG (defined by a roman numeral) relates to aircraft wingspan and tail height. Additionally, the TDG analyzes the cockpit to main gear dimension and the width of the main gear. The TDG is a primary design factor for taxiway/taxilane width and fillet standards. The TDG provides a basis

[58] FAA AC 150/5000-17, Critical Aircraft and Regular Use Determination

to evaluate the ability of the design aircraft to utilize the existing taxiway structure. See **able -** for aircraft that had more than 500 operations within 2019, as well as the aircraft's ARC and TDG.

able - Operations by Aircraft of or More Operations – FY2 19

Aircraft	Aircraft Operations	Airport Reference Code ARC	axiway Design Group DG
Airbus A320 (All Series)	682	C-III	3
Airbus A321 (All Series)	1,721	C-III	2
Airbus A330-300	655	C-V	5
Boeing 737-700	2,528	C-III	3
Boeing 737-800	13,096	D-III	3
Boeing 767-300	1,028	C-IV	5
Boeing 777-200	2,127	C-V	5
Boeing 777-300 R	811	D-V	6
Cessna 208 Caravan	1,944	B-II	1A
Piper Navajo PA-31	836	A-I	1A

Source: Traffic Flow Management System Counts (TFMSC) FY2019

Comparing the operations, ARC, and TDG above, the Airport's critical aircraft is a Boeing 777-300 R , as it has the largest ARC and TDG out of all of the aircraft evaluated. The aircraft has an approach speed of 149 knots (Category D), a tail height of 61.5 feet (Category V), and a wingspan of 199.8 feet (Category V), which corresponds to a D-V ARC. The aircraft also has a cockpit to main gear width (CMGW) of 112.6 feet and a main gear width (MGW) of 42.3 feet, making it a TDG 6 aircraft. See **Figure -** for an example of a Boeing 777-300 R aircraft.

Figure 4-4. Boeing 777-300ER

Source: Philippine Airlines

4.2.6.1 Modification of Standards

Though the Airport's critical aircraft is a D-V ARC, the FAA approved four Modification of Standards (MOS) for the Boeing 747-800 (a D-VI aircraft due to the aircraft's wingspan of 225 feet) to operate at the Airport. An FAA MOS means any change to FAA standards, other than dimensional standards for runway safety areas, applicable to an airport design, construction, or equipment procurement project that results in lower costs, greater efficiency, or is necessary to accommodate an unusual local condition on a specific project, when adopted on a case-by-case basis.[59] Regional or State standards are alternative standards that may be used within the subject Region or State for airport development projects without further documentation.

[59] FAA Order 5300.1F, Modifications to Agency Airport Design, Construction, and Equipment Standards.

The aircraft has set arrival and departure patterns, taxi routes, and terminal gate parking procedures when at the Airport. For example, the aircraft is not permitted to taxi toward or park at the south apron. Since many of the airfield design standards are more stringent for ADG VI aircraft than ADG V, the MOSs include approval for the existing runway width and blast width for Runway 6L/24R, runway width and blast width for Runway 6R/24L, Taxiway Object Free Area (TOFA) and taxiway wingtip clearances, and runway to taxiway separations. However, since the current Airport ARC is D-V, all existing airfield facilities and geometry will be evaluated based on those standards.

4.2.7 Runway System

Runways are the fundamental component supporting air transportation at any airport. The runway system is a combination of the structural pavement used for takeoffs and landings, and should include shoulders, blast pads, imaginary safety areas, and obstruction identification surfaces.

Runway dimensional requirements, except length, are determined by applying FAA runway design standards found in Appendix G, *Runway Design Standards Tables*, of FAA AC 150/5300-13B, *Airport Design*. a ch runway design standard has a matrix separated by the ARC. In order to interpret the tables correctly, each runway's visibility minimums of Instrument Approach Procedures (IAP) (expressed in Runway Visual Range [RVR] values) is needed. The runway visibility minimums, alongside the AAC and ADG of each runway, determine each runway end's Runway Design Code (RDC).

The current RDC for Runways 6L and 6R is D-V-2400 (as both runway ends contain IAPs with visibility minimums at a ½ statute mile [sm] of visibility), while Runways 24L and 24R have an RDC of D-V-5000 (as both runway ends contain IAPs with visibility minimums no lower than 1 sm of visibility). These categories provide the standards for runway width, runway shoulders, runway blast pads, and runway safety areas such as the Runway Safety Area (RSA), ROFA, Runway Obstacle Free Zone (ROFZ), and Approach and Departure Runway Protection Zones (RPZs).

4.2.7.1 Runway ength Requirements

FAA AC 150/5325-4B, *Runway Length Requirements for Airport Design*, provides the standards and guidelines for determining adequate and appropriate runway length at an airport. Factors such as airport elevation above mean sea level (AMSL), temperature, wind velocity, airplane operating weights, takeoff and landing flap settings, runway surface conditions (dry or wet), effective runway gradient, and the presence of obstructions in the vicinity of the airport are key determinants for runway length analyses.

The length of the primary runway should support the most demanding group of aircraft that will regularly use the Airport, while operating at a takeoff weight required to reach their destinations. Since the MTOW of the most demanding aircraft is greater than 60,000 pounds, design guidelines in FAA AC 150/5325-4B along with the takeoff and landing runway length requirements from manufacturers' Aircraft Characteristics for Airport Planning manuals were used to determine runway length requirements.

4.2.7.1.1 Runway akeoff e ngth Requirement

The main runway takeoff length requirements are determined using factors such as airport elevation, the mean maximum hottest month temperature, and runway high and low elevation points; higher values for each will increase the takeoff length due to aircraft performance characteristics. For the purpose of this analysis, the aircraft manufacturers' Aircraft Characteristics for Airport Planning manuals were used to identify the standard takeoff length required for an airport at sea level on a standard day (59° Fahrenheit and zero wind) with a zero runway gradient. Adjustments were then incorporated for conditions specific to the Airport which include:

- 305.0-foot Airport elevation
- 84.27° (Fahrenheit) mean maximum temperature of hottest month (June)
- 71.3-foot elevation difference between high and low points for Runway 6L-24R
    - The elevation difference between high and low points for Runway 6R-24L is 70.0 feet, so Runway 6L-24R was used to be more conservative

Of the 15 aircraft evaluated, 12 are defined by the FAA as "heavy" aircraft (aircraft capable of takeoff weights of more than 300,000 pounds), as those aircraft typically need longer runway lengths to takeoff.

I even of these aircraft (with the exception of the Boeing 747-8) are the only heavy aircraft to have at least 300 operations at the Airport between 2014 and 2019. While not defined as "heavy" aircraft, the Boeing 737-700, Boeing 737-800, and Boeing 757-200 were also analyzed because these aircraft were the most common aircraft at the Airport. **Figure -** shows the MTOW of each aircraft and the runway length required for those aircraft compared to the aircraft weight at 80, 90, 95, and 100 percent takeoff weight.

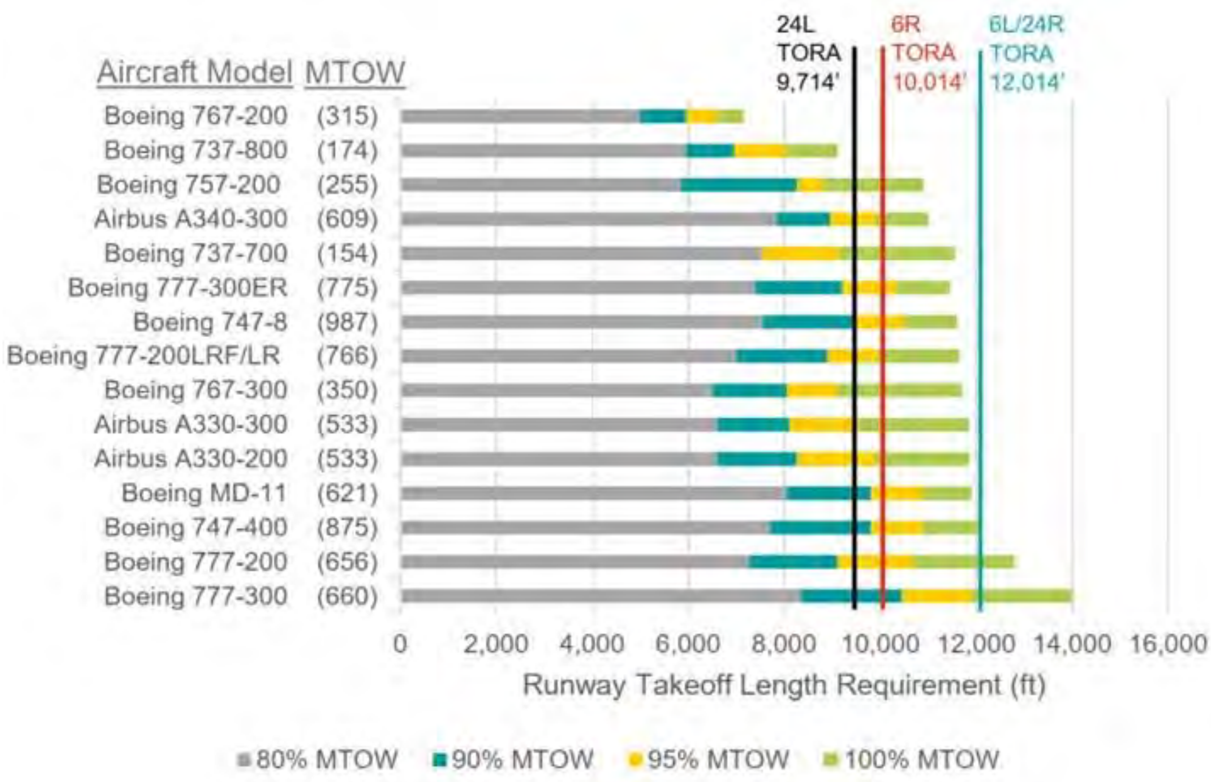

Figure 4-5. Runway Takeoff Length Requirements

Notes:

A. *MTOW is measured in thousands.*
B. *Abbreviations*
MTOW = Maximum Takeoff Weight
TORA = Takeoff Run Available

Sources:

1. *Primary Fleet Mix for Heavy Aircraft*
2. *Manufactures' APM*

The required takeoff length for each aircraft is compared with the Takeoff Run Available (TORA) (see **Section 2 2** for a definition and description of **Declared Distances**) for all four runway ends. The TORA for the four runway ends are 12,014 feet (6L and 24R), 10,014 feet (6R), and 9,714 feet (24L). Using the analysis in **Figure -** , the Airport does not have adequate TORA to accommodate the Boeing 777-300, Boeing 777-200, and Boeing 747-400 if departing at 100 percent MTOW; however, Runway 6L-24R provides adequate length for all aircraft when operating at 95 percent MTOW or less. It is important to note that these aircraft will not operate at 100 percent of MTOW.

4.2.7.1.2 Runway a nding e ngth Requirement

While departures generally require more runway length than arrivals, two of the four primary runway ends (6L and 24L) have displaced thresholds that reduce the Landing Distance Available (LDA) (see **Section 2 2 Declared Distances**). The LDA for the four runway ends are 12,014 feet (24R), 11,014 feet (6L), 10,014 feet (6R), and 8,710 feet (24L).

Landing length requirements were calculated for both wet and dry runway conditions at the Maximum Landing Weight (MLW) for the same aircraft analyzed in the runway takeoff length requirement and are presented in **Figure -6**. These operating conditions provide a conservative landing length for the purposes of evaluating and/or establishing runway length.

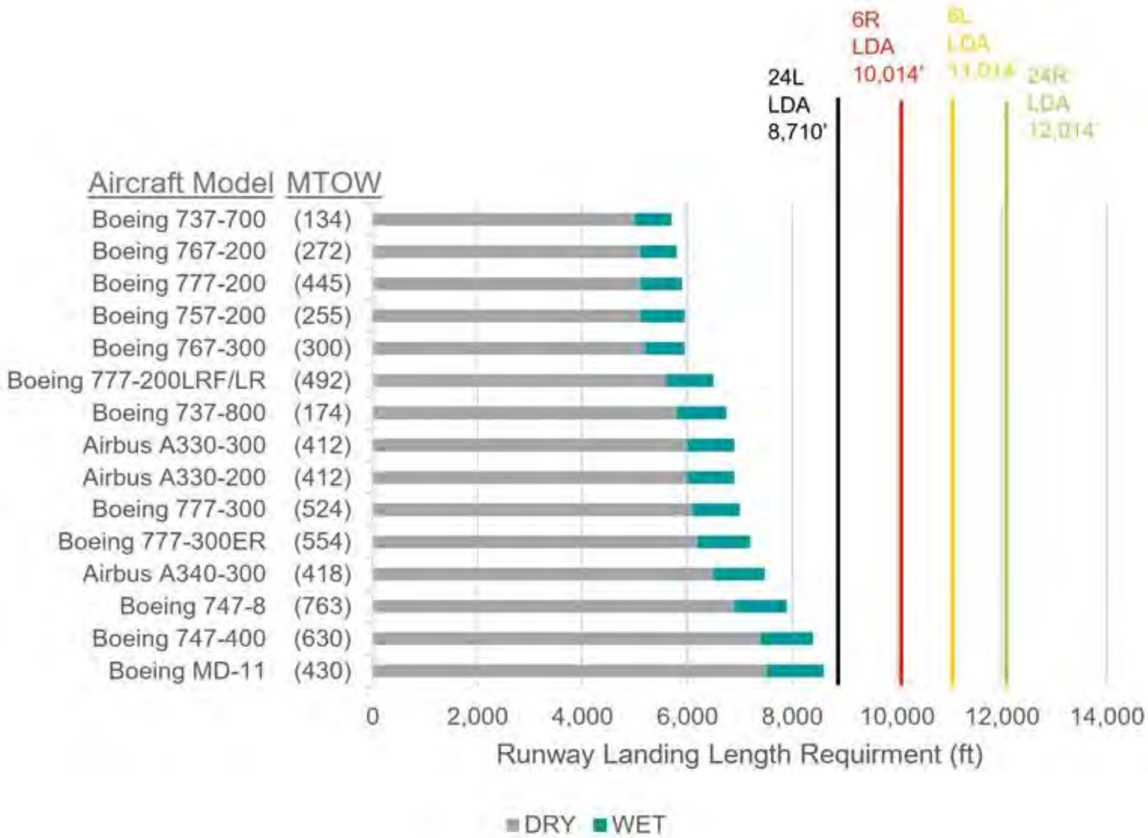

Figure 4-6. Runway Landing Length Requirement

Notes:

- A. *The Aircraft Performance Manual for the Airbus A330-200 and A330-300 did not provide landing performance on wet runways; therefore, the landing distances for dry runways were increased by 15 percent.*
- B. *MTOW is measured in thousands.*
- C. *Abbreviations*
  MTOW = Maximum Takeoff Weight
  LDA = Landing Distance Available

Sources:

1. *Primary Fleet Mix for Heavy Aircraft*
2. *Manufactures' APM*

The required landing length for each aircraft was compared with the LDA for all four runway ends. The results of the analysis indicate that the Airport has adequate LDA for all of the aircraft analyzed.

4.2.7.1.3 Aircraft Stage e ngth

Determining the stage length or range for an aircraft depends on the payload and fuel the aircraft will carry during a flight. **able -** lists five heavy aircraft that have had recent regular usage of the Airport. The APMs of these five aircraft were used to establish the aircrafts' maximum design taxi weight, maximum design zero fuel weight, useable fuel, Operating mp ty Weight (O W), and average weight of passengers (185 lbs.) and baggage (50 lbs.). va luating this information helps determine the estimated distance that the aircraft can travel with maximum passengers, baggage, and/or other payloads.

able - Aircraft Stage ength

ype of Aircraft	Aircraft Classification	Number of Passengers	Stage ength nm
Boeing 777-300 R	V	339	7,900
Boeing 747-8	VI	467	7,400
Boeing 747-400	V	420	7,000
Airbus A321neo	III	194	4,100
Boeing 737-800	III	178	3,400

Note:
A. Abbreviation
NM = Nautical mile
Source: Airplane Characteristics – Boeing and Airbus

The furthest destinations from the island of Guam include Hawaii, Hong Kong, Australia, and Korea, which all range between 1,600 and 4,000 NM. **Figure -** illustrates the stage length in relation to some of the most popular destinations from the Airport. This figure illustrates that most of the aircraft operating at the Airport only need to travel between 1,000 and 2,000 NM to most of their first destinations, with Honolulu (HNL) being the furthest destination at approximately 3,300 NM. The Airport does not anticipate it will add any new destinations that are further than 4,000 nm.

Figure 4-7. Aircraft Stage Lengths

Source: CalcMaps, 2022

4.2.8 Airfield Geometry

Proper airfield geometry is important for aircraft to safely conduct operations. This section describes and applies the FAA design standards to existing airfield facilities to determine if they meet standards and, if not, to identify necessary improvements.

4.2.8.1 Runway Pavement and Separation

Runway geometry standards address runway width, runway shoulder width, and blast pad length and width. These features are based on the ARC of the design aircraft, as well as the visibility minimums for each runway end, and are intended to provide a sufficient amount of pavement for safe operations. According to FAA AC 150/5300-13B, *Airport Design*, the existing runway widths, shoulders, and blast pads are all sufficient for runways that service D-V aircraft during all visibility minimums.

Additionally, runway separation standards are intended to provide sufficient separation between aircraft operating on a runway and other aircraft and/or vehicles on the airfield, including parallel runways, parallel taxiways, and aircraft parking aprons. The Airport's two parallel runways have a separation of 700 feet between runway centerlines, which is the minimum allowable distance for runways that accommodate heavy aircraft. A 700-foot runway centerline separation is also the minimum allowable distance for an airport to support simultaneous landings and takeoffs using Visual Flight Rules (VFR). The existing runway separation is, however, less than the recommended minimum runway centerline separation distance of 1,200 feet for runways serving ADG V and ADG VI aircraft. See **able -9** for the FAA runway design standards for a D-V ARC.

able -9 FAA Runway Design Standards

Airport Reference Code ARC – D-V						
	Standard		Runway End			
Item	½-Mile Visibility	1-Mile Visibility	6	2 R	6R	2
Visibility Minimums			½ Mile	1 Mile	½ Mile	1 Mile
Runway Geometry						
Runway Design Code	D-V-2400	D-V-5000	D-V-2400	D-V-5000	D-V-2400	D-V-5000
Runway Length	Varies		12,014'	12,014'	10,014'	10,014'
Runway Width	150'		150'	150'	150'	150'
Shoulder Width	35'		35'	35'	35'	35'
Blast Pad Length	400'		400'	400'	400'	400'
Blast Pad Width	220'		220'	220'	220'	220'
Runway Separation						
Parallel Runway Centerline	700'		700'	700'	700'	700'
Holding Position	250'		280'	280'	250'	250'
Parallel Taxiway Separation	400'		400'	N/A	N/A	N/A

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

4.2.8.2 Declared Distances

Declared distances are the runway distances an airport operator declares available for an aircraft's takeoff, rejected takeoff, and landing distance performance requirements. The FAA uses declared distanced to identify maximum distances available for arrivals and departures when the full physical length of the runway is unavailable. Declared distances are typically used when a runway has a displaced landing threshold or deficiencies to the length of its RSA, ROFA, RPZ, or obstacles that penetrate the runway's Departure Surface. a ch of these items are discussed in the following paragraphs. Declared distances do not change or impact the physical runway length.

The FAA identifies four types of declared distances. See **able -1** .

able -1 Declared Distances

Declared Distance	Definition
Takeoff Runway Available (TORA)	The runway length declared available and suitable for satisfying takeoff run requirements.
Takeoff Distance Available (TODA)	The distance of the TORA plus the length of remaining runway or clearway beyond the far end of the TORA.
Accelerate-Stop Distance Available (ASDA)	The runway length plus the stopway length (if applicable) declared available and suitable for the acceleration and deceleration of an aircraft that must abort its takeoff.
Landing Distance Available (LDA)	The runway length that is declared available and suitable for satisfying aircraft landing distance requirements.

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

able -11 presents the existing declared distances published at the Airport. The LDA for Runway 6L is 1,000 feet less than the Runway 6L/24R length due to a 1,000-foot displaced landing threshold. Additionally, the TORA, TODA, and ASDA for Runway 24L are 300 feet less than the physical runway length because of a former drainage system located within the RSA beyond the west end of the runway. The LDA for Runway 24L is 1,304 feet less than the Runway 6R/24L length because of the 300 feet needed for the drainage system, plus a 1,004-foot displaced landing threshold.

able -11 Declared Distances at the Airport

Runway		Declared Distance			
End	ength	ORA	ODA	ASDA	DA
6L	12,014’	12,014’	12,014’	12,014’	11,014’
24R	12,014’	12,014’	12,014’	12,014’	12,014’
6R	10,014’	10,014’	10,014’	10,014’	10,014’
24L	10,014’	9,714’	9,714’	9,714’	8,710’

Notes:
TORA = Takeoff Run Available
TODA = Takeoff Distance Available
ASDA = Accelerate-Stop Distance Available
LDA = Landing Distance Available
Source: GIAA

4.2.8.3 Runway Safety Area

The RSA is a defined area surrounding the runway consisting of a prepared surface suitable for reducing the risk of damage to aircraft in the event of an undershoot, overshoot, or excursion from the runway. The RSA is rectangular shaped, and the dimensions are evenly offset from the runway centerline and extend beyond the runway ends. Per FAA standards, the RSA must be free of all objects except those that must be located in the RSA because of their function, such as NAVAIDs.

The RSA dimensions for both runways are identical at 500 feet wide (250 feet off of the runway centerlines on either side) and 1,000 feet beyond all four runway ends except for Runway 24L (beyond the Runway 6R end) which is 700’ due to the drainage headwalls. The RSA is still considered to be 1,000’ beyond the departure end because of the modified declared distances. All other RSAs meet design standards.

4.2.8.4 Runway Object Free Area

The ROFA is an area centered on the surface of a runway centerline provided to enhance the safety of aircraft operations by remaining clear of objects, except for objects that need to be located in the ROFA for air navigation or aircraft ground maneuvering purposes. The ROFA must be cleared of above-ground objects protruding above the nearest point of the RSA.

Similar to the RSA, both runways have identical ROFA dimensions: 800 feet wide (400 feet off of the runway centerlines on either side) and 1,000 feet beyond all four runway ends. There are objects that penetrate both ROFAs. Beyond the Runway 6L end, two segments of the Airport perimeter fence, measuring approximately 73 and 188 feet are located within the west end of the ROFA, and beyond Runway 6R, two segments of the fence, measuring approximately 132 and 200 feet, as well as approximately 0.04 acres of Route 8, are located within the west end of the ROFA (see **Figure - **). Additionally, there are areas of terrain issues that rise up past the appropriate grade in the approach to Runway 24L.

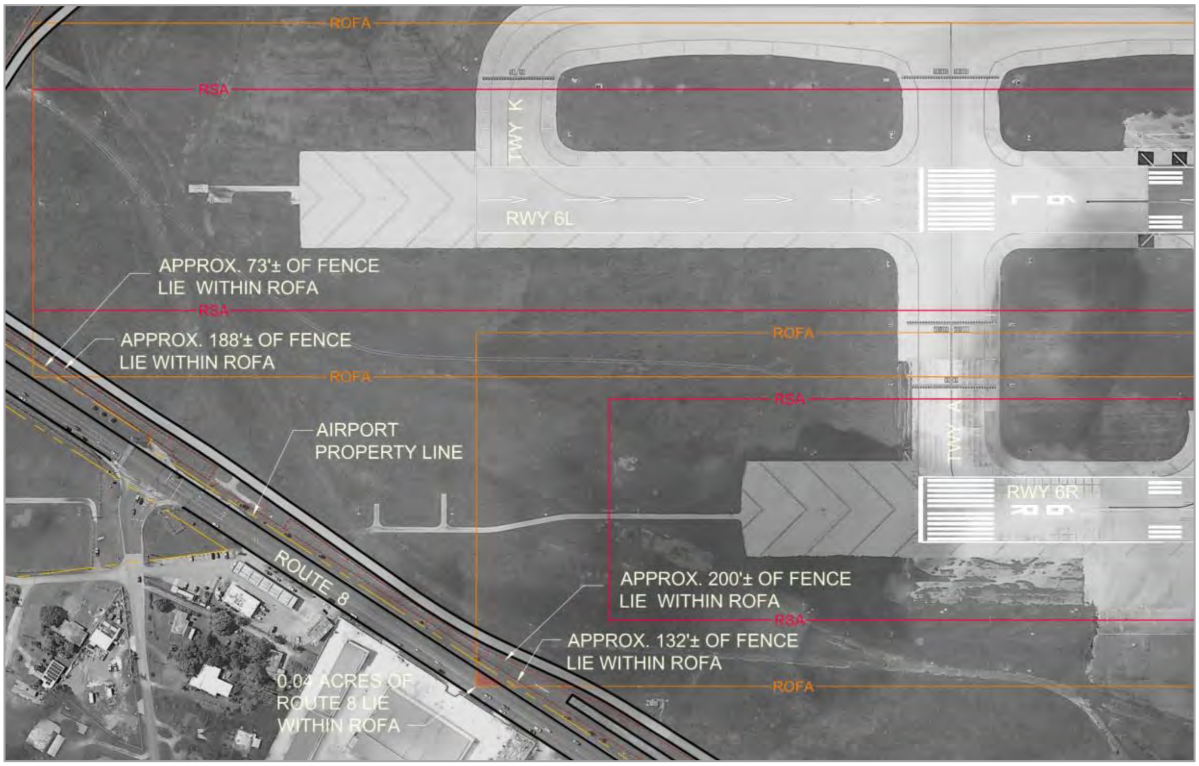

Figure 4-8. Runway 6R ROFA - Non-Standard Conditions

Source: AECOM

4.2.8.5 Obstacle Free Zone

The OFZ is a three-dimensional airspace along the runway and extended runway centerline that is clear of obstacles for protection for aircraft landing or taking off from the runway and for missed approaches. The OFZ is composed of the Runway OFZ (ROFZ), and when applicable, the Inner-Approach OFZ (IAOFZ), Inner Transitional OFZ (ITOFZ), and Precision OFZ (POFZ). The ROFZ applies to both runways at the Airport. The IAOFZ applies to runways with an Approach Lighting System (ALS), while the ITOFZ applies to runways with lower than ¾ sm approach visibility minimums. The POFZ applies to runways that utilize precision approaches.

Dimensions for both ROFZs are 400 feet wide (200 feet from the runway centerlines on either side) and 200 feet beyond all four runway ends, and there are no significant obstructions or penetrations within either ROFZ.

Both Runways 6L and 6R have IAOFZs, since both runway ends have existing ALSs. Within the Runway 6L IAOFZ, there is the Airport perimeter road, the Airport security fence, and Route 8. Within the Runway 6R IAOFZ, there is the Airport perimeter road, the Airport security fence, the ALS security fence, Route 8, Ramirez Street, Kanada-Toto Loop Road, and a conjoined McDonalds and Mobil Mart gas station. None of these items penetrate the 50:1 IAOFZ surface.

Runways 6L and 6R each have ITOFZs, as they have approach visibility minimums at less than ¾ SMs. Obstacles within the Runway 6L ITOFZ are Route 8 and part of the Mobil Mart gas station and conjoined McDonalds. Obstacles within the Runway 6R ITOFZ include Route 8, the Mobil Mart gas station/McDonalds, a Shell gas station, American Grocery, a multi-unit commercial office building, the Palmridge Inn, the Oasis Apartment Complex, and approximately 25 residential houses. Due to the elevation drop between the runway ends and these elements, none of these penetrate the 6:1 ITOFZ surface.

The POFZ is in effect when the approach includes vertical guidance, visibility is less than ¾ SMs, or when the ceiling is below 250 feet, and an aircraft is on final approach within two miles of the runway threshold. When the POFZ is in effect, an aircraft's wing can be within the POFZ when holding on an adjacent taxiway, but its fuselage and tail cannot. Runways 6L and 6R each have a POFZ. These POFZs would not be penetrated by aircraft taxing on nearby taxiways.

4.2.8.6 Runway Protection Zone

The RPZ is an area at ground level prior to the runway's landing threshold or beyond the runway end to enhance the safety and protection of people and property on the ground. RPZs are trapezoidal, and it is recommended that airports gain control of all land within an RPZ and maintain them clear of all incompatible uses within the boundaries of an RPZ. The FAA also recommends airports remove or mitigate the risk of any existing incompatible land uses in the RPZ as practical, including public roads.

The RPZ includes both an Approach RPZ (ARPZ) and a Departure RPZ (DRPZ). The ARPZ is located 200 feet from the runway threshold, while the DRPZ begins 200 feet beyond the runway end, or the far end of the TORA if it is not the same as the runway end. The ARPZ and DRPZ may be in the same location and have the same dimensions.

The Runway 24R DRPZ (located beyond the Runway 6L end) is not co-located with the Runway 6L ARPZ because of the 1,000-foot displaced threshold located beyond the runway. Similarly, the Runway 6R DRPZ (located beyond the Runway 24L end) is not co-located with the Runway 24L ARPZ because of the 1,004-foot displaced threshold located beyond the runway threshold and the Runway 24L DRPZ (located beyond the Runway 6R end) is not co-located with the Runway 6R ARPZ because of the drainage headwalls/declared distances modifications.

All RPZs beyond the Runway 24L and 24R ends are located entirely on Airport property, and the only incompatible land use within the boundaries of these RPZs is a wind cone within the Runway 24L ARPZ.

The majority of the ARPZ for Runway 6L is located on Airport property except for approximately 3.35 acres of land that falls outside of the Airport boundary and within Route 8, Kanada-Toto Loop Road, Ramirez Street, and Blas Lane. Similarly, the only portion of land that the Airport does not control within the Runway 24R DRPZ is 2.43 acres of land associated with Route 8.

Similarly, the majority of the DRPZ for Runway 24L is located on Airport property except for 4.37 acres of land. Incompatible land uses within that area include Route 8, the McDonalds/Mobil Mart gas station, American Grocery, and one residential house.

The Airport does not own 27.39 acres of land within the boundaries of the Runway 6R ARPZ. In addition, public roads such as Route 8, Ramirez Street, Blas Street, Calle Paquito, and Kanada-Toto Loop Road all lie within the boundaries of the runway's ARPZ, as well as about 20 residential houses, seven residential houses/buildings associated with Toto Gardens, half of the Oasis Apartment Complex, the McDonalds/Mobil Mart gas station, a portion of the Shell gas station, and American Grocery.

Additionally, there are power poles along Route 8 located within all four of these RPZs that may pose as an obstruction to the approaches or departures to these runways. See **Figure -9** for the existing non-standard conditions within the Runway 6L ARPZ, Runway 24R DRPZ, Runway 6R ARPZ, and Runway 24L DRPZ, and below for the FAA Runway Design Standards for an airfield with a D-V ARC.

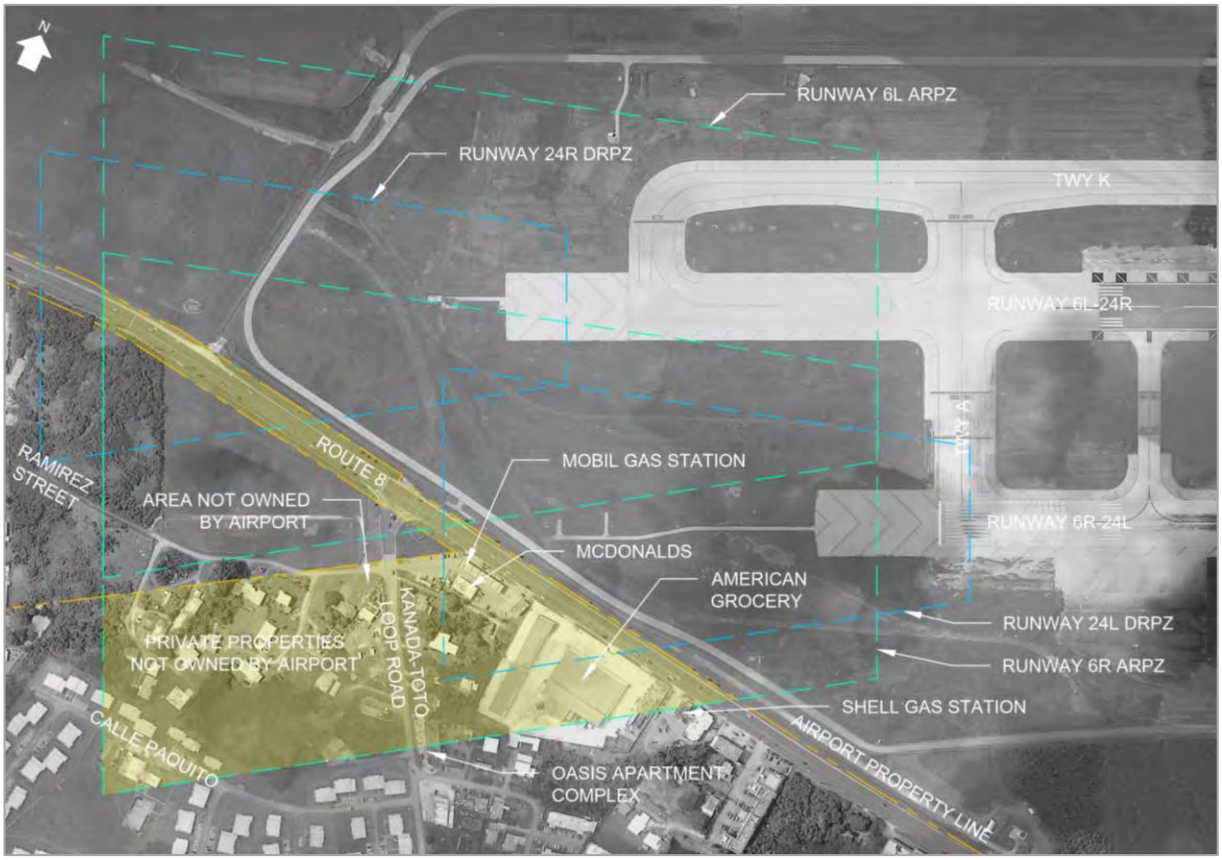

Figure 4-9. Runway 6L and 6R RPZ Non-Standard Conditions

Source: AECOM

able -12 FAA Runway Safety Area RSA Design Standards

Airport Reference Code ARC – D-V						
	Standard		**Runway End**			
Item	**½ SM Visibility**	**1 SM Visibility**	**6**	**2 R**	**6R**	**2**
Visibility Minimums	-	-	½ SM	1 SM	½ SM	1 SM
Runway Safety Area RSA						
Length Beyond Departure nd	1,000’		1,000’	1,000’	1,000’	1,000’
Length Prior to Threshold	600’		600’	600’	600’	600’
Width	500’		500’	500’	500’	500’
Runway Object Free Area ROFA						
Length Beyond Departure nd	1,000’		1,000’	1,000’	1,000’	1,000’
Length Prior to Threshold	600’		600’	600’	600’	600’
Width	800’		800’	800’	800’	800’
Runway Obstacle Free Zone ROFZ						
Length Beyond Departure nd	200’		200’	200’	200’	200’
Width	400’		400’	400’	400’	400’

Airport Reference Code ARC – D-V						
	Standard		Runway End			
Item	½ SM Visibility	1 SM Visibility	6	2 R	6R	2
Approach Runway Protection Zone ARPZ						
Length	2,500'	1,700'	2,500'	1,700'	2,500'	1,700'
Inner Width	1,000'	500'	1,000'	500'	1,000'	500'
Outer Width	1,750'	1,010'	1,750'	1,010'	1,750'	1,010'
Departure Runway Protection Zone DRPZ						
Length	1,700'		1,700'	1,700'	1,700'	1,700'
Inner Width	500'		500'	500'	500'	500'
Outer Width	1,010'		1,010'	1,010'	1,010'	1,010'

Notes:
Standard is for simultaneous VFR operations.
SM = Statute mile
Source: FAA AC 150/5300-13B, Airport Design, Appendix G

4.2.8.7 axiway System

The taxiway system provides for the safe and efficient movement of aircraft between the runways, commercial passenger terminal area, GA, cargo, and support facilities. The following paragraphs evaluate the Airport's taxiways according to design standards.

4.2.8.7.1 axiway Design

Taxiway design standards are based on the ADG and TDG of the design aircraft. The ADG determines the taxiway safety and object free areas, separation standards, and wingtip clearances, while the TDG determines the required taxiway width, main-gear safety margin, and shoulder width. **able -13** shows the taxiway and taxilane design requirements for ADG III, IV, and V, as well as TDG 3, 4, and 6, as these encompass all of the taxiway and taxilane design standards throughout the airfield.

able -13 axiway/ axilane Design Standards

Item	Airplane Design Group ADG III	Airplane Design Group ADG IV	Airplane Design Group ADG V
Safety Areas			
Taxiway Safety Area (TSA)	118'	171'	214'
Taxiway Object Free Area (TOFA)	171'	243'	285'
Taxilane Object Free Area (TLOFA)	158'	224'	270'
axiway Separation			
Parallel Centerline	144.5'	207'	249.5'
Fixed or Movable Object	85.5'	121.5'	142.5'
axilane Separation			
Parallel Centerline	138'	197.5'	242'
Fixed or Movable Object	79'	112'	135'
Wingtip Clearance			
Taxiway Wingtip Clearance	26.5'	36'	35.5'
Taxilane Wingtip Clearance	20'	26.5'	28'

Item	Airplane Design Group ADG III	Airplane Design Group ADG IV	Airplane Design Group ADG V
Item	**axiway Design Group DG 3**	**axiway Design Group DG**	**axiway Design Group DG 6**
Taxiway Width	50’	50’	75’
Taxiway dge Safety Margin	10’	10’	14’
Taxiway Shoulder Width	20’	20’	30’

Source: FAA AC 150/5300-13B, Airport Design, Table 4-1

An evaluation of the existing taxiway system reveals the non-standard conditions identified in **able -1** while **Figure -1** through **Figure -13** illustrate the non-standard taxiway conditions on the airfield.

able -1 Non-Standard axiways

Taxiway ID	ADG	TDG	Width	Paved Shoulders	Non-Standard Condition
A	V	6	150’	35’	No shoulder on the southwest portion of connector between the parallel runways Excess pavement width
B	V	6	75’	None	No shoulders
C	V	6	125’	None-30’	Excess pavement width
D	V	6	75-125’	None-30’	No shoulder between the parallel runways and between Runway 6R/24L and the south apron Excess pavement width between Taxiway K and Runway 6L/24R
E	V	6	75-125’	None-30’	No shoulders between the parallel runways and between Runway 6R/24L and the south apron Excess pavement width between Taxiway K and Runway 6L/24R
F	V	6	115’	30’	Excess pavement width
G	V	6	75-150’	None-30’	No shoulders between the parallel runways and between Runway 6R/24L and the south apron Trees/vegetation within TOFA between Runway 6R/24L and the south apron Below standard taxiway centerline to parallel south apron taxilane centerline[A] Excess pavement width between the parallel runways and between Runway 6L/24R and Taxilane K
J	V	6	90-150’	None-35’	No shoulders and excess pavement width between the parallel runways Trees/vegetation within TOFA and excess pavement width between Runway 6L/24R and the north apron
K	V	6	75’	35’	Excess pavement width at Runway 6L displaced threshold Judgmental oversteer centerlines between Taxiway K and Taxiways A, C, D, and E Below standard clearance between taxilane centerline and terminal Vehicle Service Road (VSR)[B]
L	IV/V	4/6	75’	25-100’	
South Apron	III/V	3/6	56-148’	0-30’	Below standard Taxiway G centerline to parallel taxilane centerline[C] Excess pavement width

Notes:

A. *Existing distance between taxiway centerline and taxilane centerline is 241’. Required distance is 249.5’ for ADG V. See* ***Figure 4-12****.*
B. *Existing distance between taxiway centerline and VSR is between 125.5’ and 127’. Required distance is 135’ for ADG V. See* ***Figure 4-13****.*
C. *Existing distance between taxiway centerline and taxilane centerline is 241’. Required distance is 249.5’ for ADG V. See* ***Figure 4-12****.*
D. *Abbreviations*
ADG = Airplane Design Group
TDG = Taxiway Design Group
TOFA = Taxiway Object Free Area

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

In addition to the non-standard conditions mentioned in **able -1** , where applicable, none of the taxiways meet FAA taxiway fillet design standards within runway to taxiway, taxiway to taxiway, and taxiway to taxilane intersections.

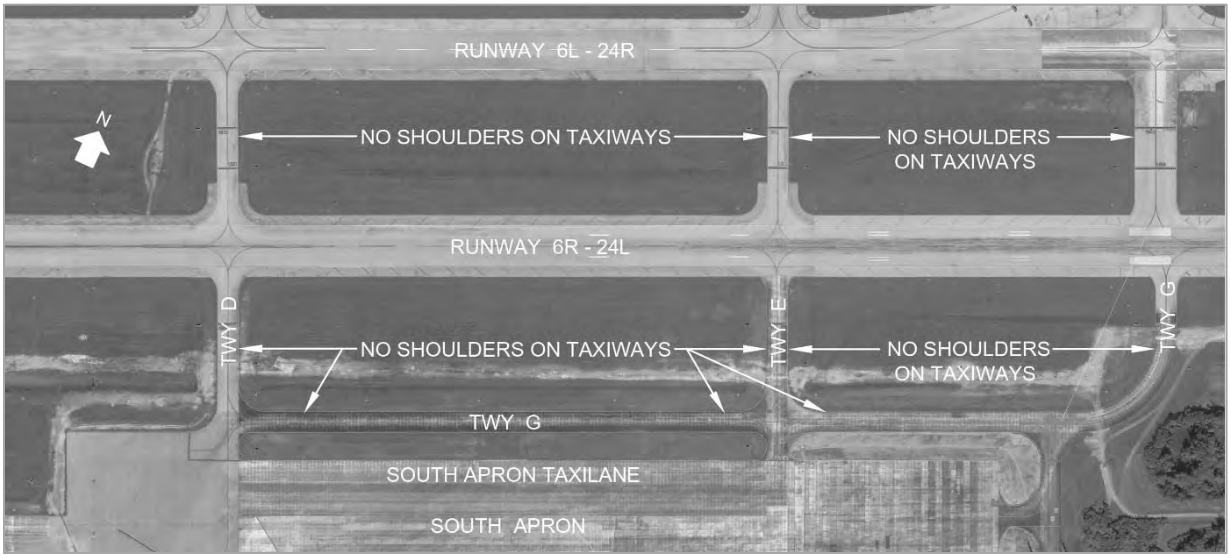

Figure 4-10. Non-Standard Taxiway/Taxilane Conditions – Lack of Paved Shoulders

Source: AECOM

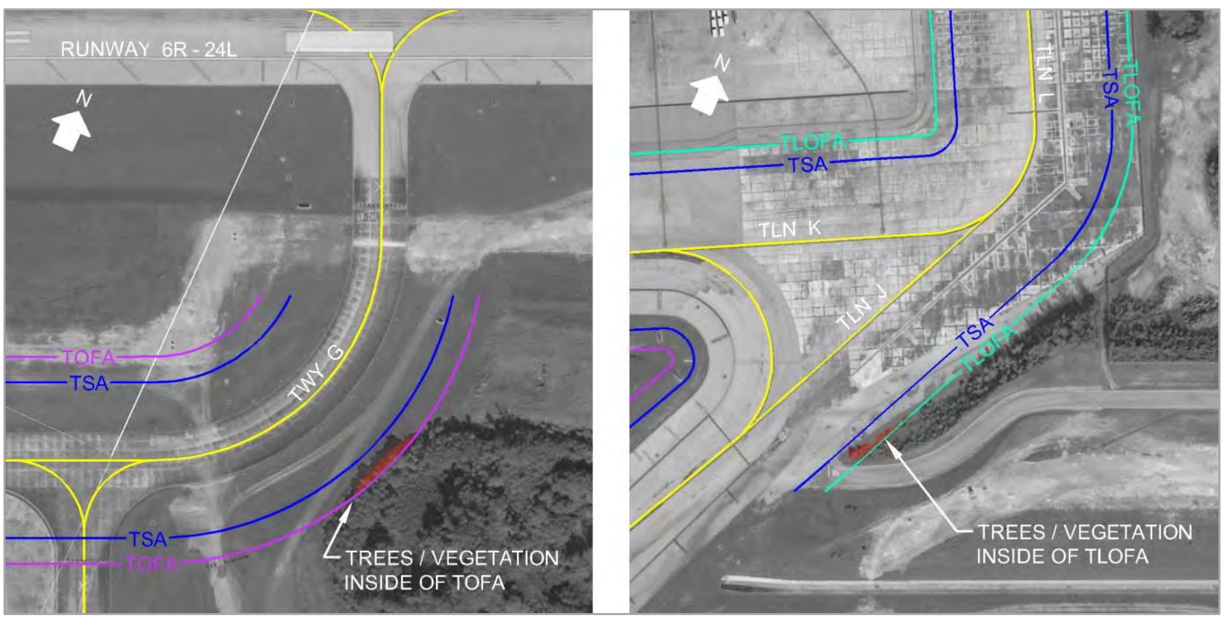

Figure 4-11. Non-Standard Taxiway/Taxilane – Trees/Vegetation Within TOFA

Source: AECOM

Figure 4-12. Non-Standard Taxiway/Taxilane Conditions – Below Standard Taxiway to Taxilane Separation

Source: AECOM

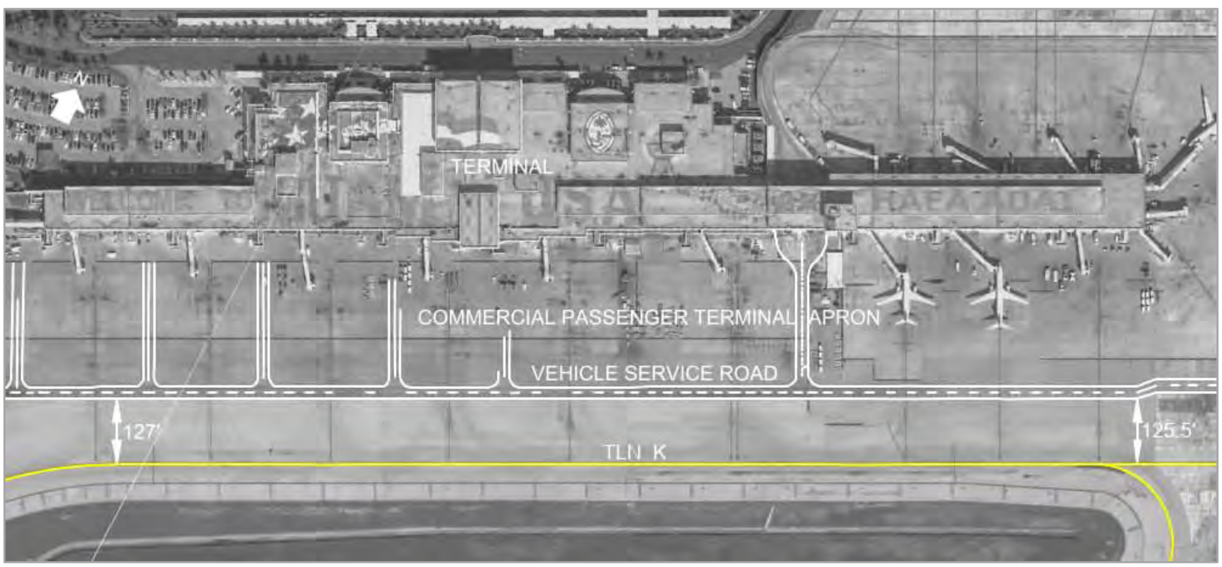

Figure 4-13. Non-Standard Taxiway/Taxilane Conditions – Below Standard Taxilane to Fixed Object Separation

Source: AECOM

4.2.8.7.2 Problematic axiway Geometry

Problematic taxiway geometry refers to areas with elevated risks of runway incursions and other aircraft safety threats. xa mples of problematic taxiway geometries include elements such as wide expanses of pavement at runway-taxiway intersections, entrance taxiways that intersect runways at something other than a right angle, complex runway-taxiway and taxiway-taxiway intersections, and direct access from an apron to a runway. A review of the taxiway system revealed multiple problematic geometries.

Six main issues were identified, three of which have five or more locations throughout the entirety of the taxiway system. See **able -1** and **Figure -1** through **Figure -16**.

able -1 Problematic axiway Geometry at the Airport

Problematic Geometry	Reasoning	Affected Taxiway/Taxilane
Short taxiways (stubs) between runways	• Can increase the risk of incursion by not providing enough distance for an aircraft to fit between adjacent RSAs • Hold bars located unexpectedly near the beginning of a taxiway provide insufficient warning to a pilot of the presence of a runway • Two hold lines close together can be confusing to pilots	A, B, D, E, G, J
Direct taxiing access to runways from ramp areas	• Can create the false expectation of a parallel taxiway prior to the runway • Taxiway geometries forcing the pilot to make turns promotes situational awareness and minimizes the risk of runway incursions	D, E, F, G, J
Short taxi distance from ramp/apron area to a runway	• Can create the false expectation of a parallel taxiway prior to the runway • Results in pilot confusion that could lead to a runway incursion • Taxiway geometries forcing the pilot to make turns promotes situational awareness and minimizes the risk of runway incursions	D, E,[A] F, G,[A] J
Wide expanses of taxi pavements entering or along a runway	• Can result in the placement of airfield signs far from a pilot's view, thus reducing the conspicuousness of critical visual cues (signs, markings, lighting) • Increases the risk for pilot loss of situational awareness	F, G
Entrance taxiway intersects runway at other than a right angle	• Acute angle reduces a pilot's field of view in one direction making it difficult for a pilot to detect an aircraft operating on the runway • Increases the width of the entrance pavement reducing the pilot's ability to maintain situational awareness	J
Use of a runway as a taxiway	• Can lead to runway incursions either by a pilot inadvertently attempting to takeoff or land on the runway while someone is taxiing or by a lapse in communication between air traffic controllers • Does not afford the same visual cues to a pilot since the signage is located far from the centerline, especially if they are to hold short of an intersecting runway	J/Runway 24R End

Notes:
A. There are multiple instances of short taxiing distance from a ramp/apron area to a runway for Taxiways E and G.
B. Abbreviation
RSA = Runway Safety Area
Source: FAA AC 150/5300-13B, Airport Design, Appendix J

Additionally, "hot spots" are locations in an airport movement area with a history or potential risk of collision or runway incursion, and where heightened attention by pilots and drivers are necessary. There are no "hot spots" located on the airfield.

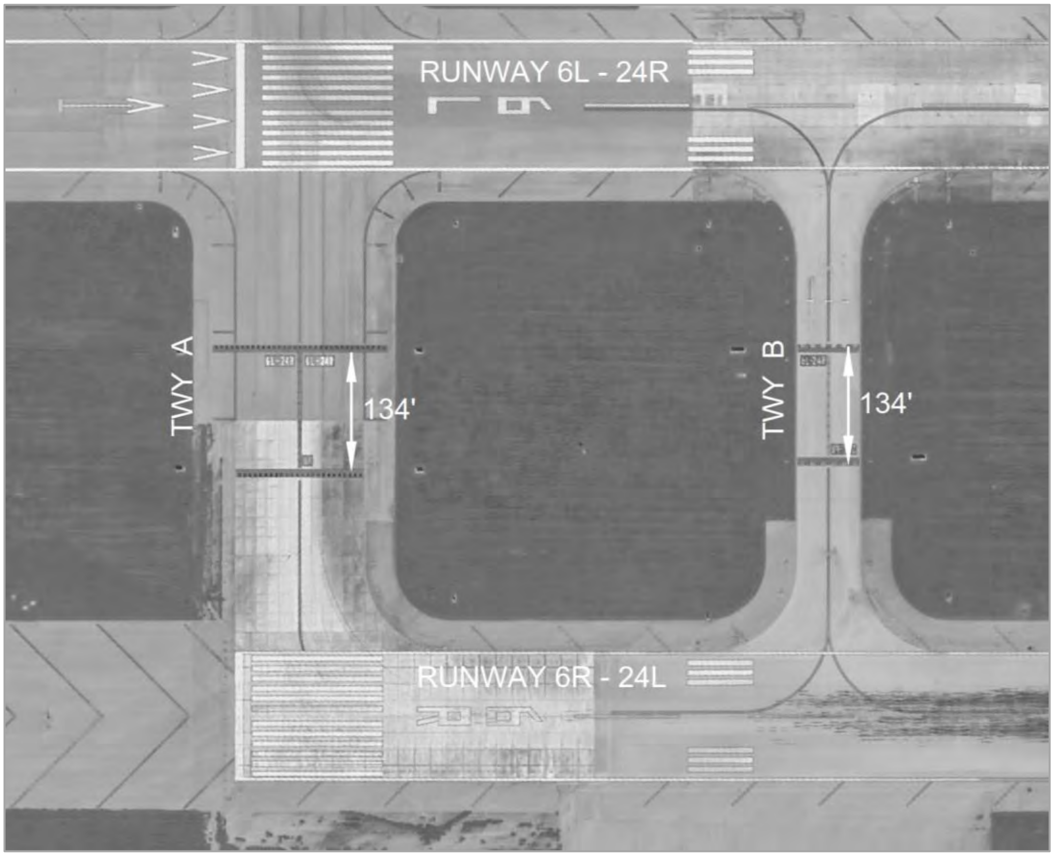

Figure 4-14. Problematic Taxiway Geometry – Short Taxiway Stubs Between Runways

Source: AECOM

Figure 4-15. Problematic Taxiway Geometry – Wide Expansive Pavement, Direct Access to Runway, and Short Taxi Distance

Source: AECOM

Figure 4-16. Problematic Taxiway Geometry – Taxiway Intersects at Other Than Right Angle, Direct Access to Runway, Short Taxi Distance, and Use of Runway as a Taxiway

Source: AECOM

4.2.8.8 Navigational Aids

a ch runway located at the Airport is equipped specifically for both visual and instrument approaches. All four runway ends have a 4-light Precision Approach Path Indicator (PAPI) system. Additionally, both runways are equipped with Instrument Landing Systems (ILS), which incorporate a signal from Localizer (LOC) antennas (located beyond the Runway 24L and 24R ends) and Glide Slope (GS) antennas (located approximately 1,000 feet in front of the Runway 6L and 6R thresholds) to provide horizontal and vertical guidance to pilots. Additionally, there are two lighted, supplemental wind cones located between the parallel runways toward the runway ends and an Automated Surface Observing System (ASOS) located in front of the south apron. The two wind cones are located within the two overlapping ROFAs and should be relocated.

4.2.8.9 Airport, Approach, Runway, and axiway ighting

Lighting at the Airport consists of a rotating beacon, the two ALSs, runway edge lights, taxiway edge lights, and apron lights to promote safe aircraft operations at night and in times of reduced visibility.

The Airport's rotating beacon is located on the roof of the commercial passenger terminal facility, between Gates 11 12. The rotating beacon consists of green and white flashing lights indicating the location of the Airport to pilots. This beacon meets existing and future requirements for airport identification during nighttime and periods with low visibility. No improvements are needed.

A Medium Intensity Approach Lighting System with Runway Alignment Indicator Lights (MALSR) is located on the approach end of Runways 6L and 6R. This approach lighting system is the FAA design standard for category (CAT) I approaches and no additional approach lighting systems are required at the Airport to meet the needs of existing or future aircraft operations.

Both runways are equipped with High Intensity Runway Lights (HIRL). This lighting satisfies FAA design standards for runways having precision instrument approaches and is sufficient for existing and future operational requirements.

The airfield is also equipped with taxiway edge lighting, which meets FAA standard. No additional lighting systems are required or recommended at the Airport.

4.2.9 Summary of Airfield Facility Requirements

The airside facility requirements section evaluates the existing airfield relative to the current FAA design standards and the future forecast demand. The following summarizes the minimum recommended airside improvements:

- Correct Runway 6L and 6R ROFA deficiencies and grade the existing terrain within the Runway 24L ROFA to that of the RSA
- Address drainage system within the Runway 24L RSA
- Address incompatible land uses for the RPZs beyond Runway 6L and 6R ends
- Construct taxiway shoulders for all or portions of Taxiways B, D, , G, and J
- Remove trees/vegetation within the TOFAs of Taxiways G and J
- Provide standard taxilane centerline to fixed object clearance between Taxilane K (ADG V) and fixed object (commercial passenger terminal apron VSR)
- Provide standard taxiway centerline to taxilane centerline separation between Taxiway G (ADG V) and the south apron taxilane (ADG V)
- Update taxiway fillet geometry for all taxiway intersections
- Reconfigure problematic taxiway geometries based on FAA design standards provided in **able -1**
- Relocate wind cones outside of ROFAs

The airfield alternatives section of **Chapter :** *Alternatives Development and Evaluation* of the Master Plan provides alternatives to help mitigate the issues identified in this section.

4.3 Commercial Passenger erminal Requirements

The commercial passenger terminal facility provides for the efficient transfer of passengers and baggage between surface vehicles and aircraft. The commercial passenger terminal is perhaps the most prominent feature of any airport. As such, the Antonio B. Won Pat International Airport Terminal (terminal) as shown in **Figure -1** is one of the primary focal points of the Master Plan. The core processing functions evaluated include:

- Terminal gates and aircraft parking stands
- Passenger check-in
- SSCP
- Outbound Checked Baggage Inspection System (CBIS)
- Holdrooms
- Secure and non-secure restrooms
- Concessions
- Inbound baggage claim
- U.S. CBP and Guam Customs and Quarantine Agency (CQA)

This section assesses the capability of the existing terminal to accommodate forecast peak hour demand and identifies additional facilities to support the expected growth in PALs. Improvements are also considered in some terminal areas to optimize the utilization of existing spaces and to enhance passenger experiences.

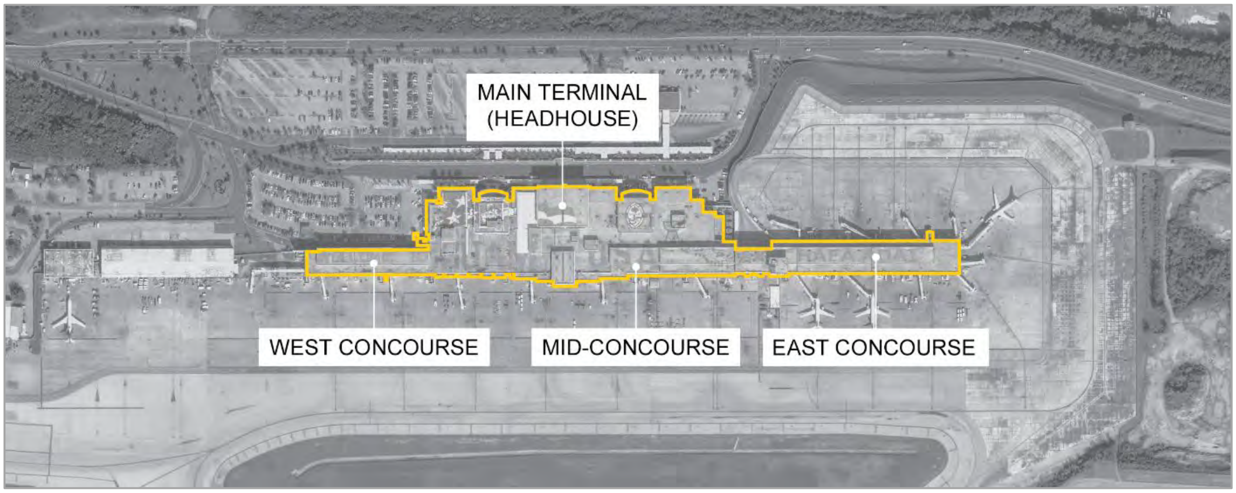

Figure 4-17. Existing Commercial Passenger Terminal Building

Sources:

1. *Google Earth*
2. *AECOM*

4.3.1 Methods, Assumptions, and Performance Specifications

Terminal facility requirements were developed based on a series of assumptions and parameters. Parameters were determined by identifying similarities with comparable airports and using terminal facility planning best practices and industry guidelines. Some of the Airport-specific assumptions were based on the observations and information collected during the site visit in March 2022.

Facility requirements can vary depending on the level of detail of the planning assumptions. The key assumptions used in this analysis were derived from the following major sources:

- Time and space standards as defined in the International Air Transport Association's (IATA's) *Airport Development Reference Manual* (ADRM) 11th edition, March 2021, as well as the ACRP Report 25: Airport Passenger Terminal Planning and Design, were both used as criteria and metrics.
- *Checkpoint Requirements and Planning Guide* (CRPG), September 2021, Transportation Security Administration (TSA).
- Planning Guidelines and Design Standards for Checked Baggage Inspection Systems (PGDS), Version 7.0, March 2020, TSA.
- Airport Technical Design Standards Manual (ATDS), November 2017, CBP.
- Relevant FAA Standards and ACs.
- Relevant ACRP Reports.

According to guidelines provided in the IATA ADRM, level of service (LoS) of many terminal facilities is dictated by two important variables: space and time—specifically queuing space and waiting time.

Figure -1 shows the LoS space-time diagram from IATA. The X-axis defines the amount of space available per occupant, whereas the Y axis denotes the maximum waiting time for passengers in queue. When both space and time fall within the optimum range, the facility is offering an acceptable LoS. Otherwise, the facility could be either underprovided, or overdesigned and require adjustments in either the time or space aspect. When planning for new or expanded facilities, typically the peak hour of the ADPM is used for demand, and the optimum LoS should be targeted for initial sizing. However, planning airport passenger terminal infrastructure is a complex matter; therefore, the LoS framework needs to be carefully assessed and understood before it is applied. One important consideration highlighted by IATA is that passenger demand usually fluctuates according to season, day of week, or time of day; as a result, the LoS will also vary through time. Airport sponsors should therefore target an optimum LoS with the knowledge that during peak traffic periods such as Thanksgiving and Christmas holidays the optimum LoS may not be achieved. Similarly, airport sponsors should also understand that during other periods of time, such as those with lower traffic than the typical busy periods, the LoS may fall into the over-design category. Hence, the best practice is to strike a reasonable balance between service quality and costs.

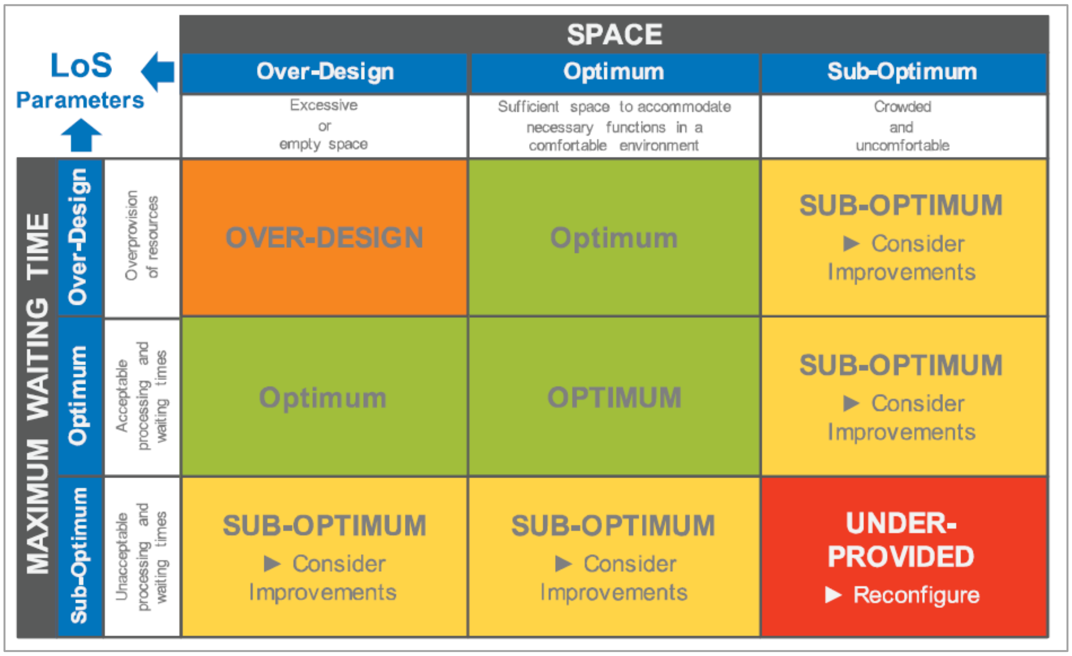

Figure 4-18. IATA LoS Space-Time Matrix for Processing Facilities

Note:

A. Abbreviation
LoS = Level of Service

Source: IATA

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Figure -19 shows the space and time LoS standards from IATA for each functional passenger processing area. This terminal facility requirements analysis uses the upper bound numbers in the optimum ranges; that is, it assumes higher waiting times (slower processing speeds) and smaller square-foot-per-passenger parameters. These assumptions estimate the minimum requirements to achieve the optimum LoS.

LoS Guidelines		SPACE GUIDELINES [SF/PAX]			MAXIMUM WAITING TIME GUIDELINES Economy Class [minutes]			MAXIMUM WAITING TIME GUIDELINES Business Class / First Class / Fast Track [minutes]			OTHER GUIDELINES & REMARKS		
	LoS Parameter:	Over-Design	Optimum	Sub-Optimum	Over-Design	Optimum	Sub-Optimum	Over-Design	Optimum	Sub-Optimum	Over-Design	Optimum	Sub-Optimum
Public Departure Hall (i.e., Check-in/Ticketing Lobby)		> 24.8	21.5 - 24.8	< 21.5	n/a			n/a			Optimum proportion of seated occupants: 15 - 20%*		
Check-in	Self-Service Kiosk (Boarding Pass/Bag Tagging)	> 19.4	14.0 - 19.4	< 14.0	< 1	1 - 2	> 2	< 1	1 - 2	> 2			
	Bag Drop Desk (queue width 4.6 - 5.2 feet)	> 19.4	14.0 - 19.4	< 14.0	< 1	1 - 5	> 5	< 1	1 - 3	> 3			
	Check-in Desk (queue width: 4.6 - 5.2 feet)	> 19.4	14.0 - 19.4	< 14.0	< 10	10 - 20	> 20	< 3 < 1	Business Class 3 - 5 First Class 1 - 3	> 5 > 3			
(i.e., Secruity Screening Checkpoint) (queue width: 4 feet)		> 12.9	10.8 - 12.9	< 10.8	< 5	5 - 10	> 10	< 1	Fast Track 1 - 3	> 3			
Gate Holdrooms ***	Seating	> 23.7	19.4 - 23.7	< 19.4	n/a			n/a			Optimum proportion of seated occupants: 50 - 70%*		
	Standing	> 16.1	12.9 - 16.1	< 12.9									
Immigration Control (Inbound Passport Control) (queue width: 4 feet)	Staffed Immigration Desk	> 12.9	10.8 - 12.9	< 10.8	< 5	5 - 10	> 10	< 1	Fast Track 1 - 5	> 5			
	Automatic Border Control	> 12.9	10.8 - 12.9	< 10.8	< 1	1 - 5	> 5	n/a					
Baggage Reclaim	Narrow Body Aircraft	> 18.3	16.1 - 18.3	< 16.1	< 0	0 / 15	> 15	< 0	0 / 15	> 15	The first waiting time value relates to "first passenger to first bag". The second waiting time value relates to "last bag on belt" (counting from the first bag delivery).**		
	Wide Body Aircraft	> 18.3	16.1 - 18.3	< 16.1	< 0	0 / 25	> 25						
Customs Control		> 19.4	14.0 - 19.4	< 14.0	< 1	1 - 5	> 5	< 1	1 - 5	> 5	Waiting time refer to a procedure when 100% of the passengers are being checked by Customs		
Public Arrival Hall (i.e., Baggage Claim Area)		> 24.8	21.5 - 24.8	< 21.5	n/a			n/a			Optimum proportion of seated occupants: 15 - 20%*		

* Lower limit to be considered only if extensive F+B seating is provided (within concession zones)
** The time between the first passenger arriving at the reclaim belt and the first baggage arriving on the reclaim belt should be zero minutes, in order to maximize the efficiency of checking a hold bag for the passenger. Bags delivered to the reclaim prior to passengers arriving at the reclaim belt (negative waiting times) can be considered over-design. The time to deliver all bags from a flight should be no more than first-bag delivery
+15 minutes for narrow body aircraft flights and
+25 minutes for a wide body aircraft flights.
*** The space requirements for Gate Holdrooms have been updated incorporating the Maximum Occupancy factor in the space requirements

NB with regards to chapter 3.4.5.2 - LoS Category UNDER-PROVIDED: For processing facilities, the LoS UNDER-PROVIDED only results when both space and waiting time parameters are sub-optimum. For the boarding gate lounge and holdrooms, the LoS UNDER-PROVIDED only results when space parameter and seating requirements is sub-optimum. For the public departure and arrival halls, the LoS UNDER-PROVIDED only results when the space per occupant is 80% or less than the targeted optimum LoS parameter.

Figure 4-19. IATA LoS Guidelines for Airport Terminal Facilities

Note: Conversions from International System of Units (SI) units to imperial units by AECOM.
Source: IATA ADRM 11th edition

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Future terminal requirements can be determined, in part, by identifying the number of peak hour passengers projected to flow through the terminal. Peak hour passenger volumes are derived from the aviation demand forecast. Peak hour enplanement and deplanement demand was approximated through a rolling 60-minute flow of arriving and departing passengers across the design day. **able -16** provides a summary of peak hour enplanements and deplanements throughout the planning horizon. For the purposes of this section, years associated with all forecasts will be designated as its FY unless stated otherwise. FY2019 is considered the base year while FY2024 is considered PAL 1, FY2029 is considered PAL 2, FY2034 is considered PAL 3, and FY2039 is considered PAL 4.

able -16 Peak our Enplanements and Deplanements

PA	Annual Enplanements[A]	Peak our Enplanements	Peak our Deplanements
istorical			
FY2019 (Base Year)	1,885,108	1,477	1,483
Forecast			
PAL 1 (FY2024 / Base Year + 5 years)	1,277,397	1,001	1,005
PAL 2 (FY2029 / Base Year + 10 years)	1,960,402	1,536	1,542
PAL 3 (FY2034 / Base Year + 15 years)	2,123,073	1,663	1,670
PAL 4 (FY2039 / Base Year + 20 years)	2,312,858	1,812	1,820

Note:
A. *Annual enplanement forecasts for the baseline scenario.*
B. *Abbreviation*
PAL = Planning Activity Level
FY = Fiscal year

Source: ***Chapter 3****: Aviation Demand Forecasts*

Peak hour enplanements and deplanements include origin and destination (O&D) passengers as well as connecting passengers. As identified in **Section 3 2 3**, between 87 and 91 percent of the Airport's enplaned passengers are O&D passengers and 9 to 13 percent are connecting passengers. For the purpose of projecting terminal facility requirements, peak departure and peak arrival demand profiles assume 100 percent O&D since all inbound international connecting passengers require the same baggage claim and immigration processing as all terminating passengers. Furthermore, outbound international connecting passengers typically arrive in the evening or after midnight for morning departures. Because of the long layover in Guam (over three hours), some connecting passengers may leave the secured concourse and return to the terminal for check-in and security screening the next morning. Assuming 100 percent O&D ensures sufficient check-in and security screening facilities if some connecting passengers choose to leave the secured concourse during the layover.

4.3.2 erminal Gates and Aircraft Parking Stands

The number of terminal gates and associated aircraft parking stands directly impacts the space requirements for other functional areas of the terminal. Therefore, the terminal analysis first evaluated the capacity (number and size) of existing gates against anticipated demand.

Most airlines typically attempt to minimize occupancy times to maximize aircraft and gate utilization. In general, gate or parking stand (contact or remote) shortages may occur if:

- Demand exceeds available capacity
- Demand for large aircraft increases unexpectedly
- Aircraft remain at the gate for an extended period

Hence, the capacity of gates or stands is closely related to the number and type of aircraft parking stands, occupancy time (turns), availability of multiple aircraft ramp stands (or restrictions between adjacent gates), and the type of gate or stands (contact or remote). The existing demand patterns and gate utilization characteristics are based on the airline design day flight schedule (DDFS) in the base month and year (August 2019).

4.3.2.1 Gate Utilization Characteristics

The existing gate utilization characteristics are based on the ADPM flight schedule in the base year and aircraft parking information (i.e., the apron striping plan) from the Airport. The gate utilization characteristics are as follows:

- All the gates are common use, which can be assigned to any airline by the Airport on an as-needed basis.
- A total of 17 contact gates are provided at the terminal. **able -1** summarizes the details.
- There is a bus gate at the apron level (Gate 11) that provides airside bus service for passengers to/from a remote stand (Stand 3) if required. However, there has not been a need for the airside bus service in recent years. Both passenger and cargo aircraft can use this remote Stand 3.
- Remote Stands 1 and 2 are outside the light aircraft commuter terminal for parking of small GA aircraft such as the Cessna 208 aircraft operated by Star Marianas Air for delivery of passengers and cargo under the GA and air taxi category.
- All of the contact stands (Stands 4 to 21) and remote Stands 1 to 3 are located at the commercial passenger terminal apron.
- The south apron provides nine remote stands (Stands S1 to S9). Hangar VQ1, where United Airlines provides line maintenance to support their operations in Japan and China, is also located at the south apron.
- Analysis of the 2019 DDFS revealed the following activity:
  - 2.2 daily departures (or turns) per gate.
  - 15 gates (11 ADG III and 4 ADG V) were required during the peak period.
  - United had 7 to 11 aircraft[60] remain overnight (RON).
  - Other airlines (OAL) had 2 aircraft RON.
- RON passenger aircraft typically stay at the contact gate if they are scheduled for departures in the early morning on the next day. Otherwise, they may be towed to the remote stands (Stand 3 in the commercial passenger terminal apron or Stands S1 to S9 at the south apron) to vacate the contact gate at the terminal for use by other aircraft.

able -1 Existing Contact and Remote Gates and Stands

Type	Gate Number	Stand Number	Airplane Design Group (ADG)	Largest Aircraft (based on wingspan)	Remark
North Apron (Commercial Passenger Terminal)					
Contact[A]	Gate 4	Stand 4	ADG VI	B747-8	
Contact[A]	Gate 5	Stand 5	ADG IV	B767-400	
Contact[A]	Gate 6	Stand 6	ADG V	B777-300ER	
Contact[A]	Gate 7	Stand 7	ADG V	B777-300	
Contact[A]	Gate 8	Stand 8	ADG V	B777-300ER	
Contact[A]	Gate 9	Stand 9	ADG V	B777-300ER	
Contact[A]	Gate 10	Stand 10	ADG V	B777-300ER	
Contact[A]	Gate 12	Stand 12	ADG IV	B767-300	
Contact[A]	Gate 13	Stands 13, 13A	ADG III	B737-800	Stand 13A is dependent on Stands 13 and 15
Contact[A]	Gate 14	Stand 14	ADG IV	B767-300	
Contact[A]	Gate 15	Stands 15, 15A	ADG III	B737-800	Stand 15A is dependent on Stand 15

[60] According to *Marianas Business Journal* and *Guam News*, United used to have 11 aircraft based in Guam in 2016 (seven B737-800s and four B737-700s).

Type	Gate Number	Stand Number	Airplane Design Group (ADG)	Largest Aircraft (based on wingspan)	Remark
Contact[A]	Gate 16	Stand 16	ADG IV	B767-400	
Contact[A]	Gate 17	Stand 17	ADG III	B737-800	
Contact[A]	Gate 18	Stand 18	ADG VI	B747-8	
Contact[A]	Gate 19	Stand 19	ADG III	B737-800	
Contact[A]	Gate 20	Stand 20	ADG IV	B767-300	
Contact[A]	Gate 21	Stand 21	ADG V	B777-3ER	
Remote[B]	Gate 11 (Bus Gate)	Stands 3, 3A	ADG VI	B747-8	Stand 3A is dependent on Stand 3 Accommodate up to B747-8
Sub-Total for Commercial Passenger Terminal	**17 Contact Gates** **1 Remote Gate**	**17 Contact Stands** **1 Remote Stand**	**3 ADG VI,** **6 ADG V,** **5 ADG IV,** **& 4 ADG III**		Only independent gates/stands are counted
North Apron (Light Aircraft Commuter Terminal)					
Remote[C]	Gate 1	Stands 1, 1A	ADG I	Cessna 208	Stand 1A accommodates ADG V aircraft but it is dependent on Stands 1 and 2
Remote[C]	Gate 2	Stands 2	ADG I	Cessna 208	
Sub-Total for Light Aircraft Commuter Terminal	**2 Remote Gates**	**2 Remote Stands**	**2 to 4 ADG I**		
South Apron					
Remote	N/A	Stand S1	ADG V	B777-300	
Remote	N/A	Stands S2, S2A, S2B	ADG V	B747-400	Stands S2A and S2B are for ADG III aircraft. These are dependent parking positions at the airside access to the ACI hangar.
Remote	N/A	Stand S3	ADG V	B747-400	
Remote	N/A	Stand S4	ADG IV	B767-400ER	ADG IV instead of V because of the vehicle service road
Remote	N/A	Stands S5, S5A, S5B	ADG V	B747-400	Stands S5A and S5B are for ADG III aircraft. These are dependent on parking positions at the airside access to the United hangar.
Remote	N/A	Stand S6	ADG V	B747-400	
Remote	N/A	Stand S7	ADG V	B747-400	
Remote	N/A	Stand S8	ADG V	B747-400	
Remote	N/A	Stand S9	ADG V	B747-400	
Sub-Total for South Apron		**9 Remote Stands**	**8 ADG V** **& 1 ADG IV**		

Notes:

- *A. Passengers access aircraft via passenger boarding bridges (PBBs).*
- *B. Passengers access aircraft by bus.*
- *C. Passengers access aircraft by walking to/from the light aircraft commuter terminal building.*
- *D. Abbreviations*
  N/A = Not available
  ACI = Aviation Concepts, Inc

Source: Apron striping plans from GIAA

4.3.2.2 Contact Gate Requirements

Contact gate requirements for the Airport were developed using two approaches from ACRP Report 25: *Airport Passenger Terminal Planning and Design*, the average enplaned passengers per gate approach, and the departures per gate approach.

4.3.2.2.1 Enplaned Passengers per Gate Approach

The enplaned passengers per gate approach uses the current ratio of annual passengers per gate, adjusted for forecast changes in fleet mix and annual load factors. This approach assumes that the pattern of gate utilization will remain relatively stable over the 20-year forecast period.

The future gate requirements determined in the average passengers per gate approach are driven by the growth rates of enplaned passengers per departure. The growth in enplanements per departure is used to determine the enplanements per gate for forecast planning years. The number of required gates in those years is then determined by dividing the annual enplaned passengers by the enplaned passengers per gate values.

4.3.2.2.2 Departures per Gate Approach

While the enplaned passengers per gate approach assumes that the pattern of service and gate utilization is basically stable, the departures per gate approach considers the possible change in gate utilization. For example, airlines may add flights to their hub airports from spoke cities, which typically results in higher gate utilization. On the other hand, if there are new entrant airlines, they are more likely to follow existing scheduling patterns, which may result in a demand for gates during the same afternoon peak and reduce the average gate utilization.

For the case of Guam, the peak period is in the afternoon because flights from the top Asian markets like Japan and Korea mostly depart in their morning and arrive at Guam in the early afternoon for a turnaround by late afternoon. The growth in demand is more likely at the same afternoon peak. Hence, the increase in average gate utilization may be minimal. The departures per gate approach assumes a slight increase in average daily gate utilization from 2.2 departures per gate in 2019 to 2.5 departures per gate by 2039. This growth in daily departures per gate was used to determine the annual departures per gate for the forecast period. The number of required gates was then determined by dividing the annual departures by the annual departures per gate values.

able -1 summarizes the gate requirements from the estimation by both methods. The existing 18 gates (17 contact and one remote) are adequate to accommodate the projected gate requirements. See **Section 6** for additional information on projected gate requirements.

able -1 Gate Requirements

PAL	Annual Enplanements	Annual Departures	Enplaned Passengers per Gate Approach			Departures per Gate Approach			Gate Requirements (Average of both methods)
			Annual Enplaned Pax per Gate	Enplaned Pax per Departure	No. of Gates	Annual Departures per Gate	Daily Departures per Gate	No. of Gates	
FY2019 (Base Year)	1,885,108	11,645	125,674	162	15	776	2.2	15	**15**
PAL 1 (FY2024)	1,277,397	10,506	94,390	122	14	776	2.2	14	**14**
PAL 2 (FY2029)	1,960,402	12,603	120,752	156	16	812	2.3	16	**16**
PAL 3 (FY2034)	2,123,073	13,351	123,446	159	17	847	2.4	16	**16**
PAL 4 (FY2039)	2,312,858	14,223	126,240	163	18	882	2.5	16	**17**

Note:

A. Abbreviation
PAL = Planning Activity Level
FY = Fiscal year

4.3.2.3 RON Requirements

Near the end of the evening when airline arrivals outnumber available gates and no departures are scheduled until the following day, these aircraft are considered RON aircraft. RON aircraft parking is a key component of an airline's operation to ensure that the right aircraft is located at the correct airport to begin daily operations. Total RON parking consists of on-gate and off-gate aircraft parking positions. On-gate RON positions use a contact gate that may include a passenger boarding bridge. Off-gate RON positions are those that cannot be accommodated at a contact gate and must be parked at remote stands. The need to vacate the contact gates for mid-night arrivals and early morning departures are considered. The number of off-gate RON positions is the total RON demand minus the number of contact gates.

RON parking is a fluid aspect of terminal apron requirements and can vary based on the available gates to use for RON aircraft parking. Sometimes a gate used by an airline needs to remain vacant overnight and cannot be used for RON by another airline due to early morning scheduling of arrivals and departures. Based on the 2019 DDFS, 10 gates were required for early arrivals and departures between 1 a.m. and 5 a.m. at the Airport. Hence, only 7 contact gates were available as on-gate RON positions in the base year.

able -19 summarizes the RON aircraft parking requirements for the 20-year planning horizon. The existing 10 remote stands are adequate to accommodate the off-gate RON requirements.

able -19 RON Aircraft Parking Requirements

PA	otal RON Demand[A]	On-Gate RON	Off-Gate RON
FY2019 (Base Year)	13	7	6
PAL 1 (FY2024)	13	8	5
PAL 2 (FY2029)	13	6	7
PAL 3 (FY2034)	14	6	8
PAL 4 (FY2039)	14	5	9

Notes:

A. *The total RON demand assume United Airlines has 11 based aircraft at the Airport that require overnight parking regularly.*

B. *Abbreviation*
PAL = Planning Activity Level
FY = Fiscal year
RON = Remain overnight

4.3.3 Passenger Check-in

The airline check-in process continues to evolve with technological advances such as added self-service facilities that provide convenience, efficiency, and more passenger control in the check-in process. As the technology evolves in the future, facility requirements for check-in facilities will inevitably evolve as well. The objective is to provide space flexible enough to respond to such evolution.

4.3.3.1 ey Assumptions

Passengers arrive at the Airport for a departing flight allowing time for check-in, security screening, concessions, and flight boarding. The number of minutes that passengers arrive at the terminal before a scheduled flight departure is referred to as an arrival curve or show-up profile. Since passenger activity is not evenly distributed during the peak hour, but more typically follows a curved distribution, the base year DDFS also helps with constructing a passenger show-up profile to understand how many passengers are processed through each facility during the peak 15, 30, 60, 120, and 240 minutes and reference the PGDS.

The show-up profiles used to estimate the peak demands for international and domestic passengers are given in **Figure -2** . These profiles incorporate the following opening hours and cut-off time for checking-in at the Airport:

- Agent counters are opened three hours before scheduled departure time.
- Passengers must check in their bags no later than 45 minutes before scheduled departure time for international flights and 30 minutes before scheduled departure time for domestic flights.

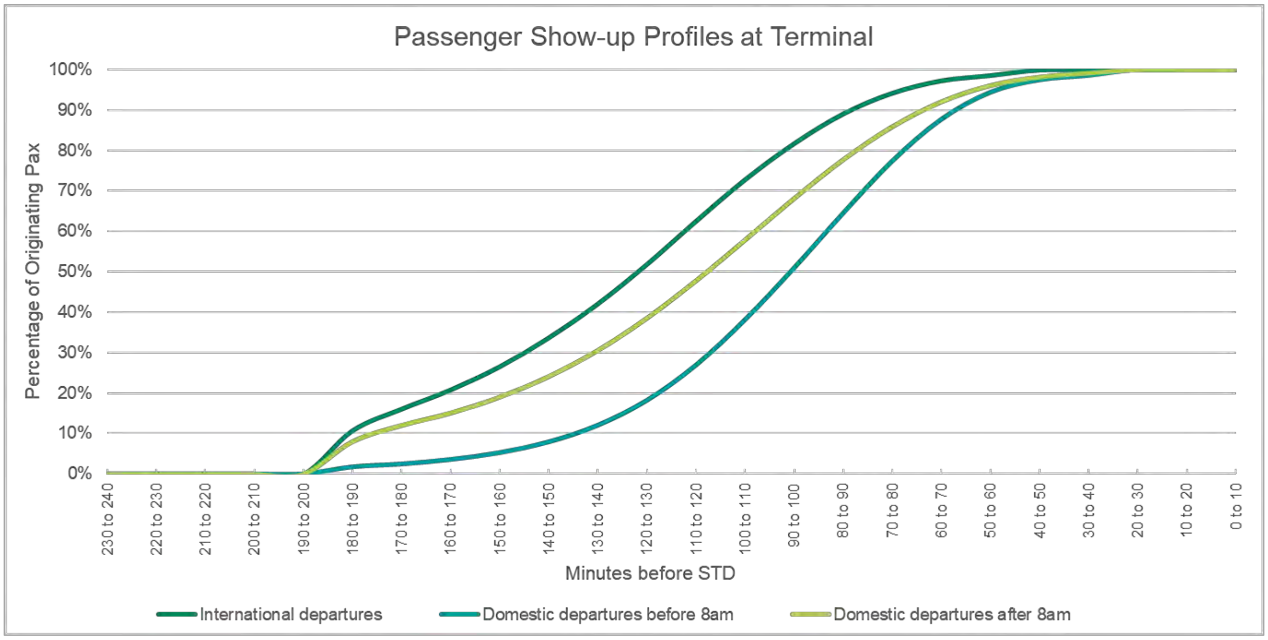

Figure 4-20. Passenger Show-up Profiles at Terminal

Note:
A. Abbreviation
STD = Scheduled Time of Departure
Source: PGDS v7.0 – Adjusted for counter opening hours.

Figure -21 and **Figure -22** illustrate the domestic and international originating passenger flows. **able -2** summarizes the percentages of passengers using different check-in options by airlines and travel class. The data are presented based on two processes: the options for getting boarding passes, and the options for checking in bags.

Airlines typically provide three options for getting boarding passes at the Airport:

- Full-service agent counters (Premium/ conomy)
- Self-service kiosks (Premium/ co nomy, include scale, bag activation, and induction by agent)
- Mobile/online

Among the three options, passengers can check in their bags at full-service agent counters. United Airlines (UA) provides self-service kiosks that include the scale and induction points for passengers to drop their bags at the kiosk positions. With mobile/online boarding pass retrieval, passengers still need to proceed to a counter or kiosk position to check in their bags. Therefore, in **able -2** , the percentages of passengers who have checked bags are reported separately from passengers who use the three options for getting boarding passes.

able -2 Check-in Options

Airlines/Travel Class/Market	Options for Obtaining Boarding Pass [C]				Mobile/Online with Bags	Mobile/Online without Bags (Go straight to SSCP)
	Full-Service Agent Counters	Self-Service Kiosks	Mobile/Online	Total		
UA Premium Domestic[A]	50%	30%	20%	100%	20% x 70% = 14%	6%
UA Premium International[A]	60%	20%	20%	100%	20% x 90% = 18%	2%
UA Economy Domestic[A]	30%	50%	20%	100%	20% x 70% = 14%	6%
UA Economy International[A]	40%	40%	20%	100%	20% x 90% = 18%	2%
OAL Premium International[B]	90%	0%	10%	100%	10% x 90% = 9%	1%
OAL Economy International[B]	90%	0%	10%	100%	10% x 90% = 9%	1%

Notes:

- *A. UA departure peak is in the morning, and it includes both domestic and international departures.*
- *B. OAL departure peak is in the afternoon, and they are all international departures.*
- *C. Percentage split for check-in options reference other recent projects and adjusted for the characteristics of the Airport.*
- *D. Abbreviation*
  SSCP = Security Screening Checkpoint
- *E. Airline Abbreviations*
  UA = United Airlines
  OAL = Other Airlines

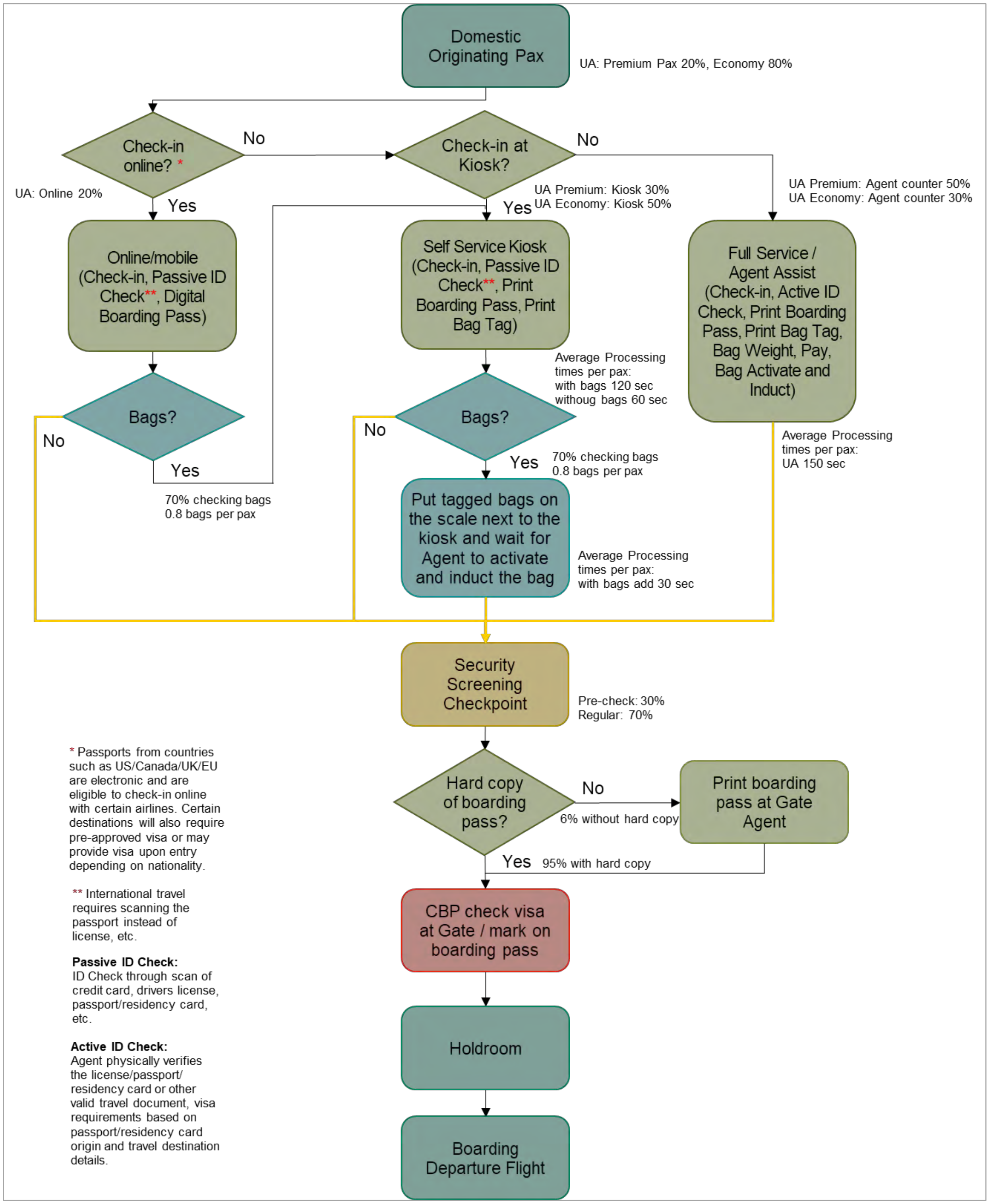

Figure 4-21. Domestic Originating Passenger Flows

Source: AECOM

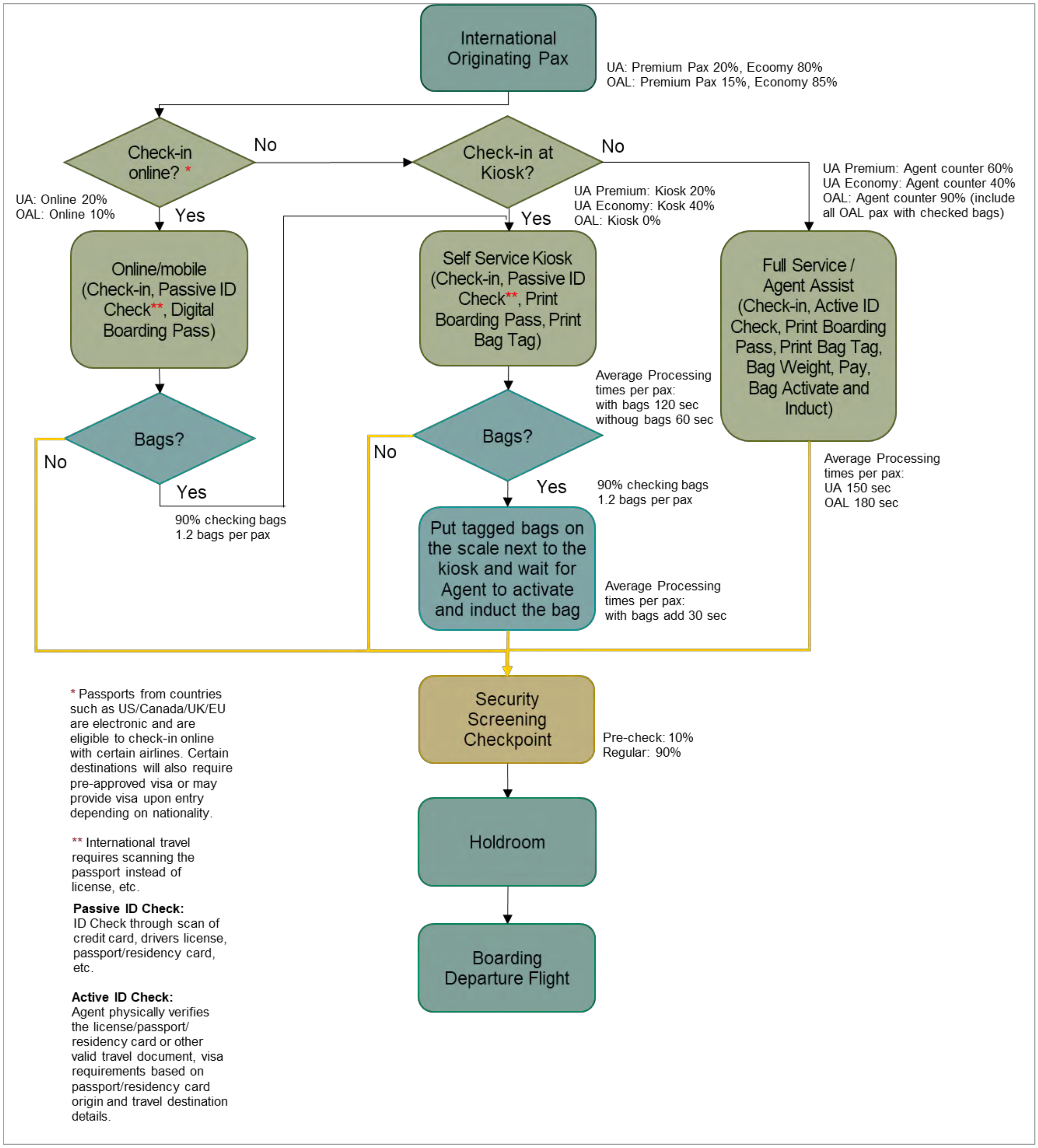

Figure 4-22. International Originating Passenger Flows

Source: AECOM

able -21 provides a summary of passengers with checked bags and the average number of checked bags per passenger. Leisure travelers usually have a higher number of checked bags than business travelers. Flights to/from Asia also tend to have more checked bags than U.S. domestic flights. Hence, the percentage of passengers with checked bags and the average number of checked bags per passenger for Guam is slightly higher than other commercial airports across the nation.

able -21 Percentage of Passengers with Checked Bags and Average Checked Bags per Passenger

Airlines/Market	Percentage of Passengers with Checked Bags	Average Checked Bags per Passenger[A]
UA Domestic	70%	0.8 bags/passenger
UA International	90%	1.2 bags/passenger
OAL International	90%	1.2 bags/passenger

Note:
A. Includes passengers without bags.
B. Airline Abbreviations
UA = United Airlines
OAL = Other Airlines

Airlines typically provide dedicate check-in counters and kiosks for premium passengers, which include their first and business class passengers and members of frequent-flyer programs. **able -22** summarizes the assumed percentages of premium passengers for different airlines.

able -22 Premium Passenger Percentages

Airlines/Market	Percentage of Premium Passengers
UA Domestic	20%
UA International	20%
OAL International	15%

Note:
A. Airline Abbreviations
UA = United Airlines
OAL = Other Airlines

able -23 summarizes average passenger check-in processing times at different check-in facilities. The information is based on assumptions used in other commercial airports and validated with observations during the site visit at the Airport in March 2022.

able -23 Average Check-in Processing imes per Passenger

	Average Check-in Processing imes per Passenger seconds		
Airlines	Full-service Agent Counters	Self-Service iosks without Bags	Self-Service iosk with Bags[A]
UA	150	60	150
OAL	180	N/A	N/A

Notes:
A. Includes printing bag tags, bag activation, and induction by agent.
B. Airline Abbreviations
UA = United Airlines
OAL = Other Airlines
C. Abbreviation
N/A = Not Applicable

able -2 provides a simplified summary of the maximum waiting time from the IATA ADRM LoS guidelines for the check-in facilities.

able -2 Maximum Waiting ime in Queue for Optimum oS

Check-in Facility	**Maximum Waiting ime Minutes**
Premium full-service agent counters	5
conomy full-service agent counters	20
Premium/ conomy self-service kiosks (without bags)	2
Premium kiosks with agent for bag activation and induction	3
conomy kiosks with agent for bag activation and induction	5

Note:
A. Abbreviation
LoS = Level of Service
Source: IATA ADRM

4.3.3.2 Check-in Facility Requirements

The existing terminal has a total of 88 check-in positions, including 76 positions with baggage induction points and 12 additional positions that require airlines/ground handlers to deliver the checked bags from the counters to an induction point by carts and feed them manually into the baggage handling system. The 76 check-in positions are divided into the UA check-in area, the a st check-in area, and the West check-in area. The additional 12 positions without induction points are located by the entrances between the a st and West check-in areas. **Figure -23** to **Figure -2** show the existing check-in areas.

UA has dedicated full-service counters and kiosks at the UA check-in area (**Figure -26**). OAL use the Airport's common use full-service check-in counters in the a st or West check-in areas. Common use counters and the additional isolated counters are allocated to airlines during their active operation (**Figure -2** and **Figure -2**). Passengers from other carriers cannot use a full-service counter not assigned to their airline. Hence, the check-in facility requirements for UA and OAL are estimated separately during their corresponding peak periods. UA requirements are based on UA's morning peak for both international and domestic departures. OAL requirements are based on the Airport's afternoon peak for international departures and are estimated by individual airlines. The total Airport requirements are the sum of UA and OAL check-in requirements.

The facility requirements focus on both the number of units needed and the queue space required to achieve optimum LoS. Based on the processing time per passenger, the maximum allowable queue time, the passenger show-up profiles, and the queue space required, the check-in facility requirements were calculated. **able -2** presents the requirements for agent counters and kiosks (with agents for bag activation and induction) in terms of the number of units and the queue space required.

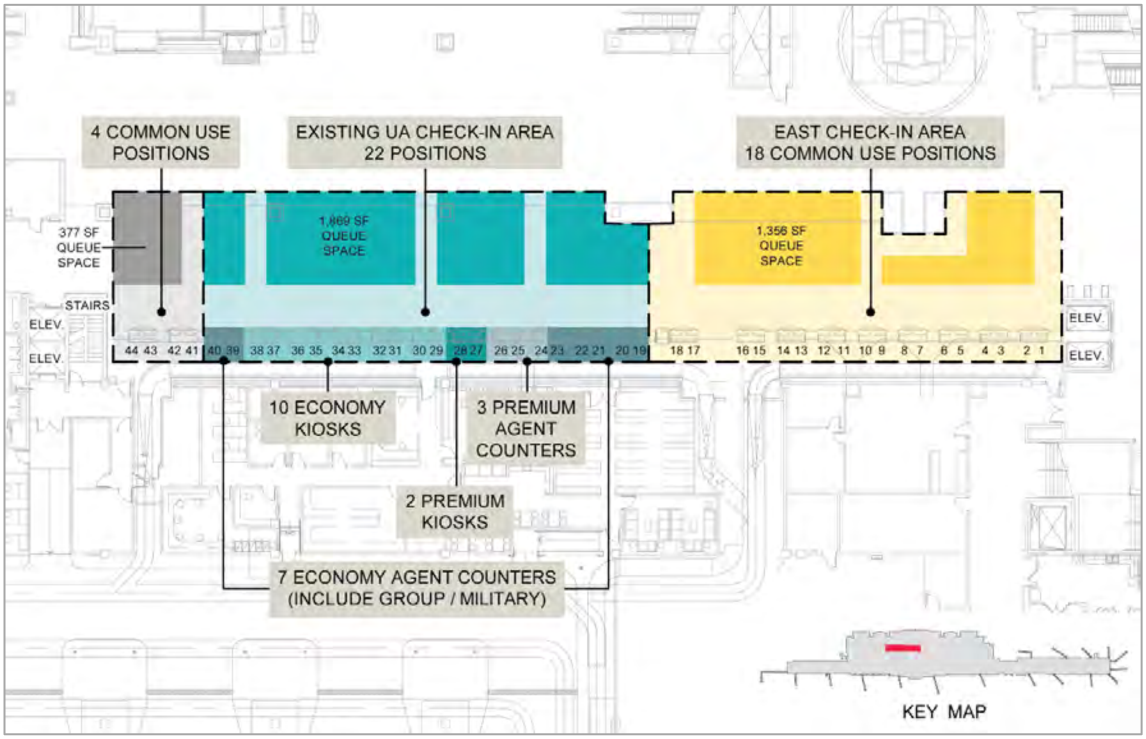

Figure 4-23. UA Check-in Area and East Check-in Area

Sources:
1. *GIAA*
2. *AECOM edits*

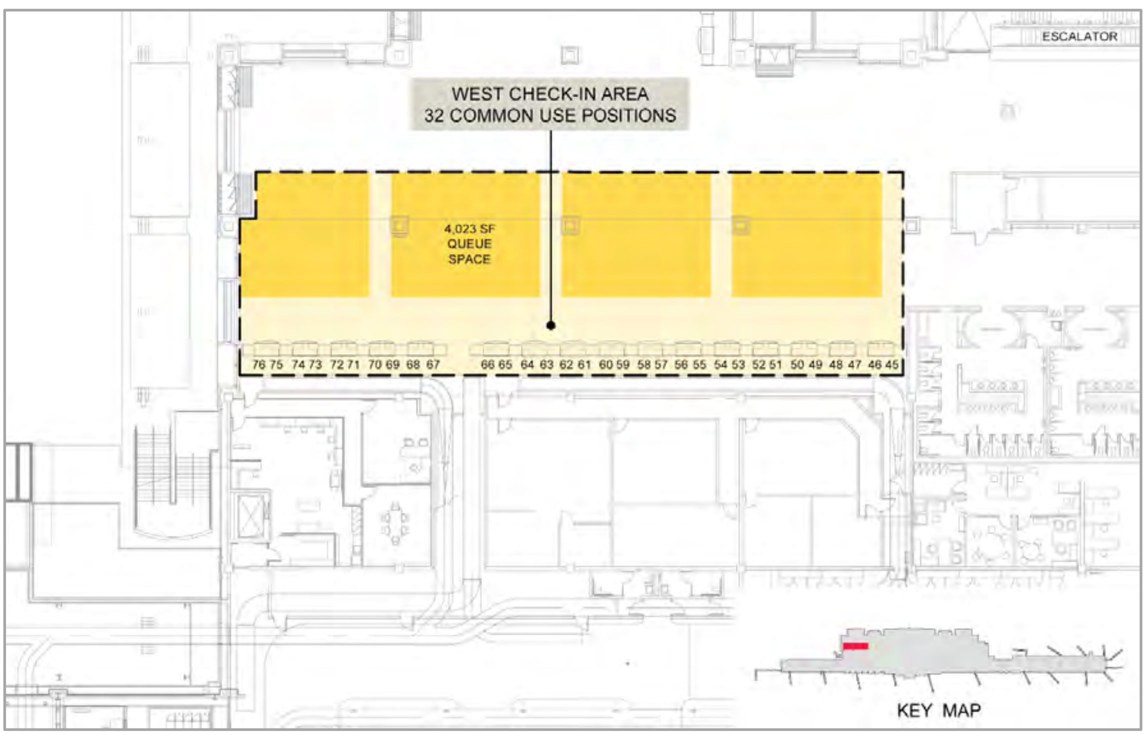

Figure 4-24. West Check-in Area

Sources:
1. *GIAA*
2. *AECOM edits*

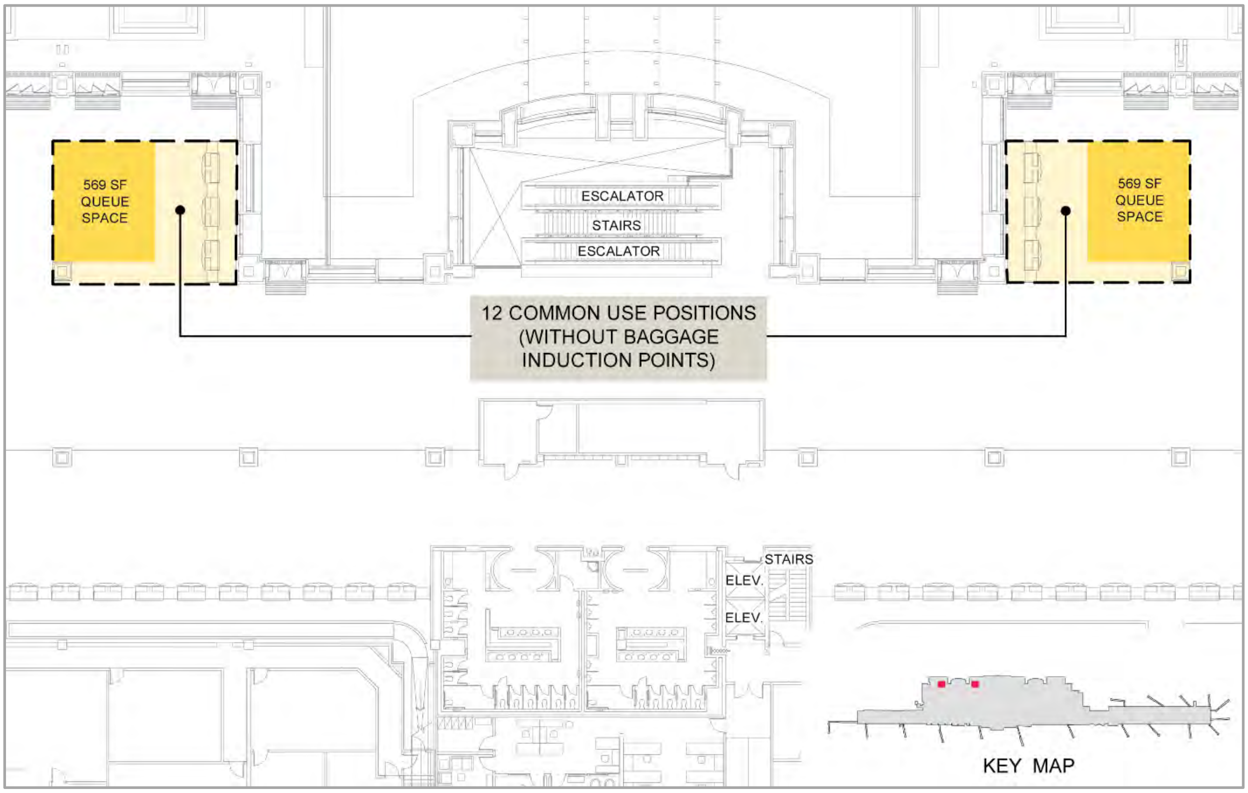

Figure 4-25. Additional Check-in Positions

Sources:
1. *GIAA*
2. *AECOM edits*

Figure 4-26. United Airlines Dedicated Check-in Positions

Source: ©2022 Photography by Elliott Lindgren

Figure 4-27. Common Use Check-in Positions

Source: ©2022 Photography by Elliott Lindgren

Figure 4-28. Additional Check-in Positions on the West

Source: ©2022 Photography by Elliott Lindgren

able -2 Check-in Facility Requirements

Description	Existing Inventory[A]	Estimated Requirements				
		FY2 19 Base Year	PA 1 FY2 2	PA 2 FY2 29	PA 3 FY2 3	PA FY2 39
UA Check-in Positions Morning Peak						
Premium full-service agent counters	3	3	2	3	4	4
conomy full-service agent counters (include military/group)	7	6	5	7	7	8
Premium kiosks	2	4	3	4	4	4
conomy kiosks	10	12	9	12	13	14
Sub-Total for UA	**22**	**2**	**2**	**26**	**2**	**3**
OA Check-in Positions Afternoon Peak						
Premium full-service agent counters	N/A	11	9	12	13	15
conomy full-service agent counters	N/A	34	24	35	38	42
Sub-Total for OAL	**66**		**33**		**1**	
Total Check-in Positions			**3**	**3**	**9**	
UA Queue Space SF						
Premium full-service agent counters		84	56	84	112	112
conomy full-service agent counters (include military/group)	**1, 69**	672	560	784	784	896
Premium kiosks		84	70	84	84	84
conomy kiosks		336	252	336	364	392
Sub-Total for UA		**1,1 6**	**93**	**1,2**	**1,3**	**1,**
OA Queue Space SF						
Premium full-service agent counters		294	252	322	336	378
conomy full-service agent counters	**6, 9**	3,192	2,268	3,290	3,584	3,962
Sub-Total for OAL		**3, 6**	**2, 2**	**3,612**	**3,92**	**,3**
otal Queue Space SF	**, 63**	**,662**	**3,**	**,9**	**,26**	**, 2**

Notes:

*A. The number of existing counters and kiosks are counted from the as-built drawings from the Airport. Queue areas are estimated from the areas highlighted in **Figure 4-23** to **Figure 4-25**, which include 10 feet circulation in front of counters based on the existing queue layout at UA counters and exit circulation with a minimum width of 5 feet based on IATA's optimum LoS. IATA requires minimum queue width to be 4.6 to 5.2 feet.*

B. Red text indicates required exceeds inventory.

C. Airline Abbreviations
UA = United Airlines
OAL = Other Airlines

D. Abbreviations
PAL = Planning Activity Level
FY = Fiscal year
N/A = Not available
SF = Square feet

In summary, UA will require more check-in positions to provide optimum LoS as traffic demands increase through the planning horizon. There are vacant counters available on the two ends of the existing UA check-in area to meet the future requirements. Overall, the total number of existing check-in positions are adequate to meet the combined UA and OAL demands.

Although the total number of check-in positions and total queue space are adequate throughout the planning horizon, the following recommendations will increase capacity and operational efficiency, and enhance passenger experience at the check-in facility:

- Since the peak periods of UA and OAL typically occur at different times of the day, dedicated UA check-in positions are not fully utilized during OAL's afternoon peak. Changing some of UA's check-in positions to common use and allocating them to specific airlines during their active departure operations will increase the capacity of the existing check-in facilities during the Airport's afternoon peak.
- The existing common use check-in positions at the Airport are traditional agent counters. With the advancement in technology, the use of automated, self-service, remote, and mobile check-in systems is increasing. Adding common use self-service kiosks that allow passengers to print their boarding pass and tag their own bags will improve the operational efficiency. The advancement of mobile check-in application allows some airlines to provide touchless check-in at kiosks. Passengers can check in online with their mobile devices and then scan the digital (or printed) boarding pass at the kiosk to print bag tags automatically.
- There are no baggage induction points for the 12 positions next to the entrances between the a st and West check-in areas. Checked bags collected at these check-in positions must be manually delivered to the other check-in positions by baggage carts for induction into the CBIS. It is recommended to add induction points to these check-in positions in the future for added flexibility and capacity.

4.3.4 Security Screening Checkpoints

After completing the check-in process, passengers proceed to the SSCPs. Security screening is generally regarded as a major "pressure point" in terminal facility planning for several reasons:

- Unlike other areas that might only be used by a percentage of passengers (for instance some people might not check bags to bypass the ticketing facility), the SSCP is a function that must serve all passengers.
- More airports are moving to a 100 percent security screening policy for employees. While some portion of the employee population will use passenger SSCPs, more airports are investigating dedicated employee SSCPs as an option to reduce the employee population using passenger SSCPs.
- In contrast to other areas where technology and new processes expedite the flow of people, security screening technology steadily evolves with increasing complexity and protocols to address threats and heightened security levels.

In developing requirements for the SSCPs, an allowance should be provided to accommodate future changes to security screening equipment and processes.

A typical SSCP consists of standard module sets or a combination of standard module sets of screening equipment. A module set includes either one or two inspection lanes. A typical single-lane module set consists of (a/an):

- Travel Document Checker (TDC) which may consist of the TDC podium, credential authentication technology (CAT) with optional e-gate, or biometric authentication technology (BAT)
- Advanced Technology (AT) X-ray or Computed Tomography scanning (CT) components (may include Remote Resolution Room) with the latest Checkpoint Property Screening System (CPSS)
- Walk-Through Metal Detector (WTMD) and/or Advanced Imaging Technology (AIT)
- xp losive Trace Detection (TD)
- Bottled Liquids Scanner (BLS)
- Passenger inspection
- Bag inspection
- Other security technologies

- Private screening room (shared across multiple module sets)

A dual-lane module set is similar to a single-lane module set with the addition of an AT or CT and associated screening equipment. The dual-lane module set, or multiples of dual-lane module sets, increases the efficiency of the SSCP with higher utilization of screening equipment and TSA personnel than a single-lane module. However, a single-lane module set is recommended if the peak hour demand only supports single-lane or an odd number of lanes.

The existing SSCP at the Airport has three dual-lane modules and one single-lane module, i.e., a total of seven lanes. The single- or dual-lane configuration can be assigned/configured as "Standard" for all passenger screening or "Pre-check" to screening passengers who have Known Traveler Numbers (KTNs) and have been approved for use of Pre-check lanes. While Pre-check lanes do not typically include AIT equipment, for flexibility AITs should be provided for all SSCP lanes.

4.3.4.1 ey Assumptions

Security screening requirements are subject to TSA regulations, which may change in response to the level of threat perceived. As TSA procedures, protocols, and equipment continue to evolve, the configuration and size of the SSCPs may change as well. The estimation of the SSCP requirement is based on the latest CRPG (dated September 2021) and assumptions for other similar projects. **able -26** summarizes the key assumptions for the SSCP facilities.

able -26 SSCP ey Assumptions

SSCP Facility	hroughput Passenger/hour/lane [A]	Percentage Split of Passengers[B]	Maximum Waiting ime minutes [C]	Queue Space Requirements SF [D]
Pre-check Lane	220	20%	10	600 SF per lane
Standard Lane	140	80%	15	600 SF per lane

Notes:

A. *Assumes a lower throughput for the existing X-ray machine than the CT. It is uncertain if TSA will allocate the new CPSS to Guam. Pre-check lanes allow pre-approved travelers to leave on shoes, light outerwear and belts, laptops in the case, and 3-1-1-compliant liquids/gels bag in the carry-on luggage. Hence, the throughput for pre-check lanes is higher than standard lanes.*

B. *TSA's pre-check lanes are limited for the use of individuals with Known Traveler Numbers, which represent approximately 20 percent of passengers traveling through airports each day based on TSA's Testimony on Transportation and Maritime Security, October 2019. Since Guam has a high percentage of foreign visitors who do not have Known Traveler Numbers, the percentage of pre-check passengers assumes 20 percent and it will not increase significantly throughout the planning period.*

C. *Based on different project experience, the target maximum (95-percentile) wait time from TSA varies from 5 minutes for pre-check to 20 minutes for standard. Recommend utilizing moderate assumptions with 10 minutes for pre-check and 15 minutes for standard in this Airport.*

D. *TSA's CRPG (dated September 2021) requires 600 SF per lane.*

E. *Abbreviations*
SF = Square feet
SSCP = Security Screening Checkpoint

4.3.4.2 SSCP Facility Requirements

able -2 provides the estimated facility requirements for each type of SSCP lane, as well as the total requirements.

able -2 SSCP Facility Requirements

Description	Existing Inventory^{A}	Estimated Requirements				
		FY2 19 Base Year	PA 1 FY2 2	PA 2 FY2 29	PA 3 FY2 3	PA FY2 39
Number of anes						
Pre-check Lane	1	1	1	1	1	1
Standard Lane	6	5	4	5	6	6
otal No of anes		**6**		**6**		
Queue Space SF						
Pre-check Lane	**2, 96**	600	600	600	600	600
Standard Lane		3,000	2,400	3,000	3,600	3,600
otal Queue Space SF		3,600	3,000	3,600	4,200	4,200

Notes:

A. *Existing number of lanes and the queue area are based on the as-built drawings from GIAA as shown in* ***Figure 4-29****.*
B. *Red text indicates required exceeds inventory.*
C. *Abbreviations*
PAL = Planning Activity Level
FY = Fiscal year
SF = Square feet
SSCP = Security Screening Checkpoint

In summary, the total number of SSCP lanes (i.e., seven lanes) is adequate for the planning period. However, the queue space is insufficient to meet the TSA requirements. **Figure -29** highlights the existing queue space for the SSCP at the Concourse Level, which is constrained by the available space between escalators, stairs, and the TDC podiums and the need to maintain accessible corridors from the elevators. During historical peak periods (pre-COVID-19), passengers lined up along the stairs and extended the queue to the departure lobby on the Apron Level. Although there is space on the Apron Level to provide a temporary overflow queue area for the SSCP, it is not desirable. To meet the TSA requirements for 4,200 SF of queue space for a seven-lane SSCP, the Airport may consider expanding the Concourse Level floor slab on the two sides of the existing SSCP queue area.

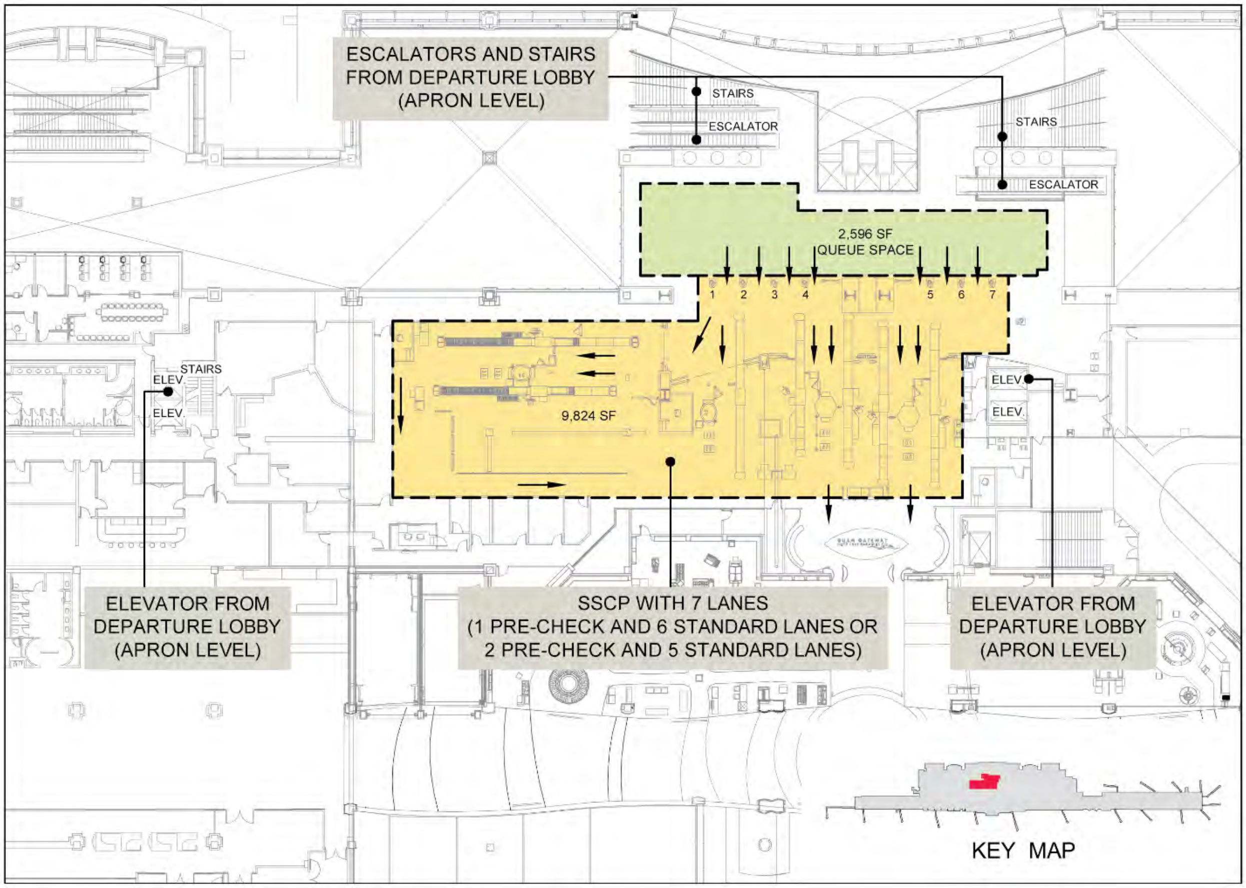

Figure 4-29. Existing SSCP and Queue Space

Note:

A. *Abbreviation*
SSCP = Security Screening Checkpoint

Sources:

1. *GIAA*
2. *AECOM edits*

If TSA is going to upgrade the existing screening equipment to CT with the new CPSS, reconfiguration and/or expansion of the existing SSCP is required. CPSS systems come in three configurations to account for various airport space constraints and throughput considerations: CPSS Base-size, CPSS Mid-size, and CPSS Full-size. All three configurations offer the same detection capability but vary in the rate at which they can process passengers.

The length of the CPSS configuration varies from approximately 75 feet for the Base-size (50 feet for equipment plus 12 feet from the TDC and 12 feet for the Supervisory Transportation Security Officer [STSO] podium) to 87 feet for the Mid-size (63 feet for equipment plus 12 feet from the TDC and 12 feet for the STSO podium) or 96 feet for the Full-size configuration (72 feet for equipment plus 12 feet from the TDC and 12 feet for the STSO podium), as depicted in **Figure -3** . The length of the existing SSCP lanes is approximately 64 feet from the TDC to the STSO podium, which is less than the length required for the shortest CPSS Base-size. Depending on which CPSS configuration TSA is planning for the upgrade at the Airport, the existing SSCP will require reconfiguration and/or expansion.

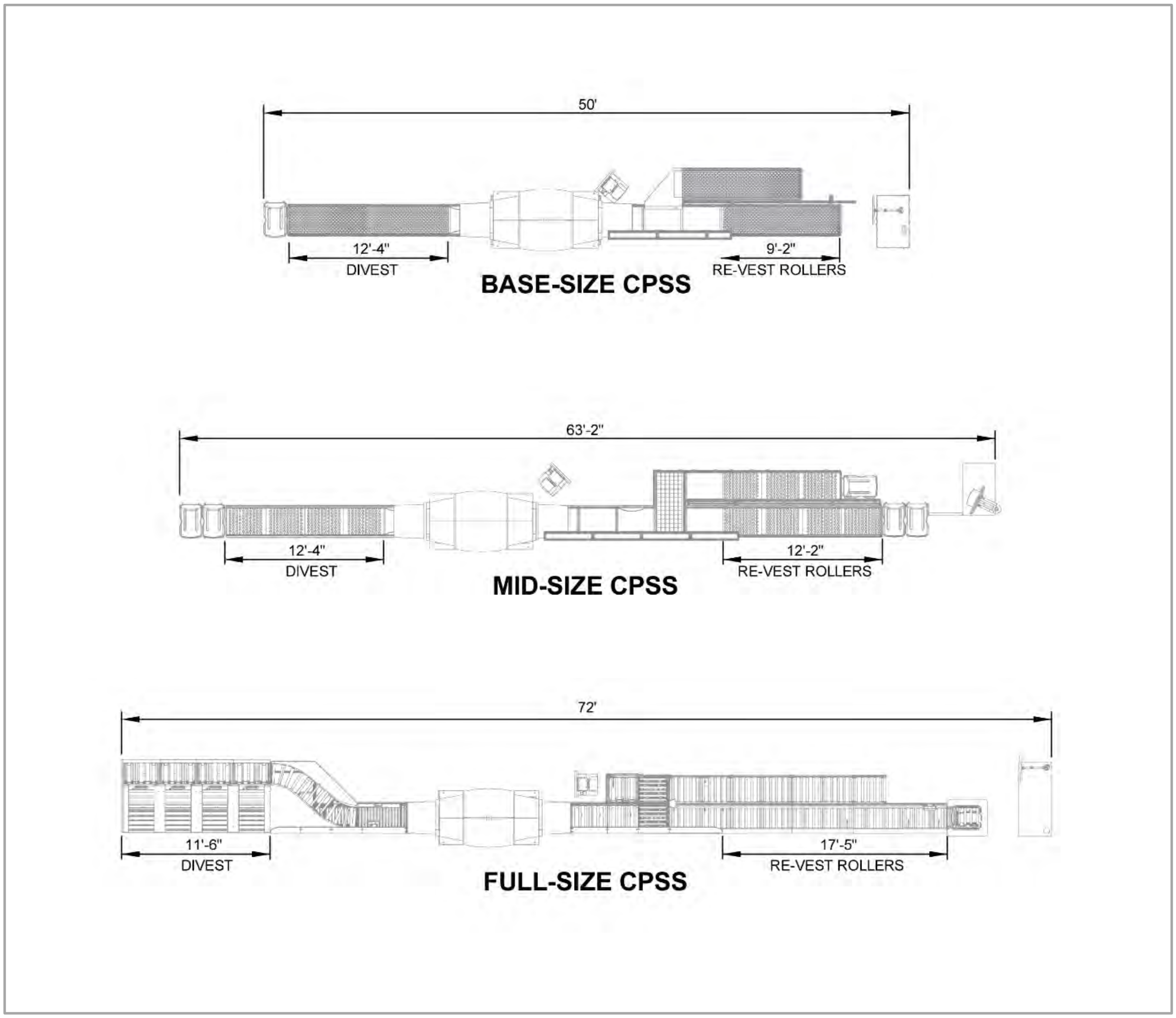

Figure 4-30. Sample Configurations of the Base-Size, Mid-Size, and Full-Size CPSS

Note:

A. *Abbreviation*
CPSS = Checkpoint Property Screening System

Sources:

1. *Mid-Size CPSS – TSA's CRPG (September 2021)*
2. *Base-Size and Full-Size CPSS – Equipment drawings from the approved vendor*

There is capacity at the existing SSCP for employee screening in the coming 10 to 15 years if it is required by TSA in the future. As passenger demands increase in the 15- to 20-year period, there is capacity at the existing SSCP for employee screening during the non-peak period (i.e., outside the afternoon peak hour between 2 p.m. and 4 p.m.). The Airport is recommended to review the employee screening requirements with TSA in the next decade to identify if there are any new requirements.

4.3.5 Outbound Checked Baggage Inspection System

The CBIS is the checked bag screening system that centers on xp losives Detection System (D S) machines. D S machines are characterized by the rated throughput capacity achieved. These machines have remained relatively large, but technological advances have increased the effectiveness, speed, and reliability of the bag screening process. In general, as throughput rates increase, fewer D S machines should be required, but increased throughput rates could also impact upstream and downstream baggage processing. Transport belts and queuing belts would be needed to accommodate the increased throughput rate.

4.3.5.1 ey Assumptions

For the purpose of this Master Plan, the assumptions for CBIS facility requirements are summarized in **able -2** .

able -2 CBIS ey Assumptions

ey Input Factors	Assumption[A]
Average checked bags per international passenger	1.2 bags per passenger
Percentage of international bags during peak period	100%
Percentage of international OOG bags	2%
Percentage of international OS bags	2%
xisting DS model	Morpho Detection's CTX-9800 DSi
DS belt speed[B]	40 feet per minute
Bag spacing	12 inches
Average length of international checked bags	30 inches
DS false alarm rate	SSI
OSR throughput	180 bag images per hour
OSR clear rate	SSI
Percentage of bags associated with DS error	1%
Percentage of Lost-in-Tracking bags	2%
Rate at which TSOs resolve international alarmed baggage via direct search	20 bags per hour
Rate at which TSOs resolve international OOG baggage via OOG search	20 bags per hour
Rate at which TSOs reinsert bags	60 bags per hour
Rate at which TSOs resolve international OS baggage via OS search	15 bags per hour

Notes:

A. *Assumptions reference the PGDS version 7.0 and other recent projections. Assumptions are used for master planning purposes only. Some of the information is security sensitive information (SSI) and should be verified with TSA.*

B. *Based on the existing EDS model, Morpho Detection's CTX-9800 DSi, which is confirmed with GIAA.*

C. *Abbreviations*
CBIS = Checked Baggage Inspection System
SSI = Security sensitive information
OOG = Out-of-gauge
OS = Oversized
OSR = On-screen resolution
EDS = Explosives Detection System
TSO = Transportation security officer

4.3.5.2 CBIS Facility Requirements

The requirements for checked baggage screening facilities were determined based on projected peak hour baggage demand and throughput rates. **able -29** depicts peak-hour bags to be screened and CBIS facility requirements, assuming that the D S machines can achieve their belt speed of 40 feet per minute, which is equivalent to approximately 650 bags per hour per D S machine with 95 percent efficiency. The facility requirements also assume that the TSA's "N+1" configuration can be achieved in keeping one D S machine in reserve and separate from the CBIS available capacity for redundancy and maintenance needs.

able -29 CBIS Facility Requirements

Description	Existing Inventory[A]	Estimated Requirements				
		FY2 19 Base Year	PA 1 FY2 2	PA 2 FY2 29	PA 3 FY2 3	PA FY2 39
Number of bags during peak hour (Includes surged 10-minute peak volume, excludes OS and OOG bags)	-	1,566	1,086	1,626	1,752	1,896
Number of DS (N+1)	3+1 = 4	3+1 = 4	2+1 = 3	3+1 = 4	3+1 = 4	3+1 = 4
Number of Remote OSR Stations	4	3	2	3	3	3
Number of Standard/OOG Baggage Inspection Stations	18	13	8	13	13	13
Number of Standard/OOG TD Stations	9	7	4	7	7	7
Number of OS Baggage Inspection Stations	4	3	2	3	3	3
Number of OS TD Stations	2	2	1	2	2	2
otal Number of Baggage Inspection Stations	**22**	**16**	**1**	**16**	**16**	**16**
otal Number of E D Stations	**11**	**9**		**9**	**9**	**9**

Notes:

A. *The number of existing equipment and inspection stations is based on the as-built drawings from the Airport and confirmed with GIAA that the existing system is a 3+1 in-line CBIS.*

B. *Abbreviations*
FY = Fiscal year
CBIS = Checked Baggage Inspection System
OOG = Out-of-gauge
OS = Oversized
OSR = On-screen resolution
EDS = Explosives Detection System
ETD = Explosive Trace Detection
PAL = Planning Activity Level

In summary, the existing four D S machines (including one redundancy), 22 baggage inspection stations, and 11 T D stations are adequate through the planning horizon.

The Airport is recommended to review the actual field data from TSA's Field Data Reporting System (FDRS) and compare it with the estimated peak hour bag demands and processing throughput rate when the passenger traffic is recovered in 2 to 3 years. If the FDRS data indicate that the bag demands are higher and the D S throughput rate is significantly lower than the Master Plan assumptions, the Airport may need to upgrade the D S machines to maintain the "N+1" allowance for redundancy.

4.3.6 o ldrooms

The holdrooms provide waiting areas for passengers prior to boarding an aircraft and contain airline agent customer service podiums, boarding queues, circulation spaces, and other amenities. The holdroom requirements in this analysis are based on the analytical approach provided in IATA ADRM and ACRP Report 25: *Airport Passenger Terminal Planning and Design*, which estimates the size of the holdrooms as a function of the dimension of different elements in the holdroom, the split of seated and standing passengers, allowance for amenities, and holdroom sharing conditions between adjacent gates.

The method is based on an open-area gate concept (similar to the Airport), which means holdrooms for adjacent gates are not blocked by walls and also have contiguous space with the adjacent concessions space. Holdrooms in such an open environment typically require less space because passengers have the flexibility to seat themselves in the areas at adjacent gates or in the concession areas, as long as they can monitor the boarding process from their seated location. Based on the open area layout, the holdroom analysis for the Airport was performed by gate areas instead of gate-by-gate. Most of the gate areas include two or more gates.

4.3.6.1 ey Assumptions

Figure -31 shows a typical layout of holdrooms, which consists of passenger seating areas, gate podium areas and queue space, boarding areas in front of the gates, and a general circulation area. **able -3** provides a summary of the key assumptions used in this analysis based on this typical layout. This analysis estimated the size required for each gate area, based on the number of gates/flights each gate area serves concurrently, the number of passengers boarding these flights, the space needed to accommodate each seated/standing passenger, the space needed for the podium, and the space needed for the boarding lanes.

Two additional factors were considered in this analysis:

- Many modern holdrooms provide additional space within the gate areas for children's play areas, work areas, or electronics charging stations. A small allowance was added to the space requirement to provide such amenities.
- In the open-gate layout, many holdrooms are often shared by two or more gates, which provides greater flexibility of use. A reduction factor was applied to account for this flexibility.

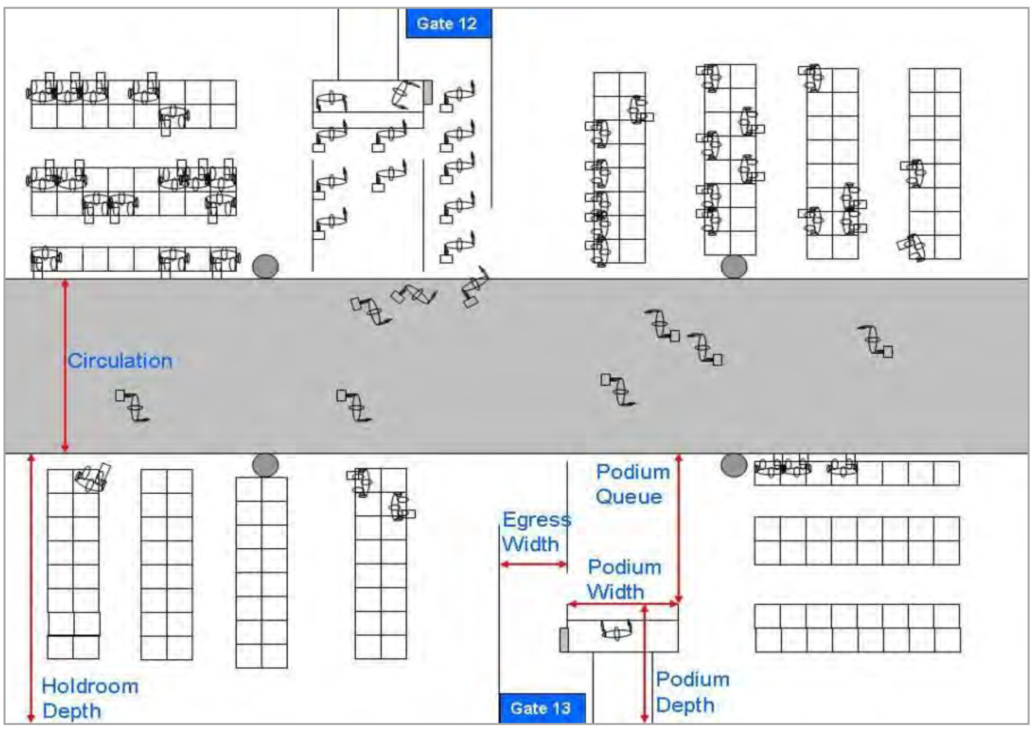

Figure 4-31. Typical Holdroom Layout Explaining the Podium and Boarding Lane Areas

Source: ACRP Report 25: Airport Passenger Terminal Planning and Design

able -3 oldroom ey Assumptions

ey Input Factors	Assumption
Typical Number of Aircraft Seats for Narrowbody Aircraft[A]	180 seats
Typical Number of Aircraft Seats for Widebody Aircraft[A]	350 seats
Load Factor[B]	84%
Percentage of Passengers Present in the Holdroom[C]	80%
Percentage of Seated Passengers in the Holdroom[C]	50%
Percentage of Standing Passengers in the Holdroom[C]	30%
Space per Seated Passengers[D]	19.4 square feet per passenger
Space per Standing Passengers[D]	12.9 square feet per passenger
Podium Area[E]	
Average podium width/position	7 feet
Average depth of podium to back wall	14 feet
Average podium queue depth	16 feet
Average area per podium position	210 square feet per podium
Boarding anes[E]	
Average boarding corridor width	7 feet
Depth of holdroom	30 feet
Average Boarding/ gress Corridor per PBB	210 square feet per PBB
Adjustment Factors	
Allowance for Amenities (% increase)	5%
Holdroom Sharing Factor (% decrease) for two adjacent holdrooms	15%
Holdroom Sharing Factor (% decrease) for six adjacent holdrooms	30%

Notes:

A. *Conservative estimates about number of seats based on typical seat configurations on narrowbody and widebody aircraft operation at the Airport.*
B. *Conservative (i.e., the highest) load factor assumptions from the multiple scenarios in* ***Chapter 3****: Aviation Demand Forecasts.*
C. *IATA ADRM and other airport projects.*
D. *Space requirements for optimum LoS, IATA ADRM.*
E. *Estimated from the terminal floor plan of the Airport per ACRP Report 25: Airport Passenger Terminal Planning and Design*
F. *Abbreviation*
PBB = Passenger Boarding Bridge

4.3.6.2 o ldroom Space Requirements

The holdroom space requirements analysis was performed to determine the areas required to maintain optimal LoS in the holdrooms if the airport were to provide unconstrained operational flexibility to schedule flights at all gates at any time. **able -31** and **Figure -32** summarize the existing and required holdroom area for each gate area. As highlighted in red in **able -31,** most of the gate areas are undersized and would require expansion or other innovative solutions to provide optimum LoS and allow unconstrained operational flexibility.

able -31 oldroom Space Requirements

Gate Areas	Existing Inventory SF	Adjusted Waiting Area for Seated and Standing Passenger SF	Boarding ane Area SF	Podium Area SF	otal Area SF
West Concourse					
Gates 4, 5	5,734	7,121	420	420	**,961**
Gate 6	3,526	3,561	210	210	**3,9 1**
Gates 7, 8	5,229	7,121	420	630	**,1 1**
Mid-Concourse					
Gate 9	3,870	3,561	210	420	**,191**
Gate 10	4,244	3,561	210	210	**3,9 1**
East Concourse					
Gate 11 (Apron Level)	3,137	3,561	210	420	**,191**
Gates 12, 14	5,796	7,121	420	420	**,961**
Gates 13, 15	3,980	3,662	420	420	**, 2**
Gates 16, 17, 18, 19, 20, 21	12,468	14,745	1,260	1,260	**1 ,26**

Notes:
A. Red text indicates required exceeds inventory.
B. Abbreviation
SF = Square feet

Furthermore, holdroom areas for Gate 7 and Gate 9 are also used for visa inspection by CBP for all domestic flights to the U.S. mainland through Honolulu. **Figure -33** illustrates the CBP podiums and queue area. The holdroom seating area and queue for boarding the departure flight overflows to the circulation corridor along the concourse as shown in **Figure -3** . The Airport is recommended to identify separate locations for the outbound CBP inspection.

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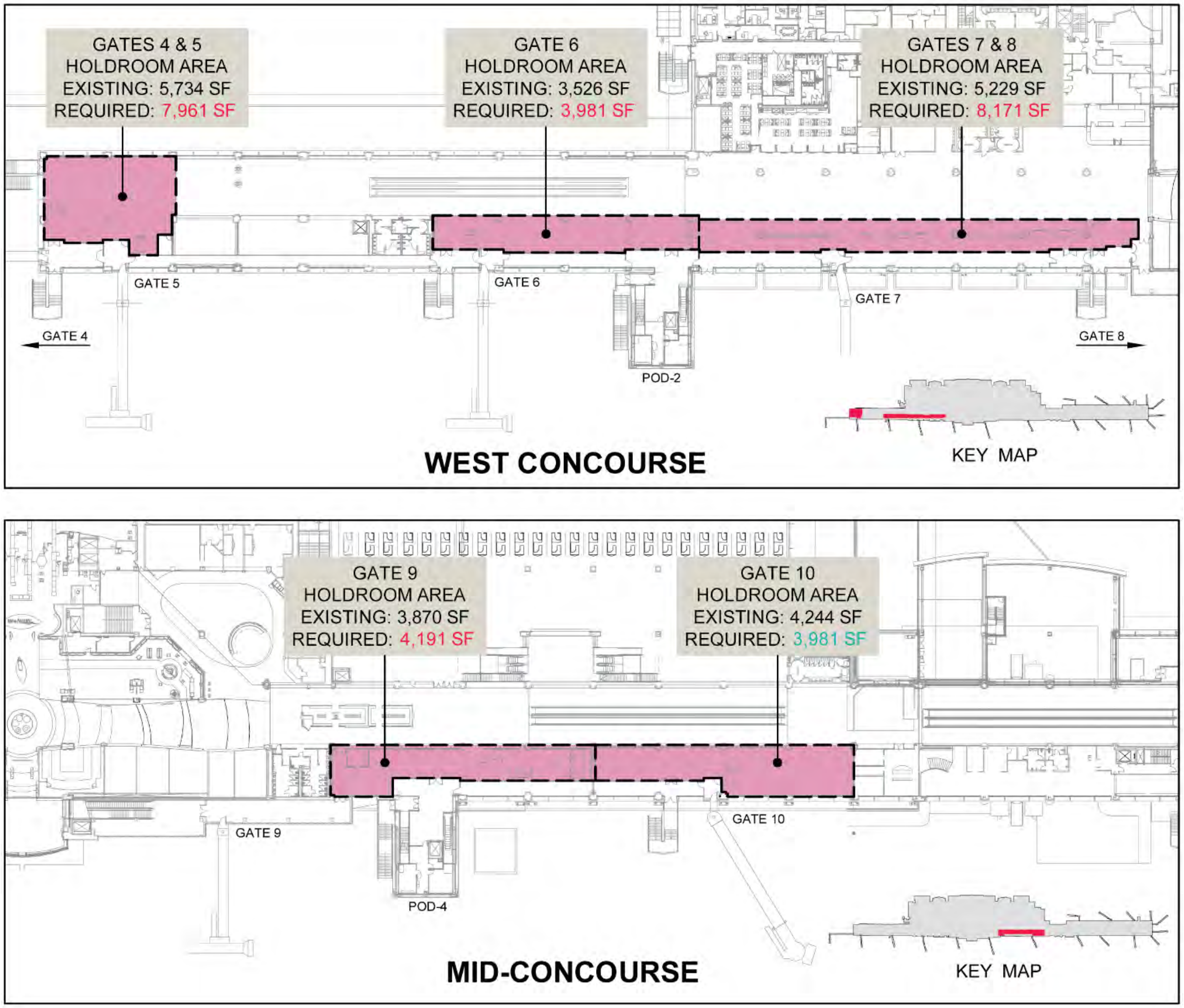
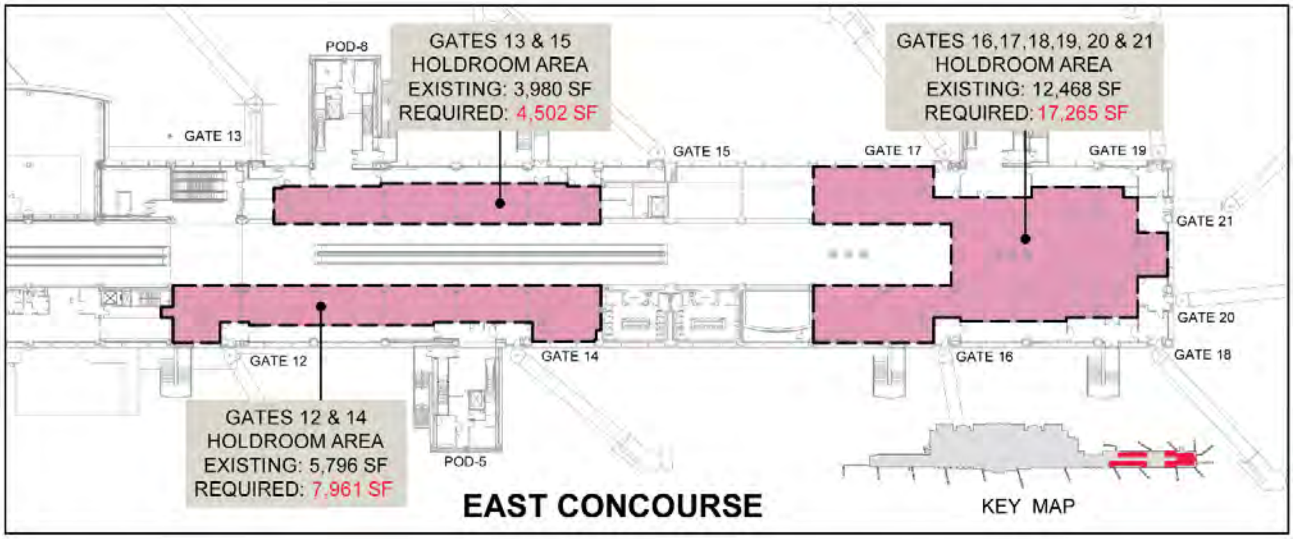


Figure 4-32. Existing and Required Holdroom Areas

Sources:

1. *GIAA*
2. *AECOM edits*



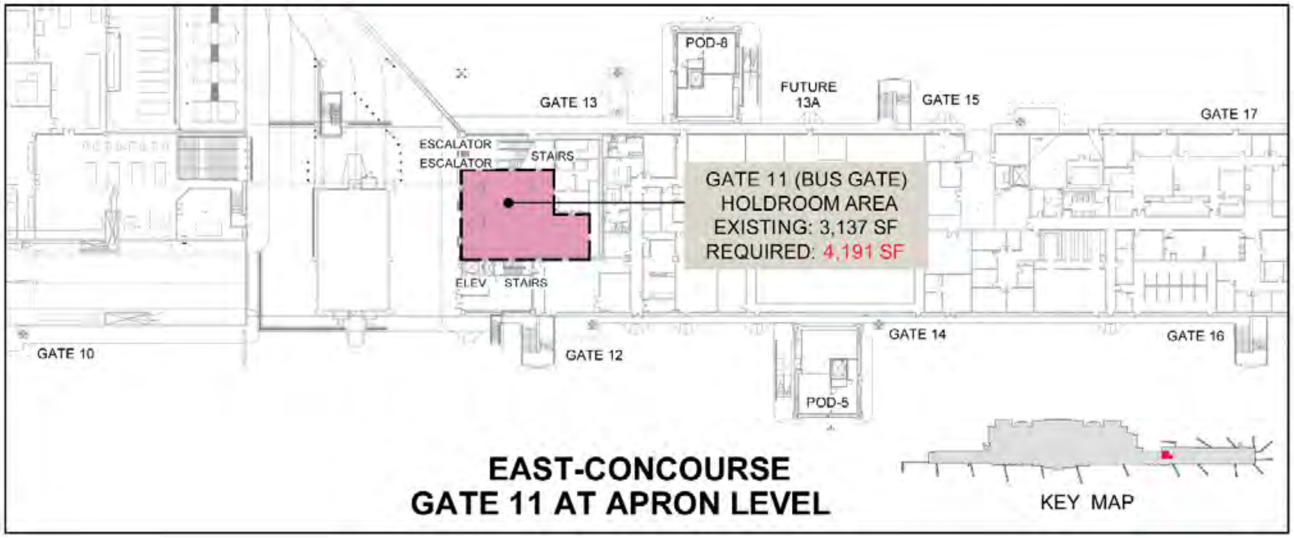


Figure 32 Existing and Required oldroom Areas Continued

Sources:

1. *GIAA*
2. *AECOM edits*

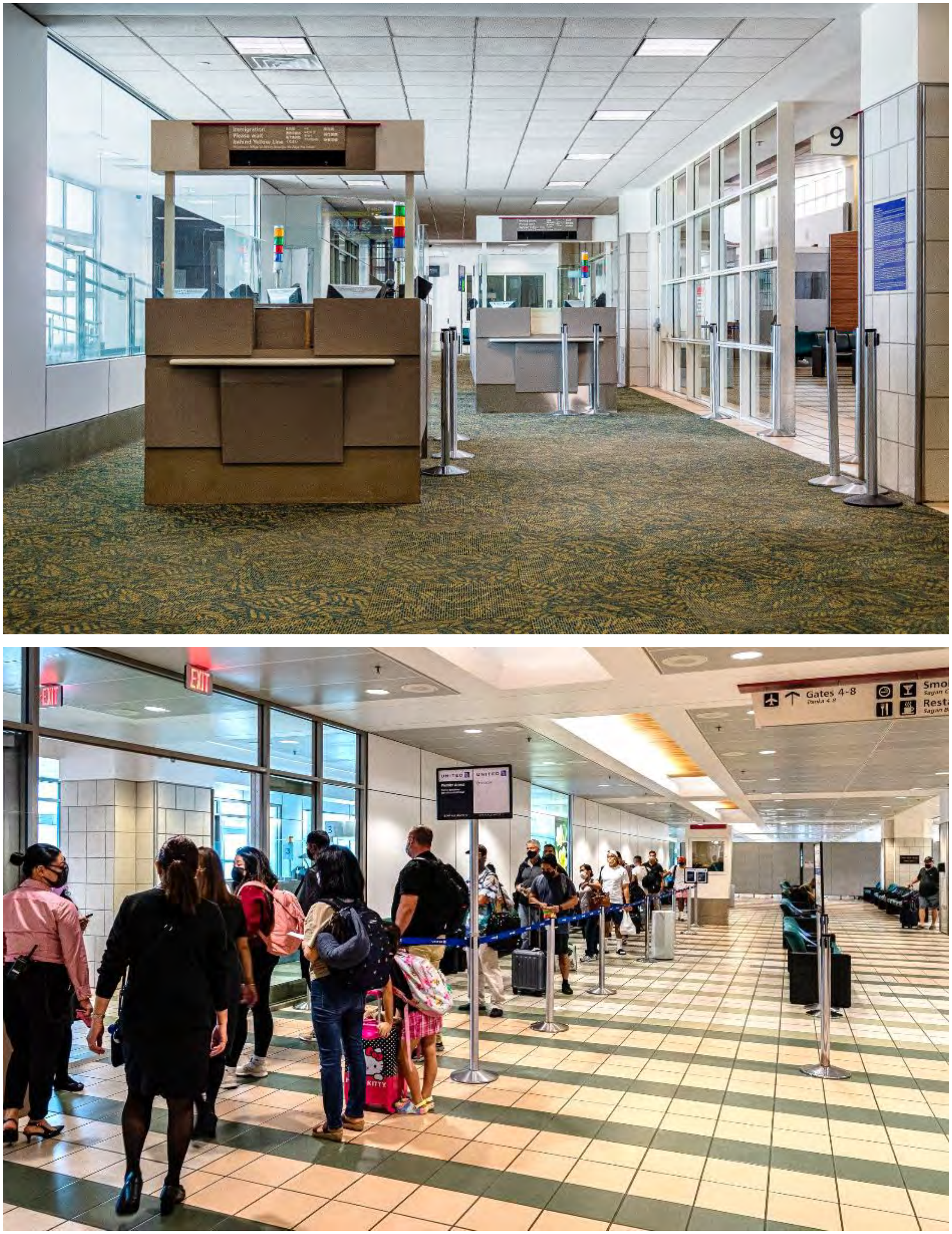


Figure 4-33. CBP Podiums Inside Gates 7, 8, and 9 Holdroom with Queues Outside the Holdroom

Note:

A. Abbreviation
CBP = Customs and Border Protection

Source: ©2022 Photography by Elliott Lindgren

Figure 4-34. Overflow of Holdroom Seating Area and Queue for Boarding the Flight

Source: ©2022 Photography by Elliott Lindgren

4.3.7 Secure and Non-Secure Public Restrooms

One of the most commented upon elements of the Airport relates to the convenience, location, design, and cleanliness of public restrooms in the terminal. According to the ACRP Report 130: *Guidebook for Airport Terminal Restroom Planning & Design*, the unique considerations of airport terminal restrooms include continuous availability and operation, changing passenger demographics, evolving customer expectations, and greater space requirements to accommodate luggage and operational/maintenance needs. The Master Plan restroom requirement analysis references the ACRP Report's, industry guidelines, and best practices at other airports.

4.3.7.1 ey Assumptions

Public restrooms at the Airport are located both before and after security. a ch public restroom module consists of a male, female, and family/assisted facility. **able -32** summarizes the key assumptions for the restroom requirement analysis. In addition, the following principles from the ACRP Report 130: *Guidebook for Airport Terminal Restroom Planning & Design*, and modifications to suit the unique operational characteristics of the Airport were used in the calculations of restroom requirements:

- The restroom requirements for the secure area are based on the types of aircraft serving the concourse. Historical observations indicate that deplaning passengers produce the greatest demand for the concourse restrooms. This is especially important when flights arriving on adjacent gates around the same time produce a surge effect on restrooms located nearby. Taking surges into account, ACRP Report 130: *Guidebook for Airport Terminal Restroom Planning & Design*, recommends using the peak 20-minute arrival period for calculating peak passenger demands for concourse restrooms. However, the majority of the arrival passengers at the Airport are international passengers who use the sterile corridor and restrooms in the CBP or baggage claim area instead of the concourse. Peak hour domestic arrival at the Airport is typically one widebody flight only in the base year. For a conservative estimate, the west concourse restroom requirements assume a maximum of three simultaneous domestic flights (one widebody and two narrowbody aircraft) arriving on adjacent gates at the same time. The mid-concourse restroom requirements assume a maximum of two widebody domestic flights arriving on adjacent gates at the same time. Since there is only one large concourse restroom serving the east concourse, the restroom requirements assume a maximum of four domestic flights (two widebody and two narrowbody) arriving at the same time. A total of nine simultaneous domestic arrivals are assumed (five widebody and four narrowbody).

- The restroom in the secure area for CBP inspection at the Concourse Level is the first available restroom for international arrival passengers after deboarding. The surge effect due to near-simultaneous international arrivals drives the demand on the restroom at the CBP inspection area. Since all of the international arrival passengers at any gate are directed to the same CBP through the sterile corridor, it is important to determine the number of near-simultaneous international arrivals in order to estimate the restroom requirements. **Chapter 3**: *Aviation Demand Forecasts* projects seven to ten arrivals during the peak hour, which represents two to four arrivals within a 20-minute interval. Hence, multiple scenarios with two to four international arrivals were used to estimate the restroom requirements for the CBP inspection area.
- The restroom requirements for the baggage claim and arrival lobby at the Basement Level are based on the number of peak hour deplaning passengers from **Chapter 3**: *Aviation Demand Forecasts*. Although the restrooms in the baggage claim area are not accessible by meeters/greeters, the total demand accounts for the additional needs from meeters/greeters who use the restroom in the arrival lobby. Since these are not the first restrooms arrival passengers encounter, the requirements are lower than the restrooms in the concourse (for domestic arrivals) or in the CBP inspection area (for international arrivals). According to the ACRP Report 130: *Guidebook for Airport Terminal Restroom Planning & Design* recommendation, one male fixture should be provided per 70 peak hour passengers for the first 400 deplaned passengers, and one male fixture per 200 peak hour deplaned passengers in excess of 400 deplaned passengers.
- The restroom requirements for the non-secure area before security screening are based on the number of peak hour enplaning passengers from **Chapter 3**: *Aviation Demand Forecasts*. It also accounts for the additional well-wishers who send off departing passengers. Similar to the arrival lobby, one male fixture should be provided per 70 peak hour passengers for the first 400 enplaned passengers, and one male fixture per 200 peak hour enplaned passengers in excess of 400 enplaned passengers.
- A separate family room (i.e., family/assisted, companion care, special needs, or unisex restroom) is recommended for each restroom module. Unlike a wheelchair-accessible stall or room, which is specifically designed and reserved for persons with disabilities, these family rooms are for multiple occupants with a variety of needs that are difficult to manage in a typical restroom. The users may be a parent with child(ren), a person assisting a companion with mobility impairment, or person who finds both male and female restrooms uncomfortable.
- Long days of traveling can be dehydrating so providing drinking fountains is important for the well-being of passengers. While the International Building Code requires only one drinking fountain per 1,000 occupants in a passenger terminal, it is a good practice to provide one at each restroom module.

The maximum walking distance for passengers to a restroom is 250 feet, where applicable.

able -32 Public Restrooms ey Assumptions

ey Input Factors	Assumption
Typical Number of Aircraft Seats for Narrowbody Aircraft[A]	180 seats
Typical Number of Aircraft Seats for Widebody Aircraft[A]	350 seats
Load Factor[B]	84%
Peak 20-minute factor for O&D Airport[C]	50%
Restroom utilization rate[C]	50%
Gender mix (Male to Female) [C]	50%:50%
Male average dwell time at fixture[C]	1.5 minutes
Female average dwell time at fixture[C]	2 minutes
Male to female fixture ratio (Calculated from average dwell time)	43%:57%
Female increase factor (Calculated from male to female fixture ratio)	1.33
Increase factor for well-wishers[D]	20%
Increase factor for meeters/greeters[D]	20%

Notes:

A. *Conservative estimates about number of seats based on typical seat configurations on narrowbody and widebody aircraft operation at the Airport. Same assumptions are used for the holdroom space requirements.*

B. *Conservative (i.e., the highest) load factor assumptions from the multiple scenarios in* ***Chapter 3****: Aviation Demand Forecasts. Same assumption is used for the holdroom space requirements.*

C. *ACRP Report 130: Guidebook for Airport Terminal Restroom Planning and Design.*

D. *Most of the passengers at the Airport are visitors to the area and do not typically have friends/family as well-wishers or meeters/greeters. Meeters/greeters are most likely to be chauffeurs and hotel concierge staff. The assumption of additional 20 percent is appropriate for the characteristics of this Airport.*

E. *Abbreviation*
O&D = Origin & Destination

4.3.7.2 Public Restroom Requirements

The restroom requirements analysis for the concourse restrooms was based on a conservative scenario assuming nine domestic flights arriving at the same time as discussed in **Section 3 1**. **able -33** summarizes the number of fixtures required for each concourse.

Overall, the concourse restrooms are adequate in terms of male and female fixtures. a ch restroom module is within the maximum 250-foot walking distance criteria on the Concourse Level; however, the following deficiencies were identified:

- Only two of the four restroom modules along the concourse have a separate family room.
- Only three of the four restroom modules have drinking fountains. Nevertheless, the east concourse restroom includes two sets of drinking fountains. Passengers at Gate 9 and Gate 10 have a long walk (over 250 feet) to find a drinking fountain.
- There is no restroom at the Apron Level for passengers boarding at Gate 11 (bus gate). These enplaned passengers have to use the restrooms in the mid-concourse or the east concourse. The walking distance from the escalator to the east concourse restroom is approximate 250 feet on the Concourse Level. If the walking distance from the Apron Level is included, the walking distance exceeds 250 feet.

able -33 Concourse Restroom Requirements

Restroom Location	Existing Inventory[B]				No. of Existing Modules	No. of Simultaneous Domestic Arrivals	Peak 20-min Passengers Using Restroom	Restroom Requirements			
	Male Fixtures	Female Fixtures	Separate Family Facility	Total Fixtures				Male Fixtures	Female Fixtures	Separate Family Facility	Total Fixtures
West Concourse Gates 4-8	5+3=8	5+3=8	1 [3]	17	2	3 (1 WB+2 NB)	149	6	8	2 [3]	16
Mid-Concourse Gates 9-10	8	8	1	17	1	2 (2 WB)	147	6	8	1	15
East Concourse Gates 11-21	12	12	0 [4]	24	1	4 (2 WB+2 NB)	223	9	12	1[4]	22

Notes:

- *A. Red text indicates required exceeds inventory.*
- *B. The number of existing fixtures is based on the as-built drawings from the Airport.*
- *C. Each male and female restroom has a family/assisted facility inside the restroom. However, only one of the two modules has a separate family/assisted facility outside.*
- *D. Each male and female restroom has a family/assisted facility inside the restroom without separate entrance.*
- *E. Abbreviations*
  WB = Widebody Aircraft
  NB = Narrowbody Aircraft

able -3 summarizes the number of fixtures required for the CBP primary inspection area on the Concourse Level for four different scenarios. The analysis shows that the existing restroom at the CBP inspection area is not sufficient to accommodate the surge demand if two or more international widebody aircraft arrive simultaneously. It is anticipated that the queue at the female restrooms will start to back up first since there are fewer female fixtures than male fixtures and females have a higher average dwell time at the restroom than males. There is also no separate family room at this restroom module, but it is equipped with drinking fountains. The walking distance from the arrival gates to the first restroom in the CBP inspection area through the sterile corridor is longer than 250 feet.

able -3 CBP Restroom Requirements Based on wo to Four Simultaneous International Arrivals

Restroom Location	Existing Inventory[B]				No. of Existing Modules	No. of Simultaneous International Arrivals	Peak 20-min Passengers Using Restroom	Restroom Requirements			
	Male Fixtures	Female Fixtures	Separate Family Facility	Total Fixtures				Male Fixtures	Female Fixtures	Separate Family Facility	Total Fixtures
CBP Primary Inspection	8	7	0 [3]	15	1	2 (1 NB+1 WB)	111	6	6	1 [3]	13
						2 WB	147	6	8	1 [3]	15
						3 WB	221	9	12	1 [3]	22
						4 WB	294	12	15	1 [3]	28

Notes:

- *A. Red text indicates required exceeds inventory.*
- *B. The number of existing fixtures is based on the as-built drawings from the Airport.*
- *C. Each male and female restroom has a family/assisted facility inside the restroom without separate entrance.*
- *D. Abbreviations*
  WB = Widebody Aircraft
  NB = Narrowbody Aircraft
  CBP = Customs and Border Protection

able -3 summarizes the number of fixtures required for the baggage claim and arrival lobby on the Basement Level.

Overall, the three restroom modules on the Basement Level are adequate in terms of male and female fixtures and drinking fountains. However, none of them have a separate family room. The walking distance between baggage claim units and the restrooms is within 250 feet.

able -3 Baggage Claim and Arrival obby Restroom Requirements

Description	Existing Inventory[B]	Estimated Requirements				
		FY2019 (Base Year)	PAL 1 (FY2024)	PAL 2 (FY2029)	PAL 3 (FY2034)	PAL 4 (FY2039)
Peak hour deplanement and meeters/greeters	-	1,780	1,206	1,850	2,004	2,184
Male fixtures	4+7+6=17	13	10	13	14	15
Female fixtures	6+8+6=20	17	13	18	19	20
Separate family/assisted facility	0[C]	3[C]	3[C]	3[C]	3[C]	3[C]
Total fixtures for baggage claim and arrival lobby with 3 modules	37	33	26	34	36	38

Notes:
- A. *Red text indicates required exceeds inventory.*
- B. *The number of existing fixtures is based on the as-built drawings from the Airport.*
- C. *Each male and female restroom has a family/assisted facility inside the restroom without separate entrance.*
- D. *Abbreviation*
  PAL = Planning Activity Level
  FY = Fiscal year

able -36 summarizes the number of fixtures required for the departure lobby.

Overall, the two restroom modules for the departure lobby are adequate in terms of male and female fixtures and drinking fountains. However, neither of them has a separate family room. The walking distance between check-in facilities and the restrooms is within 250 feet.

able -36 Departure obby Restroom Requirements

Description	Existing Inventory[B]	Estimated Requirements				
		FY2019 (Base Year)	PAL 1 (FY2024)	PAL 2 (FY2029)	PAL 3 (FY2034)	PAL 4 (FY2039)
Peak hour enplanement and well-wishers	-	1,772	1,201	1,843	1,996	2,174
Male fixtures	16+8=24	13	10	13	14	15
Female fixtures	12+8=20	17	13	18	19	20
Separate family/assisted facility	0	2[C]	2[C]	2[C]	2[C]	2[C]
Total fixtures for departure lobby with 2 modules	48	32	25	33	35	37

Notes:
- A. *Red text indicates required exceeds inventory.*
- B. *The number of existing fixtures is based on the as-built drawings from the Airport.*
- C. *Each male and female restroom has a family/assisted facility inside the restroom without separate entrance.*
- D. *Abbreviation*
  PAL = Planning Activity Level
  FY = Fiscal year

There is an additional non-secure restroom on the Concourse Level next to the SSCP. This restroom is connected by a corridor between the SSCP queue and the security screening lanes, and is not easily noticeable by passengers. Since the existing fixtures for the two restroom modules at the departure lobby on the Apron Level are adequate to meet the projected enplaned passenger demands, this non-secure restroom next to the SSCP is not necessarily required for passengers. Depending on the current usage of these SSCP restrooms by TSA officers or airport employees, the Airport may consider converting this non-secure restroom to a secured restroom for the CBP inspection area.

4.3.8 Concessions

Concessions space planning is important to the overall terminal program because of its impact on airport revenue as well as passenger convenience/satisfaction. Concessions programs are such a specialized aspect of terminal facility needs that a more refined detailed analysis is typically conducted by a firm specializing in concessions programming and planning. For master planning purposes, the primary goal is to identify existing and potential issues and recommend general programming needs based on industry guidelines. This section evaluates the overall concession space throughout the entire terminal complex and how it is allocated.

4.3.8.1 ey Assumptions

Concessions are provided both before and after the SSCP (pre-security and post-security). The standard metrics recommended for benchmarking concession space are based on annual enplanements, in multiples of one thousand. As a rule of thumb for airport master planning, IATA recommends that the total concession space should range from 8.6 square feet to 16.1 square feet per 1,000 enplaned passengers. ACRP Report 54: *Resource Manual for Airport in-Terminal Concessions* recommends 13 square feet to 13.4 square feet per 1,000 enplaned passengers for airports with one to three million annual enplanements. For the purposes of this concessions space requirements analysis, an average of 12.8 square feet per 1,000 enplaned passengers was assumed for the Airport.

The concessions space requirements analysis also assumed that the types of concessions at the Airport are split. The breakdown percentage is based on general concession planning parameters identified in the IATA ADRM, ACRP Report 54: *Resource Manual for Airport In-Terminal Concessions*, as well as local characteristics at the Airport.

The Airport includes large duty-free shops along the concourse after the SSCP. Duty-free shops are retail shops that sell merchandise that is free of import duties, excise taxes, and local and state sales taxes. Sales are limited to international enplaned passengers. Passengers from countries with high import duties, high sales taxes, or value-added taxes (VATs) or countries that levy high taxes on certain luxury items are most likely to find duty-free shopping attractive. Hence, passengers from u rope and Asia are popular duty-free customers. Most of the passengers using the Airport are international passengers from Asia, which justifies the high proportion of concessions space on duty-free shops and increases the concessions revenue. Lotte Duty Free has a significant duty-free store featuring over 200 brands including cosmetics, perfumes, fashion accessories, watches, wine, liquor, and cigarettes, etc. at the Airport. All of the specialty retail at the Airport is provided by Lotte Duty Free. Hence, the percentage for duty free in **able -3** includes specialty retail, and the percentage is on the high side of industry guidelines.

able -3 Concessions by ype

Concessions by ype	Assumption
Duty Free (include specialty retail)	50%
Convenience Retail (e.g., newsstands, books, magazines, snacks, souvenirs, etc.)	5%
Food and Beverage (F&B) (e.g., coffee bars, snack shops, restaurants, cocktail lounges, food courts, etc.)	40%
Personal or Business Services (e.g., relaxation and spa areas, currency exchange, business center, baggage wrapping/storage, banks/ATMs, medical services, pay phones, etc.)	5%
otal	**1 %**

Note:
A. Abbreviation
ATM = Automated Teller Machine
Sources:
1. IATA ADRM 10th edition
2. ACRP Report 54: Resource Manual for Airport In-Terminal Concessions

4.3.8.2 Concessions Space Requirements

able -3 summarizes the facility requirements for total concessions area, as well as a breakdown for the space required for each type of concession.

able -3 Concessions Space Requirements

Description	Existing Inventory[A]	Estimated Requirements				
		FY2019 (Base Year)	PAL 1 (FY2024)	PAL 2 (FY2029)	PAL 3 (FY2034)	PAL 4 (FY2039)
Annual enplanements[B]	-	1,885,108	1,277,397	1,960,402	2,123,073	2,312,858
Concessions area (SF per 1,000 enplanements)	-	12.4	12.4	12.4	12.4	12.4
Total Concessions Area (SF)	**36,523**	**24,129**	**16,351**	**25,094**	**27,176**	**29,604**
Concessions by Type						
Duty-Free (include specialty retail)	20,793	12,065	8,175	12,547	13,588	14,802
Convenience Retail	0	1,206	818	1,255	1,359	1,480
F&B	15,730	9,652	6,540	10,037	10,870	11,842
Personal and Business Services	0	1,206	818	1,255	1,359	1,480

Notes:
A. The area of existing concessions is based on the as-built drawings from the Airport.
*B. **Chapter 3**: Aviation Demand Forecasts.*
C. Abbreviations
PAL = Planning Activity Level
FY = Fiscal year
SF = Square feet
F&B = Food and Beverages.

Recent trends show that passengers spend less time in pre-security concessions areas because the use of online check-in and kiosks allows passengers without checked bags to bypass the pre-security areas quickly and proceed directly to the SSCP. In addition, passengers tend to allow more time to go through the security screening process, which has reduced demand for pre-security concessions and increased demand for post-security concessions.

Although there are no F&B concessions at the arrival lobby, the Airport has a small café (420 SF) at the departure lobby on the Apron Level, which is conveniently located at the escalator connecting to the arrival lobby on the Basement Level. This café serves both passengers and their meeters/greeters/well-wishers.

mp loyees represent an important portion of concession sales, especially in the F&B category. Most employees (including vendors, airline staff, and government agencies) at the Airport have security clearance and are potential customers for post-security concessions. It is estimated that some employees (e.g., car rental staff) may only have pre-security airport access, and they are likely to go for F&B outside the airport or the café at the departure lobby. Hence, the existing pre-security concessions at the Airport are considered appropriate.

In summary, the total concessions area is reasonable throughout the planning horizon. However, there is limited diversity on the type of retail and services provided at the Airport. Lotte Duty Free shop provides some souvenirs and snacks for travelers at the shop next to Gate 16 in the east concourse and at the Guam Cultural Center in the mid-concourse, but the options are limited. The Airport is recommended to incorporate the following types of concessions:

- Convenience retail, such as newsstands or kiosks with grab-and-go food, reading materials, and travel accessories.
- Personal and business services, such as services by XpresSpa and Minute Suites.

4.3.9 Inbound Baggage Claim

The existing baggage claim area as shown in **Figure -3** provides five baggage claim devices at the Basement Level. Both domestic and international arrivals use these baggage claim devices. While all baggage claim units are used for international arrivals, baggage claim units 1 and 2 are typically allocated for domestic arrivals, as these two units are closer to the entrance for domestic arrival passengers. Since the peak domestic and international arrivals occur at different times of the day and all of the arrival flights during the Airport's peak are international, the baggage claim requirements analysis is based on the peak international arrivals through the planning horizon.

Distances between existing devices are about 35 feet, which is consistent with the recommendation from IATA ADRM and ACRP Report 25: *Airport Passenger Terminal Planning and Design*. xce pt for some columns, a minimum clearance of 15 feet of retrieval and peripheral area surrounding the devices is provided. However, there are some localized areas along the south wall with less than 10 feet of circulation beyond the retrieval and peripheral area. Since both the entrances (after CBP inspection) and exits (after Guam CQA) of the baggage claim area are on the north side of the area for all international arrival passengers, there is minimal circulation flows along the south wall. ve n though the entrances for domestic arrival passengers are on the south side, passengers mainly flow from south to north along the two sides of Units 1 or 2. It is not anticipated that there will be a major issue in circulation width along the south side of the baggage claim area.

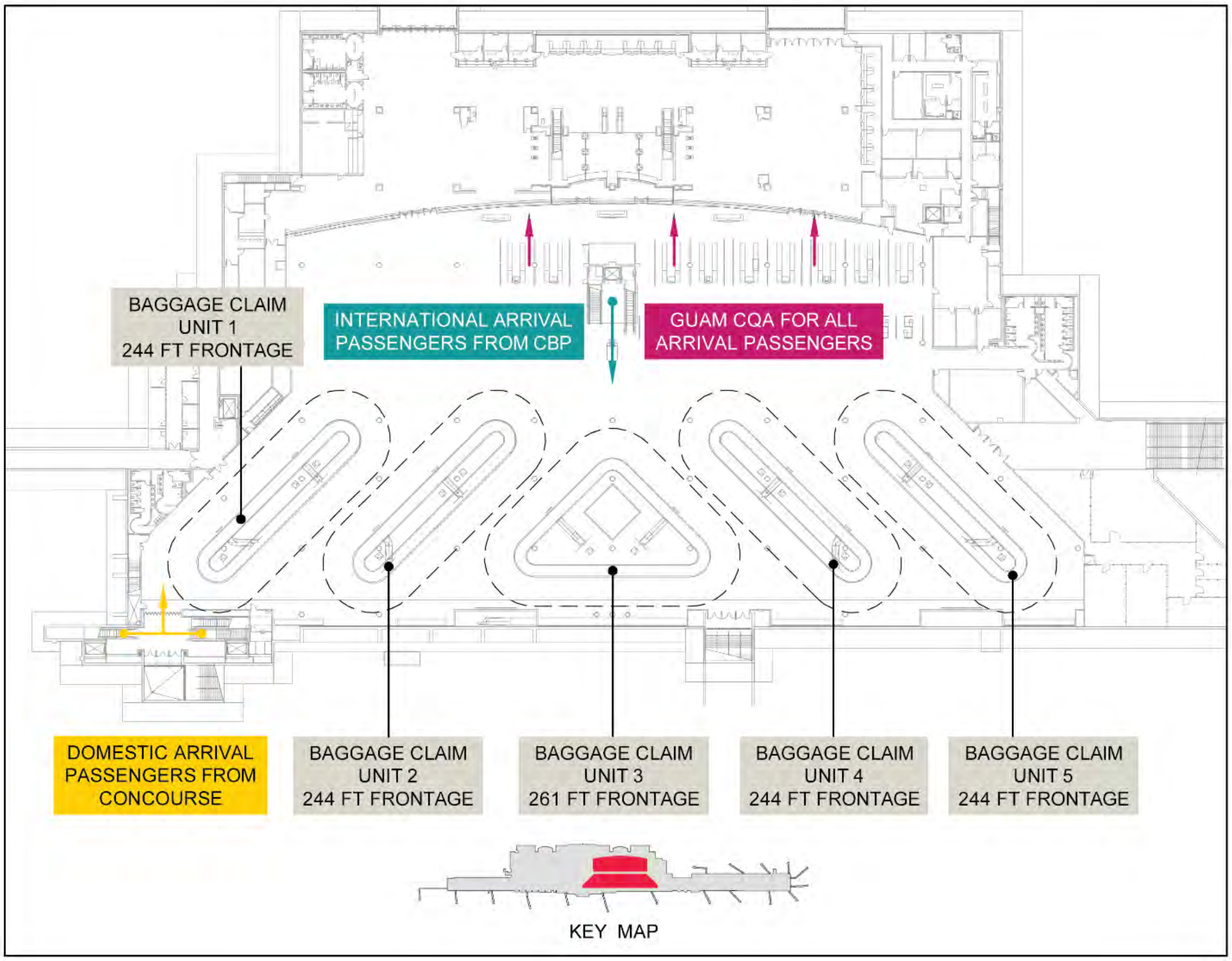


Figure 4-35. Domestic and International Baggage Claim Area

Sources:
1. *GIAA*
2. *AECOM edits*

4.3.9.1 ey Assumptions

For the purpose of this Master Plan, the assumptions for baggage claim facility requirements are summarized in **able -39**

able -39 Baggage Claim ey Assumptions

ey Input Factors	Assumption
Number of peak hour international arrival operations (varied from 2019 to 2039)[A]	7 to 10
Average claim device occupancy time per NB aircraft[B]	20 minutes
Average claim device occupancy time per WB aircraft[B]	45 minutes
Number of seats in design NB aircraft[C]	180 seats
Number of seats in design WB aircraft[C]	350 seats
Ratio of passengers with checked bags[D]	90%
Average checked bags per passenger (including passengers with or without bags)[D]	1.2 bags per passenger
Average checked bags per passenger with checked bags	1.33 bags per passenger with checked bags
Load factor for international arrivals (varied from 2019 to 2039)[A]	65% to 82%
Claim frontage per bag[B]	2.3 feet
Peak occupancy of bag[F]	30%
Claim frontage per passenger[B]	2 feet
Peak occupancy of passenger[G]	45%

Notes:

A. ***Chapter 3**: Aviation Demand Forecasts.*
B. *IATA ADRM 11th edition, ACRP Report 25: Airport Passenger Terminal Planning and Design, and other recent projects.*
C. *Conservative estimates about number of seats based on typical seat configurations on narrowbody and widebody aircraft operation at the Airport. Same assumptions are used for the holdroom space requirements.*
D. *Same assumptions are used for the CBIS facility requirements.*
E. *Calculated from ratio of passengers with checked bags and average checked bags per total passengers.*
F. *This ratio represents the maximum percentage of bags on the aircraft that are likely to be on the belt at any one time. It excludes bags that have been collected from the belt, OOG bags, and bags removed by handling agents or airline staff.*
G. *This ratio represents the maximum percentage of passengers collecting bags that are likely to be present at the belt at any one time. It excludes passengers that are still at the CBP, passengers who collected the bags and left the facility, and passengers not waiting immediately at the frontage.*
H. *Abbreviations*
NB = Narrowbody
WB = Widebody

4.3.9.2 Baggage Claim Facility Requirements

The number of baggage claim units is determined by the total number of units required for narrowbody and widebody aircraft during the peak hour. The number of narrowbody and widebody aircraft is estimated from the peak hour deplanements, load factor, and average seats per aircraft from **Chapter 3***: Aviation Demand Forecasts*. The linear frontage per device is determined by the maximum of the claim frontage driven by the number of bags on the device and the number of passengers waiting at the claim unit.

IATA recommends the claim frontage length for a device serving narrowbody aircraft to be between 131 and 230 feet and for a device serving widebody aircraft to be between 230 and 295 feet. The upper limits should only be used where the average checked bag to passenger ratios are over 1.5 bags per passenger, which is higher than 1.2 bags per passenger for the Airport. Four of the existing baggage claim units are 244 feet each, and the remaining baggage claim unit is 261 feet. All of the baggage claim units are adequate to handle both narrowbody and widebody aircraft.

Other than benchmarking the industry standards on claim frontage typically required for serving narrowbody and widebody aircraft, the requirements for the Airport were also estimated using the methodology from the IATA ADRM and the assumptions given in **able -39**

The required number of baggage claim devices, linear frontage per device, and total linear baggage claim frontage are summarized in **able -** .

able - Baggage Claim Facility Requirements

Description	Existing Inventory[B]	Estimated Requirements					
		FY2019 (Base Year)	PAL 1 (FY2024)	PAL 2 (FY2029)	PAL 3 (FY2034)	PAL 4 (FY2039)	
Peak Hour International Deplanements	-	1,483	1,005	1,542	1,670	1,820	
Peak Hour International Arrivals	-	8	7	9	9	10	
Number of NB Aircraft	-	5	5	7	6	6	
Number of WB Aircraft	-	3	2	2	3	4	
Number of NB Baggage Claim Units[A]	-	2	2	3	2	2	1
Number of WB Baggage Claim Units[A]	-	3	2	2	3	3	4
Total Number of Baggage Claim Units[A]	**5**	**5**	**4**	**5**	**5**	**5**	**5**
Linear Frontage per NB Aircraft	-	119	97	119	121	122	122
Linear Frontage per WB Aircraft	-	232	188	232	235	238	238
Linear Frontage of Baggage Claim Unit 1	244	119	97	119	121	122	122
Linear Frontage of Baggage Claim Unit 2	244	119	97	119	121	122	238
Linear Frontage of Baggage Claim Unit 3	261	232	188	119	235	238	238
Linear Frontage of Baggage Claim Unit 4	244	232	188	232	235	238	238
Linear Frontage of Baggage Claim Unit 5	244	232	-	232	235	238	238
Total Baggage Claim Frontage	**1,237**	**934**	**570**	**821**	**947**	**958**	**1,074**

Notes:
A. The numbers of baggage claim units are rounded up to the nearest unit.
B. The number of existing baggage claim devices and their claim frontage lengths are based on the as-built drawings from the Airport.
C. Abbreviations
PAL = Planning Activity Level
FY = Fiscal year
NB = Narrowbody
WB = Widebody

In summary, there is adequate baggage claim facility through the master planning horizon.

Although there is no anticipated deficiency in the baggage claim facility, the Airport is recommended to consider the following operational measures:

- Because all international arrival passengers must clear CBP inspection before entering the baggage claim area, bags most likely arrive on the claim unit before passengers are present. If passengers are delayed at the CBP processing area longer than anticipated, bags will accumulate at the claim unit. Airline or ground handling personnel may have to increase the capacity temporarily by stacking bags upright to reduce claim frontage occupied by each bag, or unload bags from the claim unit and place them on the floor for passengers to pick up.
- The distribution of arriving flights in the peak hour has an impact on the number of claim devices required because the closer the flight arrivals are, the more facilities will be required. Analytical formula assumes an ideal even distribution of arrival flights in the peak hour. In addition to using analytical formula, our analysis considers the actual distribution of arrivals by aircraft type as shown in the 2019 DDFS and the occupancy time per narrowbody or widebody aircraft. The projected requirements assume a similar arrival pattern as 2019 DDFS. Since each claim unit has the capacity to handle bags from two narrowbody aircraft, the Airport is advised to allow for overlapping flights using the same device at the same time. If two flights are allowed to use the same device simultaneously, there will be more flexibility on the scheduled arrival time for any new flights desiring to add service at the Airport.
- When the future flight schedule is available from the airlines, the Airport is recommended to analyze the distribution of arriving flights and work with the airlines to avoid multiple flights arriving within 5 to 10 minutes during the peak hour.
- There are multiple locations of bi-directional flows (cross flows) at the baggage claim area and lobby. The exits (after customs) are behind the entrances. Proper wayfinding guidance and signage are important to direct passengers to their destinations efficiently.

4.3.10 CBP and Guam CQA

The existing CBP area is configured for the traditional flow, in which passengers are processed through CBP primary inspection counters first, proceed to collect their bags, and then go through the inspection by Guam CQA before leaving the secured area.

Guam, as an insular possession of the U.S., is outside the customs territory of the U.S., and domestic passengers from the U.S. mainland must clear customs through Guam CQA at the Airport. Similarly, when domestic passengers fly from Guam to the U.S. mainland, they must clear customs through CBP at their first port of entry (such as HNL, SFO, or LAX).

Because of this split of functions between CBP and Guam CQA, CBP at the Airport focuses on the law enforcement segment of the former Immigration and Naturalization Service (INS) while Guam CQA is responsible for enforcing the customs and quarantine regulations.

The CBP inspection area is on the Concourse Level and is where all international passengers present themselves to a CBP officer for admissibility into the U.S. There are no Global n try or Automated Passport Control kiosks at the Airport, but a Simplified Arrival process has been implemented since June 2021 (**Figure -36**). Simplified Arrival is an enhanced international arrival process that uses facial biometrics to automate the manual document checks that are already required for admission to the U.S. It also provides the passengers with a touchless process that further secures and streamlines the arrival experience.

Passengers who require additional CBP processing and examination are directed to the CBP secondary processing area. An individual may be referred to the secondary processing area for passport/visa concerns, or interviews and personal search. The CBP secondary processing area typically includes referred passenger waiting areas, interview rooms, and secondary waiting area restrooms.

The custom inspection by Guam CQA is similar to the CBP's unified secondary processing and inspection. Arrival passengers who require additional processing and examination are identified by the Guam CQA agents at the primary inspection booths/workstations after collection of checked bags on the Basement Level. Arrival passengers who require additional customs processing and examination are directed to the CQA secondary processing area, which includes the secondary processing positions with secondary baggage non-intrusive inspection (NII) X-ray processing area, and interview/search rooms.

In collaboration with Guam CQA and the Guam Visitors Bureau (GVB), the Airport launched the implementation of the Guam l ectronic Declaration Form (D F) in March 2021. The D F is a mandatory digital form that all arriving passengers need to complete before entering Guam. It provides a new touchless platform for passengers to access both the required Customs Declaration form as well as the Public Health Declaration form. Passengers have the options to complete the digital declaration form online with their own device (accessible up to 72 hours prior to arrival) or use one of the six kiosks at the baggage claim area of the Airport (**Figure -3**). When the digital form is completed, passengers will be given a unique QR code, which will be scanned by a CQA officer at the primary processing area.

Figure -3 shows the existing CBP area on the Concourse Level, and **Figure -39** shows the Guam CQA area on the Basement Level.

Figure 4-36. Simplified Arrival Process at Guam

Source: CBP

Figure 4-37. Kiosk for Electronic Declaration Form and Guam CQA Primary and Secondary Processing Area

Note:

A. *Abbreviation*
   CQA = Customs and Quarantine Agency

Sources:

1. *The Guam Daily Post (March 2021)*
2. *Pacific Daily News (May 2021)*

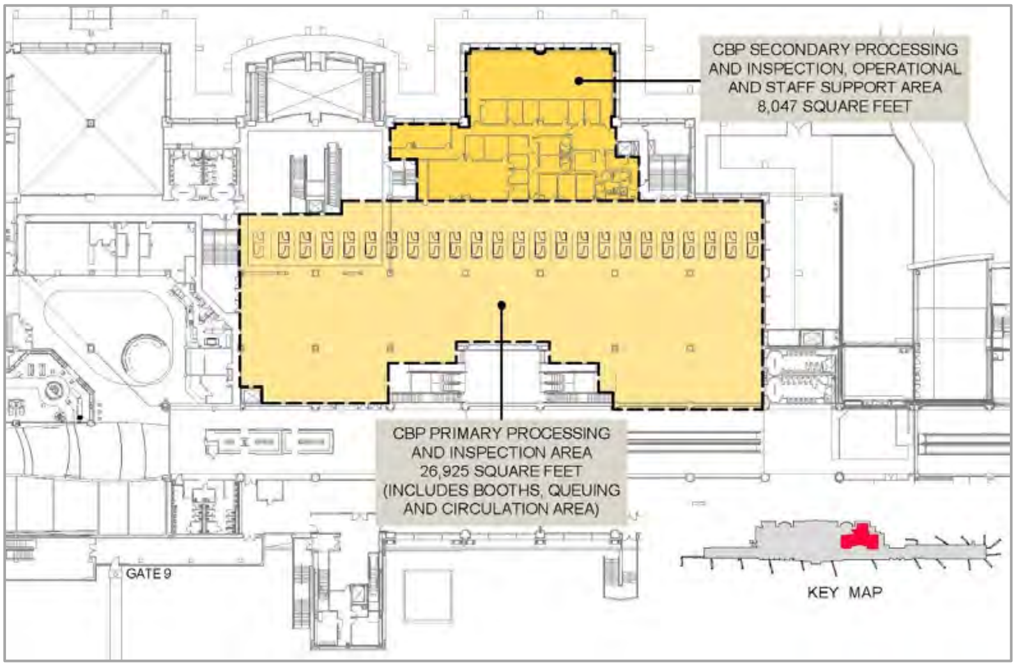


Figure 4-38. CBP Processing and Operational Support Area

Note:

A. Abbreviation
CBP = Customs and Border Protection

Sources:

1. *GIAA*
2. *AECOM edits*

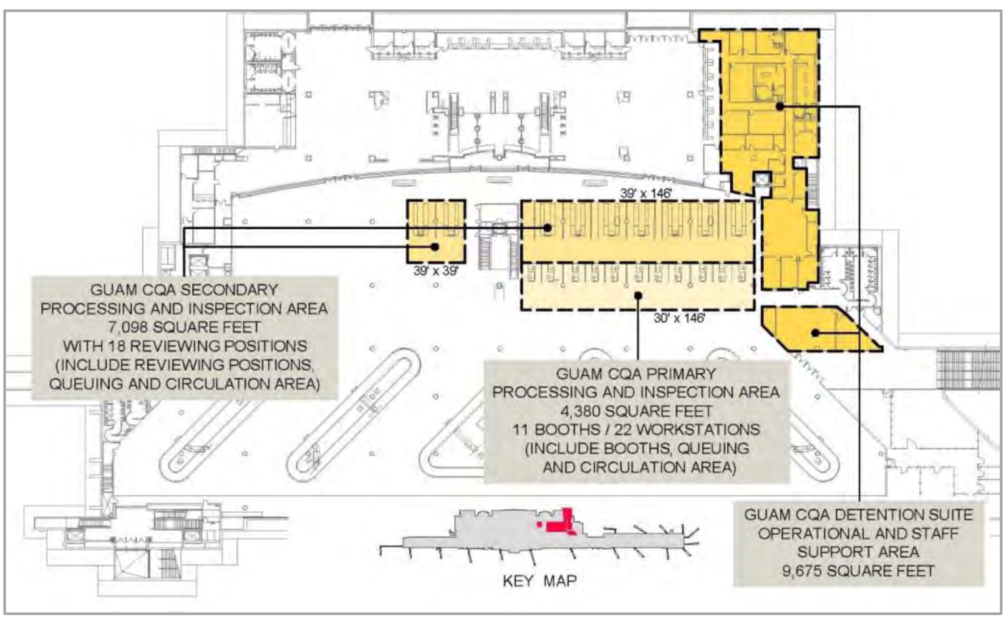


Figure 4-39. Guam CQA Processing and Operational Support Area

Note:

A. Abbreviation
CQA = Customs and Quaratine Agency

Sources:

1. *GIAA*
2. *AECOM edits*

4.3.10.1 ey Assumptions

The CBP and Guam CQA facility requirements reference CBP's ATDS, issue 2017, and the peak hour deplanements from **Chapter 3**: *Aviation Demand Forecasts*. The key assumptions are summarized in **able - 1** .

The number of CBP primary processing booths/workstations, Guam CQA secondary reviewing positions, and baggage NII X-ray processing area are based on the space requirement matrix from Chapter 5 of CBP's ATDS using the rounded peak hour arrival passenger demands.

Because the processing time at the Guam CQA primary processing area is expected to be much shorter than the CBP primary processing time as given in the ATDS, the number of Guam CQA primary processing booths/workstations and the queue area are calculated using analytical formula based on average processing time and maximum waiting time instead of using the space requirement matrix from CBP's ATDS. Furthermore, with the implementation of the digital declaration forms, the processing time to scan the QR code (or to hand over the paper declaration form) is expected to be within seconds, especially for passengers who have nothing to declare and use the green channel. These assumptions are included in **able - 1** .

able - 1 CBP and Guam CQA Processing ey Assumptions

ey Input Factors	Assumption
Average CBP primary processing rate[A]	50 passengers per hour per CBP agent workstation (i.e., 72 seconds per passenger)
Area per CBP primary processing booth (each booth includes two workstations), includes the booth, queuing and circulation area [A]	1,320 square feet per booth
Average Guam CQA primary processing time[B]	30 seconds per passenger
Maximum waiting time at Guam CQA primary processing booth[C]	5 minutes
Queue space per passenger waiting at Guam CQA primary processing[C]	14 square feet per passenger
Area per Guam CQA primary processing booth[D] (each booth includes two workstations)	200 square feet per booth
Guam CQA secondary reviewing position[A]	3 positions for 1,200 passengers per hour 4 positions for 1,800 passengers per hour 5 positions for 2,000 passengers per hour
Area per Guam CQA secondary reviewing position , includes the baggage inspection area, the workstation, queuing and circulation area between reviewing positions	395 square feet per position
Guam CQA secondary baggage NII X-ray processing area[A]	1 for 2,000 (or fewer) passengers per hour
Area per Guam CQA secondary baggage NII X-ray processing area[A]	1,476 square feet

Notes:

A. CBP's Airport Technical Design Standard, issue 2017.
B. With the implementation of the digital declaration forms, the processing time to scan the QR code (or to hand over the paper declaration form) is expected to be within seconds, especially for passengers who have nothing to declare and use the green channel. Families can use one combined form instead of separate forms for each individual member. An average of 30 seconds per passenger is a conservative estimate.
C. IATA ADRM 11th LoS guidelines.
D. Based on the as-built drawings from the Airport; 2,190 square feet for 11 booths = average 200 square feet per booth (includes the circulation area between booths but excludes the queue area, which is calculated separately).
E. Based on the as-built drawings from the Airport; 7,980 square feet for 18 positions = average 395 square feet per position (includes the queuing and circulation area).
F. Abbreviations
CBP = Customs and Border Protection
CQA = Customs and Quarantine Agency

4.3.10.2 CBP and Guam CQA Facility Requirements

The facility requirements for CBP and Guam CQA processing are summarized in **able - 2**.

able - 2 CBP and Guam CQA Facility Requirements

Description	Existing Inventory[A]	Estimated Requirements				
		FY2019 (Base Year)	**PAL 1 (FY2024)**	**PAL 2 (FY2029)**	**PAL 3 (FY2034)**	**PAL 4 (FY2039)**
Peak Hour International Deplanements[B]	-	1,483	1,005	1,542	1,670	1,820
Passengers Processed per Hour[C]	-	1,800	1,200	1,800	1,800	2,000
CBP Processing Workstations, and Space Requirements						
Number of CBP Primary Processing and Inspection Agent Workstations[D] (One booth include two agent workstations)	48	36	24	36	36	40
CBP Primary Processing and Inspection Area (including booths, queuing and circulation area)[E] (square feet)	26,925	23,760	15,840	23,760	23,760	26,400
Guam CQA Processing Workstations, Reviewing Positions, and Space Requirements						
Number of Guam CQA Primary Processing Agent Workstations[F]	22	13	9	14	15	16
Area for Guam CQA Primary Processing Agent workstation (square feet)	2,190	1,400	1,000	1,400	1,600	1,600
	2,190	1,820	1,260	1,960	2,100	2,240
Queue Area for CQA Primary Processing (square feet)[G]	4,380	3,220	2,260	3,360	3,700	3,840
Number of Guam CQA Secondary Reviewing Positions[H]	18	4	3	4	4	5
Area for Guam CQA Secondary Reviewing Positions (SF)	7,098	1,580	1,185	1,580	1,580	1,975
Number of Guam CQA Secondary baggage NII X-ray processing area[H]	Included above	1	1	1	1	1
Area for Guam CQA Secondary baggage NII X-ray processing[H]	Included above	1,476	1,476	1,476	1,476	1,476
Guam CQA Secondary Processing and Inspection Area (square feet)	7,098	3,056	2,661	3,056	3,056	3,451

Notes:

A. *Existing number of agent workstations and queue areas are based on the as-built drawings from the Airport. See **Figure 4-38** and **Figure 4-39**.*
B. ***Chapter 3**: Aviation Demand Forecasts.*
C. *Rounded up to match the passengers processed per hour specified in CBP's ATDS.*
D. *CBP's ATDS, 100 passengers per hour per booth or 50 passengers per hour per workstation.*
E. *CBP's ATDS, 1,320 square feet per booth. Each booth includes two workstations.*
F. *Calculated from peak hour deplanements and average processing time in **Table 4-41**.*
G. *Calculated from peak hour deplanements and maximum waiting time and queue space per passenger in **Table 4-41**.*
H. *CBP's ATDS and summarized in **Table 4-41**.*
I. *Abbreviations*
PAL = Planning Activity Level
FY = Fiscal year
CBP = Customs and Border Protection
CQA = Customs and Quarantine Agency
SF = Square feet

In summary, the number of CBP and Guam CQA processing workstations and reviewing positions, and their corresponding queue spaces, are adequate for the planning horizon. The total operational support spaces for CBP and Guam CQA is approximately 17,800 square feet, which is consistent with the order of magnitude required for a peak hour processing throughput of 2,000 arrival passengers per hour according to the space requirement matrix in CBP's ATDS.

4.3.11 Summary of erminal Facility Requirements

- Gates and RON:
  - xi sting gates and RON parking positions are adequate through the planning horizon.
- Check-in facilities:
  - xi sting check-in positions and queue spaces are adequate through the planning horizon.
  - Add common use touchless self-service kiosks.
  - Add baggage induction points at the 12 counters next to the entrances between the a st and West Check-in Areas.
- SSCP:
  - n large the queue area.
  - Will need reconfiguration and/or expansion if TSA upgrades to CPSS at the Airport.
- CBIS:
  - 3+1 inline CBIS with high throughput D S machines is adequate through the planning horizon.
- Holdrooms:
  - Most of the holdrooms require expansion and/or innovative solutions to optimize the use of existing space.
- Restrooms:
  - Consider adding a separate family room (companion care/special needs/unisex) for each restroom module.
  - Landside restrooms are adequate, except for the separate family room.
  - Concourse restrooms are adequate, except for the separate family room. For enhanced passenger experience, the Airport may add drinking fountains at the mid-concourse restroom at Gates 9 and 10.
  - Add restrooms along the sterile corridor to reduce the walking distance from the arrival gates to the first restroom for international arrival passengers experience.
  - Add restrooms in the CBP primary inspection area.
- Concessions:
  - Total concessions area is reasonable for the size of the Airport.
  - Diversify the type of concessions and include:
    - Convenience retail, such as newsstands or kiosks with grab-and-go food, reading materials, and travel accessories.
    - Personal and business services, such as services by XpresSpa and Minute Suites.
- Baggage claim:
  - xi sting baggage claim devices are adequate through the planning horizon.
- CBP and Guam CQA:
  - xi sting CBP and Guam CQA processing and inspection areas for inbound passengers are adequate for the planning horizon.
  - Require separate areas for the outbound CBP visa inspection for domestic flights to the U.S. mainland/Honolulu instead of occupying existing holdroom spaces at Gates 7 and 9.

4.4 andside Facilities and Ground Access

This section addresses requirements for ground transportation facilities, which include the following:

- Roadways
- Terminal curb
- Parking
- Rental car facilities
- Public commercial areas
- Transportation Network Companies (TNCs) (i.e., ride share)

Requirements for landside facilities (see **Section 2** of **Chapter 2:** *Inventory of Existing Conditions*) were developed based on the airside forecasts and historical characteristics of the landside operations, including the planning parameters described in this section. In particular, the airside forecast for peak hour passenger activity projects growth of peak hour enplanements from 1,477 in FY2019 to 1,812 in FY2039, or a 22.7 percent increase, with essentially the same growth for deplanements. These peak values are related to the timing of flight arrivals and departures.

However, for the evaluation of the landside facilities, the peaks of originating and terminating passengers were used, which are related to the timing of when they use the landside elements. Typical “earliness distributions” of originating passengers accessing the Airport extend 4 or more hours prior to scheduled flight departures. With this type of distribution applied to the FY2019 enplanement profile, the FY2019 peak hour originating passenger volume was reduced to about 830 people per hour, or about 56% of the peak hour enplanements. Similar delays between flight arrivals and passenger use of landside facilities, due to customs inspections, baggage claim, and other factors, result in a reduction of peak hour terminating passengers compared to peak hour deplanements. In this case, the ratio is about 90 percent. These relationships are shown in the peak hour comparisons of passenger profiles in **Figure - .**

The resulting passenger peak hour values by PAL year are given in **able - 3**

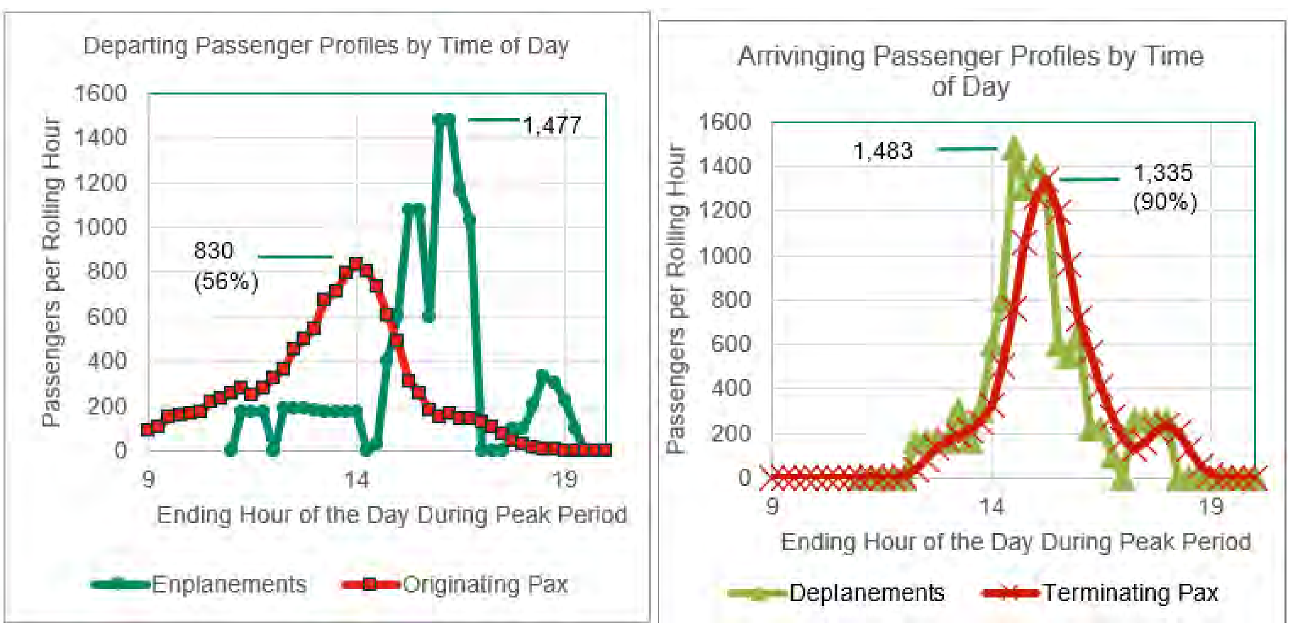


Figure 4-40. Sample 2019 Air Passenger Profile Comparisons

Note:

A. Abbreviation
Pax = Passenger

able - 3 Projected Air Passenger Peak our Volumes

PA	Enplanements	Originating Passengers	Deplanements	erminating Passengers
FY2019 (Base Year)	1,477	830	1,483	1,335
PAL 1 (FY2024)	1,001	560	1,005	905
PAL 2 (FY2029)	1,536	860	1,542	1,390
PAL 3 (FY2034)	1,663	930	1,670	1,500
PAL 4 (FY2039)	1,812	1,015	1,820	1,640

Note:
A. Abbreviation
FY = Fiscal year
PAL = Planning Activity Level

Based on FY2019 data, the estimated ground access mode split for air passengers is given in **able -** . These are also assumed for the future projections.

able - Derived 2 19 Mode Split for Air Passengers

Ground Access Mode	Percent of Passengers
Private Vehicle Self-Park	8
Private Vehicle Curb Drop/Pickup	8
Taxi	12
Limo	2
Transportation Network Company (TNC)	2
Tour Bus	30
Tour Van	11
Rental Car	22
Hotel Shuttle	5
otal	**1**

Sources: AECOM estimate based on GIAA data, including the following files:
1. *Tour Bus Summary Pax Accounting Stroll Guam – Airport pickups (2019)*
2. *Taxi Pax Totals by Association Pacair Ltd. (2019)*

Industry typical values were used for other parameters based on data from several other A C OM airport landside projects. Private vehicles were assumed to have an average of 1.4 air passengers per vehicle, with 20 per tour bus and six per tour van and shuttle. Curb drop-off mean dwell times were assumed to be 2 minutes for automobile-sized vehicles, 5 minutes for tour buses, and 3 minutes for tour vans and shuttles. Curb pick-up mean dwell times were assumed to be 2.5 minutes for automobile-sized vehicles and 3 minutes for shuttles. With these assumptions, the results below are fairly insensitive to the mode split assumptions, except for variations in tour operations.

mp loyee parking requirements were estimated as 350 spaces per million annual enplanements based on the ACRP Report 25: *Airport Passenger Terminal Planning and Design* recommended range of 300 to 450, with 20 percent, entering or exiting in the peak hour.

4.4.1 Roadways and Curbfronts

Analyzing the above data, the overall traffic into or out of the terminal area in FY2019 is estimated to have been between 800 (inbound) and 1,000 (outbound) passenger cars per hour (pcph), broken down as approximately 200 to/from the departure curb, 100 to/from the arrival curb, 200 to/from parking lots, and 300 to and 500 from the tour/rental area. By FY2039, overall traffic is projected to increase to about 1,000 inbound and 1,200 outbound pcph, with a similar percentage breakdown. To understand the related capacities, more detailed data are needed for non-Airport traffic patterns and the directional distribution of Airport traffic. These data could be derived from peak hour turning counts at the key intersections within and surrounding the terminal area. Projected peak hour inbound and outbound traffic volumes by PAL (year) are shown in **able -** .

able - Projected Airport raffic Peak our Volumes

PA	Inbound raffic, pcph	Outbound raffic, pcph
FY2019 (Base Year)	767	964
PAL 1 (FY2024)	520	653
PAL 2 (FY2029)	798	1,002
PAL 3 (FY2034)	864	1,086
PAL 4 (FY2039)	941	1,183

Note:
A. Abbreviation
PAL = Planning Activity Level
FY = Fiscal year
pcph = Passenger cars per hour

Based on the analysis of the FY2019 data, the projected internal distribution of Airport traffic is shown in **able - 6** .

able - 6 Projected Airport raffic Distributions

raffic Breakdown	Inbound raffic	Outbound raffic
To/from Departures Curb	24%	19%
To/from Arrivals Curb	11%	9%
To/from Public Parking	6%	8%
To/from mployee Parking	17%	14%
To/from Tour/Rental Area	42%	50%

Departure curb requirements to achieve a preferred LoS C are projected to increase from about 290 feet in FY2019 to about 350 feet in FY2039, still well within the approximately 927-foot length available, which should permit LoS A. Curb LoS address the amount of congestion at the curbs and are described in ACRP Report 40: *Airport Curbside and Terminal Area Roadway Operations,* as shown in **able -** .

Arrival curb requirements for LoS C are projected to increase from about 430 feet in FY2019 to about 480 feet in FY2039, still within the approximately 750-foot length available, which should permit LoS A. The existing arrival and departure curbside frontage is shown in **Figure - 1** .

The curb requirements by PAL year are shown in **Figure - 1** .

able - Curb evels of Service Criteria

evel of Service	Utilization Range	Description
A	0–0.9	xcellent: Drivers experience no interference from pedestrians or other motorists
B	0.9–1.1	Very Good: Relatively free flow conditions with limited double parking
C	1.1–1.3	Good: Double parking near doors is common with some intermittent triple parking
D	1.3–1.7	Fair: Vehicle maneuverability restricted due to frequent double/triple parking
	1.7–2.0	Poor: Significant delays and queues; double/triple parking throughout curbside
F	>2.0	Failure: Motorists unable to access/depart curbside; significant queueing along entry road

Source: ACRP Report 40: Airport Curbside and Terminal Area Roadway Operations, Table 3-6.8

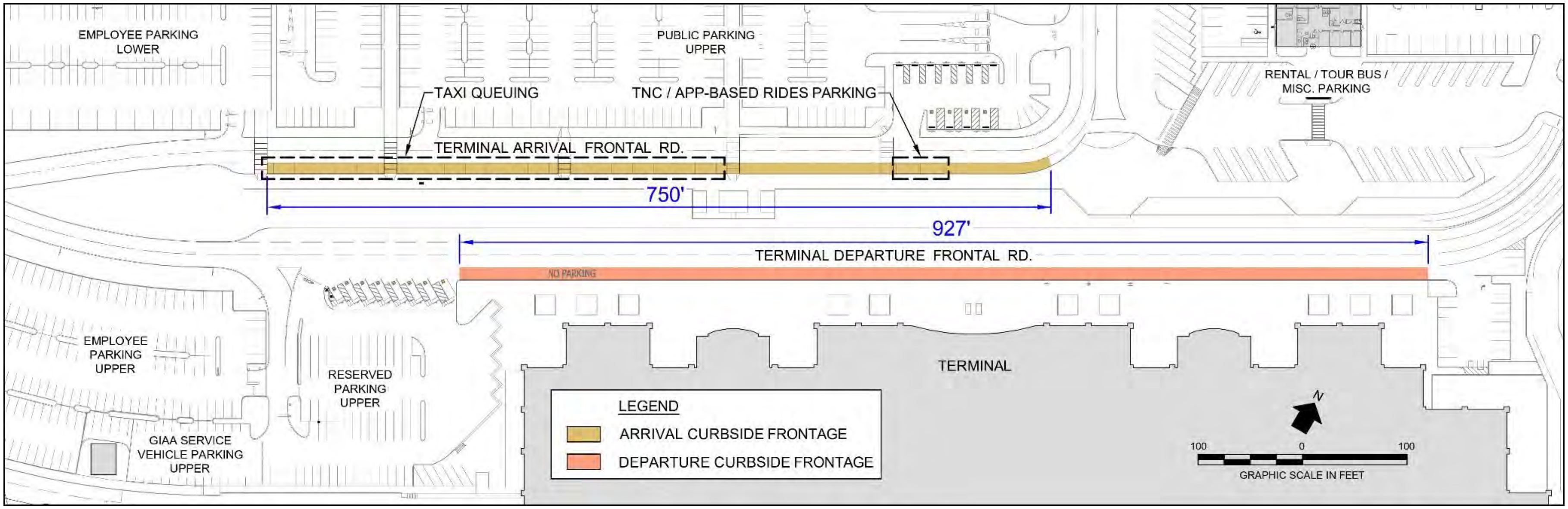


Figure 4-41. Existing Curbside Frontage

Source: AECOM

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able - Projected Airport Curb Requirements

PA	Departure Curb	Arrival Curb
FY2019 (Base Year)	287’	428’
PAL 1 (FY2024)	194’	290’
PAL 2 (FY2029)	298’	432’
PAL 3 (FY2034)	323’	441’
PAL 4 (FY2039)	352’	477’
Available Lengths	927’	750’

Note:
A. Abbreviation
PAL = Planning Activity Level
FY = Fiscal year

4.4.2 Automobile Parking

Based on the available overnight parking inventories in FY2019 and the daily pattern of enplanements and deplanements, it is estimated that peak public parking requirements for the design day (ADPM) must have been less than about 150 spaces. By FY2039, this is expected to grow to about 200 spaces, which is within the current capacity.

mp loyee parking demand is projected to grow from about 660 spaces to about 820 spaces, also within current capacity.

Consideration should also be given to the requirements for electric vehicle (V) charging stations in selected parking areas, with the number and locations to be determined during design development.

Parking demands by PAL year and capacities are shown in **able - 9** .

able - 9 Projected Parking Requirements

PA	Public Spaces	Employee Spaces
FY2019 (Base Year)	150	660
PAL 1 (FY2024)	102	447
PAL 2 (FY2029)	156	686
PAL 3 (FY2034)	169	743
PAL 4 (FY2039)	184	810
xisting Inventory	279	889

4.4.3 Rental Car Facilities

Parking space requirements in the rental car area are dependent on the projected peak flow rates for rentals and returns, and the timing of shuttling cars to and from the remote cleaning/fueling/staging areas. Based on assumed average dwell times of 8 minutes between return and shuttling to remote facilities and 8 minutes between shuttling from remote facilities and rental, the FY2019 requirements would have been for about 60 spaces. This estimate is based on estimated travel times and staffing levels. This also assumes that peak rentals and returns do not occur at the same time(s) of day. Related demands by PAL and capacities are shown in **able -** . Note that this may mean that rental companies with higher volumes may need to provide more shuttle staff to stay within allocated spaces.

able - Projected Rental and Commercial Parking Requirements

PA	Rental/Return Spaces	our Bus Spaces	our Van Spaces
FY2019 (Base Year)	60	11	8
PAL 1 (FY2024)	41	9	5
PAL 2 (FY2029)	62	14	8
PAL 3 (FY2034)	68	15	9
PAL 4 (FY2039)	74	16	10
xisting Inventory	118	26	11

Note:
A. Abbreviation
PAL = Planning Activity Level
FY = Fiscal year

4.4.4 Public ransportation

It is expected that the limited public transportation anticipated will be easily accommodated by the current facilities. See **Section 2** in **Chapter 2:** *Inventory of Existing Conditions* for more information.

4.4.5 Commercial Vehicles

It is expected that all commercial vehicles will be accommodated at the departure and arrival curbfronts, except for pickups for tour buses and tour vans, which are served at the dedicated parking area across from the baggage claim area. Again, the number of spaces required for these vehicles depends on the flow rates and dwell times. Active loading times can be relatively short, but the tour operations sometimes involve early staging of vehicles prior to the actual arrival of tour groups. In the past this has evidently been accommodated within the current number of spaces (26 buses and 11 vans). This can also be accommodated in the near future with the current number of spaces. However, by FY2039, more restrictive policies may need to be implemented to stay within the current spaces, possibly requiring some minor off-site staging. The projections by PAL years are shown in **able -** .

4.4.6 ransportation Network Companies

Historically, TNCs have been a minor factor in Guam compared with many airports around the world. That is expected to continue, with only two spaces devoted to TNC pickups. However, if demand for TNCs increases in the future, other modes will decrease, with the overall effect still within the current capacities.

4.4.7 Commercial Vehicle Staging

Off-site commercial vehicle staging is not expected to be needed, except as noted in **Section** .

4.4.8 Summary of andside Facility Requirements

The existing landside facilities should be adequate for the planning horizon, with the possible exception of internal and surrounding traffic intersections, which require further data collection and analysis.

4.5 General Aviation, Cargo, and Support Facilities

This section assesses the ability of existing GA infrastructure and support facilities to accommodate existing and forecast demand. Facility requirements were determined using FAA design standards, industry standard planning factors, and site-specific conditions such as number and type of based aircraft, itinerant operations, zoning, noise compatibility, and building codes. FAA design standards and industry standard planning factors were referenced from the following guidance:

- FAA AC 150/5300-13B, *Airport Design*
- FAA AC 150/5360-13, Planning and Design Guidelines for Airport Terminal Facilities

- TRB ACRP Report 113: Guidebook on General Aviation Facility Planning
- 2013 Airports Council International – North America's (ACI-NA) *Air Cargo Guide*

4.5.1 General Aviation a ngar

There are two typical types of GA hangars: conventional hangars and T-hangars. Currently, the Airport does not have T-hangars, nor is there an expectation that they will be needed within the current planning period. Thus, this assessment analyzes the requirement for conventional hangar space to accommodate future demand.

The size of a conventional hangar is determined by the type and number of aircraft to be stored. Hangars should provide maximum flexibility for future tenants and/or aircraft that may operate at an airport. The following planning parameters were used for the purposes of this analysis:

- 10,000 SF (100-foot by 100-foot) typical hangar bay size
- 33 percent of based aircraft to be stored in a hangar
- 15 percent additional square footage for office, training, and maintenance areas

Figure 4-42. Nose Dock Hangar

Source: ©2022 Photography by Elliott Lindgren

Currently, there are 36 based aircraft at the Airport with a ratio of approximately 30 percent jets and 70 percent piston aircraft. A 100-foot by 100-foot hangar bay (10,000 SF) could accommodate a single large corporate aircraft, four turboprop aircraft, or eight small piston aircraft. There are two GA hangars: HC-5 (also known as the ACI hangar) has an aircraft parking hangar bay of approximately 27,300 SF, and the Nose Dock hangar aircraft parking bay is approximately 9,000 SF, totaling 36,300 SF. Based on site photos and hangar size, it appears the Nose Dock hangar (**Figure - 2** can accommodate approximately seven small single-engine piston aircraft and the ACI hangar can accommodate two jets, two turboprop, and eight small single-engine piston aircraft, which is approximately 33 percent of based aircraft at the Airport. The mix of aircraft stored in hangars is approximately 40 percent propeller aircraft and 20 percent jets. Using these percentages, **able - 1** shows the hangar space requirements.

able - 1 General Aviation angar Space Requirements

PAL	Based Aircraft		Hangar Parking Positions		Hangar Bay Space Requirement (SF)	Existing Hangar Bay Space (SF)	Additional Hangar Bay Space Requirement (SF)
	Propeller Aircraft	Jets	Propeller Aircraft	Jets			
FY2019 (Base Year)	26	10	10	2	35,000	36,300	0
PAL 1 (FY2024)	26	11	10	3	45,000	36,300	8,700
PAL 2 (FY2029)	27	11	10	3	45,000	36,300	8,700
PAL 3 (FY2034)	28	11	10	3	45,000	36,300	8,700
PAL 4 (FY2039)	28	11	10	3	45,000	36,300	8,700

Notes:
A. *Red text indicates deficiency.*
B. *Abbreviation*
PAL = Planning Activity Level
FY = Fiscal year
SF = Square feet

While the existing hangar space is adequate, there isn't a lot of flexibility to accommodate an additional jet in the future; therefore, the master plan should include provisions for an additional conventional hangar for bulk aircraft storage of approximately 37,500 SF (hangar bay and offices). This will also allow space for other functions such as aircraft maintenance. For site planning purposes, the aircraft apron at the front of the hangar is typically equal to or larger than the hangar footprint. The vehicle parking requirement for the new recommended hangar is 68 spaces based on the following planning factors:

- 1 space per 1,000 SF of hangar floor area
- 1 space per 200 SF of office/operations area

4.5.2 Apron Areas

GA aircraft parking aprons are typically provided for transient aircraft operations and based aircraft. Transient aprons are utilized by aircraft that are at the Airport on a short-term basis and usually have higher activity and turnover, but lower density. As such, transient aprons are best located near GA terminal buildings. On the other hand, based aircraft parking aprons normally have lower activity, but with a higher density, as aircraft are parked for longer periods of time.

Figure 4-43. GA Aircraft

Source: ©2022 Photography by Elliott Lindgren

The based GA aircraft (**Figure - 3**) total was 37 for FY2021 with the majority being single-engine aircraft (23) followed by multi-engine (4) and jets (10).

The number of aircraft parking positions required for other aircraft was determined using the methods provided in Appendix C of ACRP Report 113: *Guidebook on General Aviation Facility Planning*.

The ACRP method uses annual transient operations to quantify the required parking positions as shown below:

(X / 2*T) / 365 * P = Number of Transient Parking Positions

Where,

X = number of Itinerant GA operations
T = percent of operations that are transient
P = percentage of transient aircraft parked on the apron at any one time (10 percent)

The Baseline Scenario forecast operations for FY2039 is 37,927 annual transient operations. Thirty eight percent of itinerant operations are transient aircraft, per **Chapter 3:** *Aviation Demand Forecasts*, of which 10 percent are expected to be parked on the apron at any given time. The formula above yields two transient parking positions for 2039 (see **able - 2**).

Assuming 33 percent of based aircraft are parked in a hangar, the remaining 67 percent are parked on the apron, as shown in **able - 2** .

able - 2 General Aviation Aircraft Parking Apron Positions – Baseline Scenario

PAL	Itinerant Operations	% Transient (T)	Required Transient Positions	Existing/Forecast Based Aircraft	Required Based Aircraft Apron Parking Positions
FY2019 (Base Year)	26,908	38%	2	36	25
PAL 1 (FY2024)	24,351	38%	2	37	25
PAL 2 (FY2029)	33,211	38%	2	38	26
PAL 3 (FY2034)	35,569	38%	2	39	27
PAL 4 (FY2039)	37,927	38%	2	40	27

Figure - depicts an aircraft parking template demonstrating the apron area required to accommodate the typical general aviation aircraft operating at the Airport. As shown, approximately 1,500 square yards (SY) of apron can accommodate one jet parking position or two propeller aircraft parking positions.

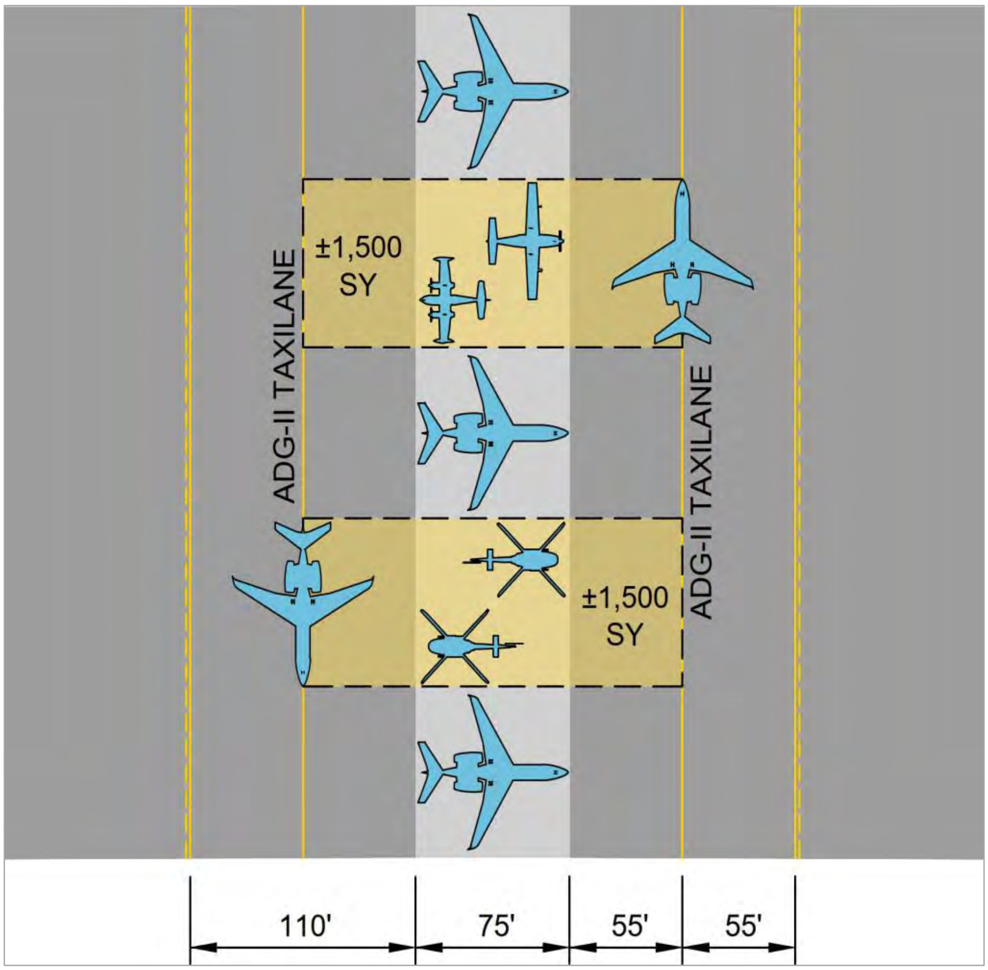

Figure 4-44. General Aviation Parking Position Layout

Source: AECOM

Total parking requirements include based aircraft positions and transient parking positions. Seventy percent of the parking requirement is made up of propeller aircraft, while jets make up the remaining 30 percent. The projected apron space requirement is shown in **able - 3**

able - 3 General Aviation Aircraft Parking Apron Positions

PA	otal Apron Parking Positions	Propeller Aircraft Parking Positions	Jet Parking Positions	Apron Requirement SY
FY2019 (Base Year)	27	19	8	26,300
PAL 1 (FY2024)	27	19	8	26,300
PAL 2 (FY2029)	28	20	8	27,000
PAL 3 (FY2034)	29	21	8	27,800
PAL 4 (FY2039)	29	21	8	27,800

Note:
Abbreviation
A. *SY = Square yard*

The current apron parking area is approximately 27,900 SY (see **Figure -**) consisting of one apron in front of the Nose Dock hangar and two overflow aprons. Based on the projected apron requirement through FY2039, no additional GA parking apron is needed.

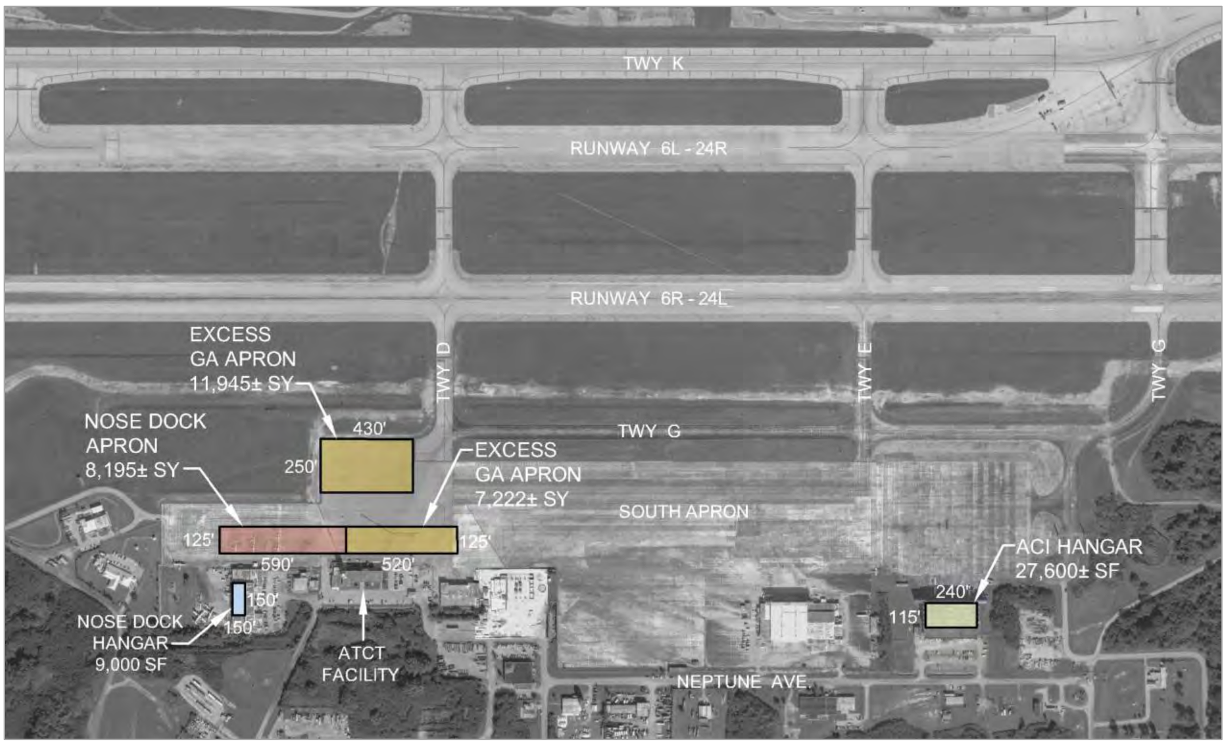

Figure 4-45. Existing General Aviation South Apron Areas

Source: AECOM

4.5.3 General Aviation erminal

The Airport does not have a GA terminal (or fixed based operator [FBO] terminal) to accommodate passengers and crew. Therefore, planning should consider a GA terminal on the south side of the Airport. A typical GA terminal accommodates a variety of functions including offices, meeting rooms, waiting areas, pilot briefing rooms, and restrooms. The required size of a GA terminal is largely based on the functions to be accommodated and peak period occupancy, but a planning factor of 450 SF per person with 2.5 persons per peak hour operation can be used as recommended in ACRP Report 113: *Guidebook on General Aviation Facility Planning*. **able -** summarizes the GA terminal size requirements.

able - General Aviation erminal Calculation

PA	Annual Operations- Itinerant & Air axi	Peak our Operations 12-hour daily operational period	Persons per Peak our Operation 2	Space Per Person SF	Approximate GA erminal Size SF
FY2019 (Base Year)	27,278	6	16	450	7,000
PAL 1 (FY2024)	20,380	5	11	450	5,200
PAL 2 (FY2029)	31,282	7	18	450	8,000
PAL 3 (FY2034)	32,768	7.5	19	450	8,400
PAL 4 (FY2039)	34,280	8	20	450	8,800

Notes:
A. Abbreviation
SF = Square feet

Vehicle parking is required for passengers and employees at a GA terminal. The parking area should be adequate to accommodate the number of parking spaces and driving lanes. Planning factors for calculating parking requirements are as follows:

GA Terminal Parking Requirements:

- 2.5 spaces per peak hour operation
- 1 space per 200 SF of office space (80 percent of the terminal)

As depicted in **Figure - 6** , the standard parking space size (10 feet by 20 feet), a driving lane width (25 feet), and buffer (5 feet) were used to determine the size of each parking space. a ch 75 feet of parking lot length can accommodate two parking spaces that are 10 feet wide. Therefore, a space allowance of 375 SF per parking space was used for the purposes of this analysis. Using the GA terminal size of approximately 8,800 SF (FY2039) requires 56 parking spaces.

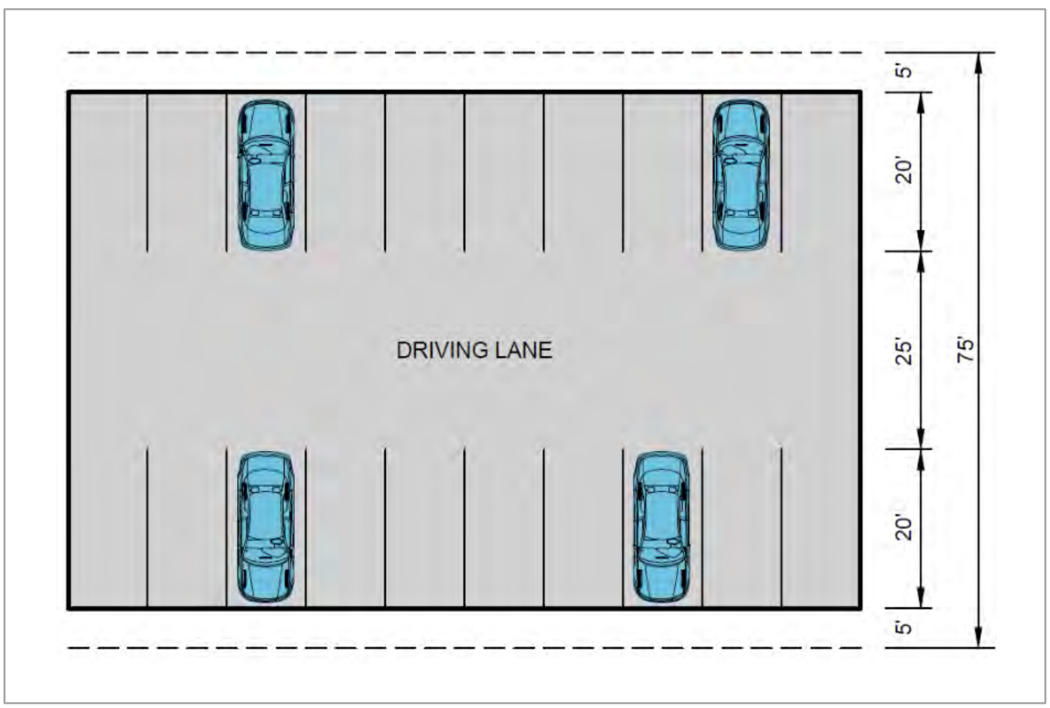

Figure 4-46. Car Parking Arrangement

Source: AECOM

4.5.4 ight Aircraft Commuter erminal

The light aircraft commuter terminal (**Figure -**), built in 1976, is located on the north side of the airfield, west of the commercial passenger terminal. There are three dedicated parking positions (1, 1A, and 2) outside of the facility that are not associated with commercial passenger terminal operations. The location is ideal for roadway access and proximity to the rental car and parking facilities. However, the terminal is old and doesn't provide an acceptable LoS and should be replaced in kind (approximately 47,000 SF). In the visioning workshop, stakeholders indicated that a new commuter terminal building with dedicated CBP facilities is desirable.

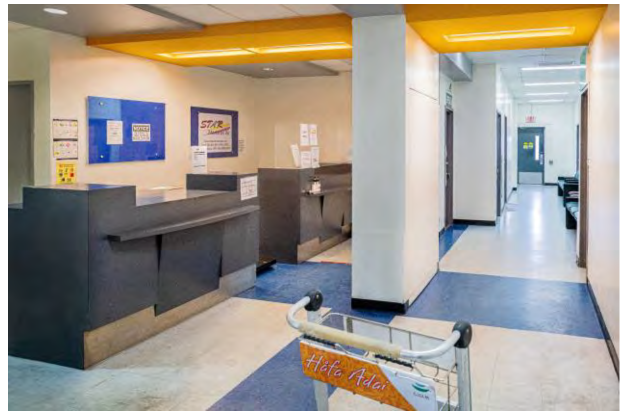

Figure 4-47. Light Aircraft Commuter Terminal

Source: ©2022 Photography by Elliott Lindgren

4.5.5 Air Cargo Facilities

Cargo service is largely driven by factors external to the Airport, such as geographic location, competing airports, established routes for passenger airlines/cargo airlines, the availability of other cost-competitive modes of cargo transport (such as sea), and the presence of industries that drive the demand for cargo services. The type and level of cargo service demand will subsequently drive the size and type of cargo facilities provided at an airport. The primary cargo operators at the Airport consist of freight forwarders, all-cargo, belly-cargo, and integrated carriers.

Freight forwarders and brokers coordinate the shipment of cargo typically by purchasing space with all-cargo or belly-cargo operators. While all-cargo operators only transport cargo, the primary business of belly-cargo operators (such as United Airlines Cargo) is the transportation of passengers, but they also utilize the lower deck (belly) of their aircraft to transport cargo. Processing and sortation for freight forwarders, all-cargo, and belly-cargo occurs at the cargo facilities consisting of the Guam Integrated Air Cargo (GIAC) facility, Triple B Forwarders, CTSI Logistics, and DHL facility, with some off-airport freight forwarders who also handle sea and air shipments.

In the case of GIAA, the integrated carrier services, referring to operators that only transport cargo, such as UPS and Fed x, do not typically operate out of dedicated cargo facilities with associated dedicated apron areas. Their activity and their handlers operate out of the GIAC.

Guam by its location is unique and, as demonstrated by the recent pandemic and from past tropical storm emergencies, can be critical in handling substantial increases in cargo demand. GIAA has the advantage of these opportunistic cargo flow events that require facilities with capacity flexibility and ability to distribute to the local surrounding islands. Any new facility can be the accommodation of short-term emergency needs that could also transition to long-term demand for the managed development of a domestic market operation for agriculture or aquaculture as a return to a previous Guam strength for exports. A focus for new perishable cargo demand will require specialized facilities for temperature control and consumable food hygiene. The U.S. Department of Agriculture Plant (USDA) inspection station is on the south side of the Airport, and its relocation adjacent to any perishables cargo facility development is recommended.

As noted, Guam has a unique logistics situation as an island with limited domestic export, so an assessment for air cargo facilities requires consideration of a number of qualitative and quantitative factors.

Based on the positive (and negative) quantitative and qualitative conditions noted above, the development of a greenfield air cargo facility through a logistics developer is a reasonable path to take for additional air cargo capacity and flexibility with limited risk to the Airport. Based on the provision of one to two cargo aircraft positions on the proposed cargo apron as a capacity driver, a facility size can be estimated based on assumptions on a design aircraft, frequency, and load factors for inbound-outbound-transshipment.

4.5.5.1 Air Cargo Facility Requirements

Cargo facilities typically include an aircraft parking apron; a processing building for the sortation, screening, and transitioning cargo between the secure airside and landside ground transportation connections; adequate landside operating areas to accommodate large cargo delivery/transfer vehicles during peak hours; and private vehicle parking areas.

Figure - depicts the existing conditions for the air cargo area at the Airport. The following sections summarize the facility requirements based on forecast demand and recommend cargo development plan accordingly.

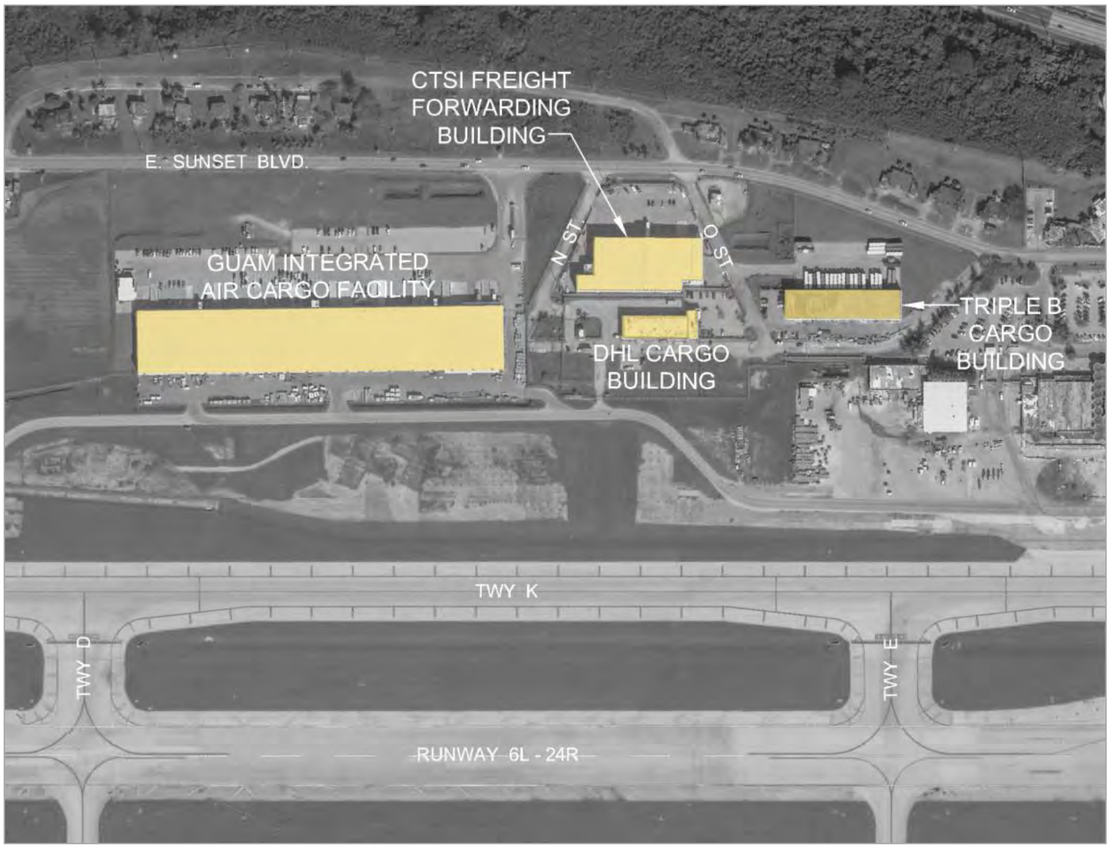

Figure 4-48. North Side Cargo Area

Source: AECOM

Facility requirements for air cargo facilities were determined using industry guidelines and considered site-specific conditions to assess the capacity of the existing cargo facilities and the need for new or updated facilities. While there are numerous variables that may impact the specific needs for air cargo facilities, the 2013 ACI-NA *Air Cargo Guide* provides general 'rules of thumb' and are used to the extent practical for the purposes of this analysis.

4.5.5.2 Aircraft Parking Apron

The aircraft parking apron not only supports aircraft operations but also the associated ground support equipment (GS) for aircraft servicing and loading of cargo onto the aircraft. As such, the size of the parking apron is dependent upon the number of aircraft parking positions, the size of the aircraft, and a sufficient GS operating area for each.

The number of aircraft parking positions required can be typically based on the ADPM operations. For GIAA, based on the profile and schedule of all-cargo and belly-cargo operations, which is only one flight per week per integrator, the APDM does not apply. The possible highest peak would be a UPS and Fed x flight landing at the same time on the same day of the week.

No dedicated air cargo apron positions are currently provided at the Airport. The two main integrators use available apron space for their operations, which utilize Boeing 747-8F (B748F) or McDonnell Douglas MD-11 (MD-11) aircraft. Since these flights operate weekly with limited dwell time, if non-coincident, a single aircraft parking position would suffice with management of GS equipment. A second position would cover any time overlap, as well as accommodate an unscheduled charter or emergency operation. However, actual demand will be based on market conditions, such as new or expanded industries generating air cargo demand or a higher frequency of flights to Guam, which could increase the minimum number of positions required. The dwell time on the aircraft parking position is also affected by the amount of cargo, loaded or unloaded, as transshipment turn times can be short.

In terms of cargo apron provision, a two-aircraft-position cargo apron could handle 25,000 tons per year, based on a cargo weight capacity between a fully loaded MD-11 and B748F for illustration. Using 240,000 pounds per flight, or 120 tons, this would yield 240 tons times 52 weeks for approximately 12,500 tons for an arrival and departure. Cargo operations by two operators do not necessarily overlap, so a single aircraft position might only be used for part of a 24-hour period of each week. Consequently, a future cargo apron that could accommodate up to two parking positions would be adequate for the Airport's facility demand as well as accommodating any RON aircraft.

The air cargo aircraft fleet presented in **able -** was used to determine an adequate apron area for each cargo aircraft operation.

able - Air Cargo Aircraft Characteristics

Operator	Aircraft ype	Cargo Operations / Year at GIAA	ADG/ DG	Wingspan	ength
Fed x	MD-11F	52	IV / 6	170.5'	202'
UPS	B748F	52	VI / 5	224.5'	250'
Future					
Future	B773 R	TBD	V / 6	212.6'	242.4'
Future	B744F	TBD	V / 5	213'	231.9'

Notes:
A. Abbreviations
GIAA = A.B. Won Pat International Airport Authority, Guam
ADG = Airplane Design Group
TDG = Taxiway Design Group
TBD = To be determined

As depicted in **Figure - 9** , a Boeing 777-300 R is being used to determine required air cargo apron space requirements as the future trend in freighters. This results in an area of 14,690 SY including operational aircraft nose clearances and aircraft tail clearances.

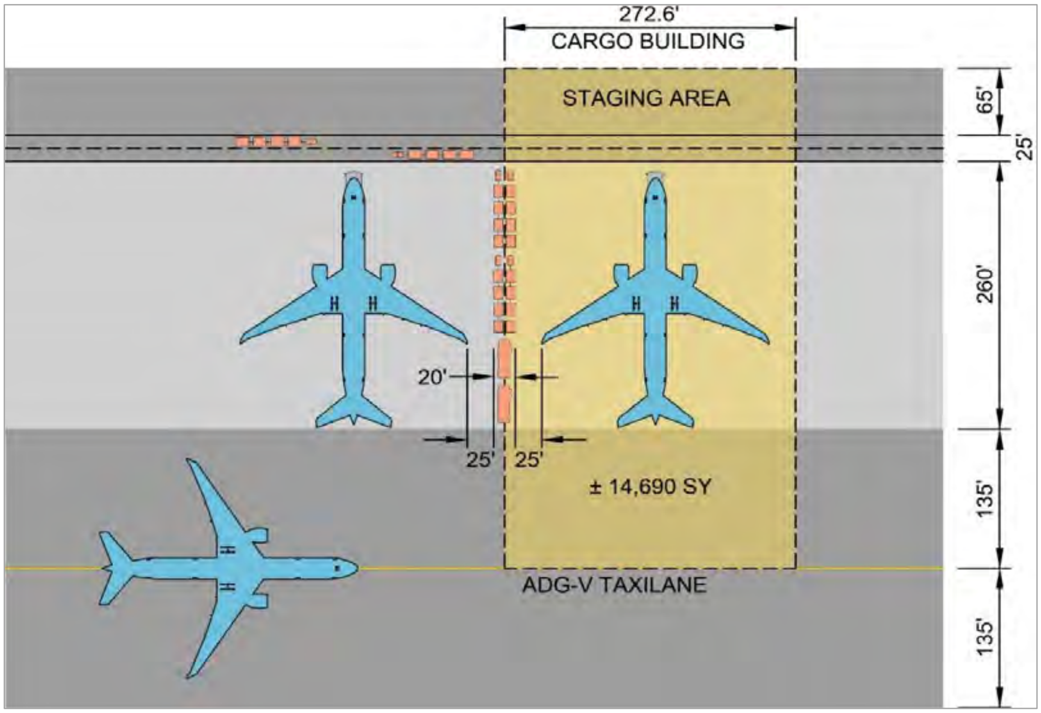

Figure 4-49. Cargo Aircraft Parking Positions

Source: AECOM

4.5.5.3 Cargo Processing Buildings

Cargo warehouse space requirements vary significantly among air cargo operators and the type of operations being conducted. Size requirements for air cargo facilities are typically evaluated based on utilization rates (tons of cargo per square feet of building). Building depth for landside to airside transfer operations range from 100 feet for smaller facilities to 250 feet for larger facilities.

ACI-NA's *Air Cargo Guide* notes that utilization rates typically range from 0.5 tons per square foot at smaller airports to over 1.0 ton per square foot at larger airports. For planning purposes, the ACI-NA recommended a utilization rate of 1.0 ton per square foot be used to determine the size of an air cargo facility. A planning factor of 0.50 tons per square foot has been used as the industry standard for belly-cargo at some airports.

The Master Plan documents from 2012 indicate no need for facilities based on an accepted ratio comparison of cargo tonnage throughput and the floor area of cargo facilities. A baseline of 1.0 ton per 1 square foot was used, which reflects an air cargo facility using some manual and automated operations.

The cargo forecast (see **Chapter 3:** *Aviation Demand Forecasts*) projects 50,000 tons in 2039 using the baseline scenario. An industry standard metric for estimating cargo facility area is, as noted, 1.0 ton (transported in a year) per 1 square foot of building space. Using a similar ratio, the baseline could be met by the current total existing area of cargo facilities consisting of the GIAC, Triple B Forwarders, CTSI Logistics, and DHL for combined building area of over 200,000 SF. Using the ratio of freighter to passenger belly cargo/small aircraft of approximately 70 to 30 percent, a space requirement of 65,000 SF was calculated for the baseline scenario.

Despite the appearance of adequate building capacity, the current tenant profile and operations are mixed and not necessarily pure air cargo operations. The GIAC building houses several Airport-related operations beyond cargo handling. The GIAC building is unique in that space is leased to companies other than cargo operators. These agencies/companies do not provide cargo services and are not included in the utilization rate in order to better analyze capacity against demand. Additionally, CTSI has indicated that air and sea cargo are managed in their facility, and it is fully utilized.

In order to project a recommendation beyond the future baseline cargo forecast being currently met by the existing cargo facilities, it is assumed that air cargo utilization of the existing buildings is 50 percent of the existing square footage.

As an indication of the impact of a single weekly widebody flight that loads and unloads the entire payload weight at the Airport, one can take a cargo weight capacity between a fully loaded MD-11 and B748F for illustration. Using 240,000 pounds per flight or 120 tons, that would yield 240 tons times 52 weeks for approximately 12,500 tons for an arrival and departure for a total of 25,000 SF per year. Comparing this to cargo statistics for year 2020 at the Airport, this would be approximately a 30 percent increase in cargo for the Airport, and it would challenge the current air cargo facility capacity.

Assuming a future case, adding one additional widebody cargo aircraft per week to the baseline, the cargo facility demand would be approximately 25,000 SF using an efficiency of 1 ton per 1 square foot of facility. Adding the capacity required outside the existing cargo facilities (32,500 SF) and the additional widebody aircraft (25,000 SF), the required demand would be 57,500 SF.

Based on a possible lower efficiency and the value of single construction effort, it would be reasonable to anticipate a future demand for a 60,000 square foot cargo facility. Since a cargo apron area is already anticipated by the Airport, the addition of a typical landside truck maneuvering and parking area would indicate an overall site footprint of 120,000 square feet for building footprint and landside operation accommodations excluding any aircraft ramp.

The current and near-future flight schedule for commercial airlines carrying cargo and the cargo integrators appears to be fairly fixed in terms of routes, flight times, and demand accommodation. However, additional future daily/weekly cargo scheduled service can significantly increase cargo throughput and put pressure on existing facilities and the necessary accommodation of cargo inside a facility, especially temperature-controlled cargo. Tempering this possible need for additional or buffer cargo facilities is whether the cargo is transshipment, which can require limited cargo facilities.

This sizing will also be affected by available land area near the proposed air cargo apron, which has to include the landside truck dock maneuvering area, the cargo facility dimensions, especially the building depth, and the interface with the proposed cargo apron. As this proposed north side available land area is long and narrow, the geometry of the site, besides the size of facility, will determine the appropriate accommodation of a cargo facility in this location.

4.5.5.4 andside Facilities

The landside facilities are a key element in evaluating the overall efficiency of cargo operations. Landside facilities include truck stalls and the associated maneuvering area, vehicle parking, and roadway access.

4.5.5.4.1 ruck Stalls and Vehicle Parking

Per the guidelines provided in the ACI-NA *Air Cargo Guide* and ACRP Report 113: *Guidebook on General Aviation Facility Planning*, the following planning factors can be used to determine the landside facility requirements:

- 0.6 truck stalls per 1,000 SF of building
- 15-foot on-center truck docks at 60-foot length for semi-truck use
- 150-foot truck stall depth for truck parking/staging/maneuvering
- 4 vehicle parking spaces per 1,000 SF of building, dependent on the nature of the operations
- 350 SF per vehicle parking space
- 15 percent contingency for other areas

For general landside planning, from the face of the cargo building for typical truck loading and maneuvering area, an allowance depth of 150 feet is recommended along the face of the building. Car parking can be included in this area or provided beyond this area. Truck staging or trailer storage would be an addition to the landside truck area. Based on the above criteria, a new 60,000 SF cargo building would have 36 truck stalls and 240 vehicle parking spaces with the parking space being dependent on the mode of transportation to the new cargo facility.

4.5.5.4.2 Roadway Access

The ACI-NA *Air Cargo Guide* recommends using a 0.95 peak hour vehicle volume for every 1,000 SF of building and in each direction—inbound and outbound. As the peak periods may be related to integrator flights, this would represent one time period for managing access as well as the traffic linked to Asia Pacific Airlines flights.

If a new cargo facility were developed, using 60,000 SF as reasonable size for a new cargo facility, this would equate to 62 vehicle operations for a peak hour traffic volume in each direction. This level of activity is highly dependent on the operations inside the cargo facility and nature of the trucks being used.

4.5.5.5 Current Development – Year 2 22

The Airport is currently developing an air cargo apron (**Figure - **) to the west of the GIAC building and is interested in providing land for a developer of logistics operations and cargo facilities. Forecasted cargo quantities may be realized through the integrators increasing flight frequency or the strategy of the logistics developer taking responsibility for the marketing of the Airport for cargo operations, assuming they have tenants to attract and that they are offering a higher level of service at a lower cost. One opportunity for cargo growth envisioned by the Airport is the ability to pre-clear cargo to the U.S. mainland at the Airport to avoid congestion/delays at U.S. airports of entry.

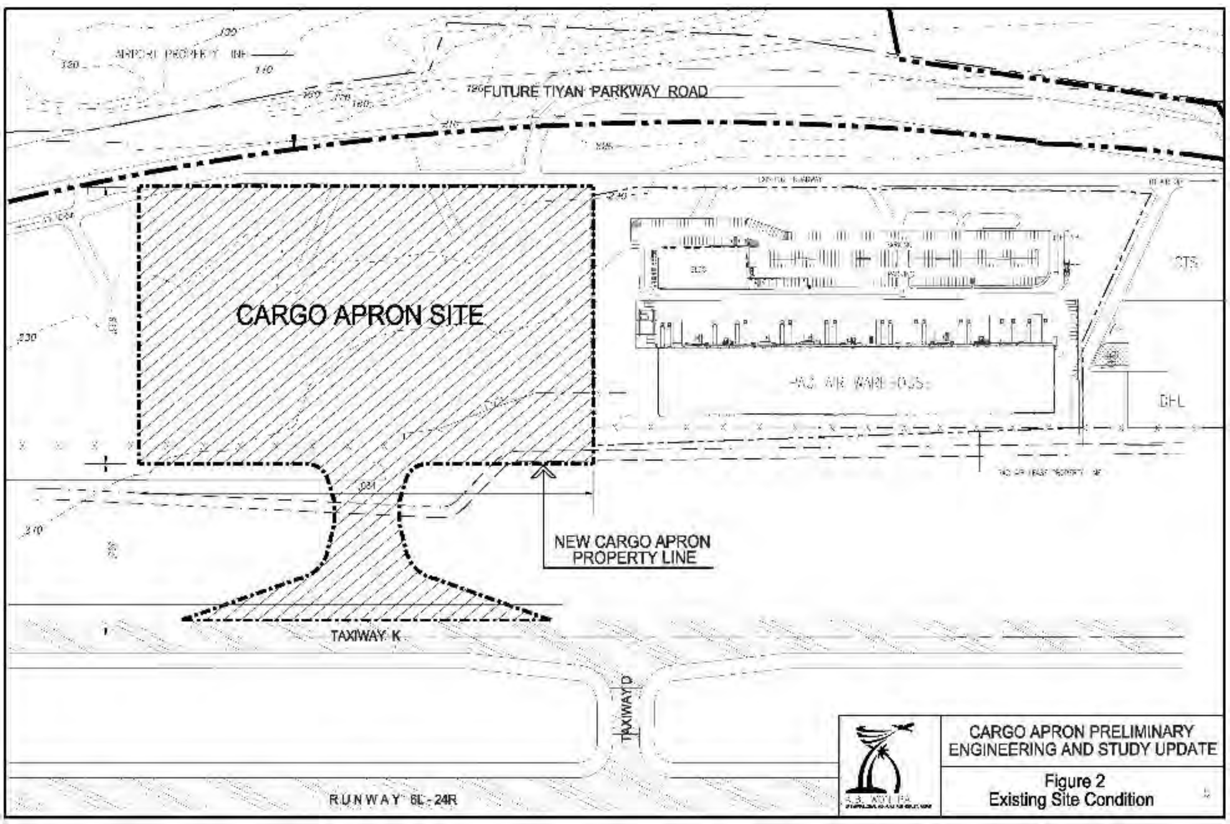

Figure 4-50. Proposed Air Cargo Apron

Source: Cargo Apron Engineering and Study Update, E.M. Chen & Associates, Inc. (2014)

4.5.6 Aircraft Maintenance Facilities

Chapter 2: *Inventory of Existing Conditions* indicates the existing aircraft maintenance facilities at the Airport include the VQ-1 Hangar. Constructed in 1962 and then renovated in 2005, the VQ-1 Hangar is operated by United Airlines and is approximately 71,700 SF. The hangar door height and hangar door width determine the aircraft accommodation of the hangar, and the United Airlines hangar can accommodate a narrowbody aircraft but only the nose of widebody aircraft such as the B777s in service for UA. Also noted in **Chapter 2:** *Inventory of Existing Conditions* and addressed in the GA section is the

ACI hangar with 51,600 SF, which is the only large-scale hangar that could also be used for some commercial/general aviation maintenance.

Figure 4-51. United Airlines and ACI Hangars

Source: ©2022 Photography by Elliott Lindgren

This analysis will focus on a new hangar for commercial aircraft that would be a differentiator for GIAA in providing a capability for larger aircraft maintenance. Asia Pacific Airlines is based at Honolulu, but a new hangar development at the Airport may also be beneficial to their operations. Therefore, a new hangar capable of handling a widebody aircraft would be an opportune facility improvement at the airport for United Airlines widebodies, Pacific-Asian passenger aircraft, cargo integrator aircraft, and aircraft-on-ground situations. However, the weather in Guam allows for outdoor aircraft maintenance during certain times of the year and for certain aircraft repair operations, and the business case for a common-use widebody hangar may not suffice for its development cost without heavy use.

The existing United Airlines hangar (VQ-1) site and neighboring aircraft apron to the west could accommodate the construction of a new hangar, although it would require using a portion of the existing aircraft apron. In terms of hangar facility demand, a site reservation for a widebody hangar is advisable as a possible differentiator for the Airport.

The footprint for a single widebody aircraft position would be approximately 280 feet by 290 feet for a footprint of 81,200 SF. Adding maneuvering aircraft aprons of an equal amount to that hangar footprint and an area for landside parking of 30,000 square feet for an estimated area of 192,400 SF for apron, hangar, and landside support for stores or workshop provision would increase the hangar footprint.

If an existing or proposed aircraft apron for other uses can be shared without restricting operations, then approximately 111,200 SF is required for a new widebody hangar with some landside support with a single hangar door access point.

- Widebody Hangar Footprint: 81,200 SF – Can include some office/workshop space
- Hangar Apron: 82,200 SF
- Landside Operations: 30,000 SF

The 2012 Master Plan indicates the provision of a possible hangar on the north side of the Airport to the west of the proposed cargo apron. Aircraft maintenance hangars do not typically require proximity to the passenger terminal, as opposed to cargo facilities that serve belly-cargo operations of passenger aircraft. The locational need/demand for a hangar facility in this proposed north side location, compared to the south side of the airport, might not be the optimum based on its location conflicting with other existing cargo or logistics facilities to be developed near the passenger terminal.

To summarize, a widebody hangar, either full height or stepped for aircraft tail accommodation, would be a recommended opportunistic investment by the Airport or an aircraft maintenance operation for working on trans-Pacific aircraft as well as possibly providing additional shelter for smaller aircraft in case of emergency situations.

4.5.7 Aircraft Rescue and Fire Fighting Facilities

Currently the Airport is constructing a new Aircraft Rescue and Fire Fighting (ARFF) facility on the south side of the airport to replace the existing one. The new facility will be located adjacent to the existing ARFF and will meet Airport requirements for the time horizon addressed by this master plan update. Therefore, no additional ARFF facilities are required.

4.5.8 Aircraft Fuel Storage Facilities

Per **Chapter 2**: *Inventory of Existing Conditions*, the fuel farm consists of two 320,000-gallon storage tanks of Jet A fuel, one 15,000-gallon storage tank of Avgas, a truck loading stand, and an operations building. The storage facility is connected by an underground, 16-inch-diameter pipeline to a distribution system located beneath the aircraft aprons. a ch of the aircraft gates is equipped with in-pavement fuel pits. Per Airport-provided fuel use statistics, the existing fuel farm has capacity for a 5-day supply, which is consistent with GIAA policy.

Consequently, the current storage capacity is in line with a reserve for current and future operations. However, a higher reserve is recommended based on recent supply chain issues, shipping issues, and geo-political issues. Therefore, planning should allow for one additional Jet A fuel tank and one additional Avgas fuel tank.

U.S. mainland airport locations may use a 3- or 5-day supply as a guideline; however, this may be not ideal for a remote island destination, especially one subject to typhoons and the possibility of significant supply interruptions.

4.5.9 Summary of GA, Cargo, and Support Facility Requirements

The GA, cargo, and support facility requirements compares existing facilities to future forecasted demand in order to determine if additional facilities are required. The following summarizes the requirements and recommendations for GA and support facilities:

- GA facilities
  - A recommended 37,500 SF conventional hangar for bulk aircraft storage and maintenance.
  - A dedicated 8,800 SF GA terminal with at least 56 vehicle parking spaces.
- Light aircraft commuter terminal
  - A recommend replacement of the existing facility with a newer facility of similar size to include dedicated CBP facilities.
- Air cargo facilities
  - A 60,000 SF air cargo facility with associated loading docks and vehicle parking is recommended to accompany the current cargo apron development.
- Aircraft maintenance facilities
  - A total hangar space of 81,200 SF is recommended to accommodate future widebody aircraft maintenance operations.
- Aircraft fuel facility
  - A new Jet A fuel storage tank and Avgas fuel storage tank is recommended based recent supply chain issues, shipping issues, and geo-political issues.

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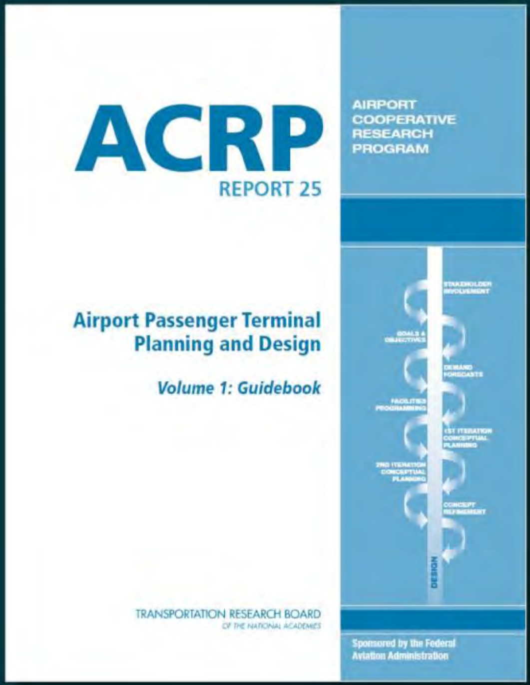
4.6 Gate Demand Analysis – Approach and Methodology February 23, 2 23

Approach and Methodology

Two approaches from the ACRP Report 25 were adopted in forecasting gate demand:

1. Enplaned passengers per Gate Approach
   - Use the current ratio of annual enplanements per gate used during peak period, adjusted for forecast changes in fleet mix and load factors.
   - The changes in passengers per gate would be due to changes in enplanements per departure (due to aircraft seat capacity and/or passenger load factors), as opposed to increasing (or decreasing) the number of departures per gate.
2. Departures per Gate Approach
   - Use the growth in daily departures per gate to determine the annual departures per gate and the gate requirements.
   - This approach considers changes in gate utilization. E.g., airlines may add flights which results in higher average gate utilization.



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1. Enplaned Passengers per Gate Approach

- Calculations:
  - Existing and forecast annual enplanements (Column B) and annual departures (Column C) are provided in the master plan forecast.
  - Average enplanement per departure in Column F is calculated by dividing Column B by Column C.

Enplaned Passengers per Gate Approach

A	B	C	D	E	F
Year	Annual Enplaned Passengers	Annual Departures	# of Gates	Enplaned Passengers per Gate	Enplaned Passengers per Dept.
2019	1,885,108	11,645	15	125,700	162
2024	1,277,397	10,506	**14**	94,400	122
2029	1,960,402	12,603	**16**	120,800	156
2034	2,123,073	13,351	**17**	123,500	159
2039	2,312,858	14,223	**18**	126,300	163

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1. Enplaned Passengers per Gate Approach

- Calculations:
  - Existing and forecast annual enplanements (Column B) and annual departures (Column C) are provided in the master plan forecast.
  - Average enplanement per departure in Column F is calculated by dividing Column B by Column C.
  - Use the existing number of gates used during peak period to calculate the existing average enplaned passenger per gate e.g., 1,885,108 / 15 = 125,700 in 2019

Enplaned Passengers per Gate Approach

A	B	C	D	E	F
Year	Annual Enplaned Passengers	Annual Departures	# of Gates	Enplaned Passengers per Gate	Enplaned Passengers per Dept.
2019	1,885,108	11,645	15	125,700	162
2024	1,277,397	10,506	**14**	94,400	122
2029	1,960,402	12,603	**16**	120,800	156
2034	2,123,073	13,351	**17**	123,500	159
2039	2,312,858	14,223	**18**	126,300	163

Note: 1. The assumption of 15 gates being used during the peak period in 2019 is a conservative estimate based on the flight schedule since there were only 12 passenger aircraft operations during the peak hour in the afternoon. If 12 gates are used in 2019, the estimated gate requirements will be further reduced.

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1. Enplaned Passengers per Gate Approach

- Calculations:
  - Existing and forecast annual enplanements (Column B) and annual departures (Column C) are provided in the master plan forecast.
  - Average enplanement per departure in Column F is calculated by dividing Column B by Column C.
  - Use the existing number of gates used during peak period to calculate the existing average enplaned passenger per gate

    e.g., 1,885,108 / 15 = 125,700 in 2019
  - The ratio of enplanements per gate for each forecast year is calculated by multiplying the current factor (Column E) by the percentage increase in enplanements per departure (Column F)

    e.g., 123,500 x 162.62 / 159.02 = 126,300 in 2039

Enplaned Passengers per Gate Approach

A	B	C	D	E	F
Year	Annual Enplaned Passengers	Annual Departures	# of Gates	Enplaned Passengers per Gate	Enplaned Passengers per Dept.
2019	1,885,108	11,645	15	125,700	161.89
2024	1,277,397	10,506	**14**	94,400	121.59
2029	1,960,402	12,603	**16**	120,800	155.55
2034	2,123,073	13,351	**17**	123,500	159.02
2039	2,312,858	14,223	**18**	126,300	162.62

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1. Enplaned Passengers per Gate Approach

– Calculations:
  - Existing and forecast annual enplanements (Column B) and annual departures (Column C) are provided in the master plan forecast.
  - Average enplanement per departure in Column F is calculated by dividing Column B by Column C.
  - Use the existing number of gates used during peak period to calculate the existing average enplaned passenger per gate

    e.g., 1,885,108 / 15 = 125,700 in 2019
  - The ratio of enplanements per gate for each forecast year is calculated by multiplying the current factor (Column E) by the percentage increase in enplanements per departure (Column F)

    e.g., 123,500 x 162.62 / 159.02 = 126,300 in 2039
  - Future gate requirements are estimated by dividing annual forecast passengers (Column B) by the estimated enplanements per gate (Column E)

    e.g., 2,312,858 / 126,300 = 18 gates in 2039

Enplaned Passengers per Gate Approach

A	B	C	D	E	F
Year	Annual Enplaned Passengers	Annual Departures	# of Gates	Enplaned Passengers per Gate	Enplaned Passengers per Dept.
2019	1,885,108	11,645	15	125,700	162
2024	1,277,397	10,506	**14**	94,400	122
2029	1,960,402	12,603	**16**	120,800	156
2034	2,123,073	13,351	**17**	123,500	159
2039	2,312,858	14,223	**18**	126,300	163

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2. Departures per Gate Approach

- Calculations:
  - Existing and forecast annual enplanements (Column B) and annual departures (Column C) are provided in the master plan forecast.

Departures per Gate Approach					
A	B	C	D	E	F
Year	Annual Enplaned Passengers	Annual Departures	# of Gates	Annual Departures per Gate	Daily Departures per Gate
2019	1,885,108	11,645	15	780	2.2
2024	1,277,397	10,506	**14**	770	2.2
2029	1,960,402	12,603	**16**	810	2.3
2034	2,123,073	13,351	**16**	850	2.4
2039	2,312,858	14,223	**16**	890	2.5

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2. Departures per Gate Approach

- Calculations:
  - Existing and forecast annual enplanements (Column B) and annual departures (Column C) are provided in the master plan forecast.
  - Average annual departures per gate for 2019 in Column E is calculated by dividing Column C by Column D.
  - Average daily departures per gate for 2019 in Column F is calculated from Column E divided by 350.

Departures per Gate Approach					
A	B	C	D	E	F
Year	Annual Enplaned Passengers	Annual Departures	# of Gates	Annual Departures per Gate	Daily Departures per Gate
2019	1,885,108	11,645	15	780	2.2
2024	1,277,397	10,506	**14**	770	2.2
2029	1,960,402	12,603	**16**	810	2.3
2034	2,123,073	13,351	**16**	850	2.4
2039	2,312,858	14,223	**16**	890	2.5

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2. Departures per Gate Approach

- Calculations:
  - Existing and forecast annual enplanements (Column B) and annual departures (Column C) are provided in the master plan forecast.
  - Average annual departures per gate for 2019 in Column E is calculated by dividing Column C by Column D.
  - Average daily departures per gate for 2019 in Column F is calculated from Column E divided by 350.
  - Assume the average daily gate utilization would increase gradually from 2.2 departures per gate in 2019 to 2.5 departures per gate in 2039.

Departures per Gate Approach

A	B	C	D	E	F
Year	Annual Enplaned Passengers	Annual Departures	# of Gates	Annual Departures per Gate	Daily Departures per Gate
2019	1,885,108	11,645	15	780	2.2
2024	1,277,397	10,506	**14**	770	2.2
2029	1,960,402	12,603	**16**	810	2.3
2034	2,123,073	13,351	**16**	850	2.4
2039	2,312,858	14,223	**16**	890	2.5

Note: 1. Gate utilization at 2 to 2.5 departures per gate is relatively low as compared to other O&D airports which typically operate at approximately 5 departures per gate, or even higher for busy airports. If higher gate utilization are used, the estimated gate requirements will be further reduced.

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2. Departures per Gate Approach

- Calculations:
  - Existing and forecast annual enplanements (Column B) and annual departures (Column C) are provided in the master plan forecast.
  - Average annual departures per gate for 2019 in Column E is calculated by dividing Column C by Column D.
  - Average daily departures per gate for 2019 in Column F is calculated from Column E divided by 350.
  - Assume the average daily gate utilization would increase gradually from 2.2 departures per gate in 2019 to 2.5 departures per gate in 2039.
  - The ratio of annual departures per gate for each forecast year is calculated by multiplying the current factor (Column E) by the percentage increase in daily departures per gate (Column F)

    e.g., 850 x 2.5 / 2.4 = 890 in 2039

Departures per Gate Approach					
A	B	C	D	E	F
Year	Annual Enplaned Passengers	Annual Departures	# of Gates	Annual Departures per Gate	Daily Departures per Gate
2019	1,885,108	11,645	15	780	2.2
2024	1,277,397	10,506	**14**	770	2.2
2029	1,960,402	12,603	**16**	810	2.3
2034	2,123,073	13,351	**16**	850	2.4
2039	2,312,858	14,223	**16**	890	2.5

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2. Departures per Gate Approach

– Calculations:
  - Existing and forecast annual enplanements (Column B) and annual departures (Column C) are provided in the master plan forecast.
  - Average annual departures per gate for 2019 in Column E is calculated by dividing Column C by Column D.
  - Average daily departures per gate for 2019 in Column F is calculated from Column E divided by 350.
  - Assume the average daily gate utilization would increase gradually from 2.2 departures per gate in 2019 to 2.5 departures per gate in 2039.
  - The ratio of annual departures per gate for each forecast year is calculated by multiplying the current factor (Column E) by the percentage increase in daily departures per gate (Column F)

    e.g., 850 x 2.5 / 2.4 = 890 in 2039
  - Future gate requirements are estimated by dividing annual forecast departures (Column C) by the estimated annual departures per gate (Column E)

    e.g., 14,223 / 890 = 16 gates in 2039

Departures per Gate Approach

A	B	C	D	E	F
Year	Annual Enplaned Passengers	Annual Departures	# of Gates	Annual Departures per Gate	Daily Departures per Gate
2019	1,885,108	11,645	15	780	2.2
2024	1,277,397	10,506	**14**	770	2.2
2029	1,960,402	12,603	**16**	810	2.3
2034	2,123,073	13,351	**16**	850	2.4
2039	2,312,858	14,223	**16**	890	2.5

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Summary of Both Methods

Enplaned Passengers per Gate Approach

A Year	B Annual Enplaned Passengers	C Annual Departures	D # of Gates	E Enplaned Passengers per Gate	F Enplaned Passengers per Dept.
2019	1,885,108	11,645	15	125,700	162
2024	1,277,397	10,506	**14**	94,400	122
2029	1,960,402	12,603	**16**	120,800	156
2034	2,123,073	13,351	**17**	123,500	159
2039	2,312,858	14,223	**18**	126,300	163

Departures per Gate Approach

A Year	B Annual Enplaned Passengers	C Annual Departures	D # of Gates	E Annual Departures per Gate	F Daily Departures per Gate
2019	1,885,108	11,645	15	780	2.2
2024	1,277,397	10,506	**14**	770	2.2
2029	1,960,402	12,603	**16**	810	2.3
2034	2,123,073	13,351	**16**	850	2.4
2039	2,312,858	14,223	**16**	890	2.5

Average of Both Methods

Year	Passengers per Gate	Departures per Gate	GATES
2024	14	14	**14**
2029	16	16	**16**
2034	17	16	**16**
2039	18	16	**17**

Source: ACRP Report 25 Airport Passenger Terminal Planning and Design, Spreadsheet Model

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Summary of Both Methods

Table 4-4. Gate Requirements

Planning Activity Level (PAL)	Annual Enplanements	Annual Departures	Enplaned Passengers per Gate Approach			Departures per Gate Approach			Gate Requirements (Average of both methods)
			Annual Enplaned Pax per Gate	Enplaned Pax per Departure	No. of Gates See Note 2	Annual Departures per Gate	Daily Departures per Gate	No. of Gates See Note 1 and 2	
2019 (Base Year)	1,885,108	11,645	125,674	162	15	776	2.2	15	**15**
PAL 1 (2024)	1,277,397	10,506	94,390	122	14	776	2.2	14	**14**
PAL 2 (2029)	1,960,402	12,603	120,752	156	16	812	2.3	16	**16**
PAL 3 (2034)	2,123,073	13,351	123,446	159	17	847	2.4	16	**16**
PAL 4 (2039)	2,312,858	14,223	126,240	163	18	882	2.5	16	**17**

FAA approved forecast annual enplanements and annual departures

1. Enplaned Passenger per Gate Approach

2. Departures per Gate Approach

Gate Requirements

Note: 1. Gate utilization at 2 to 2.5 departures per gate is relatively low as compared to other O&D airports which typically operate at approximately 5 departures per gate, or even higher for busy airports. If higher gate utilization are used, the estimated gate requirements will be further reduced.
2. The assumption of 15 gates being used during the peak period in 2019 is a conservative estimate based on the flight schedule since there were only 12 passenger aircraft operations during the peak hour in the afternoon. If 12 gates are used in 2019, the estimated gate requirements will be further reduced.

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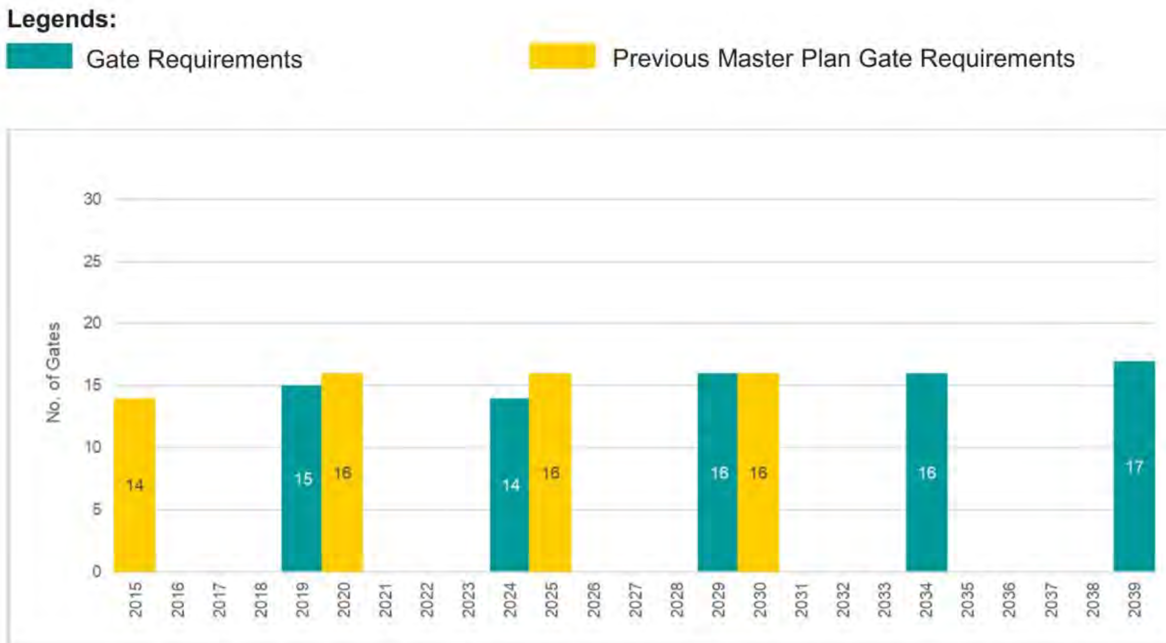
Comparison with Previous Master Plan – Gate Requirements



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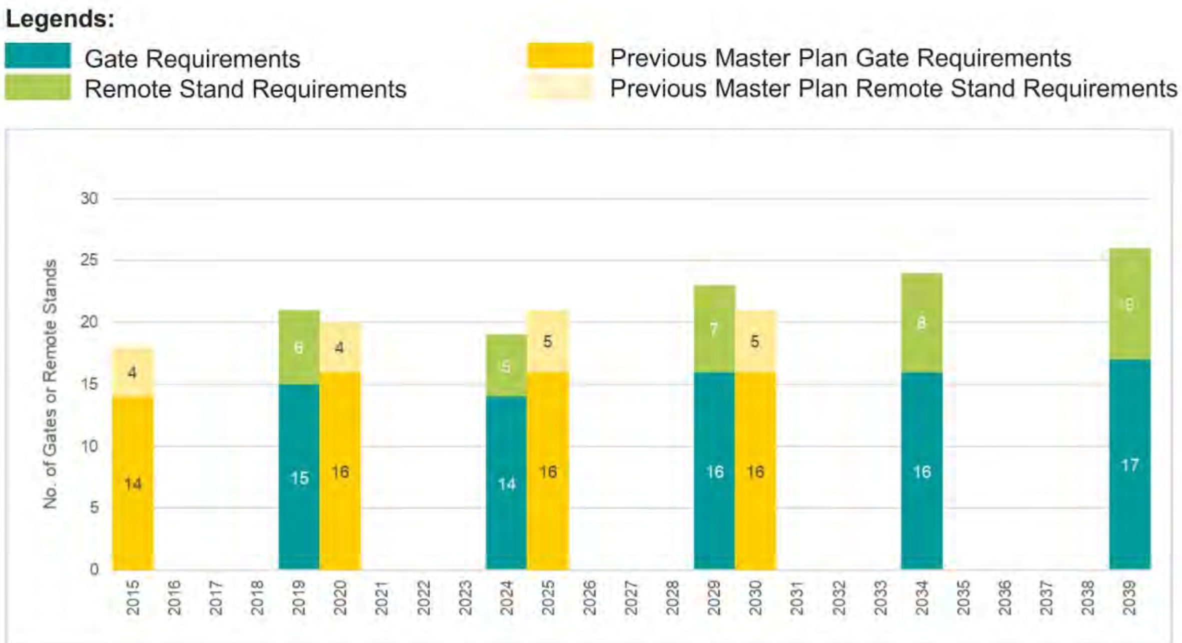
Comparison with Previous Master Plan – Gates and RON Remote Stands



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5 Alternatives Development and Evaluation

Executive Summary

The Alternatives Development and va luation chapter of the Antonio B. Won Pat International Airport (Airport) Master Plan Update documents the process and development of the preferred alternative which will ultimately become the Airport Development Plan. The goal was to create one encompassing alternative that meets the existing and future facility requirements and recommendations identified in **Chapter** : *Facility Requirements*.

The alternatives were separated into four categories:

- Airfield
- Commercial Passenger Terminal
- Landside and Ground Access
- General Aviation (GA), Cargo and Support Facilities

Alternatives for these categories were developed, refined, and evaluated over three rounds. The alternative development process began with a total of 93 alternatives spread out among specific focus areas within the four main alternative categories. These alternatives were evaluated and refined through two subsequent round of evaluation until a final preferred alternative was selected.

The Airport Development Plan satisfies the Federal Aviation Administration's (FAAs) recommendation to own and control all land within the Runway Protection Zones (RPZs) by adding a displaced threshold beyond the Runway 6R end and extending the existing displaced threshold beyond the Runway 6L end.

The Airport Development Plan also addresses the required separation between the Taxilane K centerline and the north apron vehicle service road (VSR) and addresses the non-standard separation between the south apron taxilane centerline and the Taxiway G centerline by shifting the centerlines and/or adding full-strength taxiway pavement and taxiway shoulder pavement where needed. The plan also proposes the removal of problematic taxiway geometry (PTG) on the airfield like Taxiway G between Runway 6L/24R and the north apron, and three connecting pieces of pavement for south apron access.

Additionally, the Airport Development Plan proposes the regrading of non-standard topography, removal of trees and vegetation, and the removal of drainage headwalls that are all obstructions located within sensitive runway safety areas.

This Airport Development Plan also satisfies the planned growth for GA, light aircraft, and air cargo operations while also preserving an area for potential spaceport operations that may occur outside the Master Plan planning period. Specifically, the Airport Development Plan plans for a new GA terminal adjacent to the Nose Dock hangar and other GA operations, a temporary storage hangar to the west of the Nose Dock hangar, and a new GA bulk storage hangar adjacent to the Aviation Concepts, Inc. (ACI) hangar.

Additionally, this plan provides an air cargo facility with flexible expansion capabilities to be co-located with the existing cargo functions and facilities, and aligns with the planned air cargo apron on the north side of the Airport. A new widebody maintenance hangar in proposed adjacent to the United hangar with flexible expansion capabilities to the east. A replacement light aircraft commuter terminal located next to the existing one is planned. Finally, a new Jet A fuel tank and an upgraded Avgas fuel tank will be added to the fuel farm.

The Airport Development Plan also incorporates the Guam Department of Public Works' Division of Highways' project to widen Route 10A along the Airport entrance and exit. The proposed project widens Route 10A to five lanes, from its intersection with Route 1 to the Airport's entry intersection. The additional lane will impact the Airport's lower employee, lower public, and rental car parking lots.

For the employee and public parking lots, pavement on the northern ends of each lot will be restriped to create additional vehicle parking spaces. For the rental car and tour bus lot, a two-story parking structure is proposed in the same area as the existing lot. Level 1 would be used by tour buses, vans, and limousines, while Level 2 would be used for rental cars. It is anticipated that the structure will provide enough spaces that efficient operations will be possible without off-site bus/van staging. While this plan will increase the amount of traffic on the departures road, the resulting projected volumes will still be well within capacity.

Commercial passenger terminal improvements Include improvements to the check-in hall include satisfying the estimated requirements for the United Airlines (UA) check-in positions, updating check-in technology, and removing isolated check-in counters that do not have access to the baggage handling system (BHS).

The Airport Development Plan also addresses Transportation Security Administration's (TSA's) required area for passenger queuing at the Security Screening Checkpoint (SSCP) by building out a portion of the concourse floor towards the terminal windows and relocating the vertical circulation elements (VC s) . Doing so will reduce the existing issues with passenger queues that sometimes extend to the Apron Level.

The plan also proposes to provide an additional restroom in the immigration hall by constructing a corridor to the existing restrooms adjacent to the SSCP. Security access on the door between the immigration hall and the SSCP would be modified to allow inbound passengers access to those bathrooms.

Additionally, the plan eliminates the moving walkways within the concourse, which offers a wider, more flexible, concourse. Removal of the moving walkways would allow Customs and Border Protection (CBP) to relocate their processing booths for passengers departing to Honolulu, currently stationed at Gate 7, and relocate them to the Gate 4/5 area. This would eliminate the need for the Airport to close off the entire West Concourse area when CBP processing is taking place.

Figure -1, **Figure -2**, and **Figure -3** portray the Airport Development Plan.

Based on rough order of magnitude (ROM) cost estimates, the total estimated cost of the projects depicted in the Airport Development Plan is $762,994,400. More information about cost estimates and implementation is discussed in **Chapter :** *Facilities Implementation Plan*.

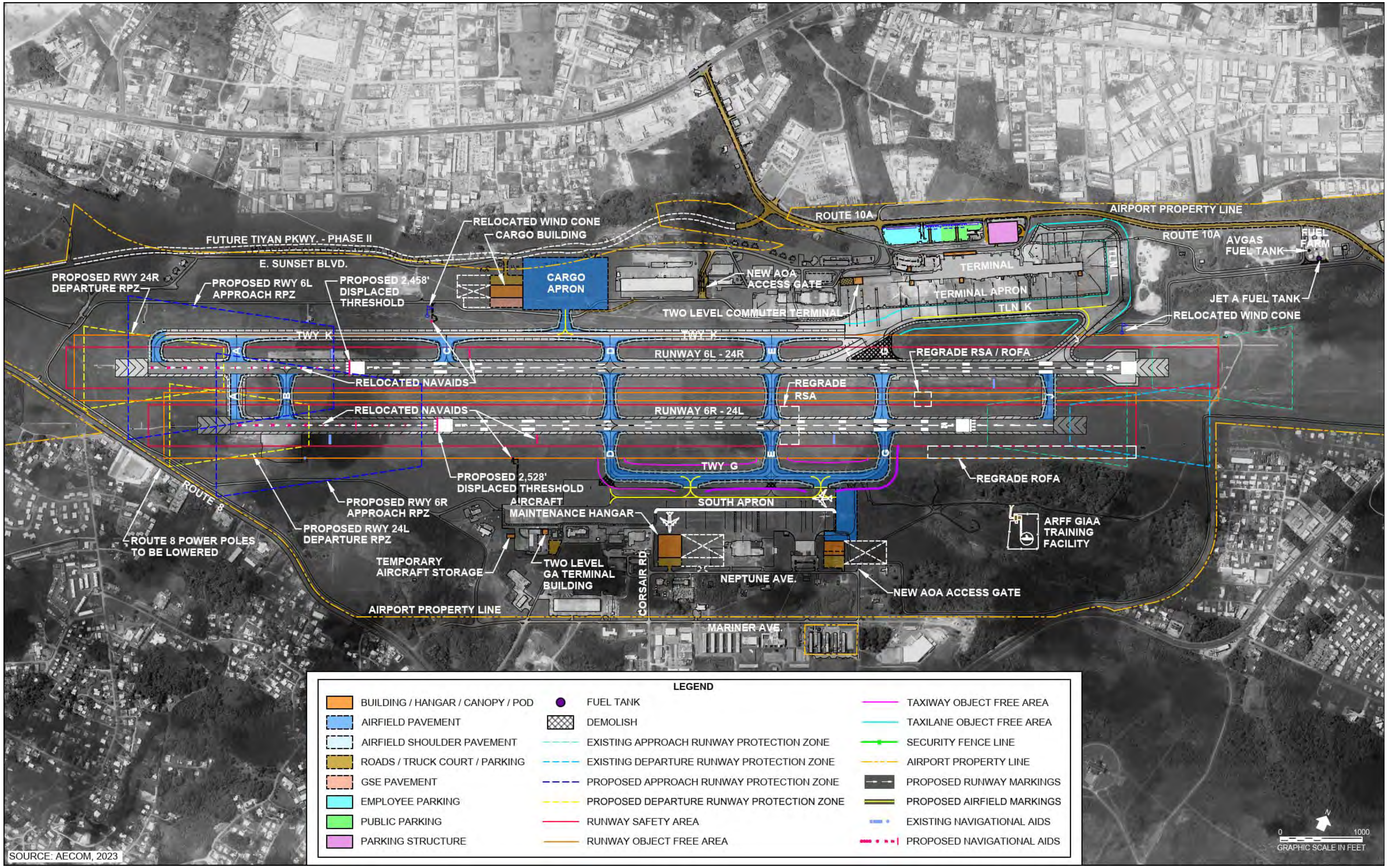

Figure 5-1. Airport Development Plan (1 of 3)

Source: AECOM

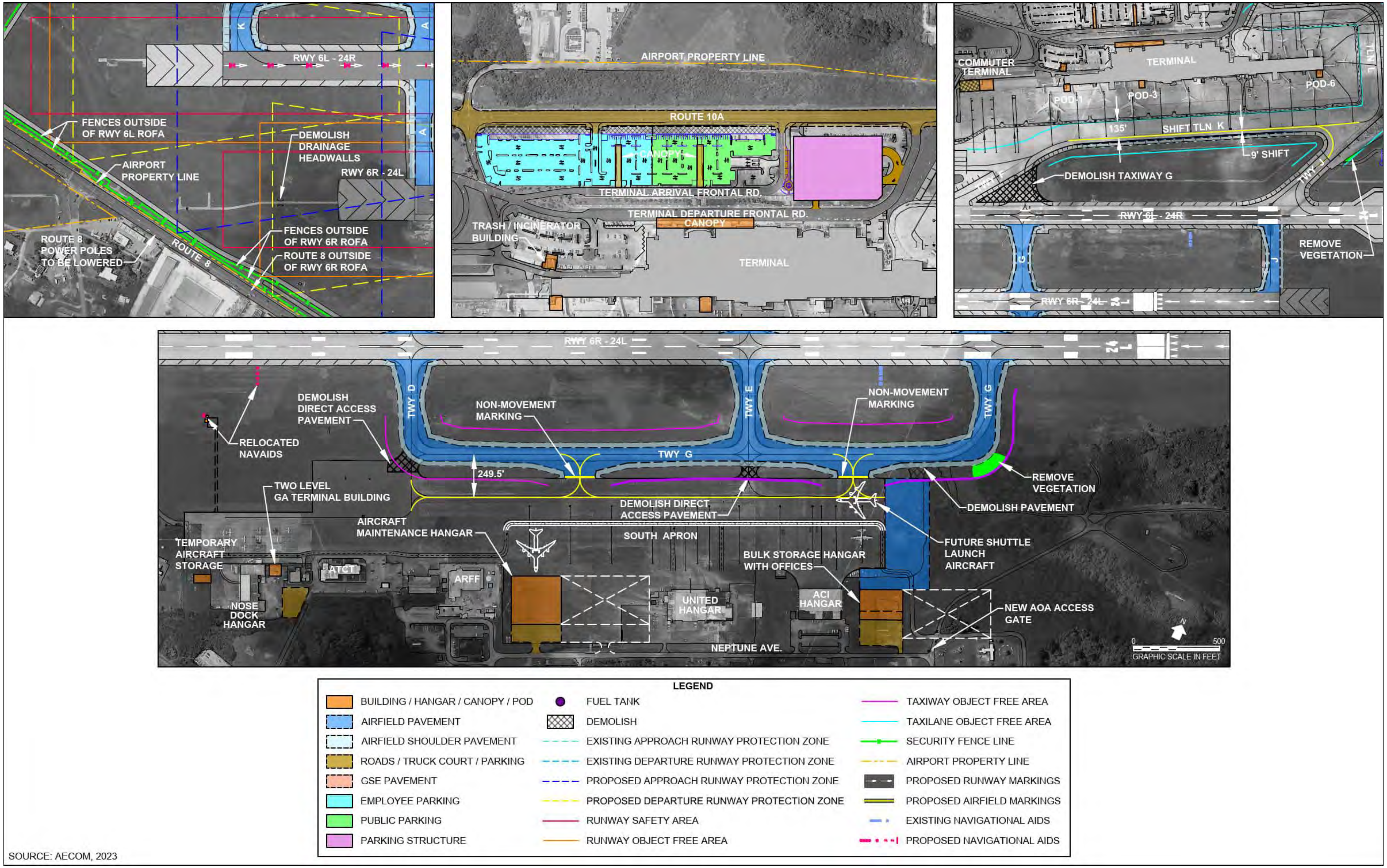

Figure 5-2. Airport Development Plan (2 of 3)

Source: AECOM

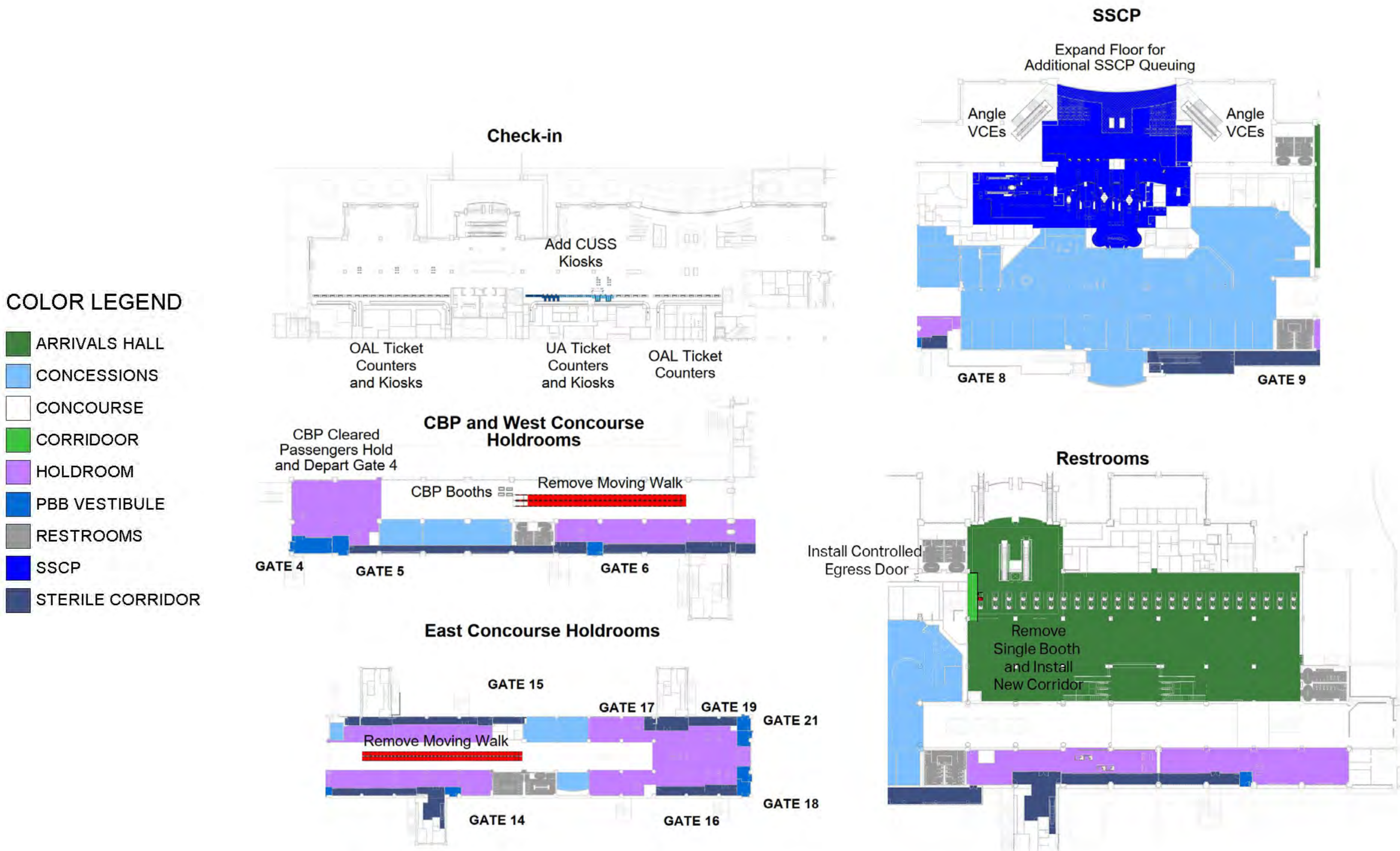

Figure 5-3. Airport Development Plan (3 of 3)

Source: AECOM

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5.1 Introduction

The Alternatives Development and va luation chapter for Master Plan Update documents the process used to arrive at the Airport Development Plan. The goal was to create one alternative that meets the existing and future facility requirements and recommendations identified in **Chapter** : *Facility Requirements*.

5.1.1 Alternatives Development and Evaluation

The alternatives process was organized into three rounds. Alternatives for each of the three rounds were developed as follows:

- Round 1 – Alternatives were created for each focus area within each Airport segment.
- Round 2 – Alternatives for each focus area were consolidated within each Airport segment.
- Round 3 – Alternatives for each Airport segment were combined to create the Airport Development Plan.

Following each round, the alternatives were evaluated, and the highest rated alternatives were refined and advanced to the next round until a preferred alternative was developed. The alternatives within each round were evaluated based on the evaluation criteria shown in **Figure -1**.

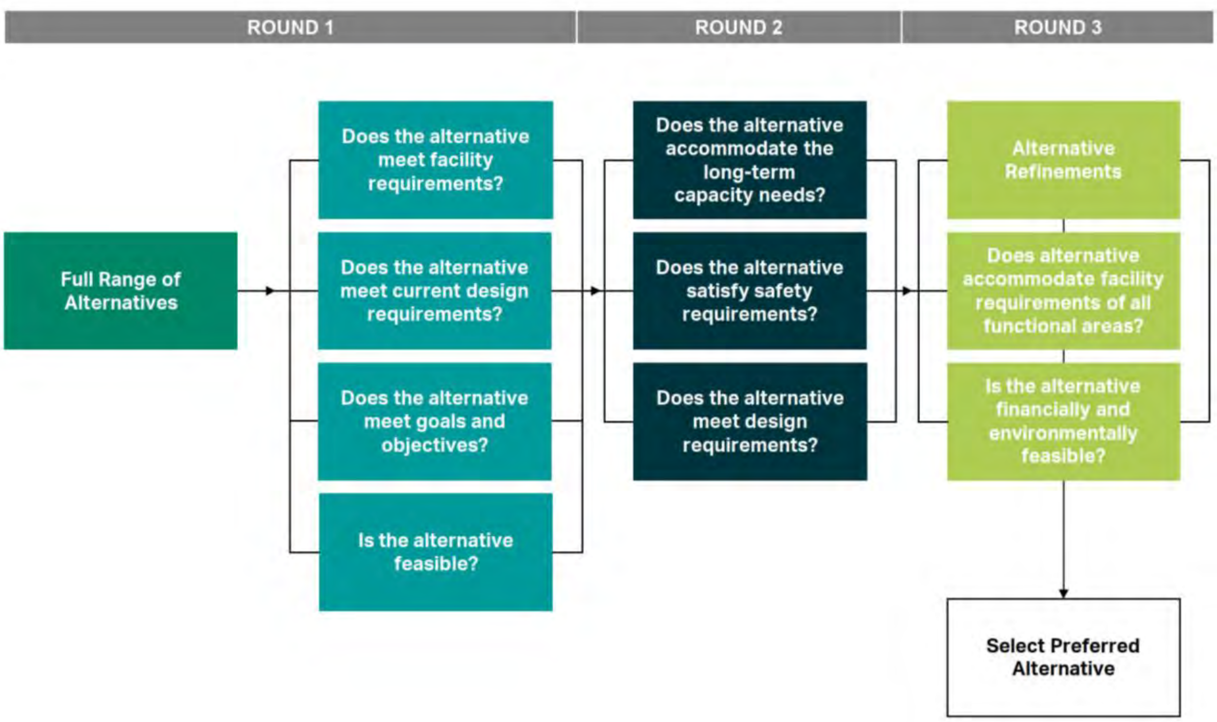

Figure 5-1. Alternatives Evaluation Method

Source: AECOM

5.1.2 Alternatives Analysis

The alternatives were divided into four main categories, with each category having specific focus areas to be analyzed based on the facility requirements. As shown in **Figure -2**, the alternatives analysis began with a total of 93 alternatives among four focus areas developed in Round 1. This was reduced to 11 alternatives in Round 2, and ultimately four alternatives, the top ranked for each category, which were combined in Round 3 to create the preferred alternative. This preferred alternative will become the Airport Development Plan.

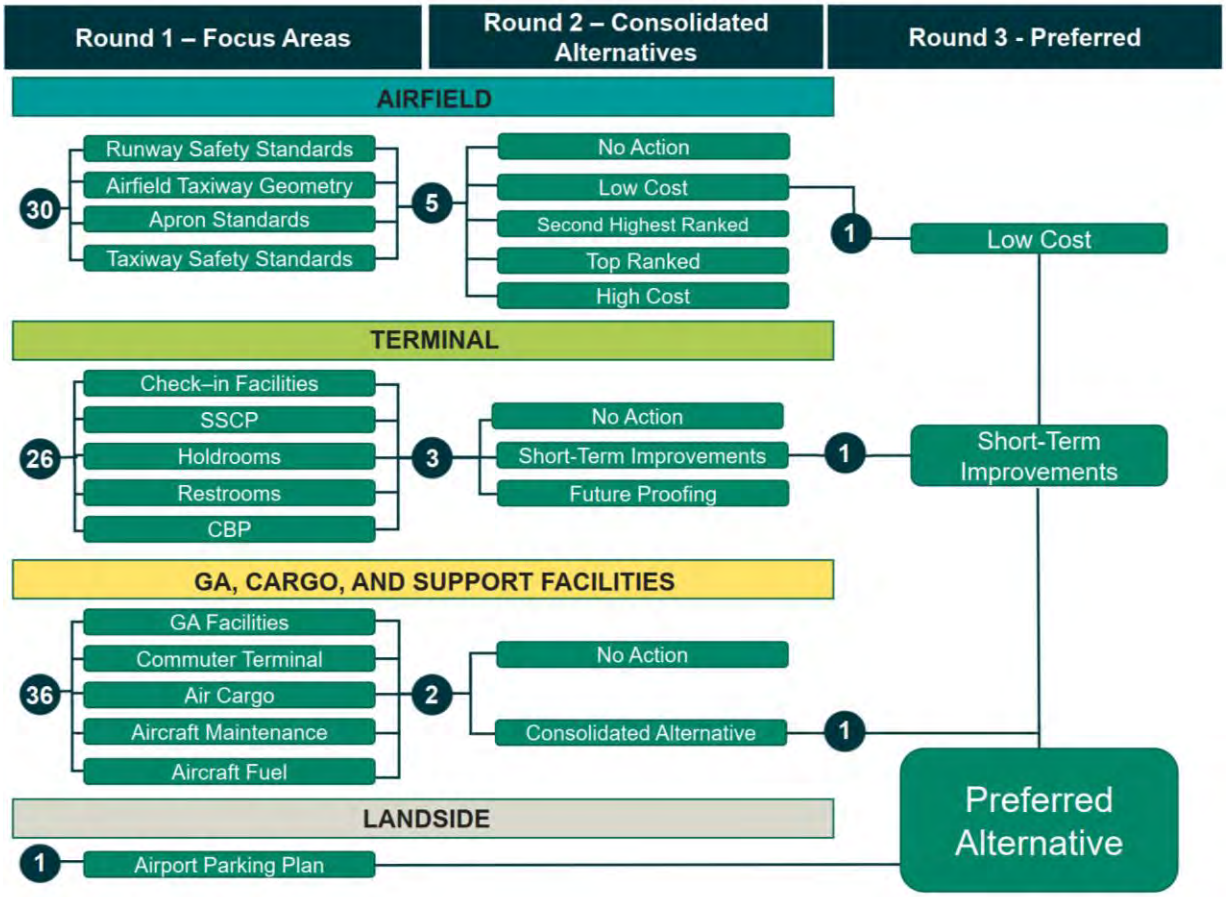

Figure 5-2. Alternatives Development Process

Source: AECOM

This chapter includes insets of all of the alternatives developed as a part of this Master Plan Update. **Appendix D** portrays more detailed exhibits of the individual alternatives.

5.2 Airfield Facilities

Four focus areas were examined in the airfield facilities alternatives analysis, as key elements within these focus areas do not meet Federal Aviation Administration (FAA) airfield design standards as noted in **Chapter :** *Facility Requirements*. A summary of the airfield facility requirements can be found in **Section 2 9**.

As shown in **Figure -3**, 30 Round 1 alternatives were developed based on the four airfield focus areas, which led to five alternatives being developed in Round 2. A preferred Round 2 alternative was selected and advanced into Round 3. This alternative was incorporated into the Airport Development Plan.

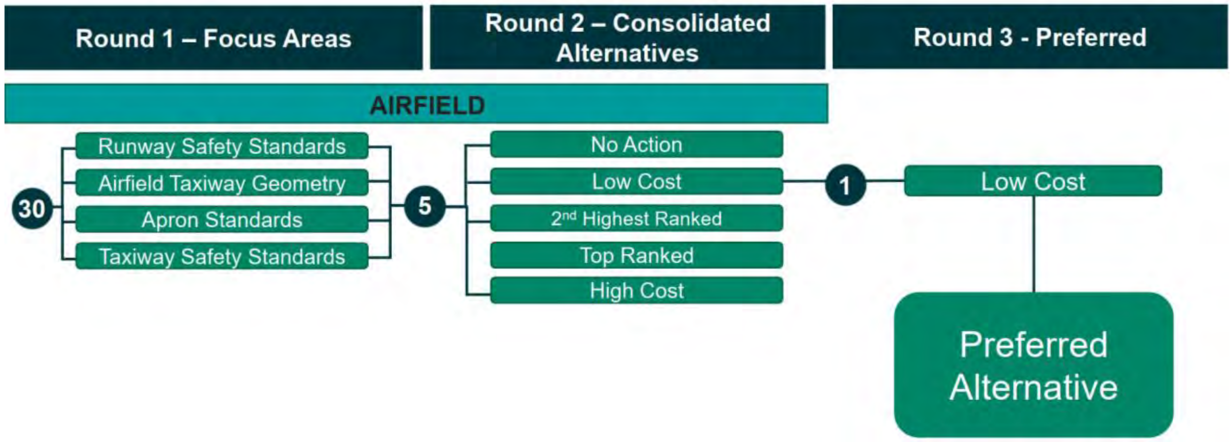

Figure 5-3. Airfield Alternatives Development

Source: AECOM

5.2.1 Round 1 Airfield Alternatives

As depicted in **Figure - ,** the four Round 1 focus areas included: Runway Safety Standards, Airfield Taxiway Geometry, Apron Standards, and Taxiway Safety Standards. Within these four areas, seven key elements were evaluated during Round 1, and 30 alternatives were developed. **Sections 2 1 1** through **2 1** describe the alternatives for each of these elements, which were presented during the airfield alternatives virtual workshop.

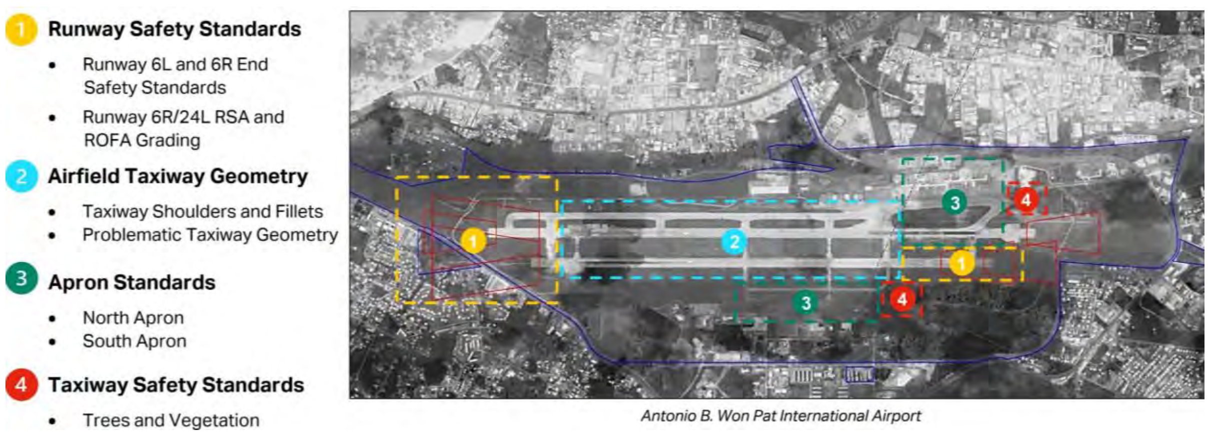

Figure 5-4. Airfield Alternatives Focus Areas

Source: AECOM

For each set of airfield alternatives, evaluation matrices were developed based on both quantitative and qualitative development criteria. While a majority of the criteria are focus-area based, all matrices include criteria such as cost impacts, airside operational efficiency, and ease of implementation. Additionally, some matrices include criteria such as new or demolished airfield pavement, off-Airport impacts, environmental impacts, and the satisfying of FAA safety area standards.

5.2.1.1 Runway 6 and 6R End Safety Standards

This set of alternatives addresses the obstructions and incompatible land uses in the Runway Safety Areas (RSAs), Runway Object Free Areas (ROFAs), and RPZs extending beyond the approach ends of Runways 6L and 6R. Obstructions in the runway safety areas include Route 8 within the Runway 24L ROFA and the Airport security fence located within the Runway 24L and 24R ROFAs. Incompatible land uses within the Runway 6L and 6R Approach Runway Protection Zones (ARPZs) and Runway 24L and 24R Departure Runway Protection Zones (DRPZs) include public roadways and buildings, as well as property underneath those RPZs that are not owned or controlled by the Airport. See **Figure -** and **Figure -9** for more details and **Figure -** for the Runway 6L and 6R end alternatives.

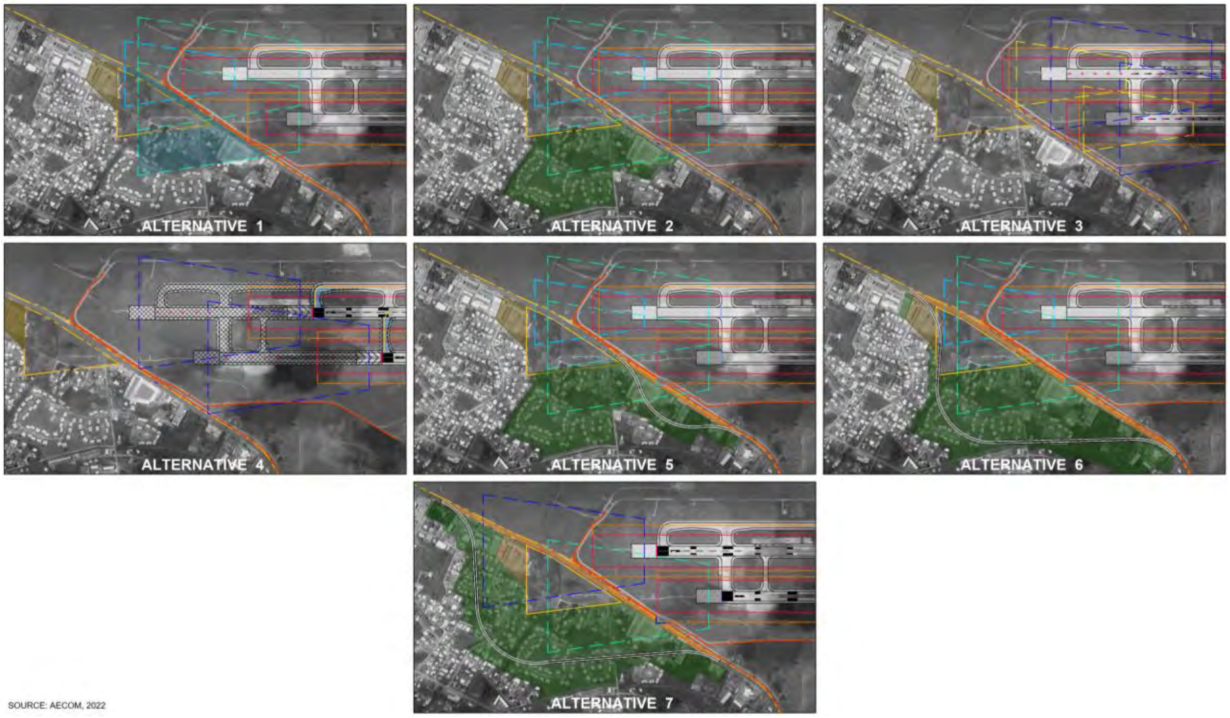

Figure 5-5. Runway 6L and 6R End Safety Standards Alternatives

Source: AECOM

Round 1 alternatives for the Runway 6L and 6R n d Safety Standards included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Reduce ROFA ength and Declared Distances:** Reduce ROFA extending beyond the Runway 6R end by 192 feet to eliminate Airport security fencing and Route 8 obstructions, reduce ROFA extending beyond the Runway 6L end by 98 feet to remove Airport security fence obstruction, and acquire ±53 acres of property or obtain avigation easements to control the land within the ARPZs and DRPZs. The resulting Landing Distance Available (LDA) for all runway ends will not impact current and future operations.
- **Alternative 3 – Shift RPZs and Reduce Declared Distances:** Reduce ROFA extending beyond the Runway 6R end by 192 feet to eliminate Airport security fence and Route 8 obstructions, reduce the ROFA extending beyond the Runway 6L end by 98 feet to remove Airport security fence obstruction, displace Runway 6R threshold by 2,528 feet to move the 6R ARPZ and 24L DRPZ within Airport property, increase Runway 6L displaced threshold by 1,458 feet to move the 6L ARPZ and 24R DRPZ within Airport property, and relocate the Approach Lighting Systems (ALSs) and associated Navigational Aids (NAVAIDs). The resulting LDA for all runway ends will not have a significant impact on current and future operations.
- **Alternative – Reduce Runway ength:** Remove runway pavement along Runway 6L (2,458 feet) and 6R (2,528 feet) ends to move all RPZs within Airport property, remove Taxiways A and B, remove a portion of Taxiway K, construct two new blast pads and taxiway connectors that connect to the new Runway 6L and 6R ends, and relocate the ALSs and associated NAVAIDs. The new Runway 6L/24R length would be reduced to 9,556 feet while the new Runway 6R/24L length would be 7,486 feet. The new runway lengths will not have a significant impact on current and future operations.
- **Alternative – Realign Route A :** Realign Route 8 2,515 feet around the RSA and ROFA extending beyond the approach end of Runway 6R, relocate the Airport security fence outside of the ROFA extending beyond the approach end of Runway 6R, acquire property to control the full length ROFA and relocated security fence, reduce the ROFA extending beyond the Runway 6L end by 98 feet to remove Airport security fence obstruction, and acquire 65 acres of properties or obtain avigation easements in order to control all land within the ARPZs and DRPZs.

- **Alternative 6 – Realign Route B :** Realign Route 8 5,965 feet around ARPZs and DRPZs, relocate the Airport security fence outside of the ROFAs extending beyond the Runway 6L and 6R ends, acquire property to control the full length ROFAs and relocated security fences, and acquire 100 acres of property or obtain avigation easements to control the land within the ARPZs and DRPZs.
- **Alternative – Realign Route C :** Remove the displaced threshold beyond the Runway 6L end to provide the full LDA, realign Route 8 6,135 feet around the proposed ARPZs and DRPZs, relocate the Airport security fence outside of the ROFAs extending beyond the Runway 6L and 6R end, acquire property to control the full length ROFAs and relocated security fences, acquire 112 acres of property or obtain avigation easements to control the land within the ARPZs and DRPZs, and relocate the ALS and associated NAVAIDs for Runway 6L. The resulting LDA for all runway ends will not impact current and future operations.

See **able -1** for the Runway 6L and 6R end alternatives evaluation matrix.

able -1 Runway 6 and 6R End Safety Areas Alternatives Matrix

Criteria	Alt 1	Alt 2	Alt 3	Alt	Alt	Alt 6	Alt
Airside Operational fficiency	Yellow	Green	Red	Red	Green	Green	Green
Cost Impacts	Yellow	Yellow	Yellow	Red	Red	Red	Red
ase of Implementation	Yellow	Green	Red	Red	Green	Green	Yellow
Pavement Demo	Yellow	Green	Green	Red	Green	Green	Green
New Airfield Pavement	Yellow	Green	Green	Red	Green	Green	Green
Off-Airport Impacts	Yellow	Green	Green	Green	Red	Red	Red
nvironmental Impacts	Yellow	Yellow	Yellow	Red	Red	Red	Red
Satisfies FAA RSA Requirements	Red	Green	Green	Green	Green	Green	Green
Satisfies FAA ROFA Requirements	Red	Red	Red	Green	Green	Green	Green
Satisfies FAA RPZ Requirements	Red	Green	Green	Green	Red	Green	Green

Notes:
A. Red = Unfavorable, Yellow = Neutral, Green = Favorable
B. Abbreviations
FAA = Federal Aviation Administration
RSA = Runway Safety Area
ROFA = Runway Object Free Area
RPZ = Runway Protection Zone
Source: AECOM

Due to the number of non-standard conditions, the no action alternative, Alternative 1, was not a realistic solution. Though Alternative 2 does not maintain a full 1,000-foot ROFA length beyond the Runway 6L and 6R ends, this alternative is appealing because it does not impact any existing pavement or further displace the runway thresholds. Like Alternative 2, Alternative 3 satisfies all FAA safety area requirements except the full length ROFAs beyond the runway ends; however, with this alternative, the Airport would not need to purchase any property or obtain avigation easements within the RPZs because the RPZs would shift onto Airport property.

Though Alternative 4 satisfies all FAA safety requirements, the major difference between Alternatives 3 and 4 is the removal of runway pavement and the addition of two new taxiway connectors in Alternative 4, while Alternative 3 only decreases the LDA for Runways 6L and 6R; therefore, Alternative 4 was removed from contention.

Lastly, the main highlight of Alternatives 5, 6, and 7 is the realigning of Route 8. While all three alternatives satisfy the FAA safety area requirements, the cost impact, environmental impacts, and the amount of property acquisition that the Airport would need, is not feasible. Therefore, **Alternatives 2** and **3** were selected as the highest rated alternatives for this focus area and were advanced to Round 2.

5.2.1.2 Runway 6R/2 RSA and ROFA Grading

This set of alternatives addresses the terrain within the Runway 6R/24L RSA and ROFA, which currently exceeds the FAA's maximum allowable slope for objects or terrain located within an RSA or ROFA. Additionally, there are drainage headwalls located beyond Runway 6R end and within the RSA which also exceed the maximum allowable slope. See **Figure -6** for the Runway 6L/24R RSA and ROFA grading alternatives.

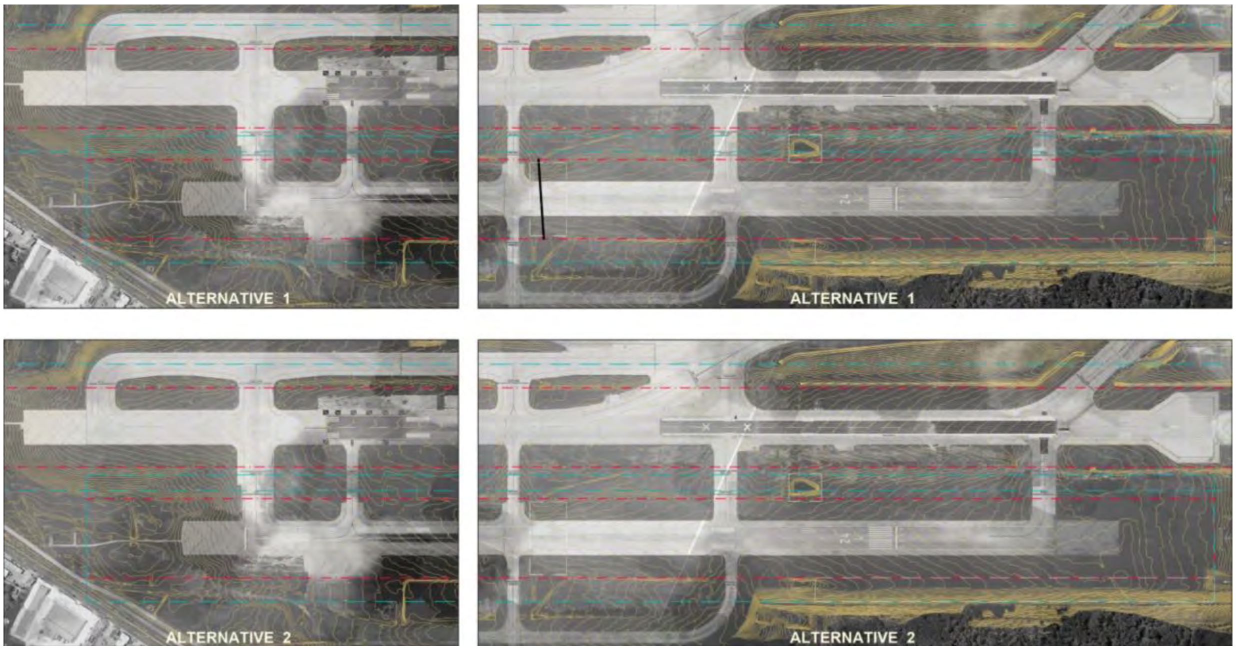

Figure 5-6. Runway 6R/24L RSA and ROFA Grading Alternatives

Source: AECOM

Round 1 alternatives for Runway 6R/24L RSA and ROFA Grading included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Regrade Areas:** Removing the drainage headwall from the Runway 6R/24L RSA to provide the RSA's full length of 1,000 feet beyond the Runway 6R end and regrade a portion of the Runway 6R/24L RSA to a maximum 5.0 percent negative slope.

See **able -2** for the Runway 6L/24R RSA alternatives evaluation matrix.

able -2 Runway 6 /2 R Runway Safety Area Alternatives Matrix

Criteria	Alternative 1	Alternative 2
Airside Operational fficiency	● (Red)	● (Green)
Cost Impacts	● (Yellow)	● (Red)
ase of Implementation	● (Yellow)	● (Red)
Satisfies FAA Design Requirements	● (Yellow)	● (Green)
Satisfies FAA Grading Requirements	● (Red)	● (Green)
Satisfies FAA Drainage Requirements	● (Red)	● (Green)

Notes:
A. Red = Unfavorable, Yellow = Neutral, Green = Favorable
B. Abbreviation
FAA = Federal Aviation Administration

Due to the high importance of RSA safety and standards, it is recommended that the Airport grade the RSA and ROFA to FAA standards and remove the drainage headwalls beyond the Runway 6R end; therefore, **Alternative 2** is the more desirable alternative compared to Alternative 1, the no action alternative.

5.2.1.3 axiway Shoulders and Fillets

This set of alternatives addresses the lack of shoulder for all or portions of Taxiways A, B, D, , G, and J and the non-standard design for all taxiways. See **Figure -1** for more details and **Figure -** for the taxiway shoulders and fillets alternatives.

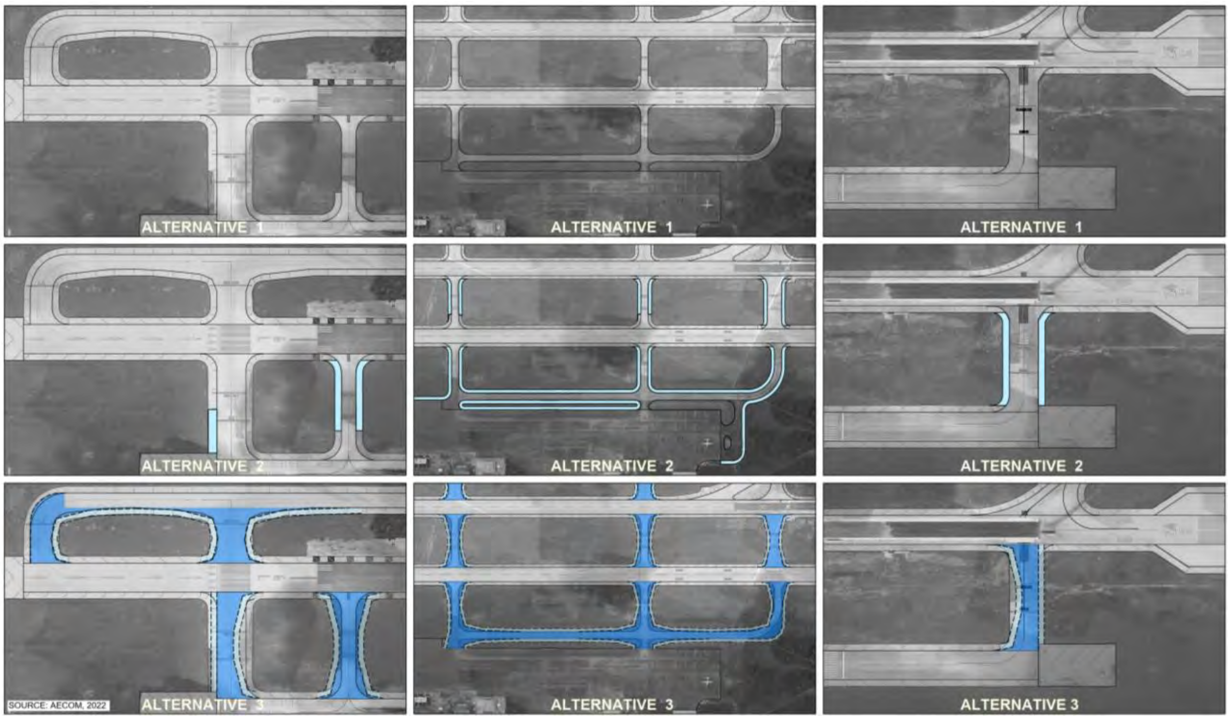

Figure 5-7. Taxiway Shoulders and Fillets Alternatives

Source: AECOM

Round 1 alternatives for Taxiway Shoulders and Fillets included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Add axiway Shoulders:** Add taxiway shoulders for all or portions of Taxiways A, B, D, , G, and J.
- **Alternative 3 – Meet FAA axiway Design Group DG 6 Standards:** Reconstruct all taxiway connectors to meet FAA TDG 6 design standards.

See **able -3** for the taxiway shoulders and fillets alternatives evaluation matrix.

able -3 axiway Shoulders and Fillets Alternatives Matrix

Criteria	Alternative 1	Alternative 2	Alternative 3
Airside Operational fficiency	Yellow	Yellow	Green
Cost Impacts	Yellow	Red	Red
ase of Implementation	Yellow	Yellow	Red
Pavement Demolition	Yellow	Green	Red
New Airfield Pavement	Yellow	Red	Red
Satisfies FAA Design Requirements	Red	Green	Green
Satisfies FAA TDG 6 Requirements	Red	Red	Green

Notes:
A. Red = Unfavorable, Yellow = Neutral, Green = Favorable
B. Abbreviations
FAA = Federal Aviation Administration
TDG = Taxiway Design Group
Source: AECOM

Due to the need for taxiway shoulders, Alternative 1 was not a reasonable alternative. Since Alternative 2 satisfies the missing taxiway shoulders for the taxiways mentioned above, this alternative should be pursued for at least a short-term improvement. Additionally, since Alternative 3 satisfies the taxiway pavement fillets for the TDG of the Airport's critical aircraft (Boeing 777-300 R), this alternative should also be pursued by the Airport. If not, a Modification of Standards (MOS) may be required for the airfield pavement. Therefore, **Alternatives 2** and **3** were chosen as the highest rated alternatives to move forward to Round 2.

5.2.1.4 Problematic axiway Geometry

This set of alternatives addresses existing areas of the airfield that have problematic taxiway geometry (PTG). These areas include connecting taxiways between the north terminal apron and Runway 6L/24R, as well as the south apron and Runway 6R/24L. See **Figure -1** , **Figure -1** , and **Figure -16** for more details and **Figure -** for the PTG alternatives.

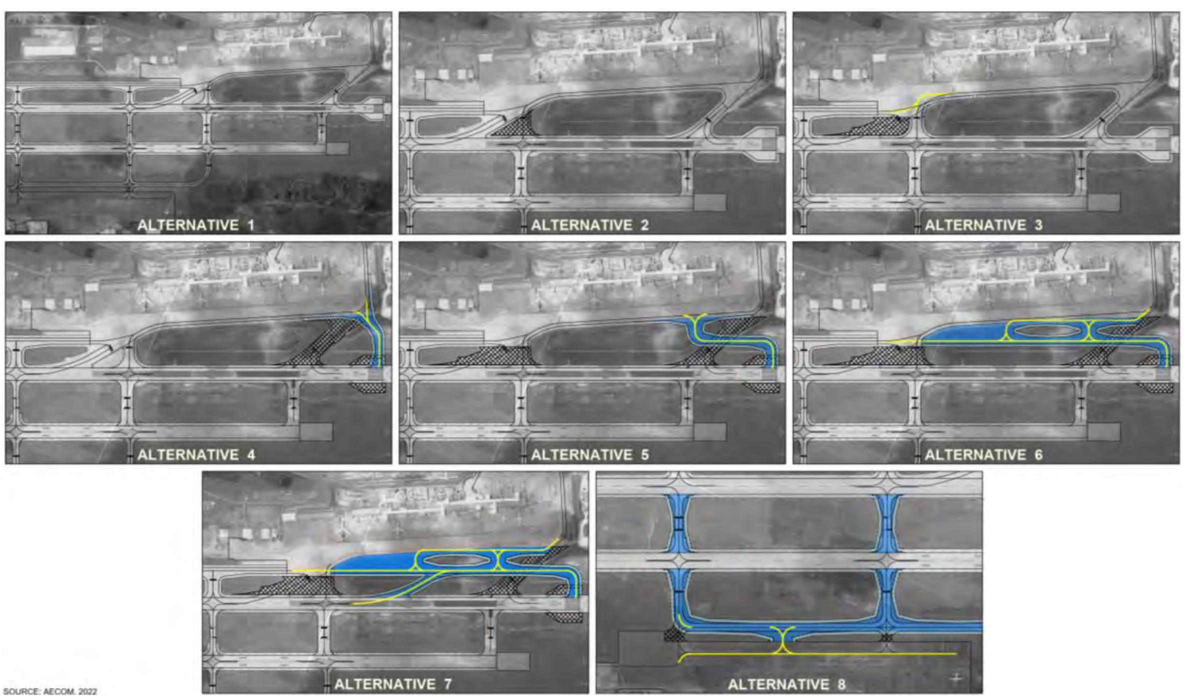

Figure 5-8. Problematic Taxiway Geometry Alternatives

Source: AECOM

Round 1 alternatives for PTG included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Remove axiway G:** Remove Taxiway G between Runway 6L/24R and Taxilane K to remove the wide expansive pavement with Taxiway F and eliminate direct access between the runway and the north apron.
- **Alternative 3 – Remove axiway F:** Remove Taxiway F between Runway 6L/24R and Taxilane K to remove the wide expansive pavement with Taxiway G and eliminate direct access between the runway and the north apron.
- **Alternative – Reconfigure axiway J:** Remove Taxiway J between Runway 6L/24R and Taxilane K to remove direct access between the runway and the north apron, the taxiway at other than a right-angle to the runway, and prevent using the runway as a taxiway. Though the reconfiguration involves direct access, the new configuration shows the taxiway at a right angle with the runway and connects with the Runway 24R end.
- **Alternative – Reconfigure axiway J and Remove axiways F and G:** Remove Taxiways F, G, and J between Runway 6L/24R and Taxilane K to remove wide expansive pavement, direct access between the runway and the north apron, the taxiway at other than a right-angle to the runway, and prevent using the runway as a taxiway. Additionally, a new Taxiway J configuration would be constructed between the Runway 24R end and Taxilane K between Gates 12 and 14 of the north apron.
- **Alternative 6 – Full ength Parallel axiway :** Remove Taxiways F, G, and J between Runway 6L/24R and Taxilane K to remove wide expansive pavement, direct access between the runway and the north apron, the taxiway at other than a right-angle to the runway, and prevent using the runway as a taxiway. Additionally, Taxiway K would be extended to the Runway 24R end to create a full-length parallel taxiway and two connectors would be constructed between Taxiway K and Runway 6L/24R.
- **Alternative – Full ength Parallel axiway – igh Speed Exit:** Alternative 7 is similar to Alternative 6 with an additional high-speed exit between Runway 6L/24R and proposed parallel Taxiway K.
- **Alternative – Eliminate South Apron Direct Access:** Remove the pavement connecting Taxiways D and with the south apron. A new connector would be constructed between Taxiway G and the south apron taxilane near south apron parking position S8.

See **able -** for the PTG alternatives evaluation matrix.

able - Problematic axiway Geometry Alternatives Matrix

Criteria	Alt 1	Alt 2	Alt 3	Alt	Alt	Alt 6	Alt	Alt
Airside Operational fficiency	Yellow	Green	Green	Green	Green	Green	Green	Green
Cost Impacts	Yellow	Yellow	Yellow	Yellow	Red	Red	Red	Yellow
ase of Implementation	Yellow	Yellow	Yellow	Red	Red	Red	Red	Yellow
Pavement Demolition	Yellow	Red	Red	Red	Red	Red	Red	Yellow
New Airfield Pavement	Yellow	Yellow	Yellow	Red	Red	Red	Red	Red
Satisfies FAA Design Requirements	Yellow	Green	Green	Green	Green	Green	Green	Green
Satisfies FAA Safety Requirements	Red	Green	Green	Green	Green	Green	Green	Green

Notes:

A. Red = Unfavorable, Yellow = Neutral, Green = Favorable

B. Abbreviation

FAA = Federal Aviation Administration

Source: AECOM

With the FAA's ongoing effort to minimize the amount of PTG on airfields, Alternative 1 was not seen as a feasible solution. Alternatives 2 and 3 proposing the removal of taxiway connectors G and F, respectively, are both cost effective and extremely impactful, as they both reduce three different types of PTG without the need to add any new airfield pavement. Additionally, while Alternative 4 would remove multiple issues of PTG including the use of Runway 24R as a taxiway in order to use the full length of the runway, Airport officials confirm that there are no aircraft that use the full length of the runway when taking off from the Runway 24R end; therefore, a new connector is not preferred.

Alternatives 5, 6, and 7 all involve the removal of taxiway connectors F, G, and J and the addition of new taxiway pavement. While these alternatives would eliminate several PTG areas, the high cost of pavement removal and new airfield pavement is not attainable. Additionally, there is a significant drop in terrain between the north apron and Runway 6L/24R; therefore, these alternatives were not pursued.

Lastly, Alternative 8 looks at the PTG issues between the south apron and Runway 6R/24L. With the concern being direct access and a short taxi distance between the apron and the runway, the removal of the Taxiway D and connectors and the construction of a new connector off of Taxiway G is practical. Therefore, **Alternatives 2**, **3**, and all moved forward to Round 2 in the alternatives development process.

5.2.1.5 North Apron

This set of alternatives address the non-standard taxilane clearance along Taxilane K where it fronts the north apron. The existing separation ranges between 125.5 and 127 feet, while the FAA standard for an Airplane Design Group (ADG) V taxilane is 135 feet. See **Figure -13** for more details and **Figure -9** for the north apron alternatives.

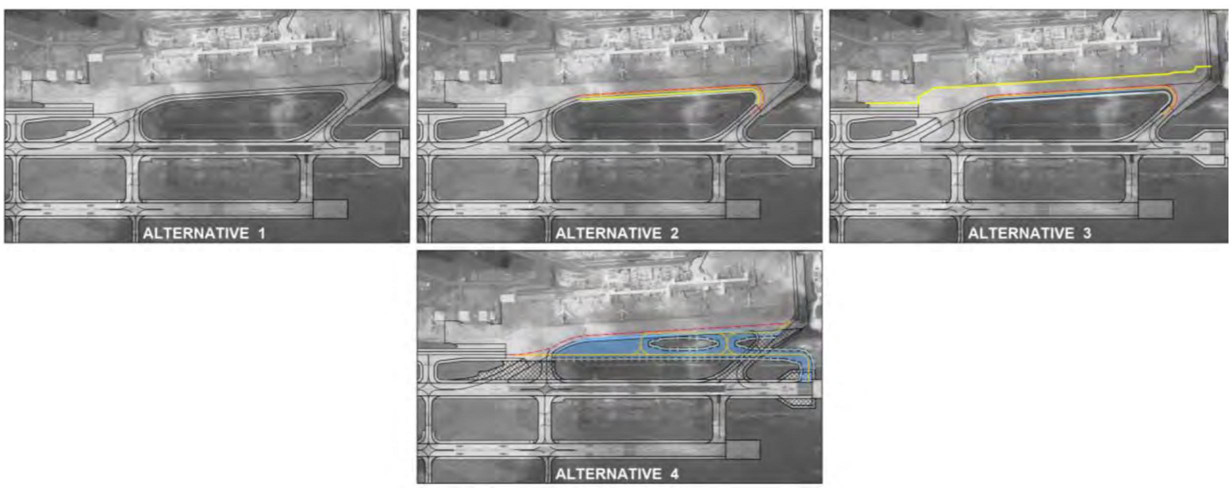

Figure 5-9. North Apron Alternatives

Source: AECOM

Round 1 alternatives for the North Apron included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Shift axilane Centerline**: Shift Taxilane K nine feet away from the VSR/aircraft parking, shift the taxilane edge, and add new taxilane and shoulder pavement.
- **Alternative 3 – Shift Centerline and Upgrade to ADG V axiway**: Shift Taxilane K centerline 16.4-feet away from the VSR/aircraft parking, shift the taxilane edge, and add new taxilane and shoulder pavement.
- **Alternative – Full ength Parallel axiway** : This alternative is the same as Alternative 6 for the problematic taxiway geometry group of alternatives. While this alternative eliminates multiple areas of problematic taxiway geometry, it removes the existing centerline for Taxilane K and provides adequate separation for an ADG V taxilane.

See **able -** for the north apron alternatives evaluation matrix.

able - North Apron Alternatives Matrix

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative
Airside Operational fficiency	Red	Green	Red	Green
Cost Impacts	Yellow	Yellow	Yellow	Red
ase of Implementation	Yellow	Yellow	Yellow	Red
Pavement Demolition	Yellow	Yellow	Yellow	Red
New Airfield Pavement	Yellow	Yellow	Yellow	Red
Satisfies FAA Taxiway/Taxilane Separation Requirements	Red	Green	Green	Green
Impacts Apron Depth	Red	Red	Red	Green

Notes:
A. Red = Unfavorable, Yellow = Neutral, Green = Favorable
B. Abbreviation
FAA = Federal Aviation Administration
Source: AECOM

The safe and efficient movement of aircraft along Taxilane K is important as the taxilane services 11 hard-stand contact gates and three hardstand positions that service the light aircraft commuter terminal. Alternative 1 does not satisfy the FAA ADG V separation standard and should not move forward in the alternatives analysis process.

Of the other three alternatives, Alternative 2 satisfies the separation issue and is the lowest cost alternative as it requires the least amount of new airfield pavement and airfield markings. While Alternative 3 also satisfies the separation issue and even upgrades the taxilane to a taxiway, this would require aircraft parked at their gate to push back onto an active taxiway, which would have to be monitored by Air Traffic Control (ATC).

While Alternative 4 is the most expensive alternative, Alternative 4 satisfies the taxilane separation issue, removes all PTG issues, and allows for a full-length parallel taxiway for Runway 6L/24L. While this may be the most expensive solution, this alternative is recommended as a long-term solution; therefore, **Alternatives 2** and were chosen as the preferred alternatives and were advanced to Round 2.

5.2.1.6 South Apron

This set of alternatives addresses the non-standard taxiway/taxilane centerline separation between Taxiway G and the south apron taxilane. The existing separation is 241 feet, while the FAA standard for an ADG V-ADG V taxiway separation is 249.5 feet. See **Figure -12** for more details and **Figure -1** for the south apron alternatives.

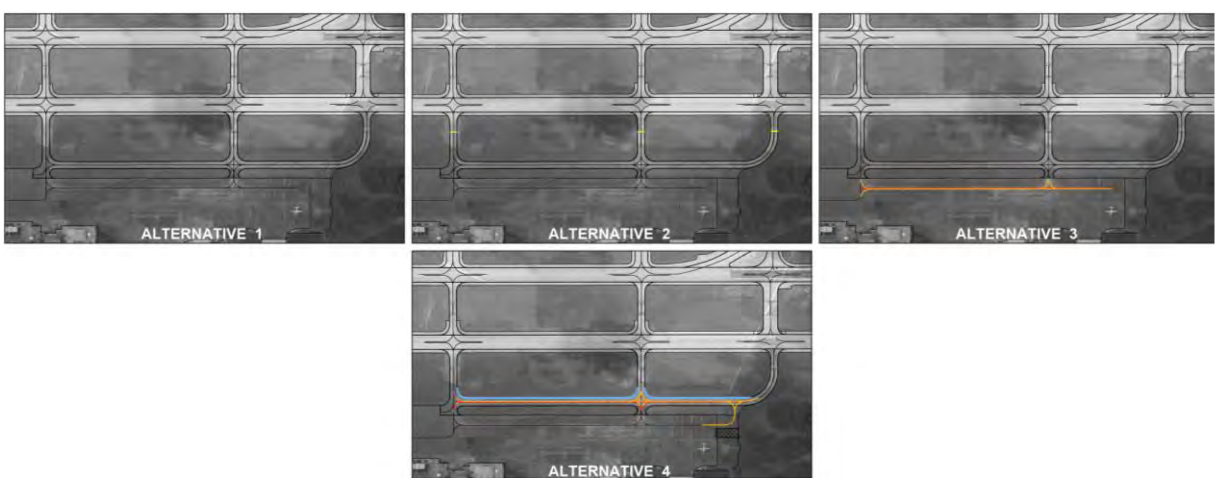

Figure 5-10. South Apron Alternatives

Source: AECOM

Round 1 alternatives for the South Apron included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Convert axiway G to axilane G**: Convert Taxiway G to Taxilane G as the existing separation between the two centerlines are standard for a taxiway-taxilane separation and relocate the non-movement area boundary line markings for Taxiways D, , and G to the existing hold-short markings.
- **Alternative 3 – Shift South Apron axilane**: Shift the south apron taxilane and VSR 8.5 feet away from the existing Taxiway G centerline.
- **Alternative – Shift axiway G and Remove Excess Pavement**: Shift Taxiway G 8.5 feet away from the existing south apron taxilane and add taxiway pavement for a 75-foot-wide taxiway.

See **able -6** for the south apron alternatives evaluation matrix.

able -6 South Apron Alternatives Matrix

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative
Airside Operational fficiency	Red	Red	Green	Green
Cost Impacts	Yellow	Yellow	Yellow	Red
ase of Implementation	Yellow	Green	Green	Red
Pavement Demolition	Yellow	Green	Green	Red
New Airfield Pavement	Yellow	Green	Green	Red
Satisfies FAA Taxiway/Taxilane Separation Requirements	Red	Green	Green	Green
Impacts Apron Depth	Yellow	Yellow	Red	Yellow

Notes:
A. Red = Unfavorable, Yellow = Neutral, Green = Favorable
B. Abbreviation
FAA = Federal Aviation Administration
Source: AECOM

Similar to the north apron alternatives, the safe and efficient movement of aircraft along Taxiway G and the south apron taxilane is important, as the south apron services nine aircraft parking positions. Alternative 1 does not satisfy the FAA ADG V taxiway to taxilane separation standard and should not move forward in the alternatives analysis process.

Alternative 2 resolves the separation issue by converting Taxiway G into a taxilane, for which the existing separation is standard for an ADG V taxilane centerline to taxilane centerline separation. The only cost associated with this alternative would be the removal of the three non-movement area markings and the addition of three new non-movement area markings by the hold short markings along Taxiways D, , and G.

Similar to Alternative 2 of the north apron alternatives, Alternative 3 shifts the south apron centerline 8.5 feet from Taxiway G and maintains Taxiway G as a taxiway. Markings associated with the south apron VSR would also need to shift down to maintain the proper taxilane to fixed object separation.

Alternative 4 would be the most expensive alternative as this alternative proposes to shift the Taxiway G centerline away from the south apron and add taxiway pavement along the north side of Taxiway G. Though this alternative would be operationally efficient, the cost of this alternative may not be feasible; therefore, **Alternatives 2** and **3** were the highest rated alternatives and advanced to Round 2.

5.2.1.7 rees and Vegetation

This set of alternatives addresses the trees and vegetation located within the Taxiway G Taxiway Object Free Area (TOFA) and Taxiway J Taxilane Object Free Area (TLOFA). The FAA standard is for all objects not fixed by function to be cleared from the TOFAs and TLOFAs. See **Figure -11** for more details and **Figure -11** for the trees and vegetation in the taxiway safety areas alternatives.

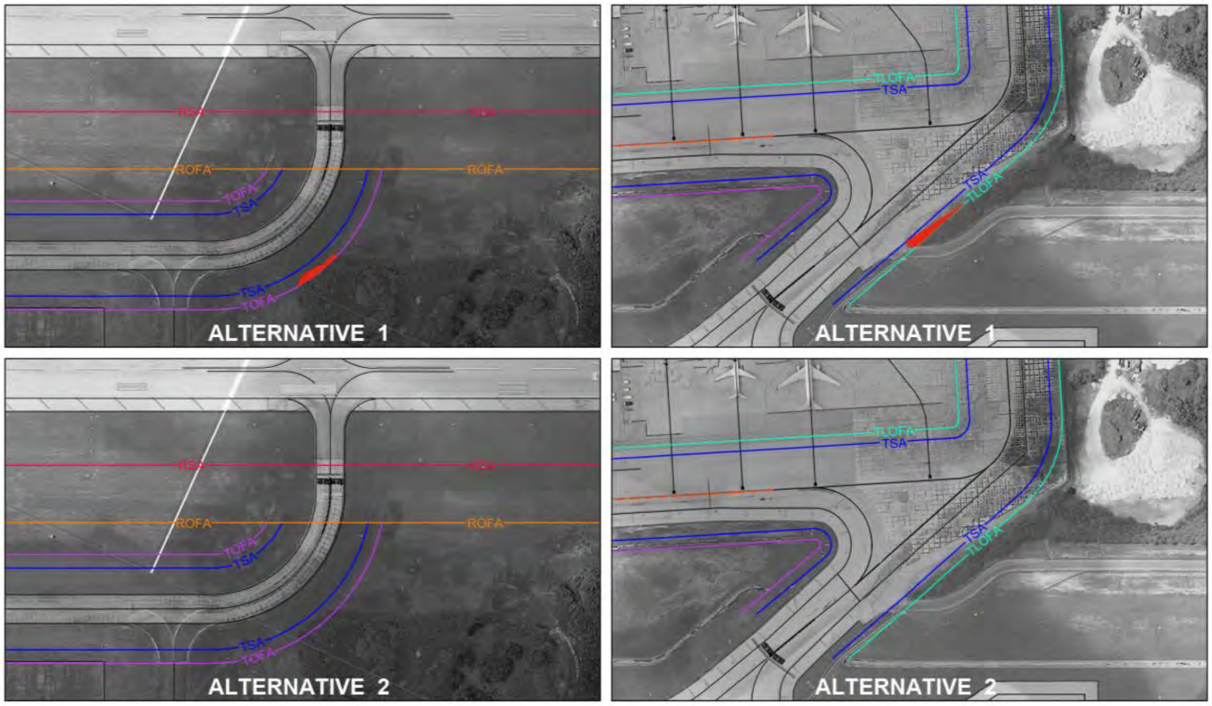

Figure 5-11. Trees and Vegetation Alternatives

Source: AECOM

Round 1 alternatives for Trees and Vegetation included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Remove   rees and Vegetation**: Remove trees and vegetation within the Taxiway G TOFA and Taxiway J TLOFA.

In order to meet FAA taxiway safety standards, the Airport should remove all trees and vegetation within the taxiway safety areas; therefore, Alternative 1 is not a viable alternative and **Alternative 2** will move forward in the alternatives process.

See   **able   -**   for the trees and vegetation in the taxiway safety areas alternatives evaluation matrix.

able   -   rees and Vegetation in   axiway Safety Areas Alternatives Matrix

Criteria	Alternative 1	Alternative 2
Airside Operational fficiency	Yellow	Green
Cost Impacts	Yellow	Red
ase of Implementation	Yellow	Green
Pavement Demolition	Yellow	Green
New Airfield Pavement	Yellow	Green
Satisfies FAA Design Requirements	Yellow	Green
Satisfies FAA Safety Requirements	Red	Green
nvironmental Impacts	Yellow	Green

Notes:
A. Red = Unfavorable, Yellow = Neutral, Green = Favorable
B. Abbreviation
FAA = Federal Aviation Administration
Source: AECOM

5.2.1.8 Summary of Round 1 Airfield Alternatives

Round 1 alternatives that were ranked in the “top 2” of their individual evaluation matrices moved forward in the alternatives process.

See **able -** for the highest and second highest ranked alternatives from each examined area. These alternatives were further developed in the second round of airfield alternatives.

able - Round 1 ighest Ranked Airfield Alternatives

Alternative Focus Area	ighest Ranked Alternative	Second ighest Ranked Alternative
Runway 6L and 6R nd Safety Areas	3	2
Runway 6R/24L RSA and ROFA	2	1[A]
Taxiway Shoulders and Fillets	3	2
Problematic Taxiway Geometry	8	2 and 3
North Apron	2	4
South Apron	3	2
Trees and Vegetation in Taxiway Safety Areas	2	1[A]

Notes:
A. Only one viable alternative, excluding the No Action alternatives, was developed to grade the Runway 6R/24L RSA and ROFA and to remove the trees and vegetation in the TOFAs/TLOFAs.
B. Abbreviation:
RSA = Runway Safety Area
Source: AECOM

5.2.2 Round 2 Airfield Alternatives

Five Round 2 airfield alternatives were advanced from the Round 1 analysis. Round 1 alternatives that were ranked in the “top 2” of their individual evaluation matrices moved forward in the alternatives process. Once the second highest and highest ranked Round 1 alternatives were developed into two Round 2 alternatives, they evolved into a low-cost alternative and a high cost alternative could be developed based on the alternatives that moved forward from the Round 1 process.

The five Round 2 airfield alternatives evaluated include:

- Alternative 1 – No Action
- Alternative 2 – Low Cost
- Alternative 3 – Second Highest Ranked Round 1 Alternatives
- Alternative 4 – Highest Ranked Round 1 Alternatives
- Alternative 5 – High Cost

See **Figure -12** through **Figure -19** for the five Round 2 airfield alternatives.

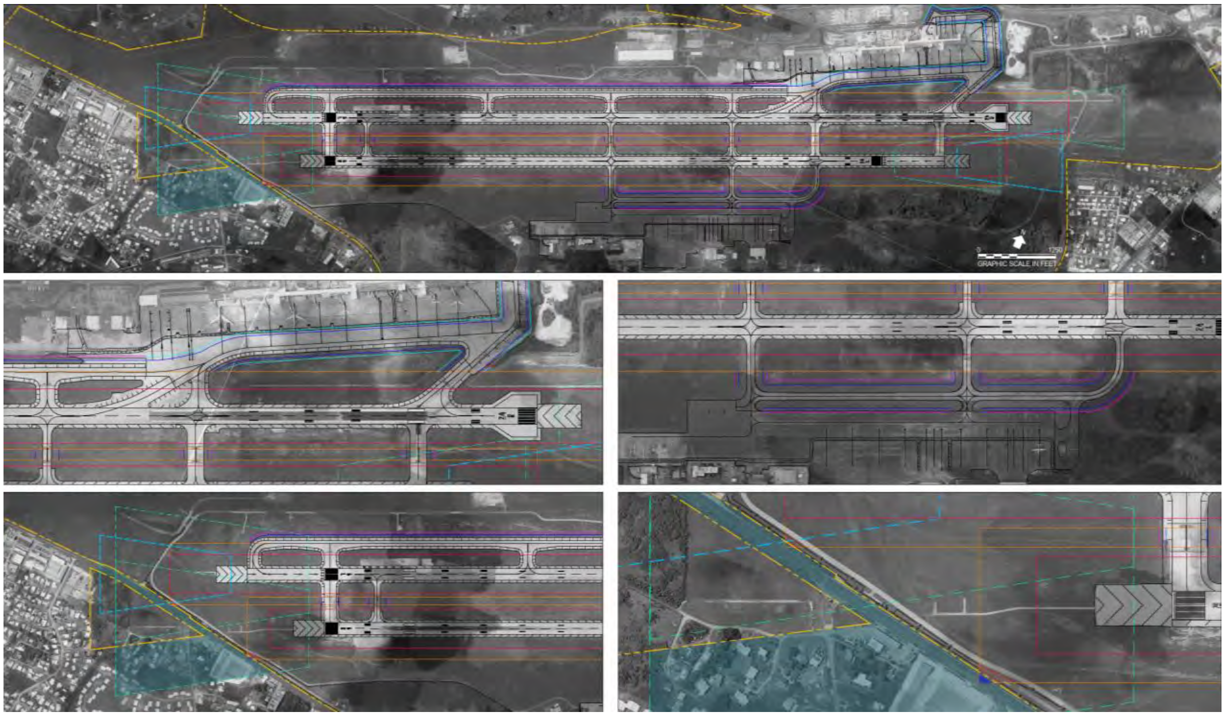

Figure 5-12. Alternative 1 – No Action

Source: AECOM

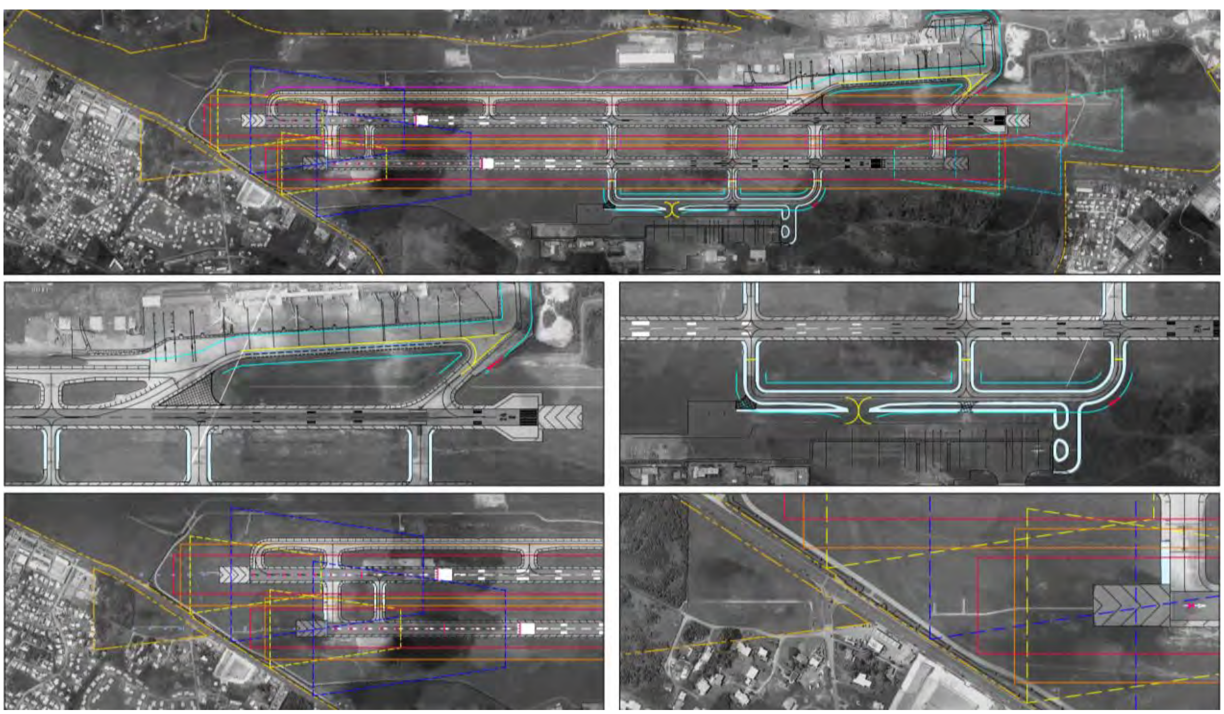

Figure 5-13. Alternative 2 – Low Cost

Source: AECOM

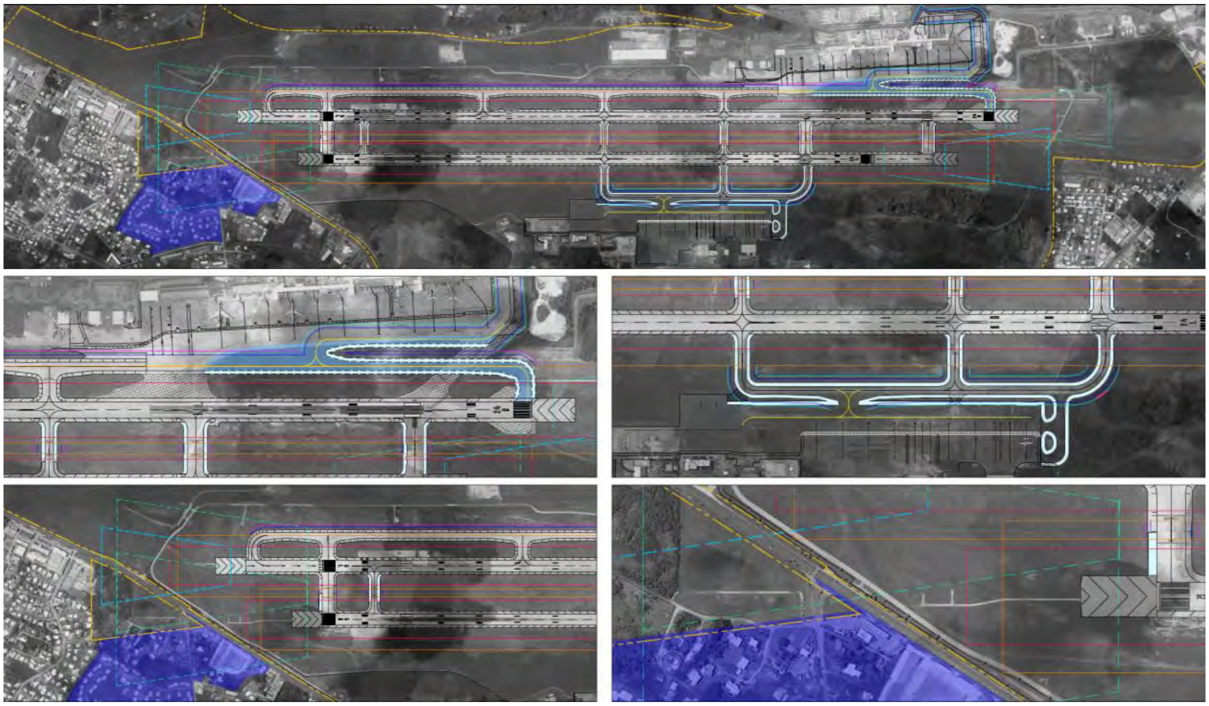

Figure 5-14. Alternative 3 – Second Highest Ranked Round 1 Alternatives

Source: AECOM

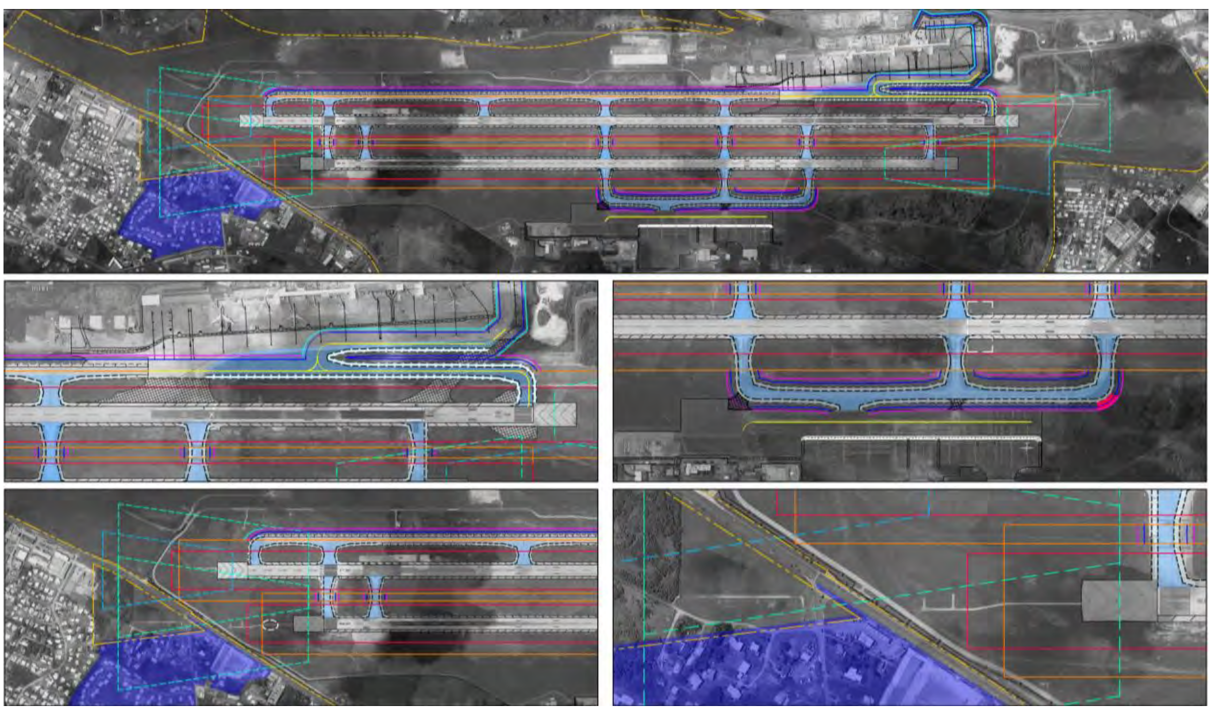

Figure 5-15. Alternative 4 – Highest Ranked Round 1 Alternatives

Source: AECOM

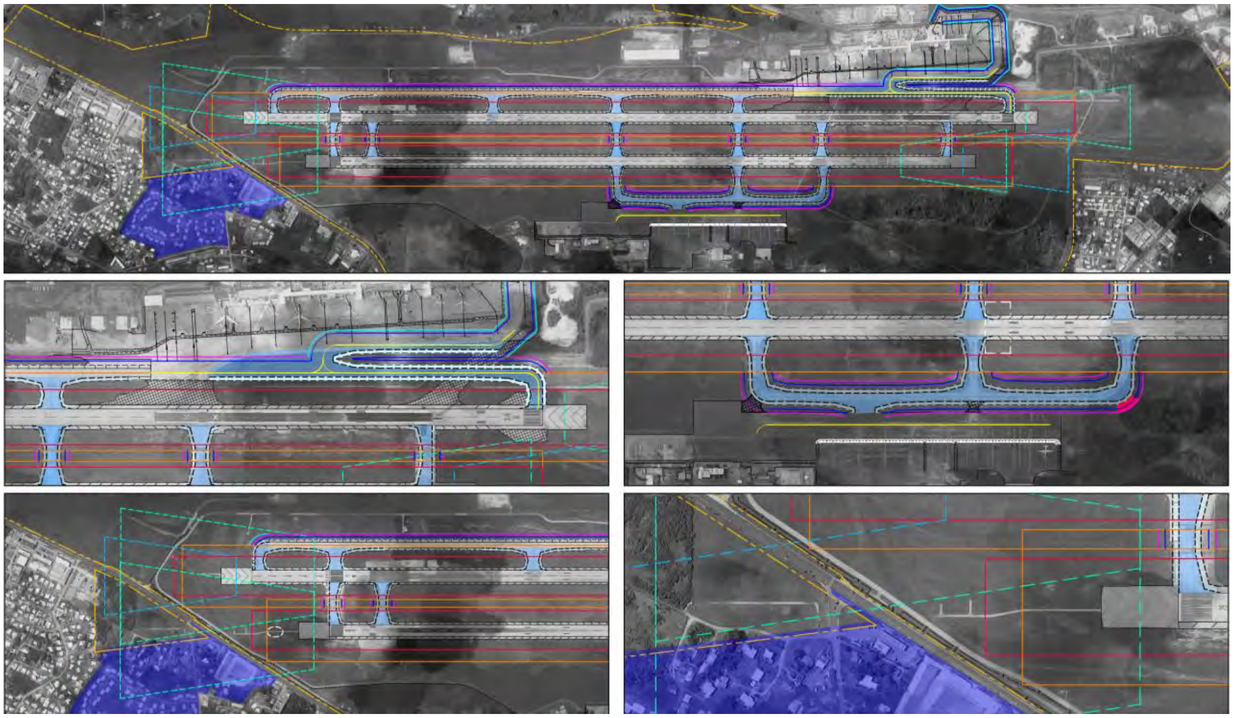

Figure 5-16. Alternative 5 – High Cost

Source: AECOM

Though the second highest ranked alternative for the south apron area was to shift the south apron taxilane, from a "low cost" perspective, relocating the non-movement area markings (the highest ranked alternative) posed a lower cost solution, so the methodology for the south apron was swapped between Alternatives 2 and 3.

Upon further review of the topography around the north apron area, one of the connectors proposed between the apron and the proposed full-length parallel Taxiway K for Alternative 4 in Round 1 of the north apron alternatives, is not feasible, so that connector has been removed from this round of alternatives.

Additionally, due to its high importance of eliminating direct access between Runway 6R/24L and the south apron, Alternative 8 for the PTG Round 1 alternatives was proposed in all of the Round 2 alternatives, excluding the No Action alternative.

Highlights of Round 2 Airfield Alternatives include:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – ow Cost:** Displace the Runway 6L and 6R ends to shift the RPZs within Airport property, shift Taxilane K by the north apron to meet FAA separation standards, relocate the non-movement area markings near the south apron and convert Taxiway G to a taxilane, and add taxiway shoulders for portions of Taxiways A, B, D, , G, and J.
- **Alternative 3 – Second ighest Ranked Alternatives in Round 1:** Purchase property and/or avigation easements within the ARPZs and DRPZs, extend Taxiway K to the Runway 24R end to create a full parallel taxiway, shift the south apron taxilane to meet FAA separation standards, and add taxiway shoulders for portions of Taxiways A, B, D, , G, and J.
- **Alternative – ighest Ranked Alternatives in Round 1:** Displace the Runway 6L and 6R ends to shift the RPZs within Airport property, shift Taxilane K by the north apron to meet FAA separation standards, shift the south apron taxilane to meet FAA separation standards, and incorporate TDG 6 fillets throughout the airfield.
- **Alternative – igh Cost:** Purchase property and/or avigation easements underneath the ARPZs and DRPZs, extend Taxiway K to the Runway 24R end to create a full parallel taxiway, shift the

south apron taxilane to meet FAA separation standards, and incorporate TDG 6 fillets throughout the airfield.

able -9 portrays the Round 2 alternatives evaluation matrix.

able -9 Round 2 Airfield Alternatives Matrix

Criteria	Weighting	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5
Airside Operational Efficiency	15%	Yellow	Red	Green	Red	Green
Cost Impacts	15%	Yellow	Green	Yellow	Yellow	Red
Ease of Implementation	5%	Yellow	Red	Green	Red	Red
New Airfield Pavement	5%	Yellow	Green	Green	Red	Red
Environmental Impacts	15%	Yellow	Green	Yellow	Red	Red
Apron Depth Impact	2.5%	Yellow	Green	Yellow	Yellow	Yellow
Satisfies FAA RSA Requirements	5%	Red	Green	Green	Green	Green
Satisfies FAA ROFA Requirements	5%	Red	Yellow	Yellow	Yellow	Yellow
Satisfies FAA RPZ Requirements	7.5%	Red	Green	Green	Green	Green
Satisfies FAA Grading/Drainage Standards	5%	Red	Green	Green	Green	Green
Addresses FAA PTG	5%	Red	Yellow	Green	Yellow	Green
Satisfies FAA TDG 6 Requirements	10%	Red	Red	Red	Green	Green
Satisfies FAA Taxiway/Taxilane Separation	5%	Red	Green	Green	Green	Green
Total	**100%**	**57.5**	**130**	**122.5**	**122.5**	**112.5**

Notes:
A. Red = Unfavorable, Yellow = Neutral, Green = Favorable
B. Abbreviations
FAA = Federal Aviation Administration
RSA = Runway Safety Area
ROFA = Runway Object Free Area
RPZ = Runway Protection Zone
PTG = Problematic Taxiway Geometry
TDG = Taxiway Design Group
Source: AECOM

5.2.2.1 Cost Estimates

ROM cost estimates were developed for the five Round 2 airfield alternatives. I ements such as new airfield pavement, new airfield markings, pavement demolition, vegetation removal, and property acquisition were all evaluated in these estimates. stimates were prepared in 2023 dollars and multiplied by a location factor of 2.6 when compared to the U.S. national average. See **able -1** for a summary of the Round 2 airfield alternatives cost estimates.

able -1 Round 2 Airfield Alternatives Cost Estimates

Airfield Alternative	Estimated otal Cost
Alternative 1 – No Action	$0
Alternative 2 – Low Cost	$31,800,000
Alternative 3 – Second Highest Ranked Round 1 Alternatives	$84,900,000
Alternative 4 – Highest Ranked Round 1 Alternatives	$121,300,000
Alternative 5 – High Cost	$174,400,000

Source: AECOM

5.2.3 Round 3 Preferred Airfield Alternative

Alternative 2 – ow Cost was chosen as the preferred airfield alternative. While the alternative decreases the LDA for arrivals on Runway 6L and 6R, this should not have a significant impact on current or future forecasted operations. See **able -11** for the proposed declared distances of the preferred airfield alternative and **Appendix E** for a graphic of these declared distances along the runways. Additionally, this alternative satisfies the FAA recommendation to own and control all land within the RPZs.

This alternative also provides standard separation between the Taxilane K centerline and the north apron VSR and provides standard separation between the south apron taxilane centerline and the proposed Taxilane G centerline. While this alternative does require the removal of the existing Taxilane K centerline marking, the addition of displaced threshold markings, and the restriping of the Runway 6L and 6R ends, the only airfield pavement that would be removed is the Taxiway G connector between Runway 6L/24R and Taxilane K, and the only pavement that is being added is a small portion of full-strength pavement and shoulder pavement along Taxiway K. **Figure -1** shows the preferred airfield alternative which will be utilized in the Airport Development Plan.

able -11 Preferred Airfield Alternative – Declared Distances

Runway		Declared Distance			
End	**ength**	**ORA**	**ODA**	**ASDA**	**DA**
6L	12,014’	12,014’	12,014’	12,014’	9,556’
24R	12,014’	10,898’	12,014’	11,916’	11,916’
6R	10,014’	10,014’	10,014’	10,014’	7,486’
24L	10,014’	8,857’	10,014’	9,822’	8,818’

Note:
A. Abbreviations
TORA = Takeoff Runway Available
TODA = Takeoff Distance Available
ASDA = Accelerate-Stop Distance Available
LDA = Landing Distance Available
Source: AECOM

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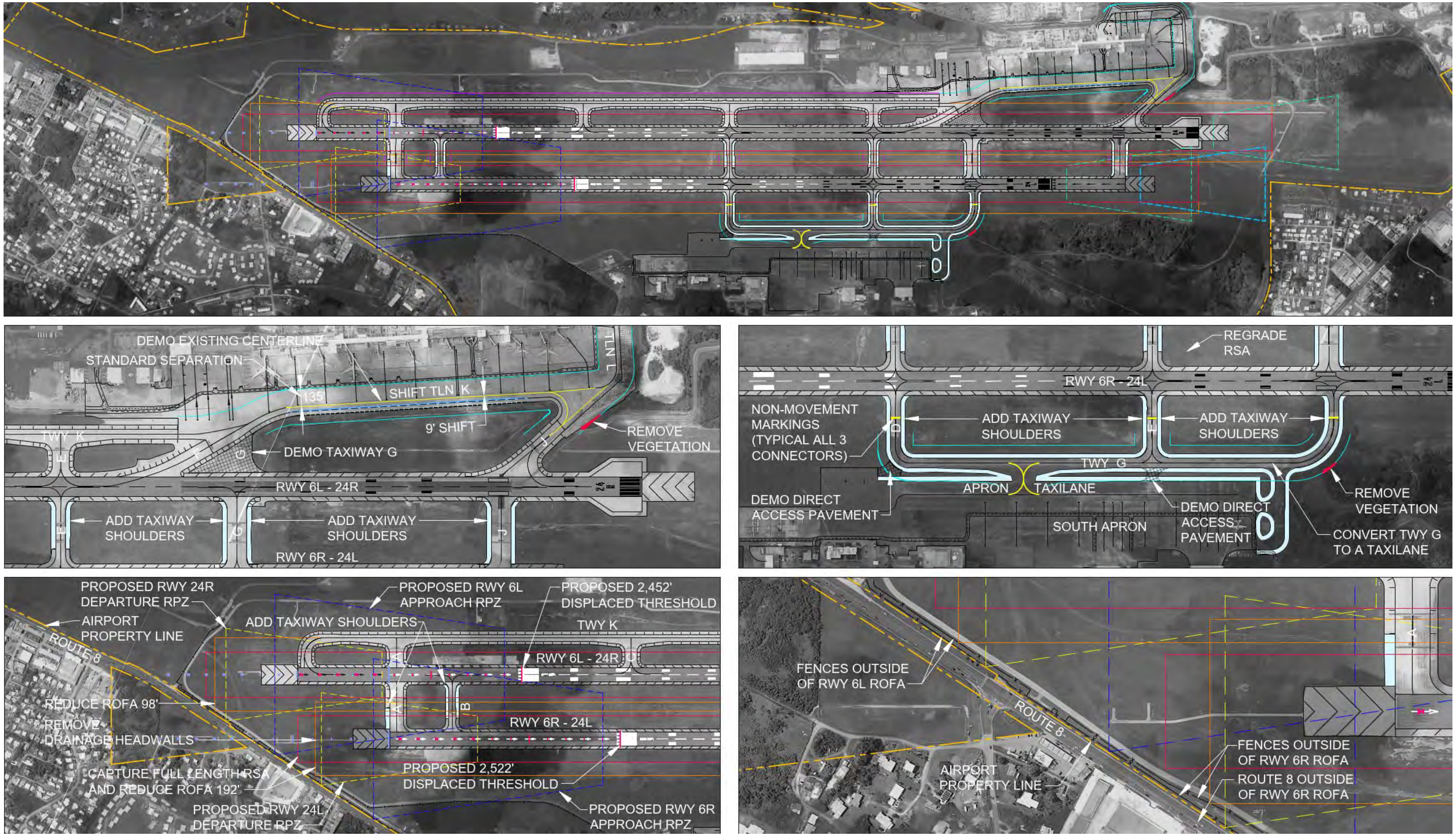

Figure 5-17. Preferred Airfield Alternative

Source: AECOM

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5.3 Commercial Passenger   erminal Facilities

Five focus areas were examined in the commercial passenger terminal facilities alternatives analysis, as key elements within these focus areas were determined to be insufficient for the planning period of this Master Plan Update. A summary of the commercial passenger terminal facility requirements can be found in **Section   3 11** of **Chapter   :** *Facility Requirements.*

As shown in **Figure   -1** , 26 Round 1 alternatives were developed based on the five commercial passenger terminal focus areas, which led to three alternatives being developed in Round 2. A preferred Round 2 alternative was selected and moved into Round 3. This alternative was incorporated into the Airport Development Plan.

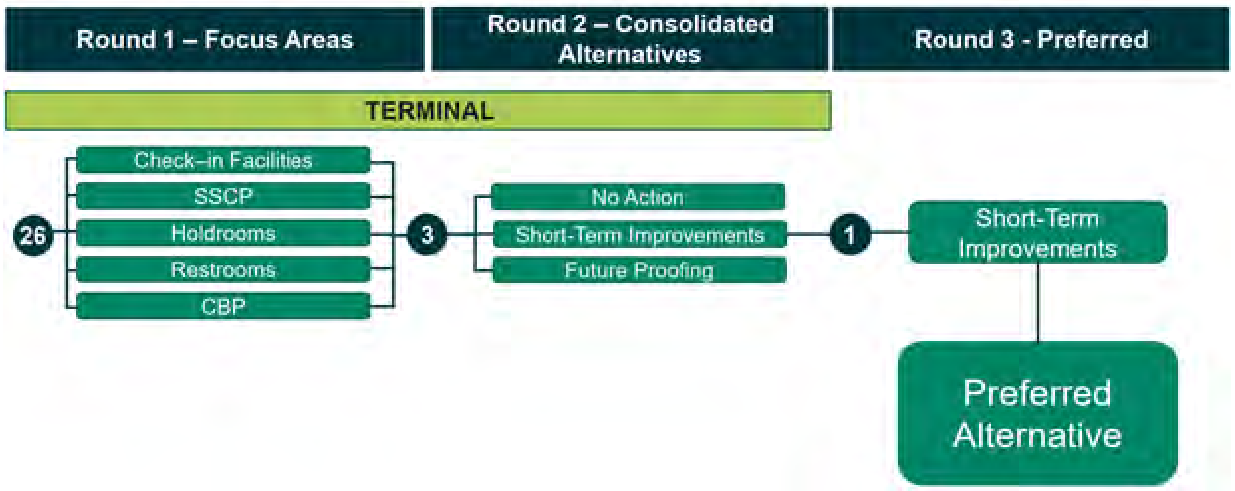

Figure 5-18. Commercial Passenger Terminal Alternatives Development

Source: AECOM

5.3.1 Round 1 Commercial Passenger   erminal Alternatives

As illustrated in **Figure   -19**, the five Round 1 focus areas include: Check-in Facilities, SSCP, Holdrooms, Restrooms, and CBP. **Sections   3 1 1** through   **3 1**   describe the alternatives for each of these elements, which were presented during the commercial passenger terminal alternatives virtual workshop.

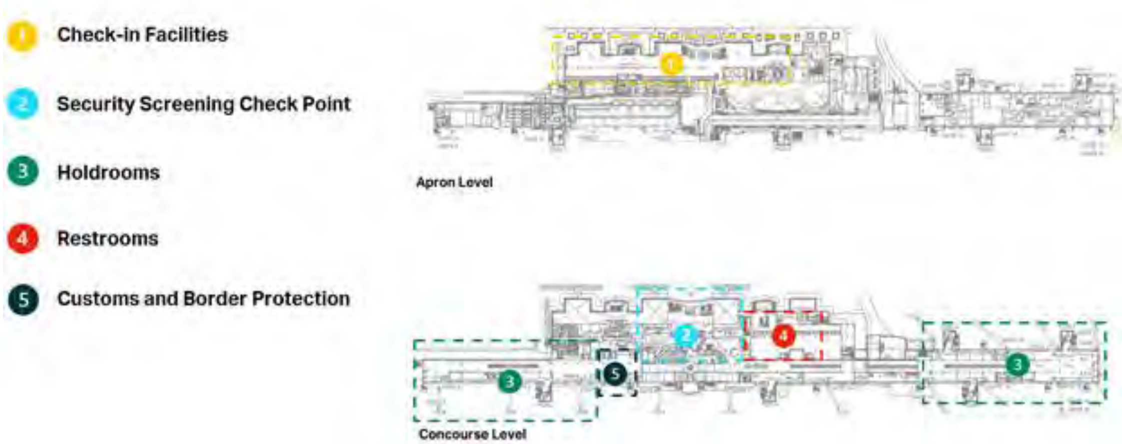

Figure 5-19. Commercial Passenger Terminal Focus Areas

Source: AECOM

For each set of commercial passenger terminal alternatives, evaluation matrices were developed based on both quantitative and qualitative development criteria. While most of the criteria are focus area-based, all matrices include criteria such as cost impacts, operational efficiency, and ease of implementation.

Additionally, some matrices include criteria such as impacts to the specific focus area, passenger moving complexity, construction impacts, and the satisfying of area-specific guidelines.

5.3.1.1 Check-in Facilities

This set of alternatives addresses the deficiencies identified in **Chapter :** *Facility Requirements* for the check-in facilities. These include the need for touchless self-service kiosks and a lack of baggage induction points at the 12 counters next to the entrances between the east and west check-in areas. These counters do not have direct access to the BHS, so collected luggage must be manually delivered to other check-in positions to be inducted into the Checked Bag Inspection System (CBIS).

These alternatives were studied to increase operational efficiency, passenger capacity, and their ability to enhance the passenger experience within the check-in facilities. See **Figure -23, Figure -2 ,** and **Figure -2** and **able -2** for more details and **Figure -2** for the check-in facilities alternatives.

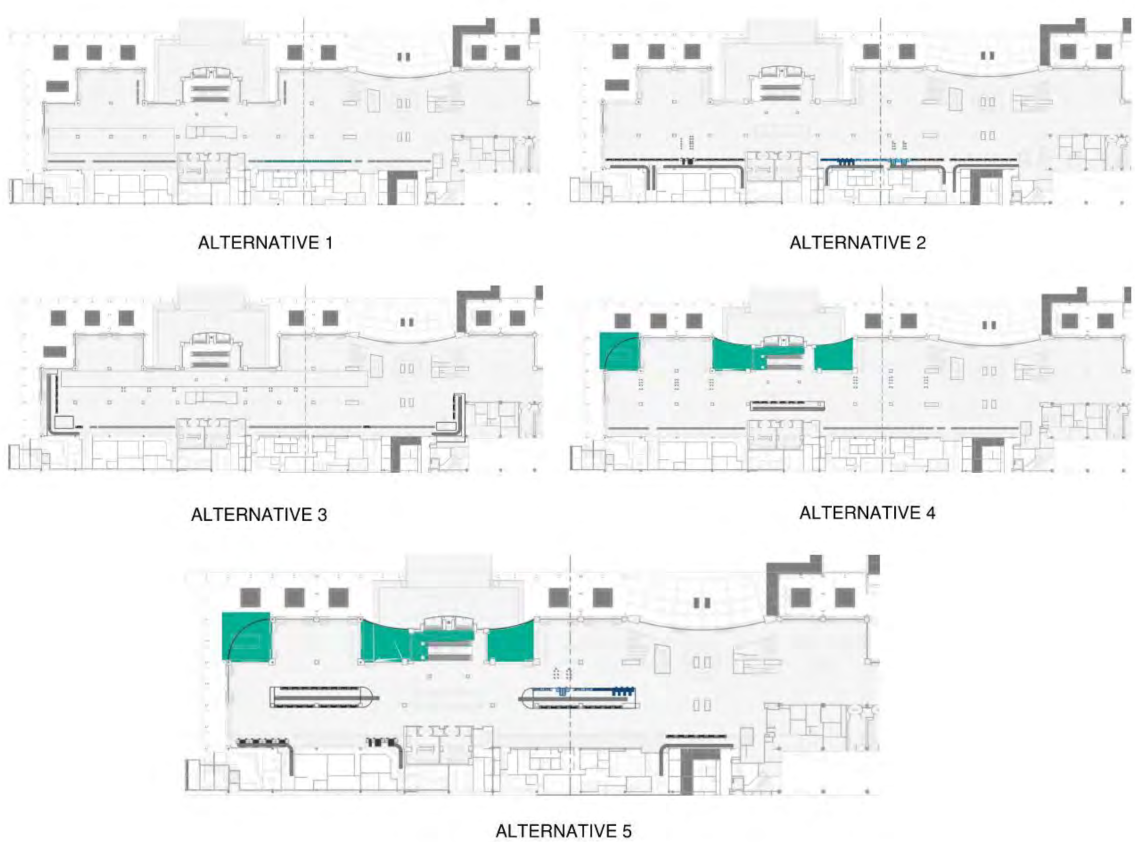

Figure 5-20. Check-in Facilities Alternatives

Source: AECOM

Round 1 alternatives for Check-in Facilities included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Add Common-Use Self-Service CUSS iosks:** Remove the 12 counters next to the entrances, maintain the west and east check-in counters, and add CUSS kiosks with bag drop-off points at the existing check-in positions to allow for direct connection into the BHS.
- **Alternative 3 – Add CUSS iosks and Relocate icket Counters:** Remove the 12 counters next to the entrances, provide L-shaped counters at the west and east end check-in counters, and add touchless self-service kiosks and a bag drop-off in the center of the ticketing lobby.

- **Alternative – Expand Frontage:** Maintain the west and east end check-in counters, add additional counters and baggage belts between the west and east counters in front of the existing restrooms, add touchless self-service kiosks in the center of the ticketing lobby, and expand the ticketing lobby by infilling areas along the departure's road entrance wall.
- **Alternative – Expand Frontage with Island:** Provide a west and east island check-in area in the middle of the ticketing lobby, reduce the number of existing counters on the wall opposite the entrance by either converting them into baggage drop-offs or removing them, and expand the lobby by infilling areas along the departure's road entrance wall.

See **able -12** for the check-in facilities alternatives evaluation matrix.

able -12 Check-In Facilities Alternatives Matrix

Criteria	Alt 1	Alt 2	Alt 3	Alt	Alt
Operational fficiency	Yellow	Green	Yellow	Green	Green
Cost Impacts	Yellow	Yellow	Red	Red	Red
ase of Implementation	Yellow	Green	Red	Red	Red
Building Demolition	Yellow	Green	Yellow	Red	Red
Building Construction Impacts	Yellow	Green	Yellow	Red	Red
Satisfies LoS Space Guidelines	Red	Yellow	Red	Green	Green
Satisfies LoS Maximum Waiting Time Guidelines (conomy)	Red	Yellow	Yellow	Green	Green
Satisfies LoS Maximum Waiting Time Guidelines (Business/First Class)	Red	Yellow	Yellow	Green	Green
Impacts Ticket Lobby	Yellow	Green	Yellow	Red	Red

Notes:

A. Red = Unfavorable, Yellow = Neutral, Green = Favorable

B. Abbreviation

LoS = Level of Service

Source: AECOM

Alternative 1 proposes no changes to the check-in hall. Although no investment would be needed to maintain the current arrangement of the check-in facilities, it does not address any existing functional problems, and the 12 remote counters will remain disconnected from the BHS; therefore, Alternative 1 was eliminated.

Alternative 2 is focused on technology upgrades rather than architectural alterations to the check-in hall. By adding kiosks and baggage drops, the check-in hall can accommodate the passenger increases through the study period of 2039. It is recommended that UA have 4 premium agent counters and 8 economy agent counters, with 4 premium kiosks and 14 economy kiosks. The recommendations for OAL is to provide 15 premium and 42 economy gate agent counters. Although not required to meet passenger demands for the study period, common-use check-in kiosks for the OAL would also help reduce space demands of the check-in hall. This alternative would group all needed counters along the rear wall of the check-in hall and eliminates the queuing circulation conflicts that exist currently at the 12 remote agent counters.

Similar to Alternative 2, Alternative 3 focuses on technology upgrades and the addition of more check-in counters perpendicular to the existing check-in counters. While this alternative satisfies the forecasted passenger increase through the planning period, the passenger queuing area between the proposed check-in counters and the existing check-in counters may cause congestion. Additionally, between Alternatives 2 and 3, Alternative 2 would be the more cost-effective solution since there are no new counters proposed and Alternative 2 would not have any queueing issues.

Alternatives 4 and 5 both propose expansion to the check-in hall frontage. These alternatives study moving the existing façade to incorporate underutilized exterior spaces as part of the interior check-in hall. The major benefit of relocating the façade is to provide additional passenger circulation within the check-in hall. The current architecture is highly restrictive in terms of passenger flow and sightlines; passengers within the west check-in are not able to visually verify the location of the next step in the airport process, the SSCP, and must rely on signage; these deficiencies can be anxiety-inducing for passengers who are not able to easily read n glish signage and make for a poor user experience. Providing direct sightlines to subsequent steps in the airport process minimizes reliance on signage and improves the overall flow of the commercial passenger terminal.

Both Alternatives 4 and 5 propose additional elements such as new counters and a new baggage belt in the middle of the check-in hall (Alternative 4) and two check-in islands, one on the west and one on the east, between the entrances and the existing check-in counters (Alternative 5). While these alternatives both provide good long-term improvements to the check-in hall, it was determined that **Alternative 2**, as well as the expanded frontage portions proposed in **Alternatives**   and , are the preferred alternatives for check-in facilities.

5.3.1.2 Security Screening Checkpoint

This set of alternatives addresses issues at the SSCP. The queuing space is insufficient to meet TSA requirements and though the total number of SSCP lanes (7) is adequate for the planning period, the length of the existing SSCP lanes is less than the length required by TSA for the shortest Checkpoint Property Screening System (CPSS) base-size. The existing SSCP will require reconfiguration and/or expansion to meet TSA requirements. For this study, TSA's Automated Screening Lanes (ASL) were used to ensure maximum flexibility at the SSCP. See **Figure   -29** and **able   -2** for more details and see **Figure   -21** for the SSCP alternatives.

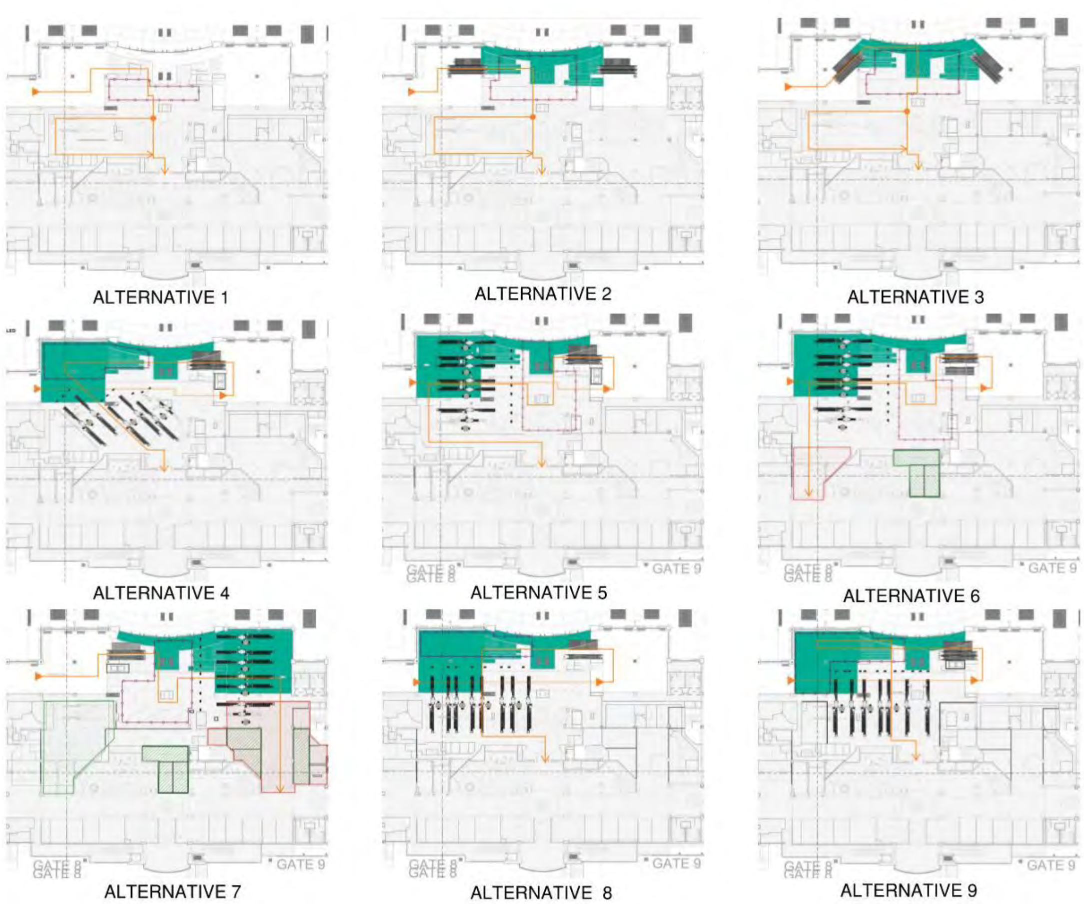

Figure 5-21. Security Screening Checkpoint Alternatives

Source: AECOM

Round 1 alternatives for the SSCP included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Expand Queuing A :** xp and the queuing area by shifting the stairs and escalators from the ticketing lobby below.

- **Alternative 3 – Expand Queuing B :** xp and the queuing area by angling the stairs and escalators from the ticketing lobby below.
- **Alternative   – Expand SSCP – Angled:** Infill a portion of the concourse level to add queuing area and reconfigure the SSCP lanes on an angle to fit the required length.
- **Alternative   – Expand SSCP – East to West A :** Infill a portion of the Concourse Level west of the queueing area and remove the west set of escalators and stairs from the ticketing hall below. Passengers would move from the queuing area on the east through the SSCP lanes located on the west.
- **Alternative 6 – Expand SSCP – East to West B :** Infill a portion of the Concourse Level west of the queueing area, remove the west set of escalators and stairs from the ticketing hall below, and remove a portion of the concessions for passengers to head straight down to the circulation area. Passengers would move from the queuing area on the east through the SSCP lanes located on the west.
- **Alternative   – Expand SSCP – East to West C :** Infill a portion of the Concourse Level east of the queueing area, remove the west set of escalators and stairs from the ticketing hall below, and remove a portion of the concessions for passengers to head straight down to the concourse area. Passengers would move from the queuing area on the west through the SSCP lanes located on the east.
- **Alternative   – Expand SSCP – North to South A :** Infill a portion of the Concourse Level west of the queueing area and remove the west set of escalators and stairs from the ticketing hall below. The queuing area would be located north of the SSCP lanes, and passengers would move from the north to the south through the inspection lanes.
- **Alternative 9 – Expand SSCP – North to South B :** Infill a portion of the Concourse Level west of the queueing area, utilize a larger queueing area adjacent to the SSCP lanes, and remove the west set of escalators and stairs from the ticketing hall below. The queuing area would be located north of the SSCP lanes, and passengers would move from the north to the south through the inspection lanes.

See **able -13** for the SSCP alternatives evaluation matrix.

able -13 SSCP Alternatives Matrix

Criteria	Alt 1	Alt 2	Alt 3	Alt	Alt	Alt 6	Alt	Alt	Alt 9
Impacts of Check-In Hall	Yellow	Yellow	Yellow	Red	Red	Red	Yellow	Red	Red
Pax Moving Complexity – Check-In	Yellow	Green	Green	Red	Red	Red	Green	Red	Red
Pax Moving Complexity – Concourse	Yellow	Yellow	Yellow	Yellow	Yellow	Green	Green	Yellow	Yellow
Pax Length of Travel	Yellow	Green	Green	Green	Yellow	Yellow	Green	Red	Green
Need for Added Vertical Capacity	Yellow	Green	Green	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow
ase of Restroom Access	Yellow	Yellow	Yellow	Red	Red	Red	Green	Red	Red
Impacts of Concessions	Yellow	Yellow	Yellow	Yellow	Yellow	Red	Red	Yellow	Yellow
Meets LoS for TSA Guidelines - Queue	Red	Green	Green	Red	Green	Green	Green	Green	Green
Meets LoS for TSA Guidelines – Post Screening	Red	Red	Red	Red	Green	Green	Green	Red	Red
Cost Impacts	Yellow	Yellow	Yellow	Yellow	Yellow	Red	Red	Yellow	Yellow
Investment Impact	Yellow	Red	Red	Red	Green	Green	Green	Yellow	Yellow
Implementation and Duration	Yellow	Yellow	Yellow	Red	Red	Red	Yellow	Red	Red

Notes:
- *A. Red = Unfavorable, Yellow = Neutral, Green = Favorable*
- *B. Abbreviations*
  - *Pax = Passenger*
  - *LoS = Level of Service*
  - *TSA = Transportation Security Administration*

Source: AECOM

Alternative 1, which maintains the current conditions of the SSCP, is the most economical solution; however, this alternative does not address the lack of queuing space and recommended clearances for modern checkpoints.

Alternatives 2 and 3 are short-term improvements and seek to alleviate the constrained queuing by altering the VC s and expanding the existing floor plate to the existing façade. These alterations create enough additional floor space to achieve the TSA's recommended 600 square feet (SF) per screen lane, or 4,200 SF for the seven existing lanes. One downside to this solution is that the existing arrangement of the screening lanes cannot be altered to meet TSA's new SSCP length recommendations. Alternative 3 was seen as a more attractive short-term improvement for the Airport.

Alternatives 4 and 5 expand the floor to the existing façade on the Concourse Level to the west side to meet the required TSA queueing area. While these alternatives maintain the existing concessions, the downside of these alternatives is that passengers have to travel farther on the apron level to get to the VC s and then backtrack to the queue before entering the CPSS. Additionally, Alternative 4 would be difficult to implement, as angling the CPSSs where the existing screening systems may be too difficult. While Alternative 5 does not cause the need to relocate any concessions, this alternative causes the longest path for passengers post check-in at almost 600 feet traveled.

Similarly to Alternative 5, Alternative 6 expands the floor to the façade on the west side and rotates the SSCP orientation to east-west; however, this alternative forces passengers to double back and enter the TSA queuing area from the east and relocates more than 3,000 SF of concessions.

Alternative 7 is the only alternative, excluding Alternatives 1, 2, and 3, that does not force passengers to back track and enter the TSA queueing area from the east side. Additionally, this alternative provides the most available queueing space of the nine alternatives. Though this alternative requires the eastern portion of the queueing area to be expanded and the relocation of concessions, this alternative satisfies TSA guidelines for queueing and post-screening, and a modified version of this alternative was preferred as a long-term investment.

Alternatives 8 and 9 provide adequate queuing area but do not meet the post-screening requirement, force passengers to back track, and may be difficult to implement because the proposed CPSS layout would be in the same location as the existing screening systems. These alternatives were not recommended to move forward as long-term improvements.

Therefore, **Alternative 3** was identified as the preferred short-term improvement alternative, while **Alternative** was identified as the preferred long-term improvement alternative.

With the current adoption of more advanced technology such as the new Computed Tomography (CT) machines and ASLs, TSA's space demands have increased significantly in the past two decades. Traditional screening lanes typically require a length of 65 feet, while the recommendation for new ASL lanes is more than 75 feet. The current arrangement at the Airport is just over 48 feet, well below TSA recommendation for generic lanes. **Alternative** would allow the Airport to accommodate the new ASLs by constructing a new floor over the ticketing lobby that experiences minimal passenger travel. When the new floor plate is combined with relocating existing rooms adjacent to the SSCP, enough space is generated to accommodate full-length ASL lanes including the recommended passenger queuing.

5.3.1.3 o ldrooms

This set of alternatives addresses the limited holdroom space. xi sting holdrooms do not have the capacity to accommodate the required seating or queuing areas and therefore passengers overflow into the circulation corridor along the concourse. See **Figure -32** and **Figure -33** and **able -31** for more details and **Figure -22** for the holdrooms alternatives.

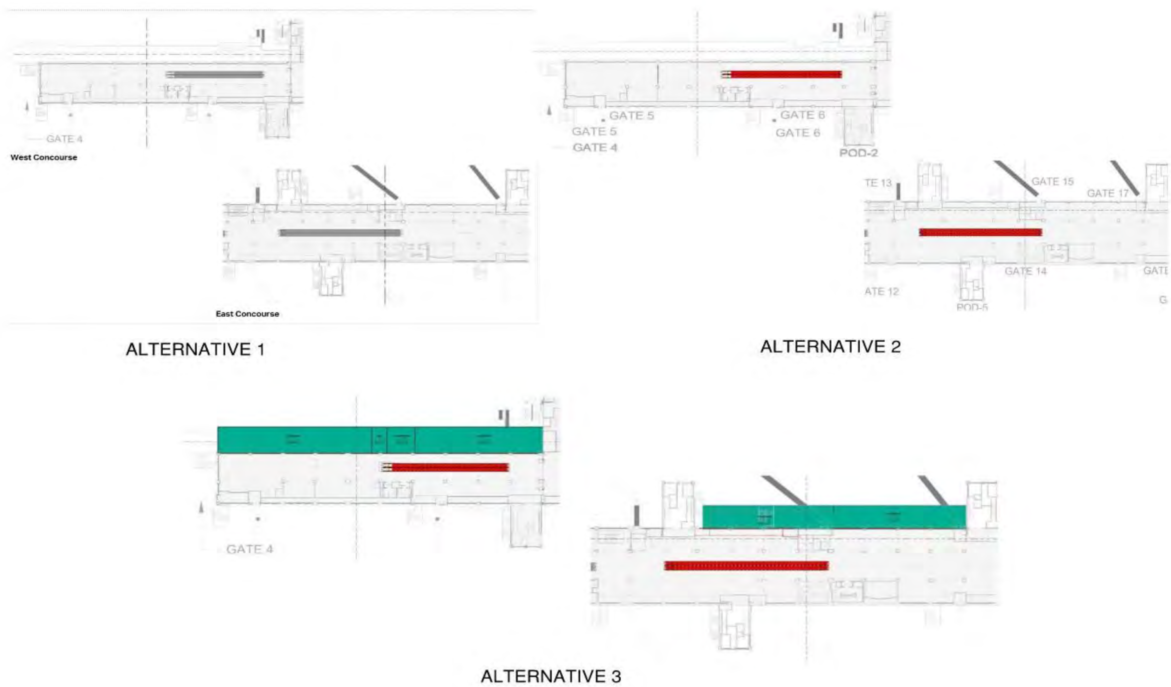

Figure 5-22. Holdrooms Alternatives

Source: AECOM

Round 1 alternatives for Holdrooms included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Remove Moving Walkways East and West:** Remove two existing walkways allowing for a more flexible area within the existing concourse footprint.
- **Alternative 3 – Remove Moving Walkways and Expand Concourses:** Remove two existing walkways and build-out the commercial passenger terminal to the north.

See **able -1** for the holdrooms alternatives evaluation matrix.

able -1 oldrooms Alternatives Matrix

Criteria	Alternative 1	Alternative 2	Alternative 3
Operational fficiency	Red	Green	Green
Cost Impacts	Yellow	Yellow	Red
ase of Implementation	Yellow	Green	Yellow
Building Demolition	Yellow	Yellow	Yellow
Building Construction Impacts	Yellow	Green	Red
Satisfies Holdroom Space Guidelines	Red	Green	Green
Potential Impacts to Loading Dock	Yellow	Green	Red

Note: Red = Unfavorable, Yellow = Neutral, Green = Favorable
Source: AECOM

Currently the most significant issue within the concourse is lack of holdroom space. Alternative 1 does not change existing conditions, and does not provide any solutions to the lack of holdroom area.

l iminating two moving walkways in Alternative 2 will not significantly impact the total travel time from the SSCP to the furthest gates and should not greatly affect passenger experience. The elimination of the moving walkways on each side frees up a significant amount of floor space to accommodate holdroom overflow.

Alternative 3 explores the most significant changes to the commercial passenger terminal by introducing substantial areas of expansion. On the west side of the concourse, a 40-foot-wide expansion is proposed over the existing delivery road. This addition provides the west concourse with over 15,000 SF of additional space that can accommodate holdroom overflow, concession space, restrooms, and supporting utility space. When the expansion is combined with the removal of moving walks, this gives the west concourse ample flexibility and space to accommodate holdroom overflow.

The east concourse is double-loaded and highly constrained in terms of area where additional space can be created. The only viable place where expansion can happen is between Pods 7 and 8. The commercial passenger terminal can be expanded 32 feet into the Airport Operations Area (AOA), creating approximately 10,000 SF, which would be split between holdrooms, the sterile corridor, and passenger boarding bridge (PBB) vestibules. This alternative would also include removing the moving walks in the main concourse, allowing passengers the option of sitting in nearby holdrooms when one becomes full without being impeded by a long physical barrier, such as moving walks.

Therefore, both **Alternatives 2** and **3** moved forward in the alternatives evaluation process where **Alternative 2** is seen as more of a short-term solution while **Alternative 3** is seen as more of a long-term solution.

5.3.1.4 Restrooms

This set of alternatives addresses the lack of public restrooms available for arriving passengers between the sterile corridor and the immigration processing hall. The immigration hall contains one restroom located in the southeast corner of the space where it is not visible to many passengers upon entering. See **able -33 thru able -36** for more details and **Figure -23** for the restrooms alternatives.

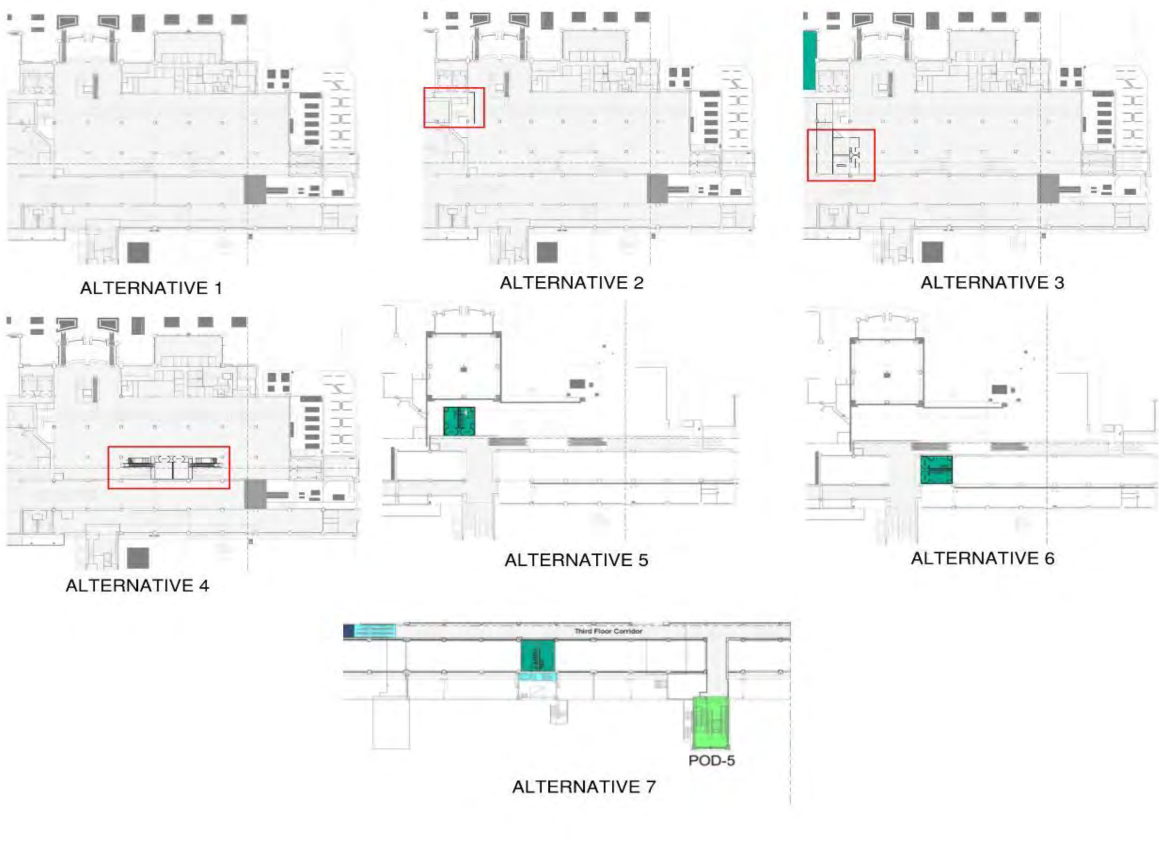

Figure 5-23. Restroom Alternatives

Source: AECOM

Round 1 alternatives for Restrooms included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Immigration Restroom A :** Provide access to the existing restroom in the arrivals hall by constructing a short corridor which will eliminate an inspection podium (2 staff positions) and modify the security access on the door that currently provides access to the restrooms from an adjacent area.
- **Alternative 3 – Immigration Restroom B :** Provide a new restroom in the southwest corner of the screening area. Modifications to the existing SSCP will be required to allow this alternative.
- **Alternative   – Central Restroom:** Locate new restrooms under the current entry stair from the sterile corridor which is located one level above the screening area and reconfigure the existing stairways and escalators to place the restrooms in this location.
- **Alternative   – Sterile Corridor:** Locate a restroom on the roof adjacent to the sterile corridor that serves the West Concourse gates just prior to entering the screening area.
- **Alternative 6 – Restroom Over Concourse:** Locate a restroom serving the West Concourse gates over the existing a st Concourse along the sterile corridor.
- **Alternative   –   igh Arrivals Sterile Corridor:** Locate a restroom serving the a st Concourse gates over the existing a st Concourse along the sterile corridor.

See   **able   -1**   for the restrooms alternatives evaluation matrix.

able -1 Restrooms Alternatives Matrix

Criteria	Alt 1	Alt 2	Alt 3	Alt	Alt	Alt 6	Alt
Operational fficiency	Yellow	Red	Green	Green	Yellow	Yellow	Yellow
Cost Impacts	Yellow	Green	Red	Red	Yellow	Yellow	Yellow
ase of Implementation	Yellow	Green	Red	Red	Yellow	Red	Red
Building Demolition	Yellow	Green	Yellow	Red	Red	Red	Red
Building Construction Impacts	Yellow	Green	Yellow	Red	Red	Red	Red
Walking Distance	Yellow	Red	Yellow	Yellow	Green	Green	Green
Availability	Yellow	Yellow	Green	Yellow	Yellow	Yellow	Yellow
Pax xperience	Red	Red	Green	Yellow	Yellow	Yellow	Yellow

Notes:
A. Red = Unfavorable, Yellow = Neutral, Green = Favorable
B. Abbreviation
Pax = Passenger
Source: AECOM

Alternative 1 does not add passenger restrooms, address any visibility issues for passengers when they are within immigration, or improve restroom access for passengers passing through the sterile corridor.

Alternatives 2 and 3 utilize the restroom near the SSCP to provide additional restroom access to passengers entering the immigration hall. To achieve this concept, one processing podium needs to be removed to add the proposed corridor to the existing restrooms. To ensure passengers do not bypass processing, controlled egress doors will need to be installed between the entrance to the restrooms and the SSCP.

To provide more centralized restroom access to the passengers, Alternative 4 adds a pair of restrooms under the main landing after the VC s down from the sterile corridors. Although this alternative would provide passengers with easier restroom access, the cost and logistics to implement it is prohibitive. Accomplishing this alternative requires the reconstruction of four stairways and eight escalators. Taking these elements offline for their reconstruction make this alternative operationally difficult to implement, and thus was eliminated from future consideration.

Alternatives 5 through 7 each add one restroom within the sterile corridor prior to entering the immigration hall. Alternatives 5 and 6 implement a restroom near the VC s in the POD-4 hall, as Alternative 5 is built on what is currently the roof over the main concourse and Alternative 6 is constructed over the existing ast Concourse level circulation area. Similarly to Alternative 6, Alternative 7 is also proposed to be built over the ast Concourse level circulation area, but more toward POD-5. Of the three alternatives, Alternative 6 was the only one eliminated, as Alternative 7 was seen as the more ideal location, and Alternative 5 can be built on the existing roof, which would minimize disruption to the main passenger concourse.

Alternatives 2, , and were selected to be pursued further in Round 2.

5.3.1.5 Customs and Border Protection Outbound Visa Inspection

This set of alternatives addresses the visa inspection issues for outbound passengers flying to the U.S. mainland/Honolulu. Holdroom areas for Gate 7 and Gate 9 on the West Concourse are currently used for visa inspection by CBP for all domestic flights to the U.S. mainland through Honolulu. During this operation, temporary partitions are erected at Gate 7 which prevents the Airport from using Gates 4 through 6. The Airport desires the CBP inspection function to be relocated to reduce the impact on their gate management practice. See **Section 3 6 2** for more details and **Figure -2** for the CBP outbound visa inspection alternatives.

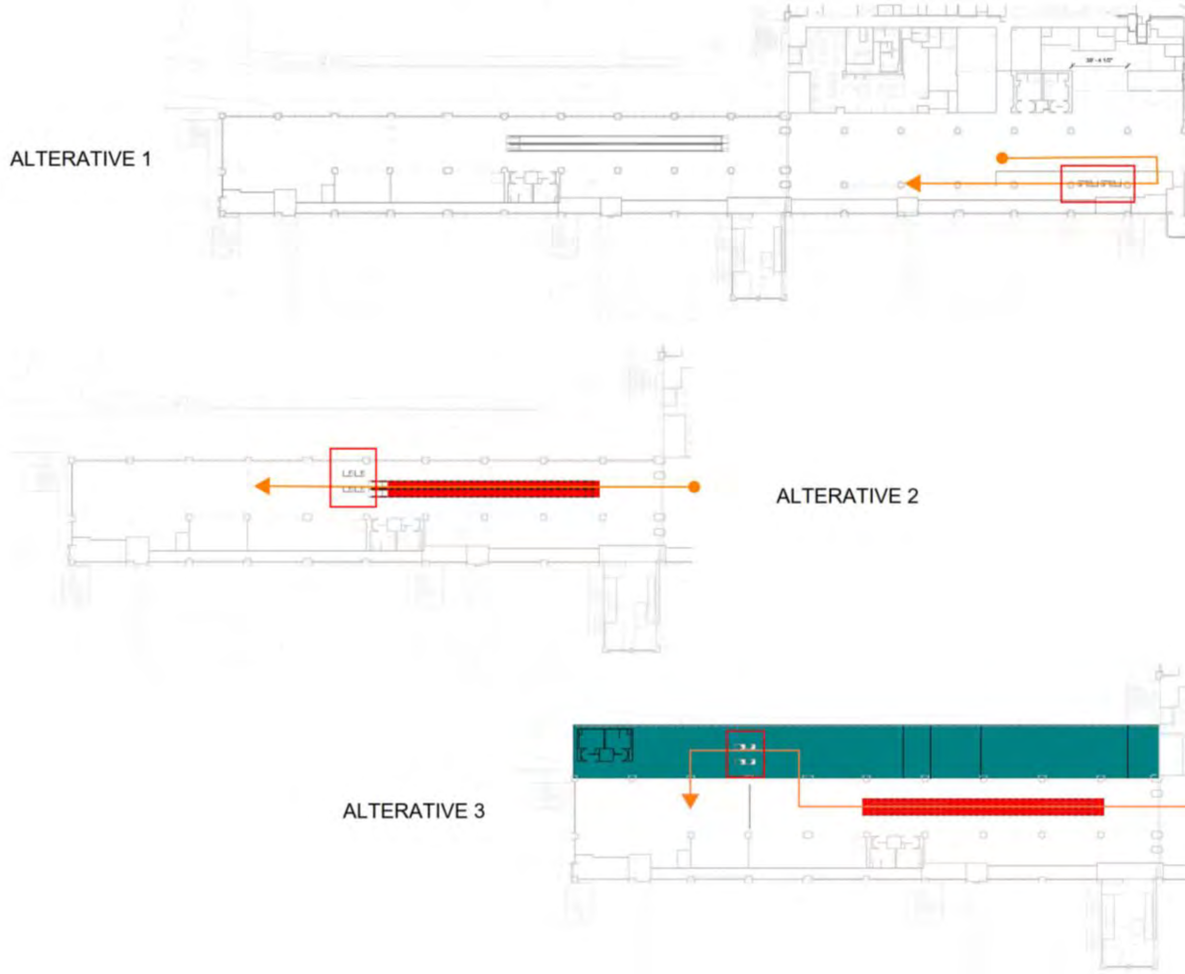

Figure 5-24. Customs and Border Protection Alternatives

Source: AECOM

Round 1 alternatives for the CBP Outbound Visa Inspection included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Shift to Gates and **: Remove the moving walkway in the West Concourse area and relocate the CBP inspection area from the holdroom areas for Gates 7 and 9 to an area past the removed moving walkway. The CBP inspection area would then serve Gates 4 and 5 at the end of the West Concourse.
- **Alternative 3 – Shift to Gates and and West Concourse Expansion:** Remove the moving walkway in the West Concourse area, build-out the West Concourse to the north, and relocate the CBP inspection area from the holdroom areas for Gates 7 and 9 to the proposed expansion area of the West Concourse. The CBP inspection area would then serve Gates 4 and 5 at the end of the West Concourse.

See **able -16** for the CBP Outbound Visa Inspection alternatives evaluation matrix.

able -16 Customs and Border Protection Outbound Visa Inspection Alternatives Matrix

Criteria	Alternative 1	Alternative 2	Alternative 3
Operational fficiency	Yellow	Green	Green
Cost Impacts	Yellow	Yellow	Red
ase of Implementation	Yellow	Green	Green
Walking Distance	Yellow	Red	Red
Concourse Availability	Red	Green	Green

Note: Red = Unfavorable, Yellow = Neutral, Green = Favorable
Source: AECOM

Alternative 2 was determined to be the preferred alternative because the Airport will not need to close off the entire West Concourse area during passenger holding, queueing, and CBP inspection, which is currently the No Action alternative (Alternative 1). Additionally, if the Airport decides to build-out the West Concourse (Holdroom Alternative 3), the expansion will provide additional room to implement the CBP **Alternative 3** in the long-term.

5.3.1.6 Summary of Round 1 Commercial Passenger erminal Alternatives

The alternatives advanced to Round 2 were based on their rating, client feedback, and in some cases, a short- and long-term alternative were preferred. **able -1** depicts the highest ranked alternatives that were advanced and further refined and developed into the second round of commercial passenger terminal alternatives.

able -1 Round 1 ighest Ranked Commercial Passenger erminal Alternatives

Alternative Focus Area	ighest Ranked Short- erm Improvement Alternative	ighest Ranked ong- erm Improvement Alternative
Check-in Facilities	2	2 and 4/5[A]
SSCP	3	7
Holdrooms	2	3
Restrooms	2	3/5/7[B]
CBP Outbound Visa Inspection	2	3

Notes:

A. *Alternative 2 was selected as the preferred short-term and long-term alternative. While portions of Alternatives 4 and 5 for the check-in facilities alternatives did not seem to be viable long-term improvements, the expanded commercial passenger terminal frontage proposed in those alternatives was preferred.*
B. *Alternatives 3, 5, and 7 were all deemed long-term improvements for the restroom alternatives.*
C. *Abbreviations*
CBP = Customs and Border Protection
SSCP = Security Screening Checkpoint

Source: AECOM

5.3.2 Round 2 Commercial Passenger erminal Alternatives

Three commercial passenger terminal alternatives were developed and analyzed in Round 2. As noted above, these alternatives were separated into short-term and long-term improvements. However, for the purposes of this Master Plan Update, only one of these alternatives was selected as the preferred commercial passenger terminal alternative.

The three Round 2 commercial passenger terminal alternatives were:

- Alternative 1 – No Action
- Alternative 2 – Short-Term Improvements
- Alternative 3 – Future Proofing

See **Figure -2** through **Figure -2** for the three Round 2 alternatives.

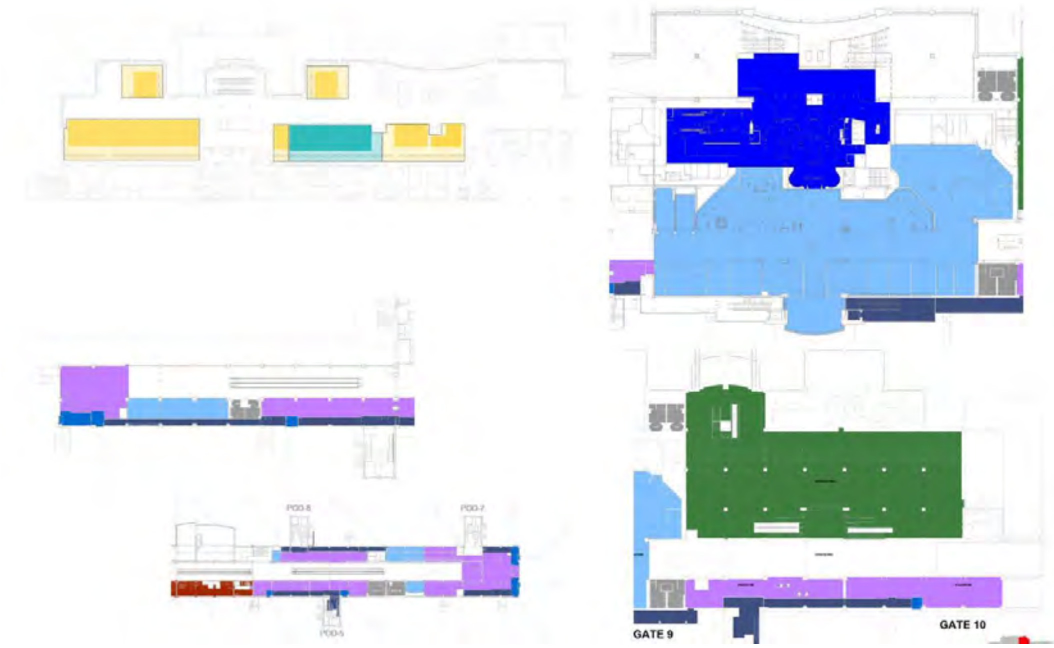

Figure 5-25. Alternative 1 – No Action

Source: AECOM

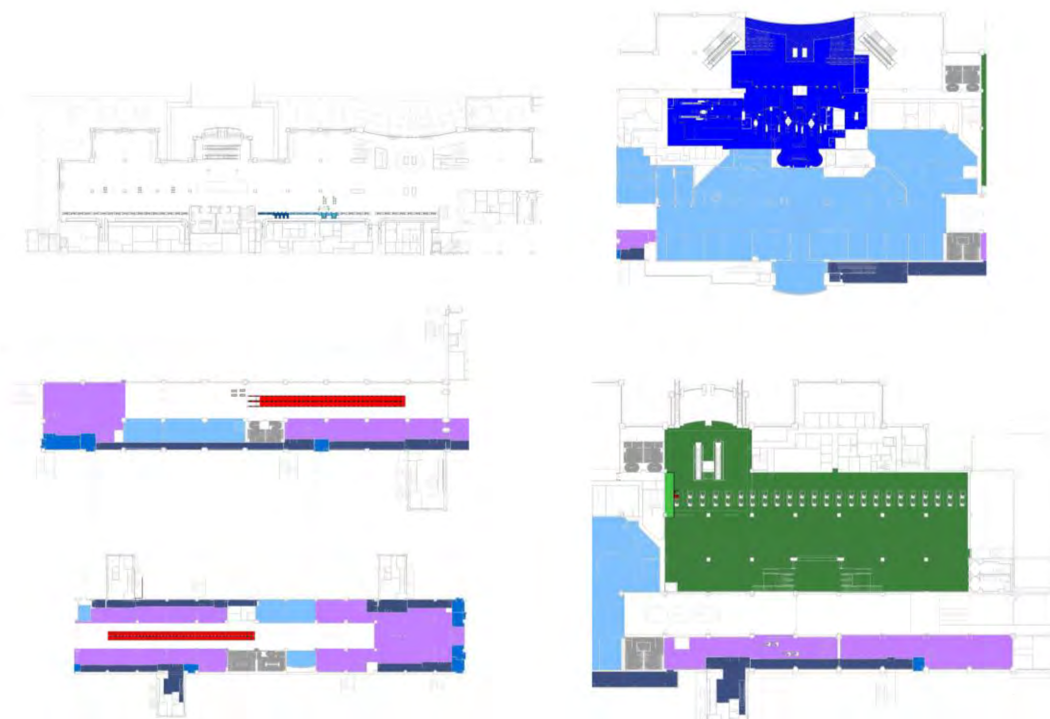

Figure 5-26. Alternative 2 – Short-Term Improvements

Source: AECOM

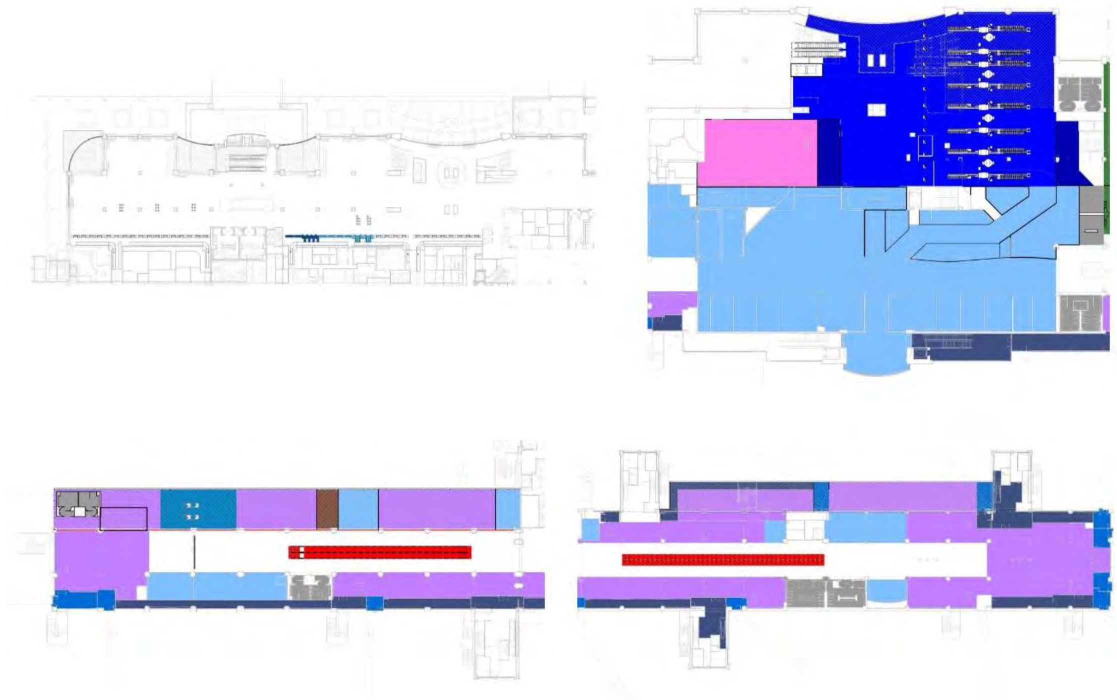

Figure 5-27. Alternative 3 – Future Proofing (1 of 2)

Source: AECOM

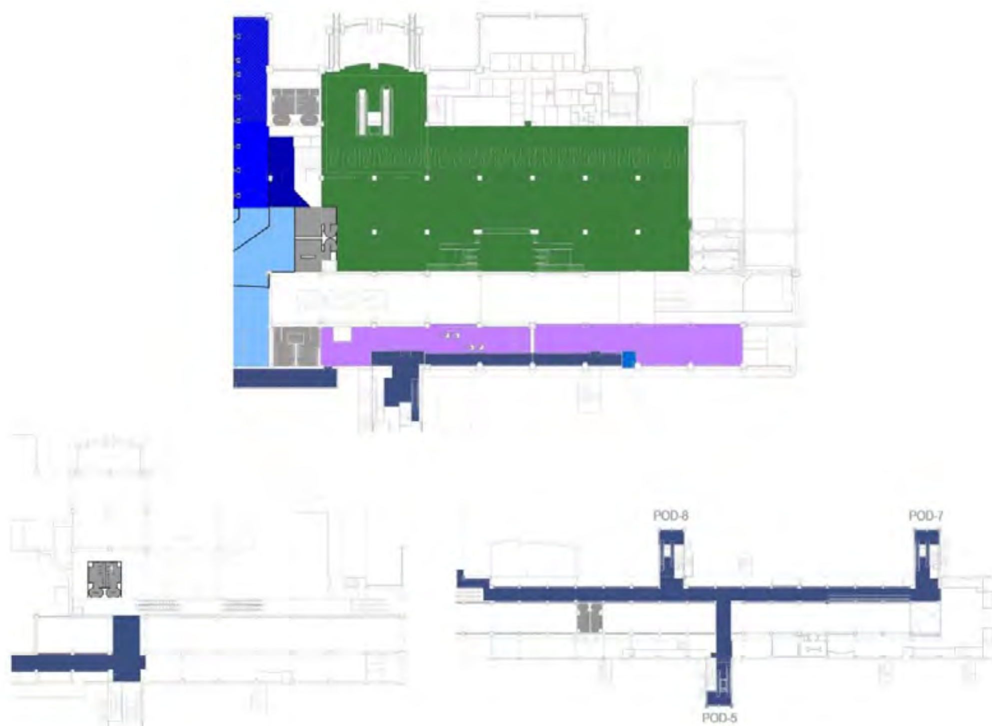

Figure 5-28. Alternative 3 – Future Proofing (2 of 2)

Source: AECOM

Highlights of the Round 2 Commercial Passenger Terminal Alternatives include:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Short- erm Improvements**: Remove the 12 ticketing check-in counters next to the Airport entrances, add CUSS kiosks with bag drop-off points at some of the existing check-in positions to allow for direct connection into the BHS, expand the SSCP queuing area by angling the VC s from the ticketing lobby below, remove the two existing walkways in the a st and West Concourse areas to allow for more flexible area within the existing concourse footprint, provide access to the existing restroom in the arrivals hall by constructing a short corridor, remove one CBP inspection position, modify the security access on the door that currently provides access to the restrooms from an adjacent area, and relocate the CBP inspection areas to the West Concourse near Gates 4 and 5.
- **Alternative 3 – Future Proofing:** Remove the 12 ticketing check-in counters next to the Airport entrances, add CUSS kiosks with bag drop-off points at some of the existing check-in positions to allow for direct connection into the BHS, expand the commercial passenger terminal frontage in front of the check-in hall, infill a portion of the concourse level east of the SSCP queueing area, remove the west set of escalators and stairs from the ticketing hall below, remove a portion of the concessions for passengers to head straight down to the concourse area after passing through the CPSS, remove the two existing walkways and build-out the commercial passenger terminal to the north within the a st and West Concourses, provide a new restroom in the back west corner of the CBP screening area, locate a restroom on the roof adjacent to the sterile corridor that serves the West Concourse gates just prior to entering the screening area, locate a restroom serving the a st Concourse gates over the existing a st Concourse along the sterile corridor, and shift the CBP inspection area out of the holdroom areas to the proposed expansion area of the West Concourse near Gates 4 and 5.

able -1 portrays the Round 2 alternatives evaluation matrix.

able -1 Round 2 Commercial Passenger erminal Alternatives Matrix

Criteria	Weighting	Alternative 1	Alternative 2	Alternative 3
Operational fficiency	10%	🔴	🟢	🟢
Cost Impacts	15%	🟡	🟢	🔴
ase of Implementation	10%	🟡	🟢	🔴
Building Construction Impacts	10%	🟡	🟢	🔴
Satisfies LoS Maximum Waiting Time Guidelines (conomy)	2.5%	🔴	🟢	🟢
Satisfies LoS Maximum Waiting Time Guidelines (Business/First Class)	2.5%	🔴	🟢	🟢
Impacts Ticket Lobby	5%	🟡	🟢	🔴
Pax Movement Complexity (Check-in)	4%	🔴	🟡	🟢
Meets LoS for TSA Guidelines (Queue)	4%	🔴	🟡	🟢
Meets LoS for TSA Guidelines (Post Screening)	4%	🔴	🔴	🟢
Impacts on Concessions	5%	🟡	🟢	🟡
Investment Impact	5%	🔴	🟡	🟢
Pax Movement Complexity (Concourse)	4%	🟡	🟡	🟡

Criteria	Weighting	Alternative 1	Alternative 2	Alternative 3
Restroom Access	5%	Red	Yellow	Green
Overall Walking Distance	4%	Yellow	Yellow	Yellow
Pax xperience	10%	Red	Yellow	Green
otal	**1 %**	**3**	**1 1**	**1**

Notes:
A. Red = Unfavorable, Yellow = Neutral, Green = Favorable
B. Abbreviations
LoS = Level of Service
Pax = Passenger
TSA = Transportation Security Administration
Source: AECOM

5.3.2.1 Cost Estimates

ROM cost estimates were developed for the three Round 2 commercial passenger terminal alternatives. l ements such as site preparation, site demolition, new equipment, floors and roof structures, plumbing, electrical, and other utilities were all evaluated in these estimates. st imates were prepared in 2023 dollars, and a location factor of 2.6 was used compared to the U.S. national average. The total construction costs do not include escalation. See **able -19** for a summary of the Round 2 commercial passenger terminal alternatives cost estimates.

able -19 Round 2 Commercial Passenger erminal Alternatives Cost Estimates

Commercial Passenger erminal Alternative	Estimated otal Cost
Alternative 1 – No Action	$0
Alternative 2 – Short-Term Improvements	$17,210,000
Alternative 3 – Future Proofing	$97,810,000

Source: AECOM

5.3.3 Round 3 Preferred Commercial Passenger erminal Alternative

Alternative 2 – Short- erm Improvements was chosen as the preferred commercial passenger terminal alternative. This alternative satisfies the estimated requirements for the UA check-in positions for the planning horizon of this Master Plan Update while improving the check-in hall with updated technology and removing isolated check-in counters that do not have access to the BHS. While this alternative does not satisfy the TSA post-screening LoS, this alternative addresses TSA's required area for passenger queuing. By building out a portion of the concourse floor and angling the VC s, this alternative looks to minimize or eliminate the existing issues with passenger queues extending down to the Apron Level. Additionally, this alternative eliminates the moving walkways within the concourse, allowing for a more flexible, wider area to meet holdroom space requirements and allows the CBP inspection booths to be relocated to the Gate 4/5 area. Finally, though one inspection position within the arrivals hall will need to be removed, this alternative provides access to the existing restroom adjacent to the SSCP area by constructing a small corridor. The security access on the door that currently provides access to the restrooms from the SSCP area would be modified. **Figure -29** shows the preferred commercial passenger terminal alternative, which will be utilized in the Airport Development Plan.

The terminal alternatives are a unique case, and the selected preferred alternative does not preclude further development and implementation of concepts presented in Alternative 3. In many cases, work completed as part of Alternative 2 – Short-Term Improvements, can be viewed as a first step in implementing Alternative 3 – Future Proofing.

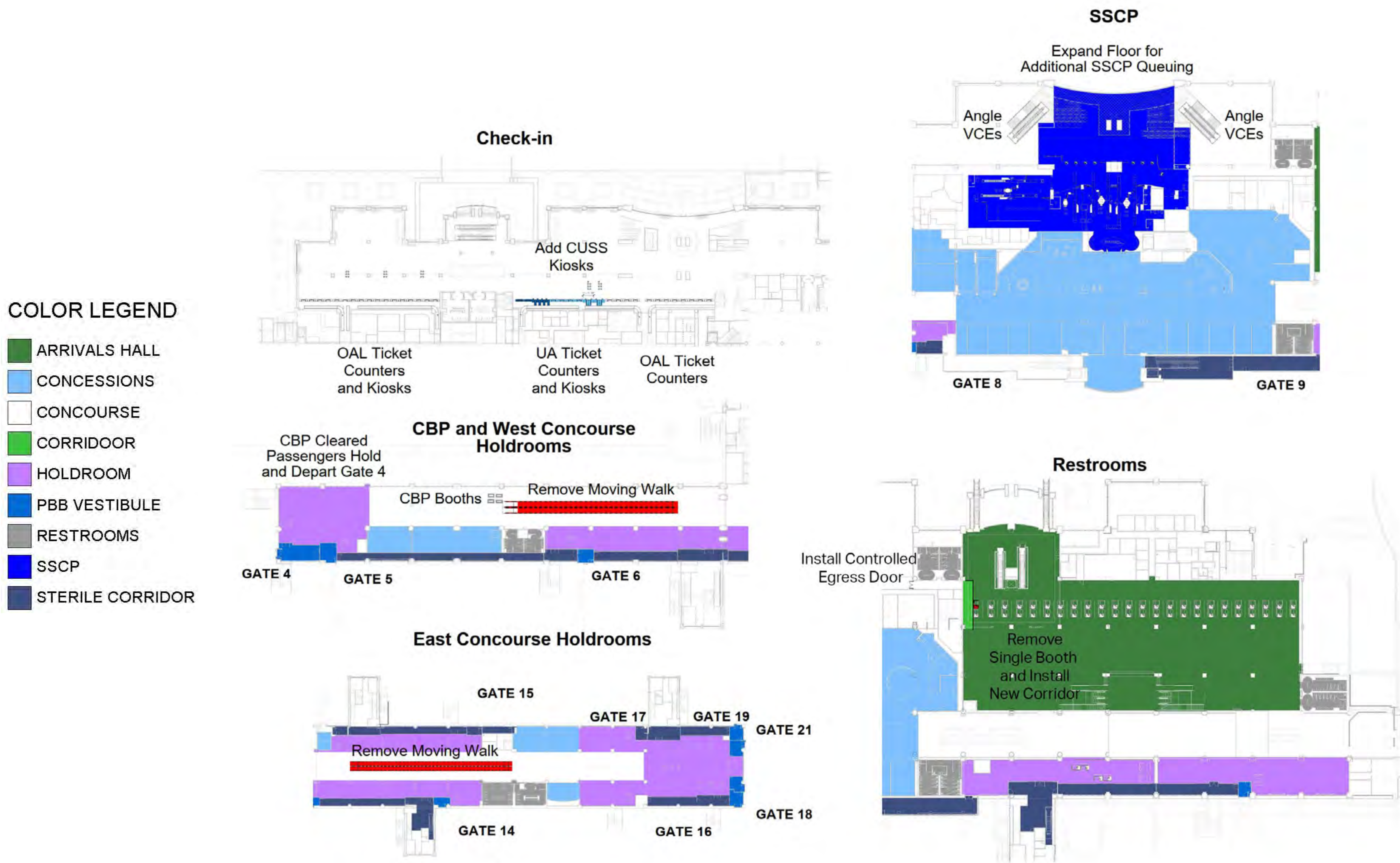

Figure 5-29. Alternative 2 - Preferred Commercial Passenger Terminal Alternative

Source: AECOM

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5.4 andside Facilities

As shown in **Figure -2** , the landside alternatives process incorporated the preferred Airport Parking Plan, developed by the Airport, prior to the Master Plan Update, based on the proposed Route 10A widening and construction of Tiyan Parkway near the Airport entrance and exit roads. As noted in **Chapter :** *Facility Requirements*, the existing landside vehicle circulation and facilities were deemed adequate; however, short-term improvements were recommended based on vehicle counts and movements at the existing Airport entrance and exit intersections. These improvements could be implemented before the widening of Route 10A and/or as part of the construction of Phase II of Tiyan Parkway.

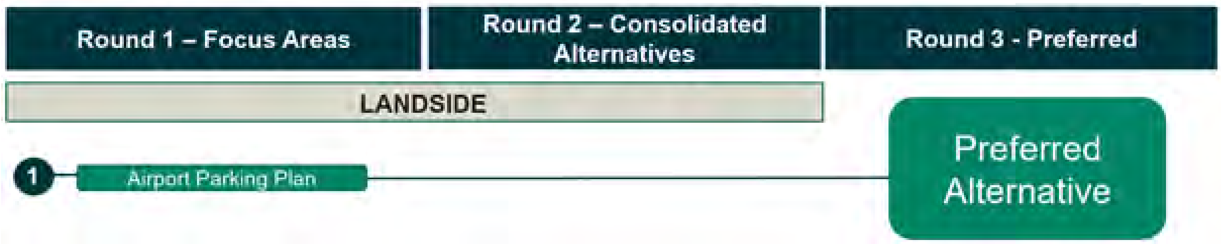

Figure 5-30. Landside Facilities and Ground Access Alternatives Development

Source: AECOM

5.4.1 Route 1 A Widening and iyan Parkway Construction

The future Route 10A reconstruction and widening is a two-phased project approved by the Guam Department of Public Works Division of Highways. The project will widen Route 10A to five lanes, from its intersection with Route 1 to the Airport's entry intersection. Highlights of this project include drainage improvements, pedestrian walkways, bicycle lanes, permanent traffic markers, and other roadway appurtenances. The Route 10A improvements, both short-term and long-term, should provide significant improvement in the traffic flows, reducing congestion and queuing.

The Tiyan Parkway project will also provide a public roadway linking Route 8 and Route 10A with sufficient traffic capacity to meet projected Year 2030 demand in conjunction with other roadway improvements identified in the 2030 Guam Transportation Plan. At the time of this Master Plan Update, Phase I of Tiyan Parkway has been completed; however, the Phase I development does not impact the areas evaluated. The Phase II Tiyan Parkway intersection with Route 10A should shift significant traffic from the Airport's entry road, providing greater capacity at the eastbound Airport entry stop-controlled intersection, as well as providing a better connection for the Tiyan Parkway traffic.

All short-term landside improvements were developed based on the Route 10A reconstruction and widening, as well as the Tiyan Parkway development.

5.4.2 andside Short- erm Improvements

Three short-term improvements were identified that could provide immediate relief of the traffic congestion experienced at the airport intersections while remaining consistent with the longer-term Route 10A widening project.

Short-Term Improvements for the Landside included:

- **Short- erm Improvement 1 – Add Eastbound ane:** Construct a 250-foot eastbound lane, with 100 feet of lane drop-back, east of the Airport entry traffic signal along Route 10A.

  The existing southernmost eastbound lane, which is currently marked as a right turn only towards . Sunset Boulevard, would be re-marked and become both a through lane and right turn lane. Associated changes to rebalance the traffic signal timing would need to be applied. This improvement would help alleviate eastbound Route 10A congestion and queuing, while being consistent with the later Route 10A widening.

- **Short- erm Improvement 2 – Restripe to Provide wo Eastbound anes:** Restripe the northernmost lane heading eastbound on Route 10A before approaching the traffic signal with the Terminal Departure Frontal Road as a through lane.

  Similar to Short-Term Improvement 1, this lane, currently marked for no vehicle traffic, would help alleviate any eastbound Route 10A congestion and queuing, allowing two lanes to travel eastbound and two lanes to travel westbound along Route 10A. This improvement would not impact the Route 10A widening.

- **Short- erm Improvement 3 – Extend Second Eastbound ane:** x tend the southernmost eastbound lane 300 feet, with 100 feet of lane drop-back, after the Terminal Departure Frontal Road.

  At the Airport exit intersection, the eastbound lanes would be restriped and remarked to provide two through lanes with associated traffic signal changes to rebalance the signal timing.

Pending the construction of the Route 10A widening, any of these improvements could be implemented by the Airport. See **Figure -31** for the three recommended landside short-term improvements.

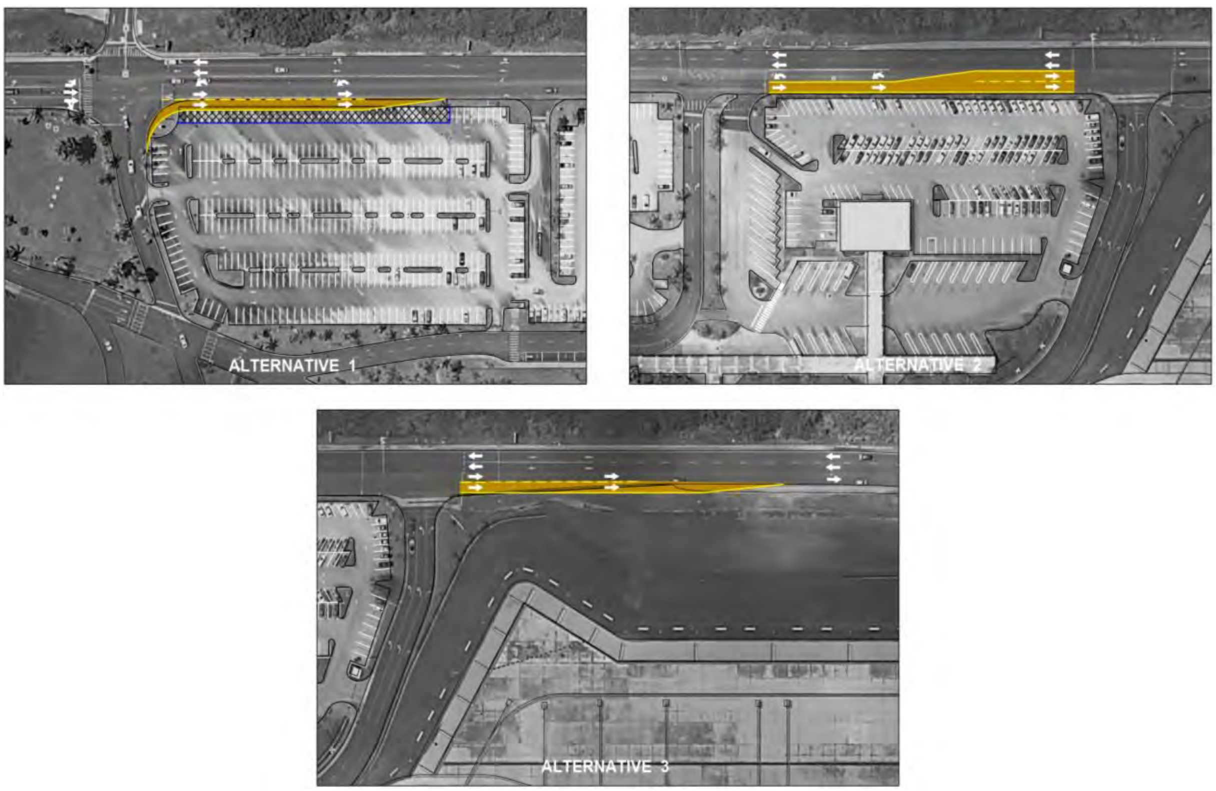

Figure 5-31. Landside Short-Term Improvements

Source: AECOM

5.4.3 Airport Parking Plan

Due to the addition of a fifth lane, the future Route 10A widening project is anticipated to impact the Airport's lower employee, lower public, and rental car parking lots. The widening is expected to remove 138 employee parking spaces, 109 public parking spaces, and 40 rental car parking spaces.

The Airport has developed a parking plan based on the impacts to the existing parking lots (see **Figure -32**). For the employee and public parking lots, though more than 100 spaces will be demolished, pavement on the northern ends of each lot will be restriped to create additional vehicle parking spaces.

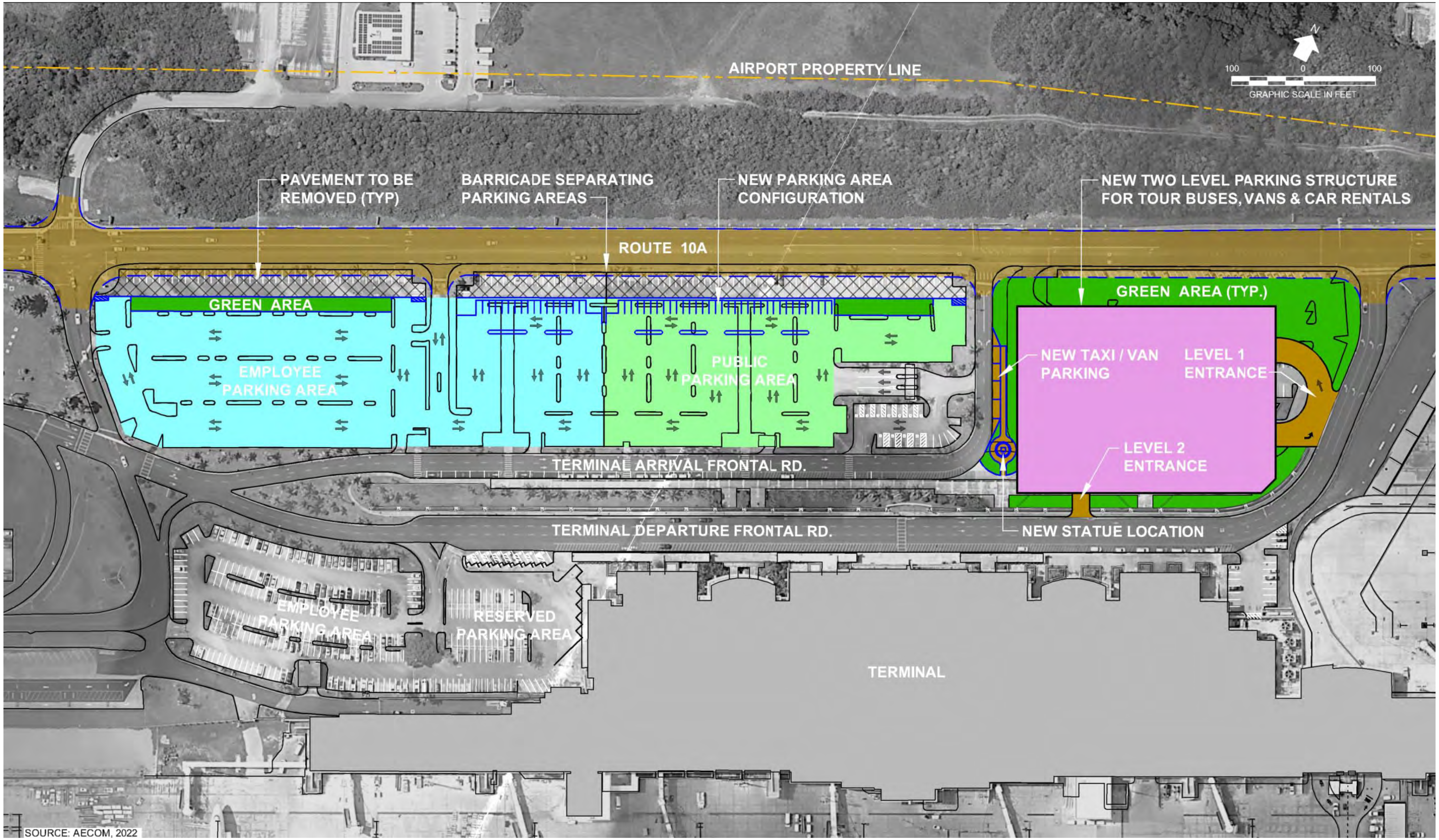

Figure 5-32. Airport Parking Plan

Source: AECOM

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For the rental car and tour bus lot, a two-story parking structure is anticipated in the same area as the existing lot. Level 1 would be utilized for the tour buses, vans, and limousines while Level 2 would be utilized for rental cars. **able -2** breaks out the number of proposed spaces and how they will be allocated in the garage. Approximately 67 parking spaces in the northwest portion of the lower public parking lot will be utilized as a temporary rental car parking lot during construction of the proposed parking garage.

able -2 Proposed Airport Parking Garage

Vehicle ype	evel	Number of Parking Spaces
Tour Bus	1	36
Van	1	30
Off-Airport Rental Van	1	2
Limousine	1	2
Rental Car	2	277
Van/Taxi	Outside Adjacent to Structure	4

Source: E&A Engineers

Upon further analysis of the parking garage, it is anticipated that the structure will provide enough spaces that efficient operations will be possible, without off-site bus/van staging. While this traffic flow will increase the amount of traffic on the departures road, the resulting projected volumes will still be well within capacity.

5.4.3.1 Cost Estimates

An ROM cost estimate was completed for the Airport parking plan developed based on the Route 10A widening. Sitework such as new pavement, pavement demolition, new markings, landscaping, and the two-story parking structure were all evaluated in this estimate. The total cost for this entire project is estimated to be approximately $148,560,000.

5.4.4 Preferred andside Alternative

The Airport Parking Plan will be utilized as the preferred landside alternative for this Master Plan Update as this was the alternative agreed upon by Airport officials based on the Route 10A widening. This alternative will be utilized in the Airport Development Plan.

5.5 General Aviation, Cargo, and Support Facilities

Five focus areas were examined in the first round of GA, cargo, and support facilities alternatives analysis as key elements within these areas were identified as recommended or required improvement areas based on future forecast numbers as noted in **Chapter :** *Facility Requirements*. A summary of the GA, cargo, and support facility requirements can be found in **Section 9**.

As shown in **Figure -33**, 36 Round 1 alternatives were developed based on the five GA, cargo, and support facility focus areas, which lead to two alternatives being developed in Round 2. A preferred Round 2 alternative was selected and moved into Round 3. This alternative was incorporated into the Airport Development Plan.

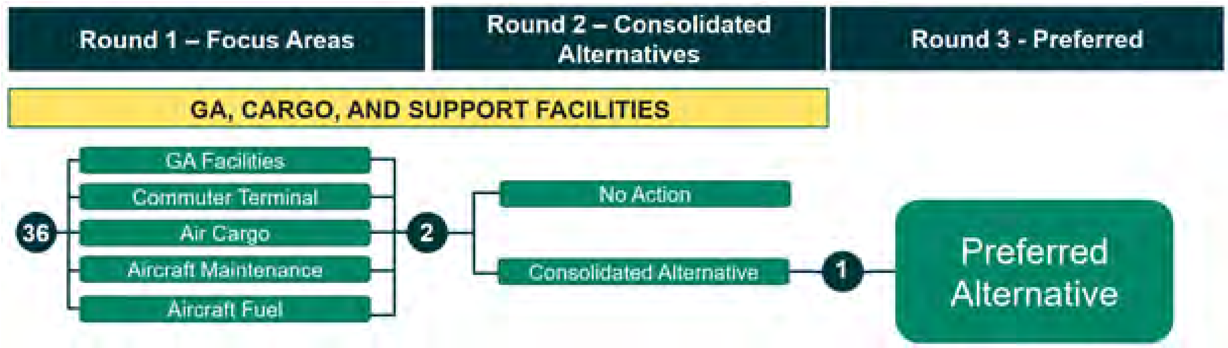


Figure 5-33. General Aviation, Cargo, and Support Facilities Alternatives Development

Source: AECOM

5.5.1 Round 1 General Aviation, Cargo, and Support Facilities Alternatives

As depicted in **Figure -3** , the five Round 1 focus areas included: GA Facilities, Light Aircraft Commuter Terminal, Air Cargo, Aircraft Maintenance, and Aircraft Fuel. Within these five areas, six key elements were evaluated during Round 1, and 36 alternatives were developed. Sections **1 1** through **1 6** describe the alternatives for each of these elements, which were presented during the GA, cargo, and support facilities alternatives virtual workshop.

Figure 5-34. General Aviation, Cargo, and Support Facilities Focus Areas

Source: AECOM

For each set of GA, cargo, and support facilities alternatives, evaluation matrices were developed based on both quantitative and qualitative development criteria. While most of the criteria are focus area based, all matrices include criteria such as cost impacts, airside operational efficiency, and ease of implementation. Additionally, some matrices include criteria such as road impacts, site planning considerations, impacts on or proximity to existing functions, and the satisfying of future Airport forecast requirements.

5.5.1.1 General Aviation erminal

xi sting GA facilities are adequate to meet future demand; however, a GA terminal on the south side of the airfield, near the current GA aircraft parking area and Nose Dock Hangar, is recommended to accommodate future GA pilots, passengers, crew, and vehicle parking. See **able -** for more details and **Figure -3** for the GA terminal alternatives.

Parameters of these alternatives include an 8,800 SF facility and a 21,000 SF vehicle parking lot.

Figure 5-35. General Aviation Terminal Alternatives

Source: AECOM

Round 1 alternatives for GA Terminal included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – West of Nose Dock angar**: Construct a new GA terminal building west of the Nose Dock Hangar access apron. This would include a vehicle parking lot and vehicle access from Admiral Sherman Boulevard.
- **Alternative 3 – East of Nose Dock angar**: Construct a new GA terminal building east of the Nose Dock Hangar, closest to the transient aircraft parking positions. This would include a vehicle parking lot between the existing parking lot and Admiral Sherman Boulevard.
- **Alternative – Repurpose Aircraft Rescue and Firefighting ARFF Facility:** Repurpose the old ARFF facility for use as a GA terminal.

See **able -21** for the GA terminal alternatives evaluation matrix.

able -21 General Aviation erminal Alternatives Matrix

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative
Airside Operational fficiency	Yellow	Green	Green	Red
Cost Impacts	Yellow	Yellow	Green	Red
ase of Implementation	Yellow	Green	Yellow	Red
Satisfies Future Airport Forecast Requirements	Yellow	Green	Green	Green
Impact on Road	Yellow	Green	Green	Red
Main Road ase of Access	Yellow	Red	Green	Green
Site Planning Consideration	Yellow	Red	Green	Red
Impact to xisting Functions	Yellow	Green	Red	Red

Note: Red = Unfavorable, Yellow = Neutral, Green = Favorable
Source: AECOM

A GA terminal is recommended to accommodate future GA operations; therefore, the no-build alternative, Alternative 1, was not pursued. Additionally, while the location of the terminal and vehicle parking is appealing for Alternative 2, this site is being considered for future transient aircraft parking and should not be considered for the location of the GA terminal.

Alternative 3 provides the best location for the GA terminal, as the proposed location provides easy access to the GA portion of the south apron and Nose Dock Hangar, and the existing vehicle parking lot could be expanded to accommodate the additional recommended vehicle parking area. Lastly, Alternative 4 looks at the repurposing of the old ARFF building. While this may appear to be a good short-term investment, the building was constructed in 1965 and would not be an appropriate long-term solution; therefore, **Alternative 3** was selected as the preferred GA terminal alternative.

5.5.1.2 General Aviation Bulk Storage a ngar

Although not required, a new aircraft bulk storage hangar is recommended to provide flexibility for future based aircraft. Based on the forecast, there is a future need for hangar space for an additional jet-sized aircraft. A new bulk storage hangar, similar in size to the current ACI hangar, is recommended to accommodate future aircraft parking needs and other aviation functions. See **able - 1** , **able - 2** , and **able - 3** for more details and **Figure -36** for the GA bulk storage hangar alternatives.

Parameters of these alternatives include a 31,250 SF apron, a 37,500 SF hangar, and a 37,500 SF vehicle parking lot.

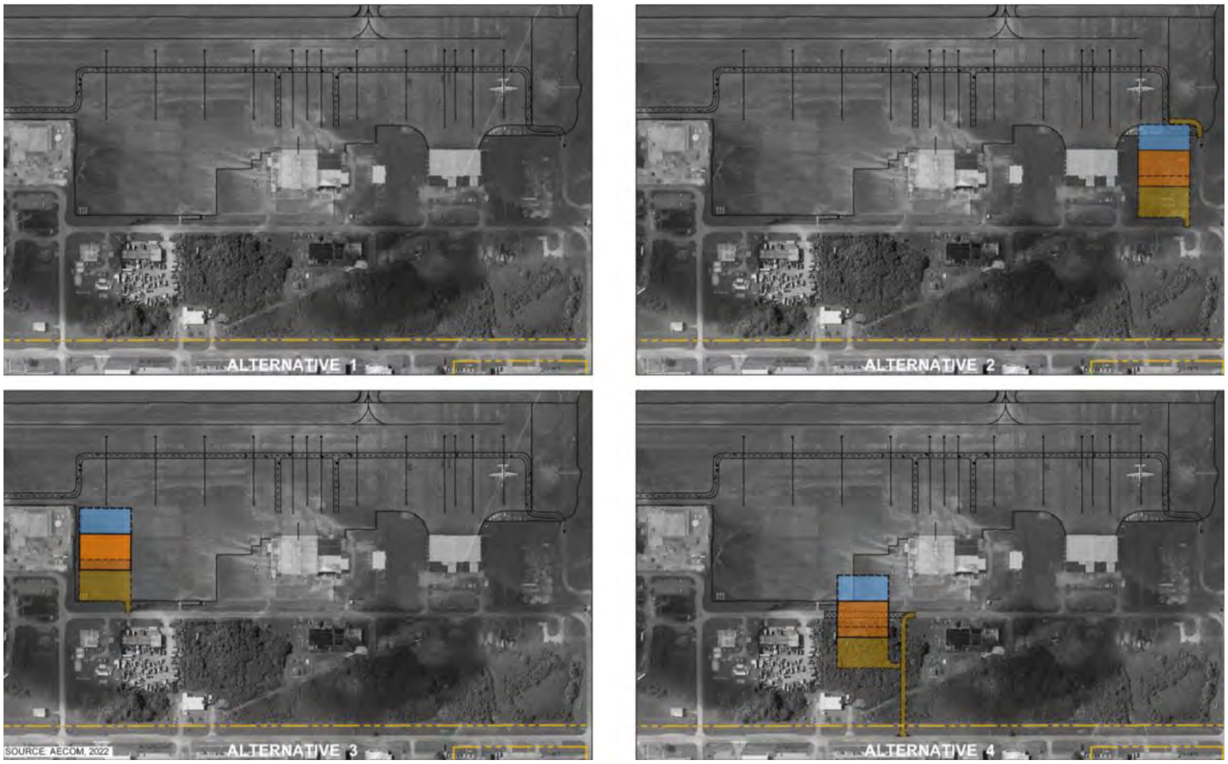


Figure 5-36. General Aviation Bulk Storage Hangar Alternatives

Source: AECOM

Round 1 alternatives for GA Bulk Storage Hangar included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – East of ACI angar**: Construct a new bulk storage hangar with associated offices and vehicle parking adjacent to the ACI hangar and realign the existing VSR. Vehicle access will be from Neptune Ave.
- **Alternative 3 – East of ARFF**: Construct a new bulk storage hangar with associated offices and vehicle parking adjacent to the ARFF building. Vehicle access will be from Neptune Ave.
- **Alternative – West of United angar**: Construct a new bulk storage hangar with associated offices and vehicle parking adjacent to the United hangar across Neptune Avenue, demolish a portion of Neptune Avenue, and construct a new vehicle access road between Neptune Avenue and Mariner Avenue.

See **able -22** for the GA bulk storage hangar alternatives evaluation matrix.

able -22 General Aviation Bulk Storage angar Alternatives Matrix

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative
Airside Operational fficiency	Yellow	Green	Red	Red
Cost Impacts	Yellow	Yellow	Green	Red
ase of Implementation	Yellow	Green	Yellow	Red
Satisfies Future Airport Forecast Requirements	Yellow	Green	Green	Green
Impact on Road	Yellow	Green	Green	Red
Main Road ase of Access	Yellow	Red	Green	Green
Site Planning Considerations	Yellow	Green	Red	Red
Impact to xisting Functions	Yellow	Green	Red	Red

Note: Red = Unfavorable, Yellow = Neutral, Green = Favorable
Source: AECOM

A bulk storage hangar at the Airport would allow additional hangar space for a future jet or multiple single-engine aircraft, as well as other functions like administration, maintenance, or aircraft storage. Alternative 1 does not provide any additional support for these elements.

The hangar location for Alternative 2 is very beneficial because it allows functions to be co-located with the ACI hangar and does not affect the existing roads or the current aircraft parking layout for the south apron. While Alternative 3 does not affect any roads, this alternative would not co-locate any storage, and this location could be better suited for a larger hangar that has the room to expand toward the United hangar.

Lastly, Alternative 4 portrays the biggest impact to existing conditions, as Neptune Ave. would need to be rerouted, and though all other alternatives (excluding Alternative 1) may need to remove one aircraft parking position to gain access to their respective hangars, Alternative 4 would have to split the existing aircraft parking area and may need to remove two parking positions or downgrade one or two of the existing positions.

Alternative 2 was chosen as the preferred GA bulk storage hangar alternative to move forward in the alternatives analysis process.

5.5.1.3 ight Aircraft Commuter erminal

The current light aircraft commuter terminal is shared with other functions and does not have dedicated CBP facilities. Due to the old age of the building, replacement of the commuter terminal is recommended to accommodate future growth. See **Section** for more details and **Figure -3** for the light aircraft commuter terminal alternatives.

Parameters of these alternatives include a 47,000 SF facility unless stated otherwise.

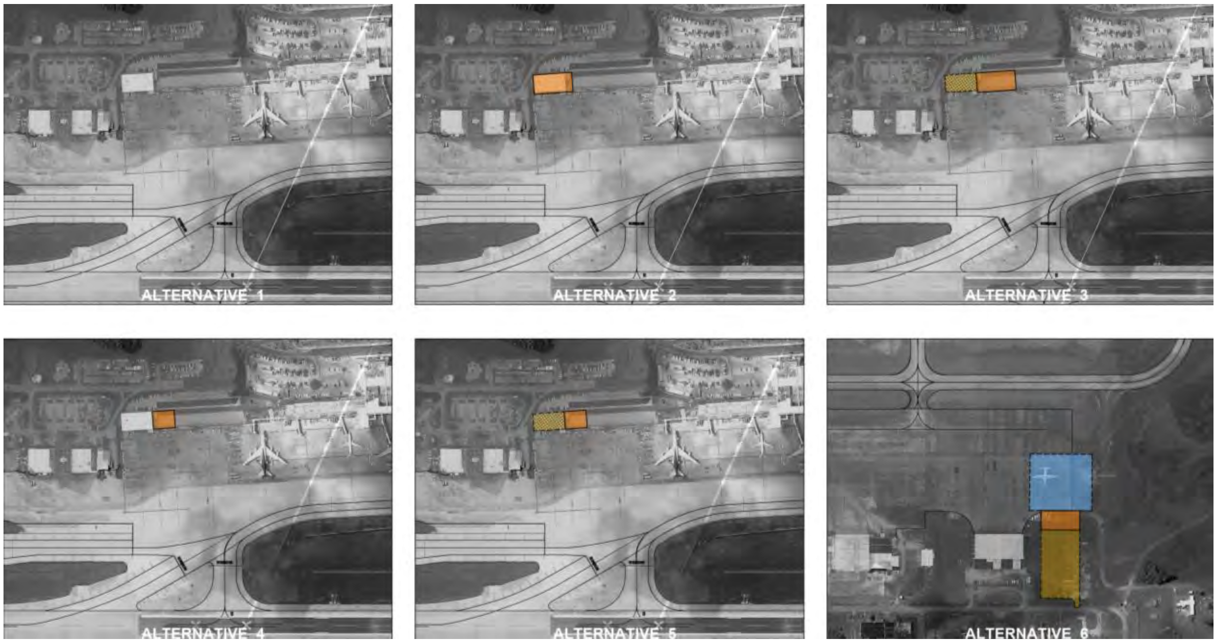


Figure 5-37. Light Aircraft Commuter Terminal Alternatives

Source: AECOM

Round 1 alternatives for the Light Aircraft Commuter Terminal included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Replace in Place**: Temporarily relocate tenants, demolish the existing facility, and construct a new commuter terminal in the existing location.
- **Alternative 3 – New Facility East of Existing and Demolish Existing Facility**: Construct a new commuter terminal adjacent to the existing facility, demolish the existing facility, and replace it with vehicle parking.
- **Alternative – New Facility East of Existing Facility and Existing Facility to Remain**: Construct a new 20,000 SF commuter terminal adjacent to the existing facility and keep other tenants in the existing facility.
- **Alternative – New Facility East of Existing, Relocate enants, and Demolish Existing Facility**: Construct a new 20,000 SF commuter terminal adjacent to the existing facility, relocate other function tenants, demolish the existing facility, and replace it with vehicle parking.
- **Alternative 6 – New Facility on South Apron**: Construct a new commuter terminal with associated aircraft parking and vehicle parking adjacent to the ACI hangar.

See **able -23** for the light aircraft commuter terminal alternative evaluation matrix.

able -23 ight Aircraft Commuter Facility Alternatives Matrix

Criteria	Alt 1	Alt 2	Alt 3	Alt	Alt	Alt 6
Airside Operational fficiency	Yellow	Green	Green	Green	Green	Red
Cost Impacts	Yellow	Red	Red	Yellow	Yellow	Red
ase of Implementation	Yellow	Red	Yellow	Green	Yellow	Green
Satisfies Future Airport Forecast Requirements	Yellow	Green	Green	Green	Green	Green
Additional Vehicle Parking	Yellow	Red	Green	Red	Green	Green
Proximity to Passenger Terminal	Yellow	Green	Green	Green	Green	Red
ase for Customs and Border Protection Agents	Yellow	Green	Green	Green	Green	Red
Impacts Ultimate Terminal xpansion	Red	Red	Red	Red	Red	Green

Note: Red = Unfavorable, Yellow = Neutral, Green = Favorable
Source: AECOM

Built in 1976, the existing facility is in need of an update within this Master Plan planning period; therefore, Alternative 1 is not a viable solution. While Alternative 2 is a safe solution because it replaces the existing commuter terminal in the same location, this alternative does not plan for any additional parking and would be difficult to implement, as all tenants would have to be temporarily relocated during demolition and construction.

The main differences between Alternatives 3 and 5 are the size of the facility and the relocation of the tenants unrelated to the operations of the commuter terminal. By relocating those tenants as proposed in Alternative 5, this allows the size of the new facility to be reduced by more than half. Though Alternative 4 also reduces the size of the new facility by keeping those tenants in the existing facility, Alternative 4 does not plan for any additional vehicle parking.

Alternative 6 is the only alternative that does not impact the ultimate commercial passenger terminal expansion since Alternative 6 is proposed along the south apron; however, it is not feasible to locate the facility on the south apron because of its proximity to the commercial passenger terminal; therefore, **Alternative** was selected as the preferred light aircraft commuter facility alternative and will move forward in the alternatives analysis process.

5.5.1.4 Air Cargo

Based on existing facility requirements, a proposed air cargo facility with associated loading docks, vehicle parking, and aircraft parking is recommended to accommodate future air cargo demand in addition to the currently proposed cargo apron development on the north side. See **Section** for more details, **Figure -3** for the north air cargo alternatives, and **Figure -39** for the south air cargo alternatives.

Parameters of these alternatives include a 654,522 SF aircraft apron, 60,000 SF air cargo facility, a 48,000 SF truck and vehicle parking lot, and a 48,000 SF ground service equipment (GS) lot (in the northern airfield alternatives) unless stated otherwise. Additionally, as stated in **Section** , the Airport is currently developing an air cargo apron to the west of the Guam Integrated Air Cargo (GIAC) facility which is shown in all of the northern airfield air cargo alternatives.

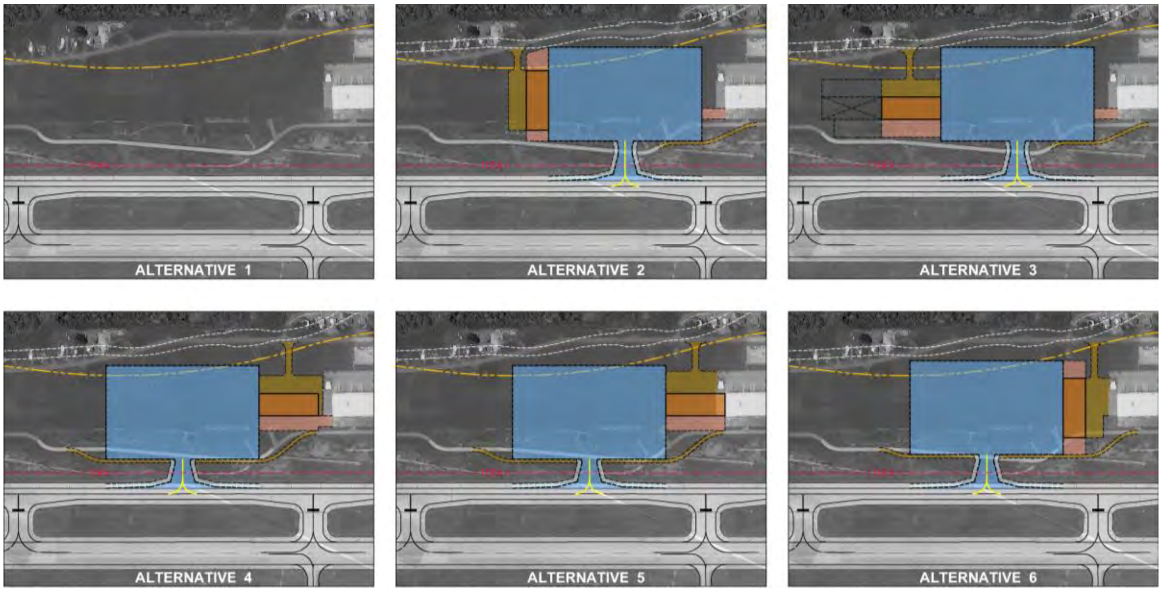


Figure 5-38. North Air Cargo Alternatives

Source: AECOM

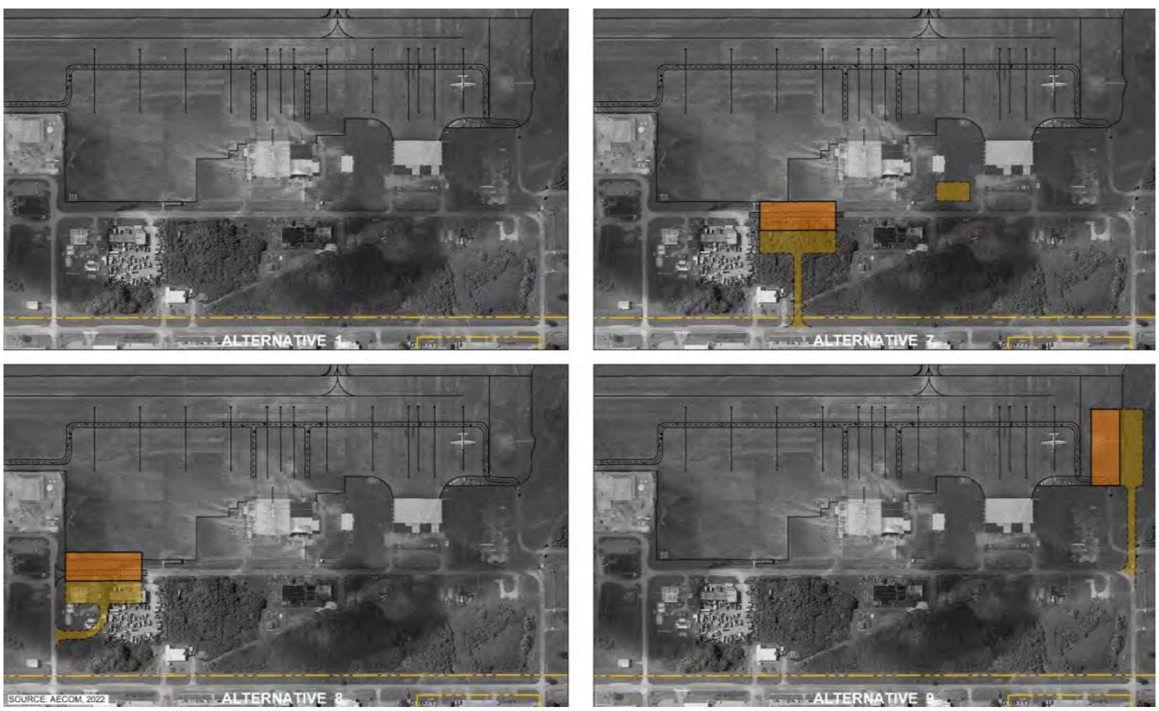


Figure 5-39. South Air Cargo Alternatives

Source: AECOM

Round 1 alternatives for Air Cargo included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – North Cargo West with West Parking**: Construct a new cargo facility, with associated GS and vehicle parking, on the west side of the proposed cargo apron in a north-south orientation, realign the VSR, and add a connection from the GIAC facility to the cargo apron. This layout does not relocate the proposed location of the planned cargo apron.
- **Alternative 3 – North Cargo West with North Parking**: Construct a new cargo facility, with associated GS and vehicle parking, on the west side of the proposed cargo apron in an east-west

direction, realign the VSR, and add a connection from the GIAC facility to the cargo apron. The facility can be expanded to the west and does not relocate the proposed location of the planned cargo apron.

- **Alternative – North Cargo East with North Parking**: Construct a new cargo facility, with associated GS and vehicle parking, on the east side of the proposed cargo apron in an east-west direction, realign the VSR, and add a connection from the GIAC facility to the cargo apron by the airside access side of the facility. This layout shifts the planned cargo apron west.
- **Alternative – North Cargo Shifted East with North Parking**: Construct a new cargo facility, with associated GS and vehicle parking, on the east side of the proposed cargo apron as an extension of the GIAC facility, realign the VSR, and connect the landside and airside areas of the GIAC facility to the new cargo facility. This layout shifts the planned cargo apron west.
- **Alternative 6 – North Cargo East with East Parking**: Construct a new cargo facility, with associated GS (only 35,000 SF) and vehicle parking, on the east side of the proposed cargo apron in a north-south direction, realign the VSR, and connect the air cargo facility vehicle parking to the GIAC facility. This layout relocates the proposed location of the planned cargo apron.
- **Alternative – South Apron Cargo Center**: Construct a new cargo facility, with associated vehicle parking, in proximity to the west side of the United hangar with a road connection to Mariner Avenue, replace parking for the United hangar to the east of the hangar, and remove a portion of Neptune Avenue.
- **Alternative – South Cargo West**: Construct a new cargo facility, with associated vehicle parking, in proximity to the east side of the ARFF with a road connection to Corsair Road, remove a portion of Neptune Avenue, and demolish the United States Department of Agriculture (USDA) Plant Inspection Station and Pacific Unlimited Inc. Repair Shop facilities when the vehicle parking for the cargo building is developed.
- **Alternative 9 – South Cargo East**: Construct a new cargo facility, with associated vehicle parking, east of the aircraft apron with a road connection to the corner of Neptune Avenue and Security Road. Aircraft parking for the ACI hangar would be shifted for freighter parking in front of the new air cargo facility.

See **able -2** for the air cargo alternatives evaluation matrix.

able -2 Air Cargo Alternatives Matrix

Criteria	Alt 1	Alt 2	Alt 3	Alt	Alt	Alt 6	Alt	Alt	Alt 9
Airside Operational fficiency	Yellow	Green	Yellow	Yellow	Yellow	Green	Green	Green	Green
Cost Impacts	Yellow	Green	Green	Yellow	Yellow	Yellow	Yellow	Red	Green
ase of Implementation	Yellow	Green	Green	Yellow	Yellow	Yellow	Yellow	Red	Green
Maintains Proposed Aircraft Ramp Location	Red	Green	Green	Red	Red	Red	Green	Green	Green
Satisfies Future Aircraft Forecast Requirement	Yellow	Green	Green	Green	Green	Green	Green	Green	Green
Aircraft Ramp xpansion	Yellow	Red	Red	Green	Green	Green	Green	Green	Yellow
Building xpansion	Yellow	Red	Green	Red	Red	Red	Green	Green	Yellow
Access to Public Transportation	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Yellow	Red
Proximity to Proposed Aircraft Apron	Yellow	Green	Green	Green	Green	Green	Red	Red	Red
Proximity to xisting Cargo Operations	Yellow	Green	Green	Green	Green	Green	Red	Red	Red
Proximity to Passenger Terminal	Yellow	Green	Green	Green	Green	Green	Red	Red	Red
Proximity to Truck Access	Yellow	Green	Green	Green	Green	Green	Green	Green	Yellow

Notes: Red = Unfavorable, Yellow = Neutral, Green = Favorable
Source: AECOM

Based on the future forecast of air cargo at the Airport and the ongoing development of the cargo apron on the north side, Alternatives 1, 7, 8, and 9 were not advanced in this analysis. While air cargo facilities could be located along the south apron, due to the open area for proposed expansion and the ability to co-locate cargo facilities in the north, Alternatives 7, 8, and 9 were dismissed.

The location of the air cargo apron in Alternatives 2 and 3 is consistent with the current cargo apron design plans and propose the new air cargo facility on the west side of the apron. The main difference between these two alternatives is the direction in which the facility and vehicle parking lots are oriented. Alternative 3 allows a much easier way of expanding the facility, parking, and GS lots than Alternative 2.

Alternatives 4, 5, and 6 all position the facility, parking, and GS lots between the planned apron (which would slightly relocate the apron from the current planned location) and the GIAC facility. While these alternatives make the most of the land available between the GIAC and the air cargo apron, these alternatives do not allow any proposed expansion of the GIAC to the west.

Due to the consistent location of the planned air cargo apron and the ability for expansion of the cargo facility to the west, **Alternative 3** was selected as the preferred air cargo alternative.

5.5.1.5 Aircraft Maintenance

A widebody hangar would be a recommended opportunistic investment by the Airport or by an aircraft maintenance operation for working on trans-Pacific aircraft, and/or providing additional shelter for smaller aircraft in case of emergency weather situations. See **Section 6** for more details, **Figure -** for the north maintenance hangar alternatives, and **Figure - 1** for the south maintenance hangar alternatives.

Parameters of these alternatives include a 81,200 SF widebody hangar and at least 30,000 SF for truck and vehicle parking. The height of the widebody hangar would be approximately 85 feet, and any additional expansion would have to comply with the Code of Federal Regulation's (CFR) Part 77 surfaces.

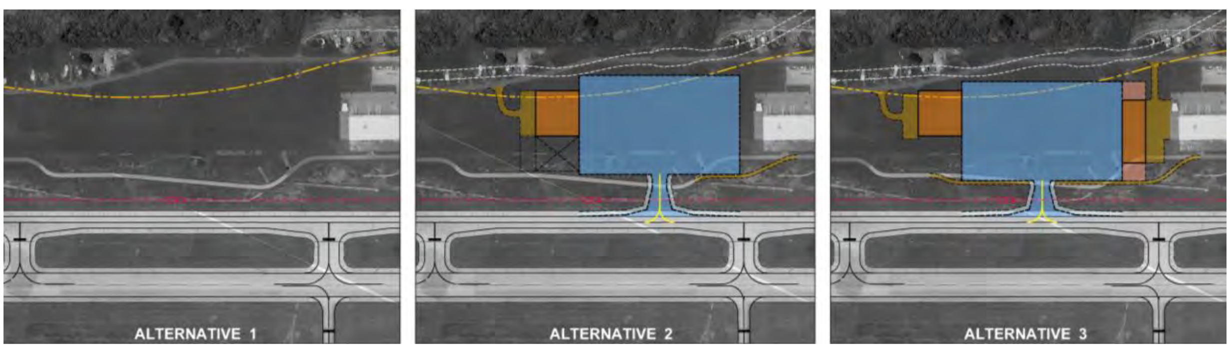


Figure 5-40. North Maintenance Hangar Alternatives

Source: AECOM

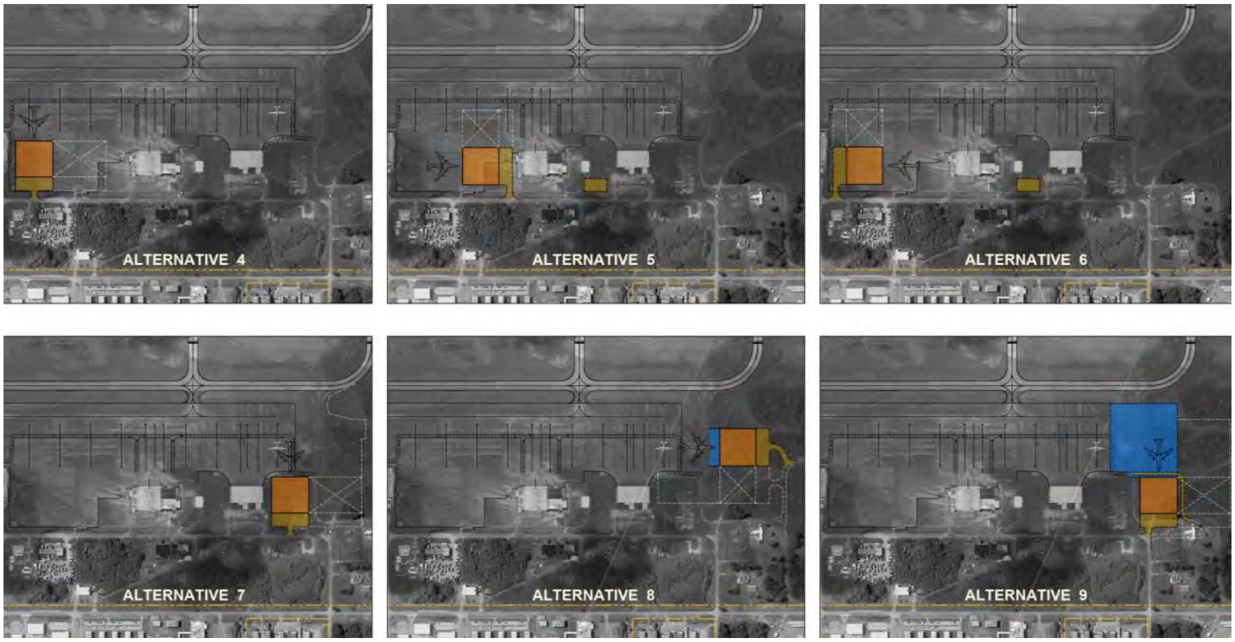


Figure 5-41. South Maintenance Hangar Alternatives

Source: AECOM

Round 1 alternatives for Aircraft Maintenance included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – North Maintenance angar**: Construct a new widebody maintenance hangar, with associated truck and vehicle parking, on the west edge of the proposed cargo apron and realign the VSR. This alternative allows for potential hangar and vehicle parking expansion to the south. This layout does not relocate the proposed location of the planned cargo apron.
- **Alternative 3 – North Maintenance angar with Cargo**: Construct a new widebody maintenance hangar, with associated truck and vehicle parking, on the west edge of the proposed cargo apron and realign the VSR. This alternative was developed to allow sharing of the proposed cargo apron for aircraft maintenance and the air cargo facility (Air Cargo Alternative 6). This layout relocates the proposed location of the planned cargo apron.
- **Alternative – South Maintenance angar West**: Construct a new widebody maintenance hangar, with associated truck and vehicle parking, in proximity to the east side of the ARFF facility area on the existing apron with a road connection to Neptune Avenue. This alternative allows for potential hangar and vehicle parking expansion to the east. The hangar door entry would be on the north face, and coordination with UA operations would be required.
- **Alternative – South Maintenance angar Center – Near United angar**: Construct a new widebody maintenance hangar, with associated truck and vehicle parking, in proximity to the west side of the United hangar on the existing apron with a road connection to Neptune Avenue. This alternative allows for potential hangar and vehicle parking expansion to the north. The hangar door entry would be on the west face, and coordination with UA operations is required.
- **Alternative 6 – South Maintenance angar Center – Near ARFF**: Construct a new widebody maintenance hangar, with associated truck and vehicle parking, in proximity to the east side of the ARFF facility area on the existing apron with a road connection to Neptune Avenue. This alternative allows for potential hangar and vehicle parking expansion to the north. The hangar door entry would be on the north face, and coordination with UA operations would be required.
- **Alternative – South Maintenance angar East**: Construct a new widebody maintenance hangar, with associated truck and vehicle parking, in proximity to the east side of the ACI hangar south of the existing apron with a road connection to Neptune Avenue. This alternative allows for

potential hangar and vehicle parking expansion to the east. The hangar door entry would be on the north face, and coordination with ACI operations would be required.

- **Alternative – South Maintenance angar Far East**: Construct a new widebody maintenance hangar, with associated truck and vehicle parking, in proximity to the east side of the existing apron with a new road connection down to the south to Neptune Avenue. This alternative allows for potential hangar and vehicle parking expansion to the south. The hangar door entry would be on the west face, and coordination with ACI operations would be required.
- **Alternative 9 – South Maintenance angar Southeast**: Construct a new widebody maintenance hangar, with associated truck and vehicle parking, in proximity to the east side of the existing open area east of the ACI hangar with a new road connection down to the south to Neptune Avenue. This alternative allows for potential hangar and vehicle parking expansion to the east. The hangar door entry would be on the north face, and coordination with ACI operations would be required.

See **able -2** for the maintenance hangar alternatives evaluation matrix.

able -2 Round 1 Maintenance angar Alternatives Matrix

Criteria	Alt 1	Alt 2	Alt 3	Alt	Alt	Alt 6	Alt	Alt	Alt 9
Airside Operational fficiency	Yellow	Green	Green	Green	Green	Green	Green	Green	Yellow
Cost Impacts	Yellow	Green	Green	Green	Yellow	Green	Yellow	Yellow	Red
ase of Implementation	Yellow	Green	Yellow	Green	Green	Green	Yellow	Yellow	Yellow
Satisfies Future Airport Forecast Requirement	Yellow	Green	Green	Green	Green	Green	Green	Green	Green
Impact on Roads	Yellow	Green	Green	Green	Green	Green	Yellow	Yellow	Yellow
Proximity to Passenger Operations	Yellow	Green	Green	Red	Red	Red	Red	Red	Red
Runway Height Restrictions	Yellow	Yellow	Green	Green	Green	Green	Green	Yellow	Green
Proximity to xisting Aircraft Maintenance	Yellow	Red	Red	Green	Green	Green	Green	Green	Green
Larger Hangar or Possible xpansion	Yellow	Yellow	Red	Green	Yellow	Yellow	Green	Red	Green
Proximity to United Airlines Hangar	Yellow	Red	Red	Green	Green	Green	Yellow	Yellow	Yellow

Note: Red = Unfavorable, Yellow = Neutral, Green = Favorable
Source: AECOM

Similar to the air cargo alternatives, aircraft maintenance alternatives were developed for both the north and south airfield.

Alternative 1 is the no build alternative, and with no existing dedicated maintenance hangar at the Airport, Alternative 1 was not recommended.

Alternatives 2 and 3 are proposed on the north side of the airfield with the maintenance hangar positioned on the west side of the air cargo apron proposed in Alternatives 2 and 3 of the air cargo alternatives. If selected, the maintenance hangar would share the air cargo apron, which could be seen as a disadvantage especially since existing aircraft maintenance activities are currently located on the south side of the Airport and co-locating functions is desirable.

The opportunities on the south side of the Airport are less restrictive for the height of the hangar as the possible locations are farther away from the runways. Alternatives 4, 5 and 6 take advantage of the large ramp area between the new ARFF facility and the United hangar. These alternatives keep existing aircraft maintenance operations co-located with the United hangar. Alternative 4 would be the easiest to implement of the three alternatives because the aircraft hangar door would face north, eliminating the need for larger aircraft to make tight turns into or out of the hangar.

Alternatives 7 and 9 locate the maintenance hangar next to the ACI hangar, which would be a beneficial position, as the proposed maintenance hangar can co-locate with ACI maintenance operations; however, the Alternative 7 area was previously reserved for the proposed bulk storage hangar, and any expansion for either Alternatives 7 or 9 would require a major south apron expansion.

Lastly, Alternative 8 is located to the area east of the south apron and could potentially conflict with the bulk storage hangar operations, and may also require a major south apron expansion.

Therefore, **Alternative** was the selected aircraft maintenance hangar alternative and moved forward in the alternatives process.

5.5.1.6 Aircraft Fuel

Based on the forecast of the Master Plan planning period, one additional Jet A fuel tank and replacement of the Avgas tank are recommended based on recent supply chain issues, shipping issues, and geopolitical issues. See **Section** for more details and **Figure - 2** for the aircraft fuel alternatives.

Parameters of these alternatives include a 320,000 gallon Jet A fuel tank and replacement of the existing Avgas fuel tank with a new 10,000-gallon tank.

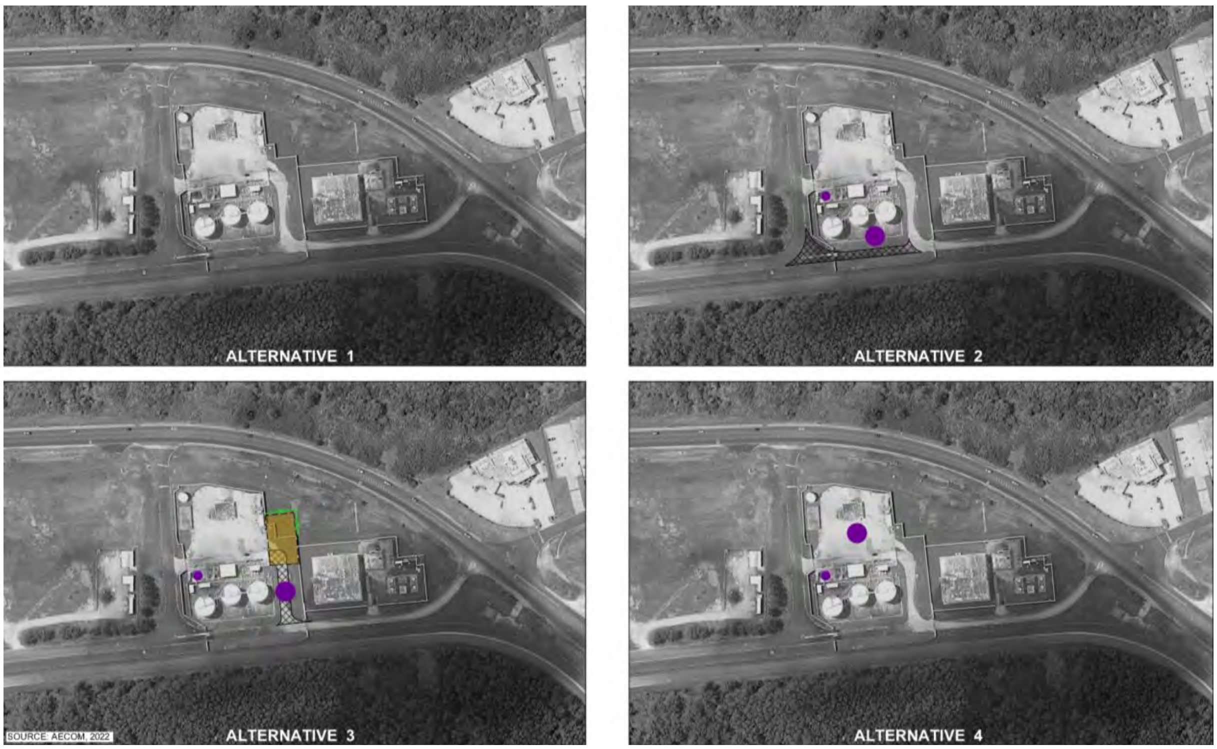


Figure 5-42. Aircraft Fuel Alternatives

Source: AECOM

Round 1 alternatives for Aircraft Fuel included:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Jet A ank South**: Construct a new Jet A fuel tank south of the existing tanks, add a new Avgas fuel tank adjacent to the fuel truck entrance road, and close a portion of the southern connector between the VSR and the fuel truck exit road.
- **Alternative 3 – Jet A ank East**: Construct a new Jet A fuel tank east of the existing tanks, add a new Avgas fuel tank adjacent to the fuel truck entrance road, demolish the eastern exit fuel truck connector, and add additional pavement and a fence for a truck turnaround location.
- **Alternative – Jet A ank North**: Construct a new Jet A fuel tank north of the existing tanks and add a new Avgas fuel tank adjacent to the fuel truck entrance road.

See **able -26** for the aircraft fuel alternatives evaluation matrix.

able -26 Aircraft Fuel Alternatives Matrix

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative
Operational fficiency	● (Yellow)	● (Green)	● (Red)	● (Red)
Cost Impacts	● (Yellow)	● (Yellow)	● (Red)	● (Red)
ase of Implementation	● (Yellow)	● (Yellow)	● (Green)	● (Red)
Satisfies Future Airport Forecast Requirement	● (Yellow)	● (Green)	● (Green)	● (Green)
Impact xisting VSR	● (Yellow)	● (Red)	● (Red)	● (Green)

Notes:
A. Red = Unfavorable, Yellow = Neutral, Green = Favorable
B. Abbreviation
VSR = Vehicle service road
Source: AECOM

It is important that the Airport incorporate a new Jet A fuel tank and a new Avgas tank to address the facility requirements; therefore, Alternative 1 was not recommended to move forward in the alternatives analysis process.

Alternatives 2 and 3 both impact the existing service roads; however, Alternative 3 requires the addition of new pavement and a possible elevation issue due to the topography around the proposed fuel truck turn around area. Additionally, while Alternative 4 does not require any new pavement or road demolition, this alternative is infeasible due to fire safety regulations. **Alternative 2** was selected as the preferred aircraft fuel alternative.

5.5.1.7 Summary of Round 1 GA, Cargo, and Support Facilities Alternatives

a ch alternative within each focus area was ranked based on evaluation criteria. Overall, multiple sites on the south apron area were identified as potential development sites, and therefore alternatives for each function were shown on each site. Thus, through the evaluation process, each site was dedicated to a specific function that best utilized the space and allowed functions to be co-located. **able -2** depicts the highest ranked alternative for each focus area; these alternatives were combined to create a Round 2 alternative.

able -2 Round 1 ighest Ranked General Aviation, Cargo, and Support Facility Alternatives

Alternative Focus Area	ighest Ranked Alternative
General Aviation Terminal	3
Bulk Storage Hangar	2
Light Aircraft Commuter Terminal	5
Air Cargo	3
Aircraft Maintenance	4
Aircraft Fuel	2

Source: AECOM

5.5.2 Round 2 GA, Cargo, and Support Facilities Alternatives

Two Round 2 alternatives were developed based on the Round 1 GA, cargo, and support facility alternatives, matrices, and feedback during the alternatives workshop. As mentioned, since only one alternative for each focus area advanced from Round 1, only two alternatives were evaluated.

The two Round 2 GA, cargo, and support facility alternatives were:

- Alternative 1 – No Action
- Alternative 2 – Consolidated Alternative

See **Figure - 3** and **Figure -** for the two Round 2 alternatives.

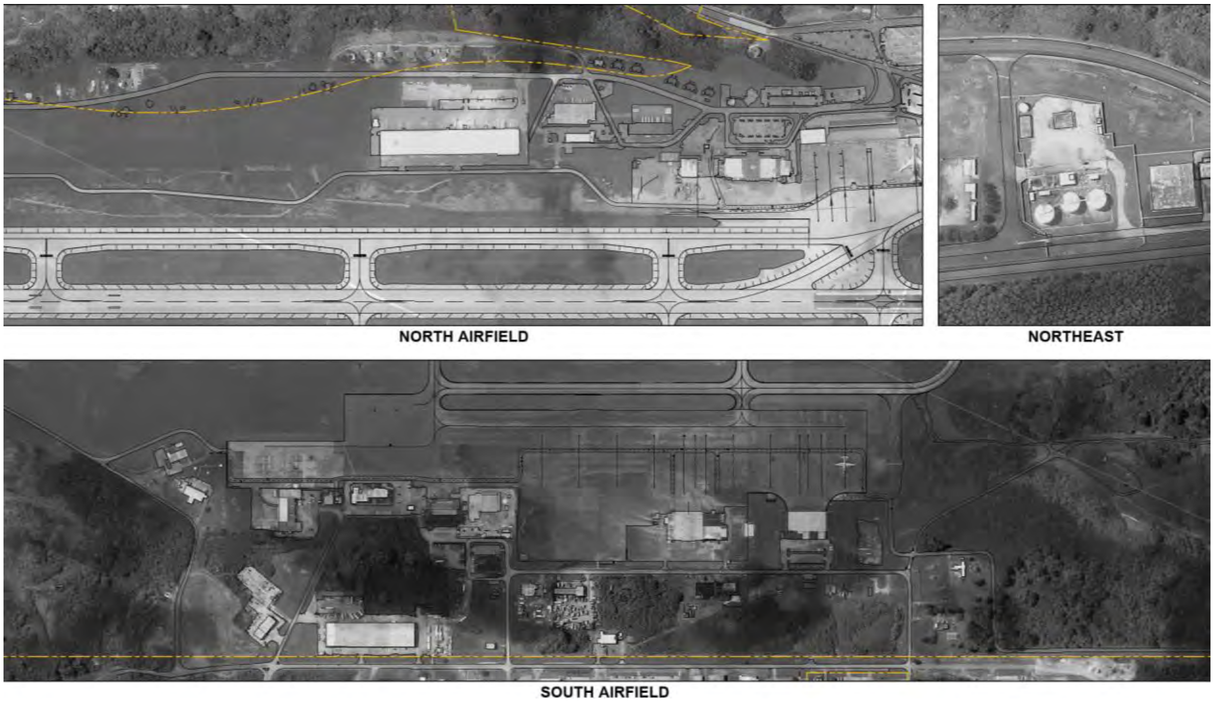


Figure 5-43. Alternative 1 – No Action

Source: AECOM

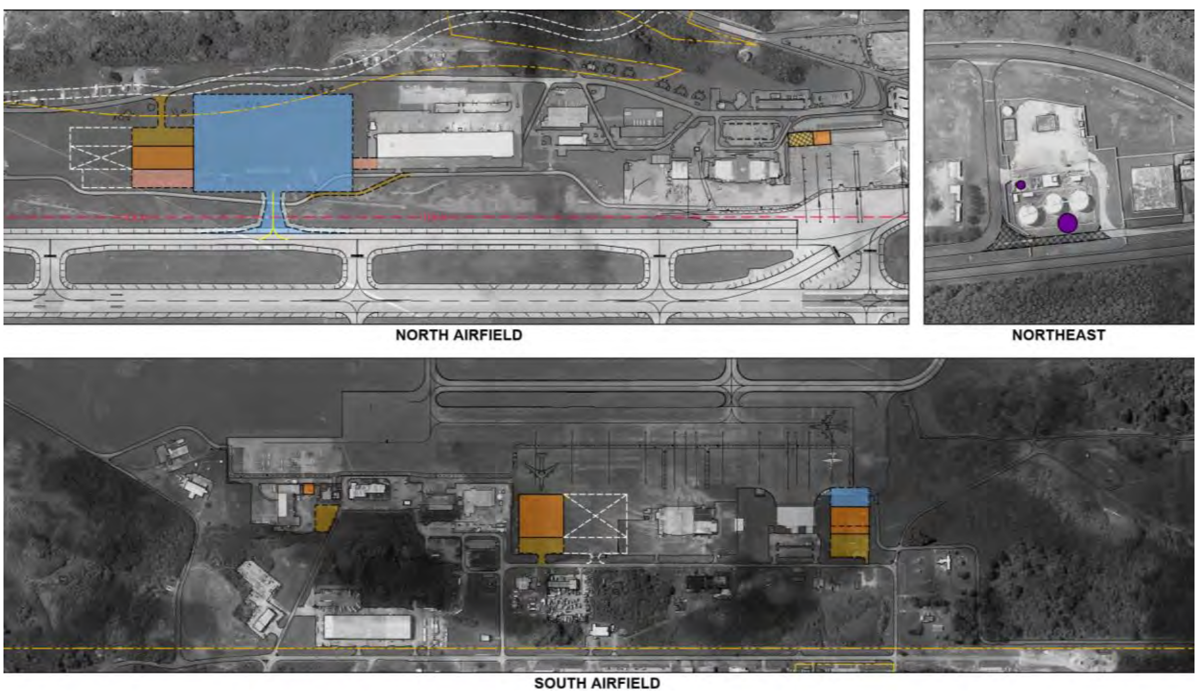


Figure 5-44. Alternative 2 – Consolidated Alternative

Source: AECOM

Highlights of Round 2 GA, Cargo, and Support Facilities Alternatives include:

- **Alternative 1 – No Action:** No action taken.
- **Alternative 2 – Consolidated Alternative**: Construct a new GA terminal building east of the Nose Dock Hangar, construct a new bulk storage hangar adjacent to the current ACI hangar, construct a new light aircraft commuter terminal adjacent to the existing facility and relocate other tenants to the new cargo building, demolish the existing facility and replace it with vehicle parking, construct a new air cargo facility on the north side, to the west of the proposed cargo apron in an east-west direction and connect the GIAC facility to the cargo apron, construct a new widebody maintenance hangar near the east side of the ARFF facility area, construct a new Jet A fuel tank south of the existing tanks, add a new Avgas fuel tank adjacent to the fuel truck entrance road, and close a portion of the southern connector between the VSR and the fuel truck exit road.

able -2 portrays the Round 2 alternatives evaluation matrix.

able -2 Round 2 General Aviation, Cargo, and Support Facility Alternatives Matrix

Criteria	Weighting	Alternative 1	Alternative 2
Airside Operational fficiency	15%	Yellow	Green
Cost Impacts	20%	Yellow	Red
ase of Implementation	10%	Yellow	Red
Satisfies Future Airport Forecast Requirement	15%	Yellow	Green
Can Accommodate Additional Future Growth and Function Changes	10%	Yellow	Green
Improves User (Passengers, Operators, etc.) xperience	7.5%	Yellow	Green
New Facilities for Long Term Usage	7.5%	Yellow	Green
Impacts Ultimate Terminal Development	5%	Yellow	Red
Preserves Future Shuttle Launch Aircraft	10%	Yellow	Green

Notes: Red = Unfavorable, Yellow = Neutral, Green = Favorable
Source: AECOM

5.5.2.1 Cost Estimates

Rough order of magnitude cost estimates were developed for the two Round 2 GA, cargo, and support facility alternatives. l ements such as new apron pavement, new truck and vehicle parking pavement, pavement demolition, building demolition, and new hangar costs were all evaluated in these estimates. st imates were prepared in 2023 dollars, and a location factor of 2.6 was used compared to the U.S. national average. See **able -29** for a summary of the Round 2 GA, cargo, and support facility alternatives cost estimates.

able -29 Round 2 General Aviation, Cargo, and Support Facility Alternatives Cost Estimates

Criteria	Estimated otal Cost
Alternative 1 – No Action	$0
Alternative 2 – Consolidated Alternative	$397,360,000

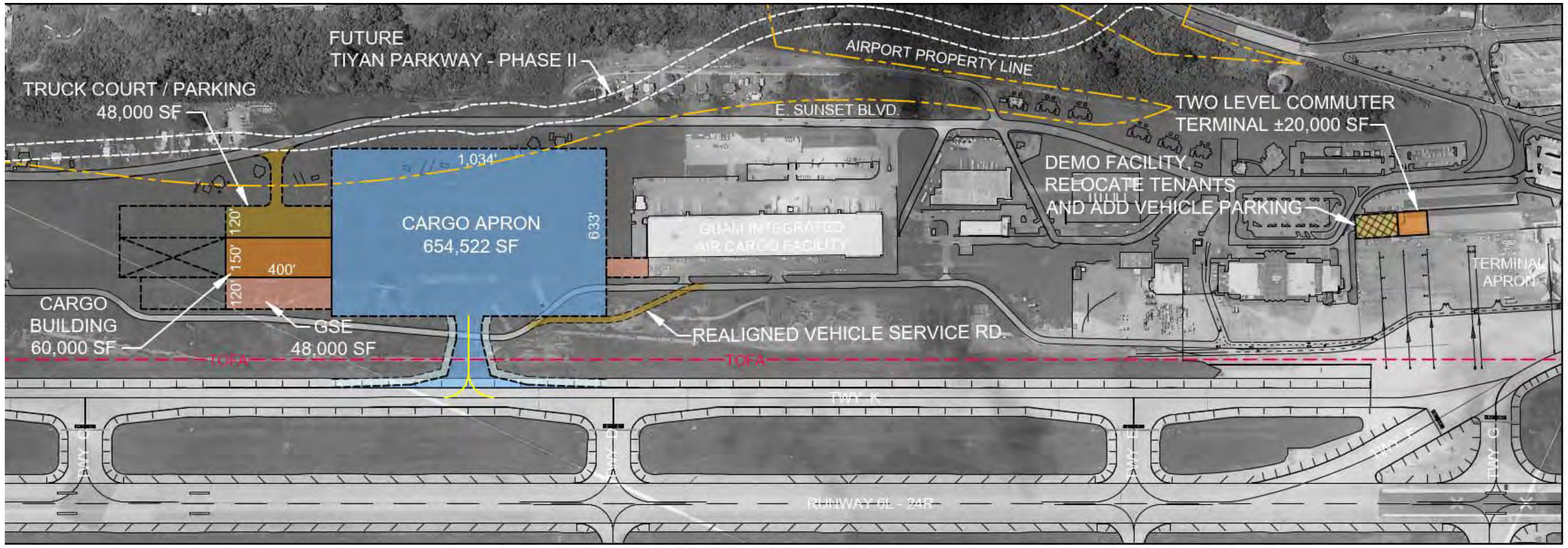
Source: AECOM

5.5.3 Round 3 Preferred GA, Cargo, and Support Facilities Alternative

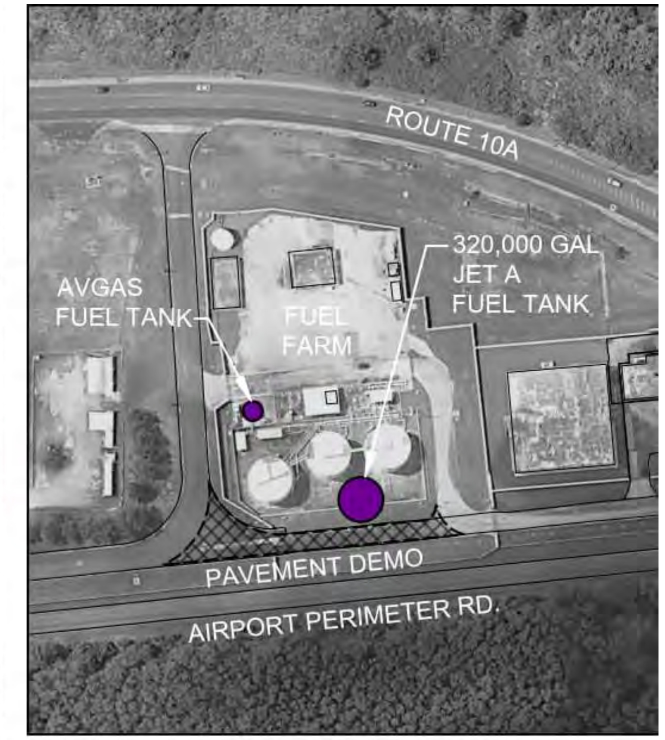
Alternative 2 – Consolidated Alternative was chosen as the preferred GA, cargo, and support facility alternative. The alternative considers all recommended improvements developed in the facility requirements chapter, and all elements were laid out strategically throughout the Airport. This alternative satisfies the planned growth for GA, light aircraft, and air cargo operations while also preserving area for potential spaceport operations that may occur outside the Master Plan planning period.

Specifically, this alternative plans for a new GA terminal adjacent to the Nose Dock hangar and other GA operations. The preferred alternative portrays a new bulk storage hangar adjected to the ACI hangar to allow GA storage to be co-located. This alternative also plans for a new and improved light aircraft commuter terminal dedicated to light aircraft operations.

Additionally, this alternative provides an air cargo facility, with flexible expansion capabilities to be co-located with the existing cargo functions and facilities, and does not impact the planned air cargo apron on the north side of the Airport. The facility requirements chapter also recommended a widebody maintenance hangar, which this alternative portrays in line with the United and ACI hangars and allows for flexible expansion capabilities. Finally, a new Jet A fuel tank and an upgraded Avgas fuel tanks will also be incorporated in this alternative. **Figure -** shows the preferred GA, cargo, and support facility alternative and this alternative will be utilized in the Airport Development Plan.



NORTH AIRFIELD



NORTHEAST

SOUTH AIRFIELD

Figure 5-45. Alternative 2 – Preferred GA, Cargo, and Support Facility Alternative

Source: AECOM

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5.6 Airport Development Plan

The Airport Development Plan is made up of the four preferred alternatives that help satisfy airfield, commercial passenger terminal, landside and ground facilities, and GA, cargo, and support facility requirements identified in **Chapter :** *Facility Requirements*. The four preferred Round 2 alternatives and their categories are:

- Airfield: Alternative 2 – Low Cost
- Commercial Passenger Terminal: Alternative 2 – Short-Term Improvements
- Landside and Ground Facilities: **Airport Parking Plan**
- GA, Cargo, and Support Facilities: Alternative 2 – Consolidated Alternative

Based on ROM cost estimates, the total estimated cost of the projects depicted in the plan is $762,994,400. More information about cost and implementation is discussed in **Chapter :** *Facilities Implementation Plan*. **Figure - 6** , **Figure -** , and **Figure -** portray the Airport Development Plan.

5.6.1 Refinements

After the alternative workshops and the initial selections of the preferred alternatives for the four designated alternative categories, refinements were made to the Airport Development Plan based on stakeholder and Airport feedback during the Master Plan Realization Meeting. Refinements for the Airport Development Plan include:

- Incorporating the TDG 6 fillet geometry instead of adding taxiway shoulder to taxiways that lack shoulder. The taxiway improvements will be implemented as the existing taxiways are rehabilitated and funding allows.
- Shifting the south apron taxilane and VSR 8.5 feet for standard ADG V centerline separation with Taxiway G instead of converting Taxiway G into a taxilane and keeping the non-movement area lines where they are.
- Widening the ultimate multi-aircraft hangar east of the proposed maintenance hangar along the south apron and adding ultimate expansion capabilities for a multi-aircraft hangar east of the proposed bulk storage hangar of the same size for south apron expansion.
- Constructing a new trash facility that accommodates two covered dumpsters where the old triturator building is located in the upper employee parking lot.
- Adding a new access road and AOA access gate to the east of the GIAC facility.
- Adding a new AOA access gate off of Neptune Avenue with access to the south apron.
- Adding a second taxiway connector between Taxiway G and the south apron and adding pavement over the former “birdbath” pavement along the east side of the south apron.
- Adding a temporary aircraft storage facility west of the Nose Dock hangar.
- Adding an ARFF GIAA training facility, stairs tower, and burn pit where the former U.S. Navy burn pit was.
- Adding two canopies over the vehicle parking lots and a canopy over the right-most lane of the Terminal Departure Frontal Road.
- Lowering the Route 8 power poles as they could be potential obstructions to the Runway 6L or 6R approaches.
- Adding PODs 1, 3, and 6 for additional passenger vertical circulation with access to the sterile corridor.
- Relocating the two existing wind cones out of the ROFAs.

These refinements are reflected in **Figure - 6** and **Figure -** .

Refinements to the commercial passenger terminal portion of the Airport Development Plan include:

- Replacing the CBP and Guam Customs and Quarantine Agency (CQA) inspections booths with booths that meet current design standards and sit higher than they are currently.
- Though not essential through facility requirements, an ultimate commercial passenger terminal expansion is shown on the Airport Layout Plan (ALP) as this area was previously studied by GIAA as part of a separate project and selected as the preferred site should the need for additional gates materialize earlier than anticipated in this Master Plan.

This refinement is reflected in **Figure -** and cost estimates for all refinements will be provided in **Chapter :** *Facilities Implementation Plan*.

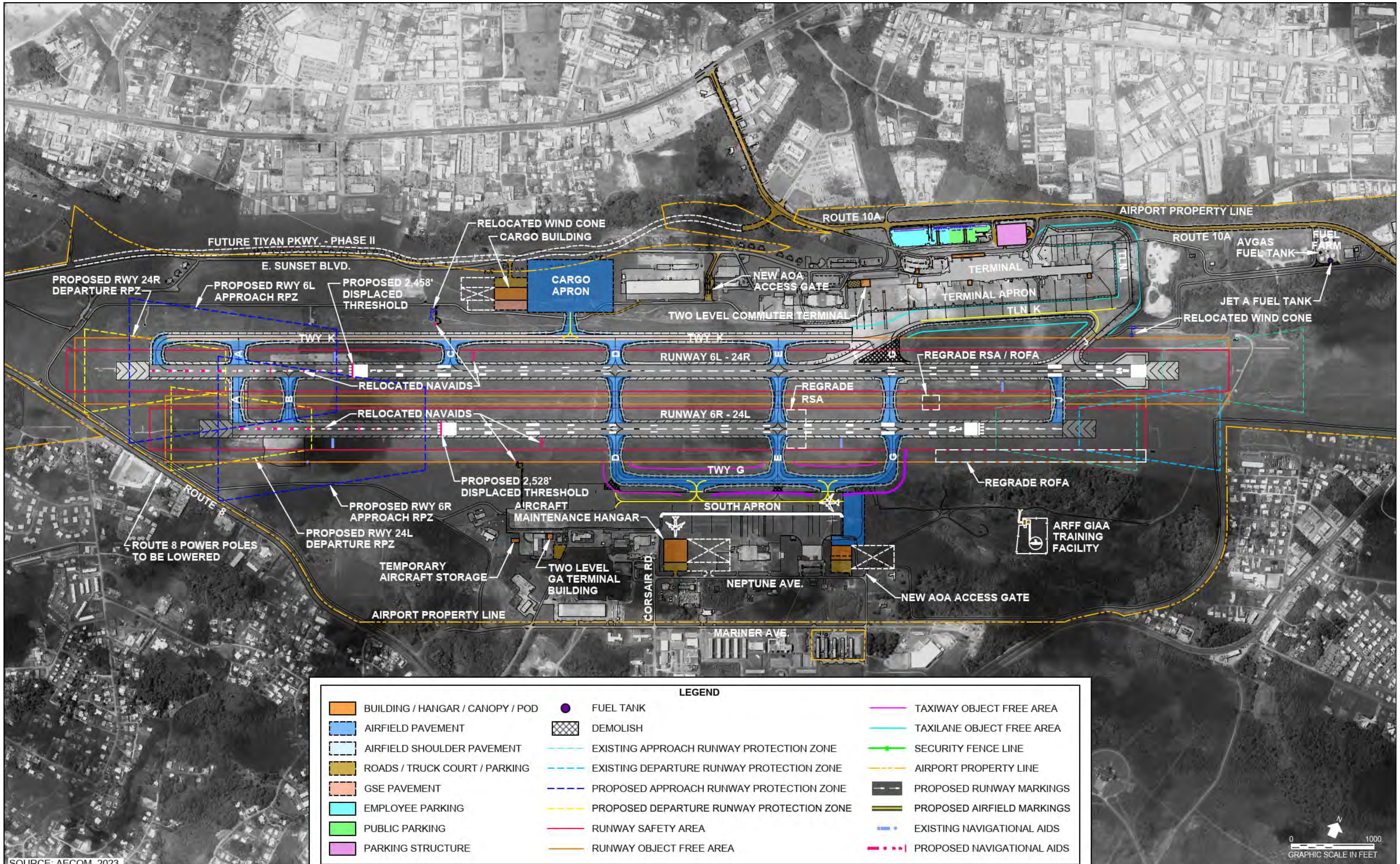
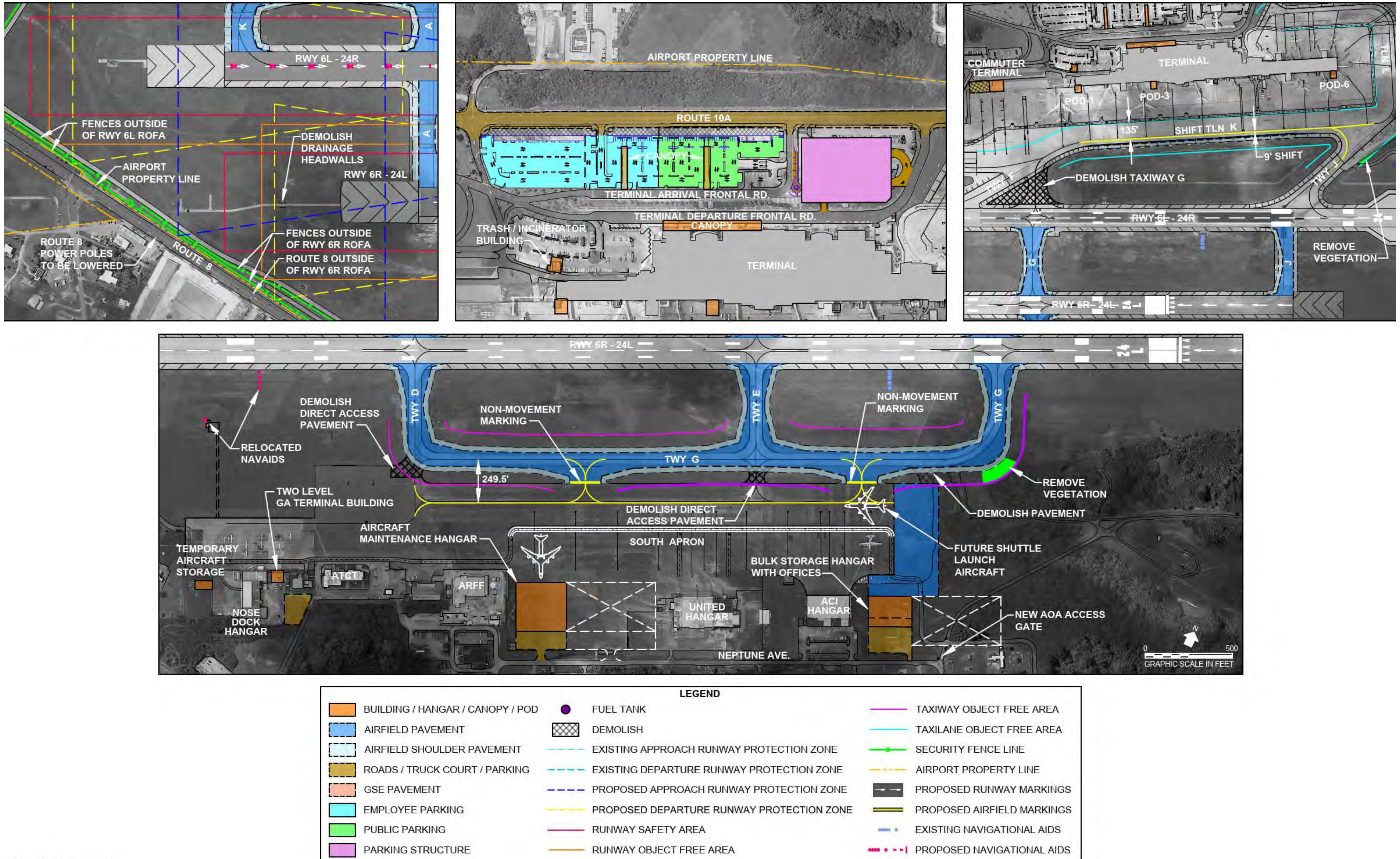


Figure 5-46. Airport Development Plan (1 of 3)

Source: AECOM



SOURCE: AECOM, 2023

Figure 5-47. Airport Development Plan (2 of 3)

Source: AECOM

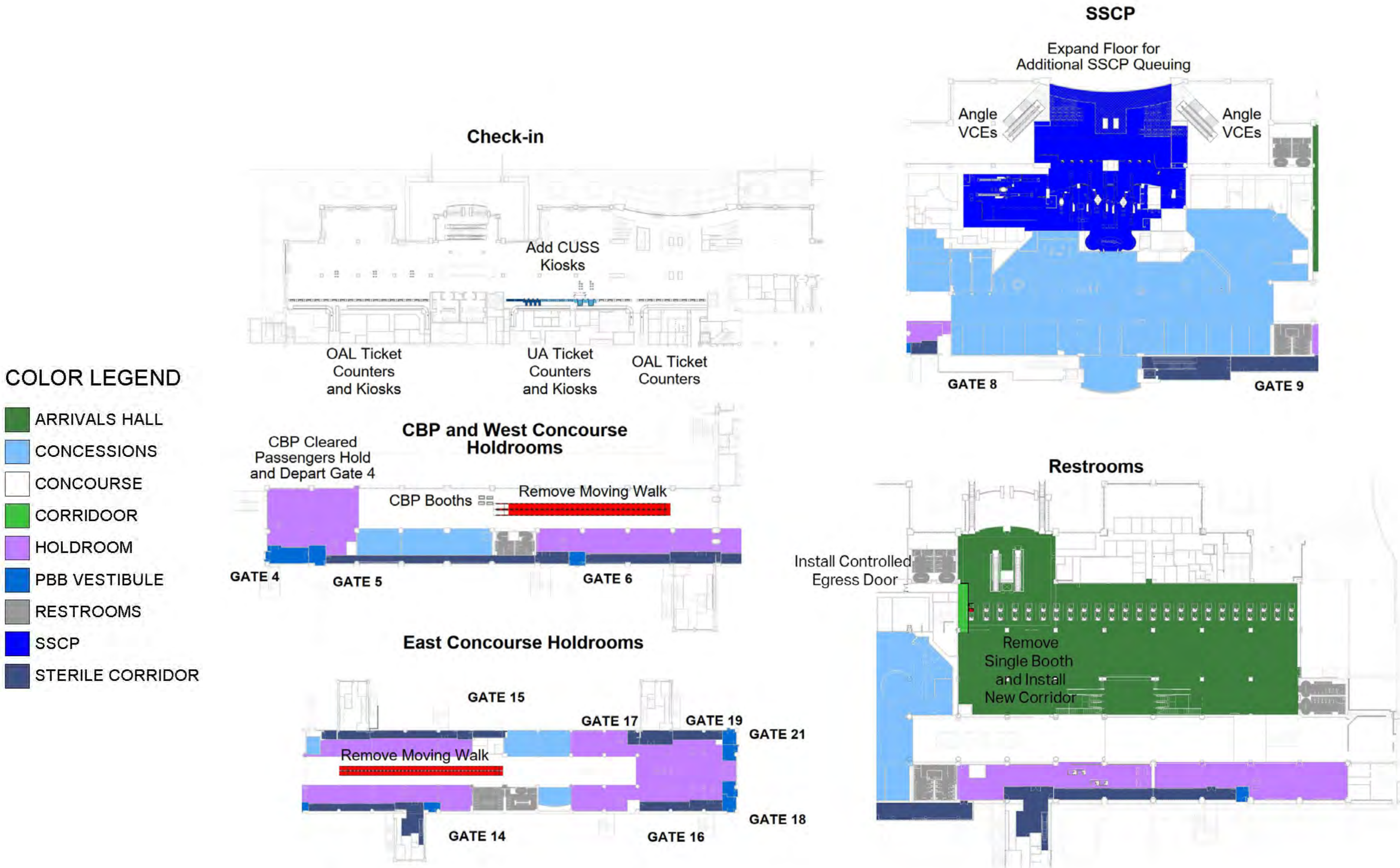


Figure 5-48. Airport Development Plan (3 of 3)

Source: AECOM

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6 Environmental Overview

Executive Summary

The n vironmental Overview chapter of the Antonio B. Won Pat International Airport Airport) Master Plan provides preliminary information about environmental resources on the Airport property, the potential for project-related effects on those resources from the implementation of the Airport Development Plan, and the rules and regulations that may apply.

The Airport Development Plan consists primarily of safety-related projects, projects to increase operational efficiency, projects to meet current and projected demand, and infrastructure projects to improve existing conditions (airfield projects) and enhance passenger convenience (commercial passenger terminal projects).

Several categories of environmental resources could be affected by construction and/operation of the Airport Development Plan projects. Based on the preliminary environmental screening analysis presented in this chapter, it is expected that Coastal Resources is the area that may require additional analysis and agency consultation in future environmental studies, when projects are ripe for development. The entire island of Guam is designated a Coastal Zone, and as such, development projects with potential to affect coastal resources may require a Coastal Zone Management consistency determination. The Guam Coastal Management Program, Bureau of Statistics and Plans, Government of Guam has developed a 2022 Guidebook for Development Requirements on Guam that will be a valuable resource for the A.B. Won Pat International Airport Authority, Guam (GIAA) when implementing the Airport Development Plan (Guam Development Guidebook | The Bureau of Statistics and Plans Guam). This guide also provides information for construction and permitting on Guam for several of the resource categories described in this chapter.

6.1 Introduction

An important component of the master planning process is the analysis of potential environmental impacts related to the Airport Development Plan discussed in **Chapter :** *Alternatives Development and Evaluation*. The purpose of this n vironmental Overview is twofold:

1. To identify significance thresholds for the various resource categories contained in Federal Aviation Administration (FAA) Order 1050.1F, n vironmental Impacts: Policies and Procedures and FAA Order 5050.4B, National n vironmental Policy Act (N PA) Implementation Instructions for Airport Actions, and
2. To evaluate the Airport Development Plan against these thresholds to identify potential environmental effects early in the process. This n vironmental Overview is based on information contained in the n vironmental Inventory previously detailed in **Section 2 9** in **Chapter 2:** *Inventory of Existing Conditions*.

The following environmental resources are discussed in this chapter:

- Air Quality (including Greenhouse Gases [GHGs] and Climate)
- Biological Resources
- Coastal Resources
- Department of Transportation Section 4(f)
- Hazardous Materials and Solid Waste
- Historic, Archaeological, and Cultural Resources
- Natural Resources and n ergy Supply
- Noise and Compatible Land Use
- Socioeconomics, n vironmental Justice, and Children's Health Safety Risks
- Visual f fects
- Water Resources

Figure 6-1 depicts the location of mapped resources on or near the Airport that will be discussed in this section.

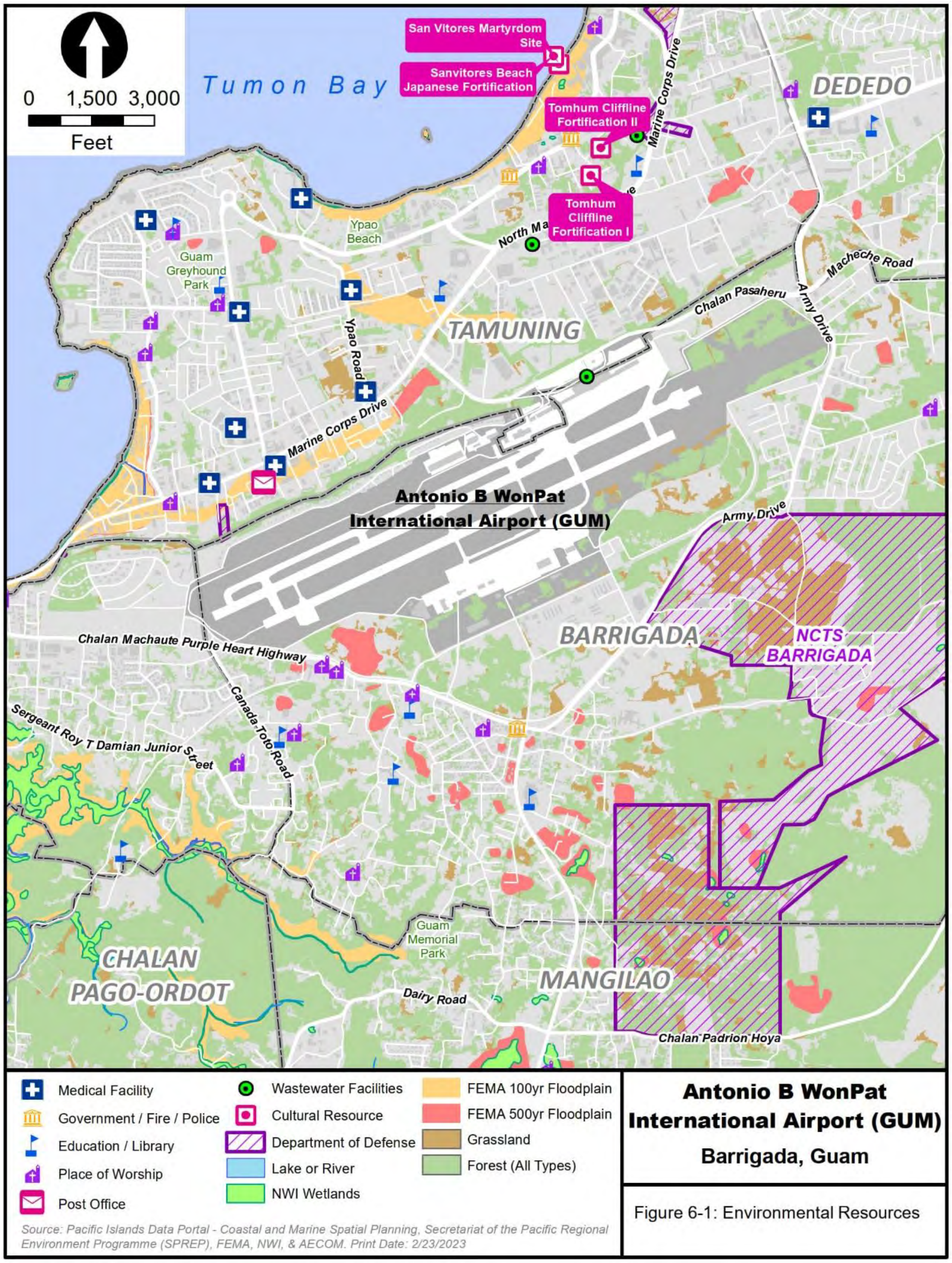

Figure 6-1. Environmental Resources

Sources:

1. *Pacific Islands Data Portal – Coastal and Marine Spatial Planning*
2. *Secretariat of the Pacific Regional Environment Programme (SPREP)*
3. *Federal Emergency Management Agency (FEMA)*
4. *National Wetlands Inventory (NWI)*
5. *AECOM*

6.2 Airport Development Plan

Chapter : *Alternatives Development and Evaluation* presented the alternatives evaluation and analysis that led to an Airport Development Plan designed to meet facility needs at the Airport through 2039. A summary of the Airport Development Plan is presented in **Figure 6-2**

6.2.1 Plan Components

able 6-1 summarizes the projects by category including airfield, commercial passenger terminal, landside, general aviation (GA), cargo, and support facilities.

able 6-1 Airport Development Plan Projects

Airfield Projects	**Commercial Passenger erminal Projects**
• Vegetation Removal • North Apron Improvements and Taxiway G Removal • Wind Cone Relocation (2) • Runway 6R/24L Safety Standards Compliance • South Apron Taxiway Connector Improvements • Shift South Apron Taxilane • Upgrade Taxiway D South, Taxiway South, and Taxiway G South • Runway 6L/24R Safety Standards Compliance • Upgrade Taxiway A North and Taxiway K Connector • Upgrade Taxiway A Center • Upgrade Taxiway B • Upgrade Taxiway C • Upgrade Taxiway D North • Upgrade Taxiway D Center • Upgrade Taxiway North • Upgrade Taxiway Center • Upgrade Taxiway G Center • Upgrade Taxiway J	• Removal of Moving Walkways in Concourse (2) • Relocate Outbound CBP Inspection Process • Arrivals Hall Restroom Access Corridor • SSCP Queue Area xpansion • Check-In Facility Upgrades • Terminal Departure Roadway Canopy • Loading Docks (2) • Upgrade CBP Protection Booths (23) • Upgrade Guam CQA Booths (11) • Construction of Pods 1, 3, and 6
andside Projects	**GA Projects**
• Airport Parking Plan • Rental Car Parking Structure	• Temporary Aircraft Storage Facility • GA Bulk Storage Hangar • GA Terminal • Light Aircraft Commuter Terminal
Cargo Projects	**Support Facilities Projects**
• Cargo Apron • Cargo Facilities	• Aircraft Fuel Avgas Tank • North AOA Access Gate • Trash Facility • Aircraft Fuel Jet A Tank • South AOA Access Gate • ARFF GIAA Training Facility • Large Aircraft Maintenance Hangar

Notes:
A. Acronyms
TDG = Taxiway Design Group
CBP = Customs and Border Protection
SSCP = Security Screening Checkpoint
CQA = Customs and Quarantine Agency
GA = General aviation
AOA = Airport Operations Area
ARFF = Aircraft Rescue and Fire Fighting
GIAA = A.B. Won Pat International Airport Authority, Guam
Source: AECOM

The projects proposed do not increase the capacity of the Airport, but instead focus on maintaining and/or improving existing pavements and other facilities with some expansion of hangar facilities, redevelopment for both terminals, and other future aviation-related development. The following sections present the environmental resources that would be considered in N P A compliance documents when a proposed project or action is ready for FAA decision making.

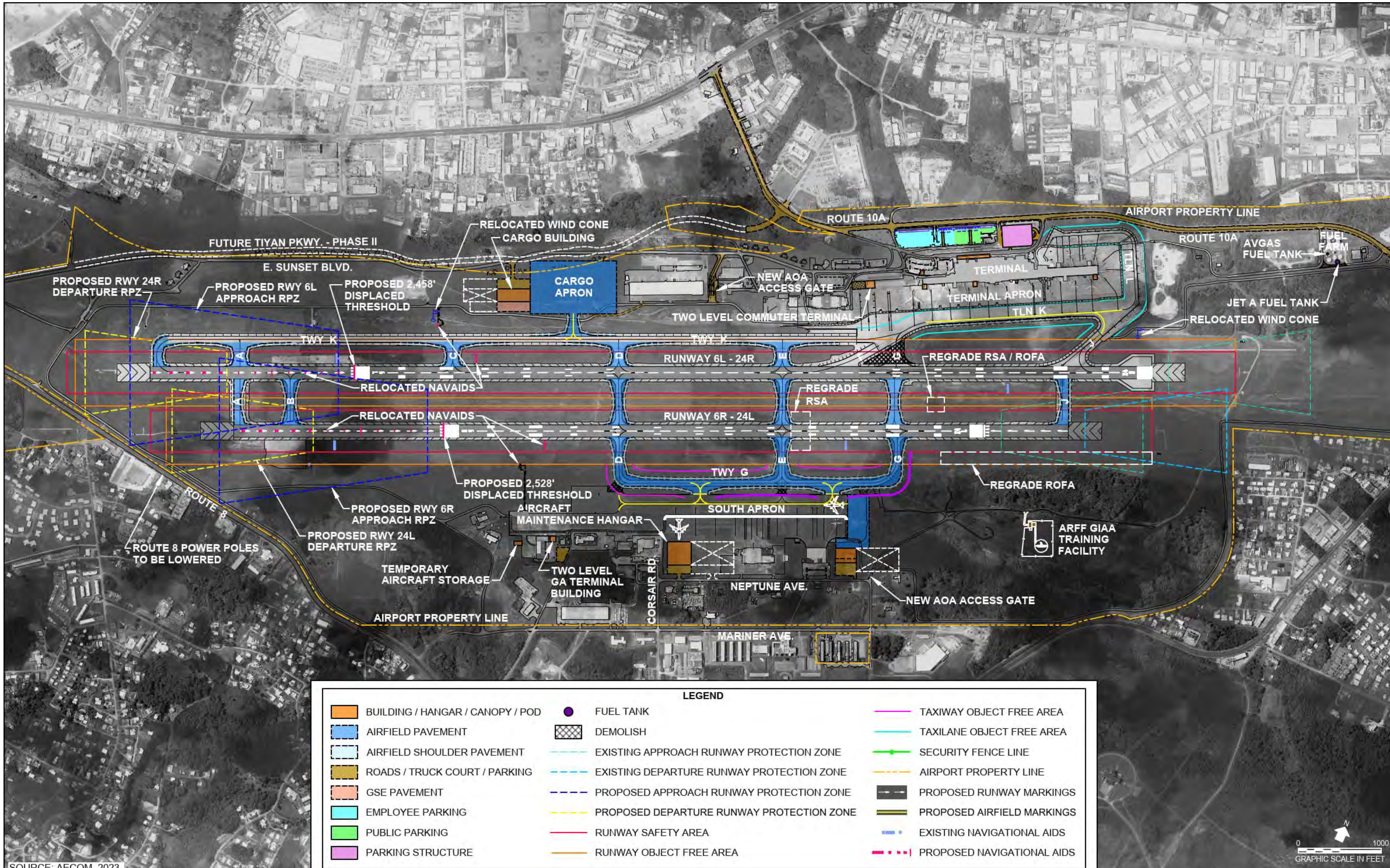

Figure 6-2: Airport Development Plan

Source: AECOM

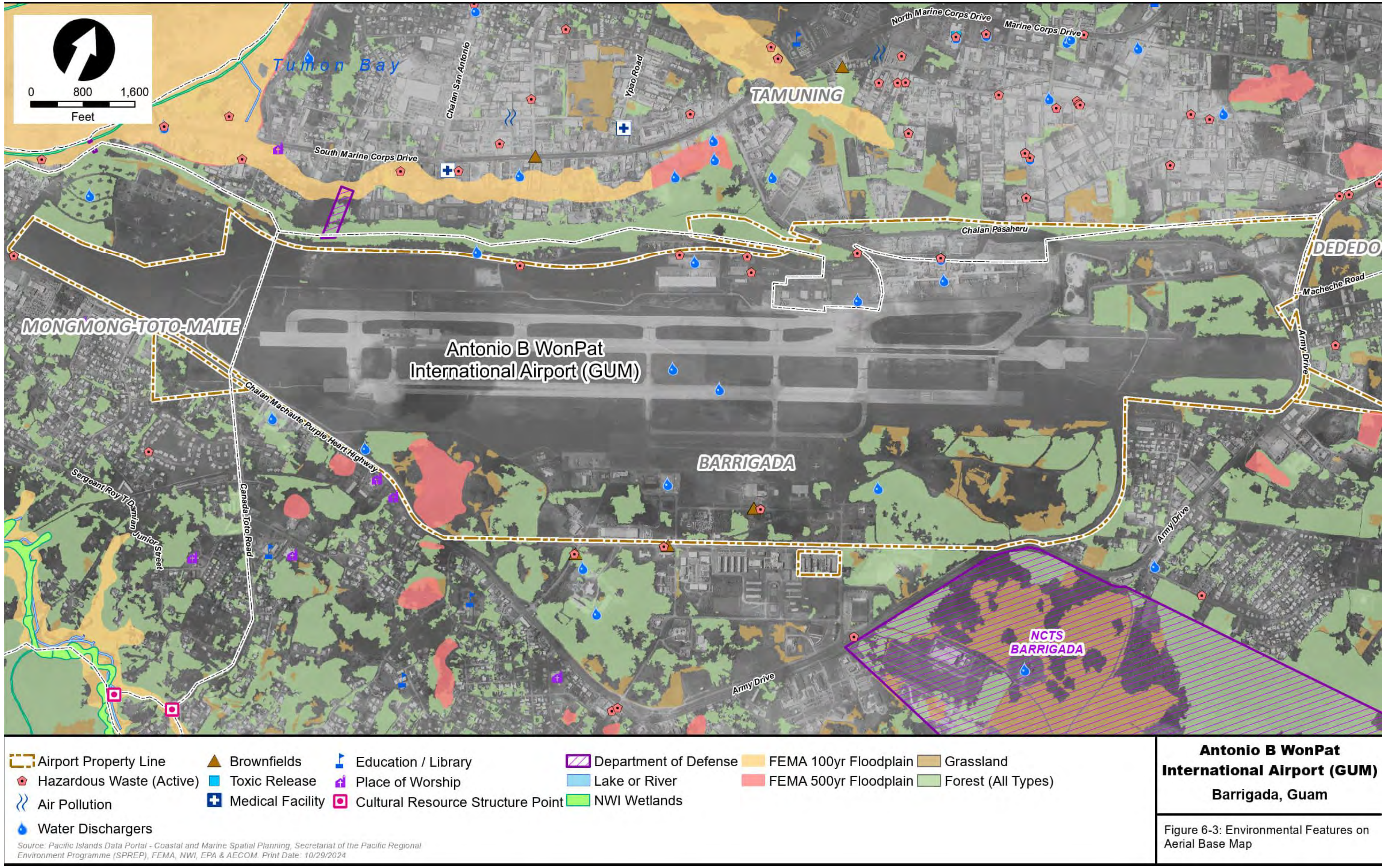

Figure 6-3: Environmental Features on Aerial Base Map

Sources:
1. *Pacific Islands Data Portal – Coastal and Marine Spatial Planning*
2. *SPREP*
3. *FEMA*
4. *NWI*
5. *AECOM*

6.3 Air Quality

This section discusses the potential effects of the Airport Development Plan on air quality at the Airport. Air quality is the measure of the condition of the air expressed in terms of ambient pollutant concentrations and their distribution. Air quality regulations are based on concerns that high concentrations of air pollutants can harm human health, especially for children, the elderly, and people with compromised health conditions; as well as adversely affect public welfare by damage to crops, vegetation, buildings, and other property.

6.3.1 Regulatory Setting

Section 176(c)(4) of the Clean Air Act (CAA) establishes the General Conformity Rule, which ensures that the actions taken by federal agencies in nonattainment and maintenance areas do not interfere with a state's plan to attain and maintain the National Ambient Air Quality Standards (NAAQS). Additionally, the CAA establishes *de minimis* levels, under which, project emissions are assumed to conform to the state's plan.[61] The Airport is in an area designated by the U.S. nvironmental Protection Agency (P A) as in attainment of the NAAQS, and so the General Conformity Rule does not apply.

The Guam P A's Air Pollution Control Program is responsible for enforcing the Air Pollution Control Standards and Regulations. These regulations were authored under the authority given by Guam's Air Pollution Control Act. This program is also responsible for helping implement actions required of Guam by the federal CAA.

6.3.2 FAA Significance hreshold

The FAA's significance threshold for air quality is when an action would cause pollutant concentrations to exceed one or more of the NAAQS, as established by the U.S. PA under the CAA, for any of the time periods analyzed, or to increase the frequency or severity of any such existing violations.

6.3.3 Potential Effects

A variety of air pollution sources are associated with airport operations. Mobile sources include aircraft, auxiliary power units (APUs), ground support equipment (GS) , and motor vehicles traveling on and off the roadways. Typical stationary/area sources include heaters, generators, fuel storage tanks, de-icing and anti-icing operations, and paint facilities.

The Airport Development Plan involves the construction of new and expanded Airport facilities that include the potential for increased air emissions. The nature and extent of these added emissions will depend on the ultimate scope of each project; therefore, project-specific air quality analyses may be needed to predict the additional emissions that a project would cause. After the appropriate air quality analyses are conducted, all applicable permits, certifications, and approvals would need to be obtained prior to any construction.

During construction, temporary air quality impacts would be expected; however, these impacts are not anticipated to be significant and can be mitigated by implementing best management practices including, but not limited to:

- Using construction equipment that can operate on alternative fuels or electricity wherever possible to minimize emissions associated with diesel- and gasoline-powered equipment.
- Instituting particulate control measures, such as watering and stabilizing wind erodible soil, as soon as practical after earth disturbance.

Because Guam is in attainment status for NAAQS, it is anticipated that project-induced emissions increases would not be significant.

[61] *The Territory of Guam has an approved State Implementation Plan (SIP):* Approved Air Quality Implementation Plans in Guam | US EPA

6.3.4 Greenhouse Gas Emissions, Climate Change, and NEPA

GHG[62] emissions continue to be an emerging issue for airports, the aviation industry, and the FAA. The Council on n vironmental Quality (C Q) recently updated its guidance for considering the effects of GHG emissions and climate change in N P A reviews.[63]

The FAA recommends that airports take the first step to reduce ground-based GHG emissions by estimating (or inventorying) the amount of GHG emissions from airport sources. Having a baseline inventory enables airports to:

- Better understand GHG emissions trends.
- Identify opportunities to reduce GHG emissions.
- Set GHG reduction targets.
- Track progress toward meeting targets.

Preparing a comprehensive GHG inventory is a recommended action item in the development of a sustainability program for the Airport, as explained further in **Chapter 9:** *Sustainability*.

For Master Plan projects that require quantification of air emissions, gross emissions increases or reductions in GHGs should be quantified individually, as well as aggregated in terms of total carbon dioxide equivalence by factoring in each pollutant's global warming potential (GWP) using the best available science and data.

6.4 Biological Resources

This section discusses the potential effects of the Airport Development Plan on biological resources at, or near, the Airport. Biological resources consist of existing populations of wildlife, fish, and plants present on the Airport property or in the vicinity of the Airport, including those that may be classified as threatened or endangered.

6.4.1 Regulatory Setting

There are five federal regulatory programs designed to protect biological resources:

- Federal n dangered Species Act (SA)
- Marine Mammal Protection Act (MMPA)
- Magnuson-Stevens Fishery Conservation Management Act
- Bald and Golden a gle Protection Act
- Migratory Bird Treaty Act

The Airport Development Plan does not involve activities that would have the potential to impact marine mammals, so no authorization under the MMPA will be sought. Similarly, the plan does not involve work in or near aquatic resources protected by Magnuson-Stevens Fishery Conservation and Management Act; therefore, coordination with the National Marine Fisheries Service will not be necessary.

6.4.2 FAA Significance hreshold

The FAA's significance threshold for biotic communities is when an action would have the potential for:

- A long-term or permanent loss of unlisted plant or wildlife species (i.e., extirpation of a species from a large project area);
- Adverse impacts to special status species or their habitats;

[62] Gases that trap heat in the atmosphere are called GHGs. The main GHGs are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O).
[63] *Council on Environmental Quality (CEQ -2022-0005) National Environmental Policy Act Guidance on Consideration of Greenhouse Gas Emissions and Climate Change/ Federal Register/Vol. 88, No. 5 / Monday January 9, 2023*.

- Substantial loss, reduction, degradation, disturbance, or fragmentation of native species' habitats or their populations; or
- Adverse impacts on a species' reproductive success rates, natural mortality rates, non-natural mortality, or ability to sustain the minimum population levels required for population maintenance.

6.4.3 Potential Effects

Airport property encompasses 1,654.19 acres, which include impervious and undeveloped areas. The impervious areas include buildings and paved areas such as roadways, runways, taxiways, aircraft aprons, and vehicular parking lots. The undeveloped areas consist of vegetative communities such as trees, scrub/shrub, and grassland (see **Figure 6-**). Grass areas are actively managed and mowed on a regular basis.

xi sting vegetative communities could provide habitat for wildlife, some of which may be classified as threatened, endangered, rare, or of special concern. Based on a review of the US Fish and Wildlife Service (USFWS) Information for Planning and Consultation (iPAC) database, 22 federally listed species are known to occur in the vicinity of the Airport. See **able 6-2** and **Section 6 1** .

able 6-2 hreatened and Endangered Species

Species	Scientific Name	Status
Mammals		
Mariana Fruit Bat	*Pteropus mariannus*	Threatened
Birds		
Guam Micronesian Kingfisher	*Halcyon cinnamomina cinnamomina*	ndangered
Guam Rail	*Rallus owstoni*	ndangered
Reptiles		
Green Sea Turtle	*Chelonia mydas*	ndangered
Slevin's Skin	*Emoia Slevini*	ndangered
Snails		
Fragile Tree Snail	*Samoana fragilis*	ndangered
Guam Tree Snail	*Partula radiolata*	ndangered
Humped Tree Snail	*Partula gibba*	ndangered
Insects		
Mariana ight-spot Butterfly	*Hypolimnas octocula marianensis*	ndangered
Mariana Wandering Butterfly	*Vagrans egistina*	ndangered
Flowering Plants		
Aplokating-palaoan	*Psychotria malaspinae*	ndangered
Berenghenas Halomtano	*Solanum guamense*	ndangered
Cebello Halumtano	*Bulbophyllum guamense*	Threatened
Dendrobium guamense		Threatened
ugenia bryanii		ndangered
Maesa walkeri		Threatened
Nervilia jacksoniae		Threatened
Tabernaemontana rotensis		Threatened
Tinospora homosepala		ndangered
Tuberolabium guamense		Threatened
Ufa-halomtano	*Heritiera longipetiolata*	ndangered
Conifers and Cycads		
Fadang	*Cycas micronesica*	Threatened

Source: USFWS iPAC

Most of the projects in the Airport Development Plan are in previously disturbed, paved areas. The proposed projects that would occur on undeveloped land include:

- Vegetation removal
- Construction of an air cargo apron
- Construction of a connector taxiway between the south apron and Taxiway G
- Construction of an ARFF GIAA training facility and burn pit
- Construction of a temporary aircraft storage facility
- Regrading the Runway Object Free Area (ROFA) for Runway 6R/24L ROFA
- Construction of an air cargo facility, vehicle parking lot, and access road
- Construction of a GA bulk storage hangar, apron, vehicle parking lot, and access road
- Construction of a GA terminal building, parking lot, and access roadway

Agency consultation may be required to determine the presence or absence of listed species habitat at a project-specific level. The outcome of these consultations would dictate if any mitigation measures are necessary to protect listed species and their habitat.

Figure 6-4: Land Cover Types

Sources:

1. *Pacific Islands Data Portal – Coastal and Marine Spatial Planning*
2. *SPREP*
3. *FEMA*
4. *NWI*
5. *AECOM*

6.5 Coastal Resources

This section discusses the potential effects of the Airport Development Plan on coastal resources, which include all natural resources occurring within coastal waters and their adjacent shorelands. Coastal resources include islands, transitional and intertidal areas, salt marshes, wetlands, floodplains, estuaries, beaches, dunes, barrier islands, and coral reefs, as well as fish and wildlife and their respective habitats within these areas.

6.5.1 Regulatory Setting

The entire island of Guam has been designated a “coastal zone” in the context of the Coastal Zone Management Act of 1972 (CZMA). Rather than designating a distinct "Coastal Zone" through delineation of an inland boundary by distance (e.g., 1,000 yards in California) or by geographical features, all non-federal property on the island of Guam, including the surrounding sea out to 3 miles, was included under the jurisdiction of the Guam Coastal Management Program (GCMP), established in 1979. Therefore, all the territory’s land and sea areas and all its land-use-related planning and regulatory agencies, programs, and laws fall within the jurisdiction of the program. The Bureau of Statistics and Plans administers the GCMP.

6.5.2 FAA Significance hreshold

The FAA has not established significance thresholds for coastal resources but has identified factors to consider in N P A documentation. These factors consist of activities that would:

- Be inconsistent with the relevant coastal zone management plan.
- Impact a coastal barrier resources system unit (and the degree to which the resource would be impacted).
- Pose an impact to coral reef ecosystems (and the degree to which the ecosystem would be affected).
- Cause an unacceptable risk to human safety or property.
- Cause adverse impacts to the coastal environment that cannot be satisfactorily mitigated.

6.5.3 Potential Effects

Section 307 of the CZMA, called the “federal consistency” provision, gives states and territories a strong voice, which they otherwise would not have, in federal agency decision-making for activities that affect a state’s coastal uses or resources. Generally, federal consistency requires that federal actions, within and outside the coastal zone, that have reasonably foreseeable effects on any coastal use (land or water), or natural resource of the coastal zone, be consistent with the enforceable policies of a state’s federally approved coastal management program. Federal actions include federal agency activities, projects, or actions requiring a federal license or permit, and federal financial assistance activities, such as grants to states and territories. The approval of airport development projects (49 U.S.C. 1716) is a listed federal action in the GCMP. Applicants for federal licenses and permits and recipients of federal funding are required to determine whether their projects that affect the coastal zone are consistent with the Program.

All federal activities, including issuance of permits and funding, must be consistent with the 18 enforceable policies of the GCMP. These policies are enshrined in Guam’s Comprehensive Development Plan and apply to all agencies and instrumentalities of the Government of Guam pursuant to xe cutive Order 78-37. See **Section 6 16** for the Guam GCMP policies.

Depending on an individual project’s potential to affect coastal resources, Airport Development Plan projects may require a CZMA consistency determination; this will be evaluated on a project-specific level.

6.6 Department of ransportation Section f Resources

This section discusses the potential effects of the Airport Development Plan on Section 4(f) resources.

6.6.1 Regulatory Setting

The U.S. Department of Transportation (DOT) Act of 1966 included a special provision, Section 4(f), which protects the use of land by publicly owned parks, recreation areas, wildlife and waterfowl refuge areas of national, state or local significance, and public and private historical sites. A "use" of Section 4(f) property may be a direct use (property is permanently incorporated into the transportation project), a temporary use (property is temporarily occupied in a way that is adverse to the property's purpose), or a constructive use (the project's impacts substantially impair the protected activities, features, or attributes of the property).

6.6.2 FAA Significance hreshold

FAA's significance threshold for Section 4(f) properties notes that a significant impact would occur when the action involves more than a minimal physical use of a Section 4(f) resource or constitutes a "constructive use" based on an FAA determination that the aviation project would substantially impair the Section 4(f) resource.

6.6.3 Potential Effects

Several publicly owned parks/recreation areas are located around the Airport (see **Figure 6-**). The Guam National Wildlife Refuge (NWR) is located 11 miles north of the Airport. The Guam NWR is composed of three units: the Andersen Air Force Base (AAFB) Overlay Unit (Air Force Overlay Unit), the Navy Overlay Unit, and the Ritidian Unit. The Ritidian Unit, known to the Native Chamorro people as *Puntan Litekyan*, is located on the northern tip of Guam and encompasses 1,217 acres, including 385 terrestrial acres and 832 acres of submerged areas offshore.

Section 4(f) also applies to historic sites, which are discussed later in this chapter. There are no National Register of Historic Places (NRHP) sites listed or eligible on Airport property or near any of the projects in the Airport Development Plan. Refer to **Figure 6-1** for the location of historic/cultural resources.

The Airport Development Plan, as proposed, would not physically "use" any Section 4(f) properties; however, because a "use" could include "constructive use," supplemental analysis may be required to address potential indirect effects on Section 4(f) resources farther from the Airport, such as aircraft overflights and noise impacts, when projects are ready for implementation.

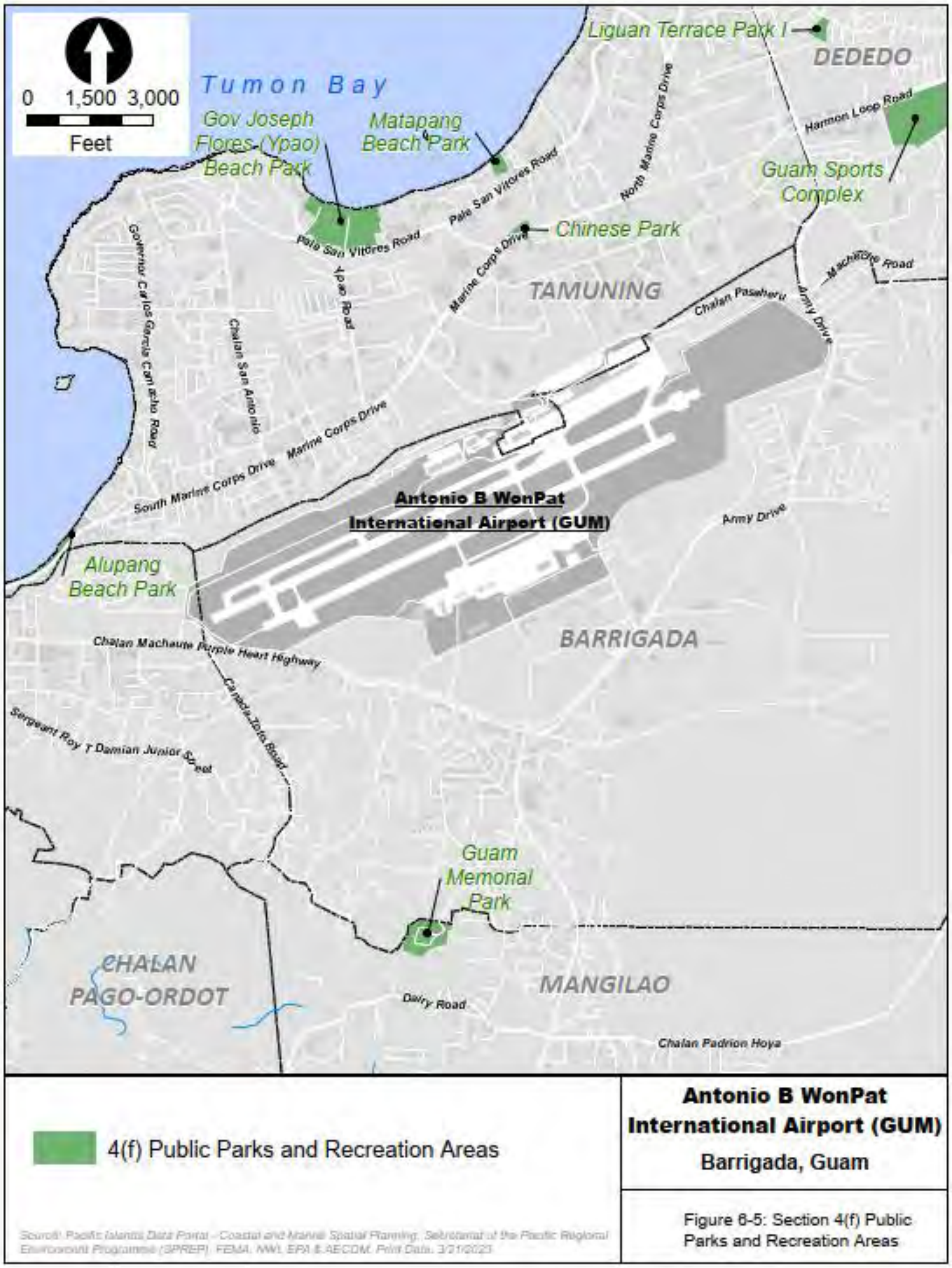

Figure 6-5: Section 4(f) Public Parks and Recreation Areas

Sources:

1. *Pacific Islands Data Portal – Coastal and Marine Spatial Planning*
2. *SPREP*
3. *FEMA*
4. *NWI*
5. *AECOM*

6.7 aza rdous Materials and Solid Waste

This section discusses the potential effects of the Airport Development Plan on hazardous materials and solid waste in terms of handling, disposal, and collection.

6.7.1 Regulatory Setting

Federal aw

Hazardous waste is considered any waste that can be dangerous or potentially harmful to human health or the environment. The Hazardous Waste program originated in 1965 with the federal Solid Waste Disposal Act. In 1976, the United States passed the Resource Conservation and Recovery Act, commonly known as RCRA, which split Hazardous Waste and Solid Waste into two distinct areas. This law gave the U.S. P A greater ability to regulate hazardous waste from “cradle-to-grave.”

ocal Mandates

In December 1998, Guam Public Law 24-64 created the Hazardous Waste Management Program. This program was created to protect Guam’s environment from potentially dangerous and harmful chemicals. This includes liquids, storage facilities for hazardous waste, and other areas. Many of the areas this program focuses on match federal mandates established for other states and territories, for example working with Underground Storage Tanks (USTs) or shipping hazardous materials.

6.7.2 FAA Significance hreshold

The FAA has not yet established a significance threshold for hazardous materials, solid waste, or pollution prevention. However, the FAA has identified factors to consider in evaluating the context and intensity of potential impacts. If these factors exist, there is not necessarily a significant impact; rather, the FAA must evaluate these factors considering context and intensity to determine if there are significant impacts.

Factors to consider that may be applicable to hazardous materials, solid waste, and pollution prevention include, but are not limited to, situations in which the proposed action or alternative(s) would have the potential to:

- Violate applicable federal, state, tribal, or local laws or regulations regarding hazardous materials and/or solid waste management.
- Involve a contaminated site (including, but not limited to, a site listed on the National Priorities List [NPL]). Contaminated sites may encompass relatively large areas. However, not all of the grounds within the boundaries of a contaminated site are contaminated, which leaves space for siting a facility on non-contaminated land within the boundaries of a contaminated site. If appropriately mitigated, actions within the boundaries of a contaminated site would not have significant impacts.
- Produce an appreciably different quantity or type of hazardous waste.
- Generate an appreciably different quantity or type of solid waste or use a different method of collection or disposal and/or would exceed local capacity.
- Adversely affect human health and the environment.

6.7.3 Potential Effects

- The use, handling, storage, and disposal of hazardous materials and other regulated substances at the Airport are typical of most commercial airports. Activities that involve the use of these materials include:
- Fueling, servicing, maintenance, and repair of aircraft, GS , and motor vehicles.
- Operation and maintenance of the airfield, commercial passenger terminal complex, and passenger concourses.
- Other special purposes connected with commercial aviation (e.g., rental car and air cargo facilities, navigation and air traffic control functions).

- Activities with the highest involvement of hazardous and/or regulated materials include fuel storage and maintenance of aircraft, equipment, and buildings. Other, smaller amounts of petroleum products (e.g., lubricants and solvents), waste materials (e.g., used oils, cleaning residues, spent batteries), and manufactured chemicals (e.g., herbicides, fertilizers, paints, etc.) are found at various locations throughout the Airport. These are used on a routine basis in support of aircraft, GS , and motor vehicle maintenance activities and for a range of other functions to keep the Airport operational.
- According to available data sources, there are no NPL sites or 'Superfund' cleanup activities involving Airport property or lands adjacent to the Airport. NPL sites are considered by the P A to have the most significant public health and environmental risks to surrounding areas. Airport development projects in the Airport Development Plan avoid the identified brownfield sites depicted on **Figure 6-3** and summarized in **Chapter 2:** *Inventory of Existing Conditions*.
- Airport officials have identified a potentially contaminated area of concern adjacent to the existing cargo building that is undeveloped and protected by fencing. The proposed new gate/fencing project may disturb some of this area. It is possible that this project, or other proposed construction projects, could encounter contaminated soils and/or groundwater requiring treatment or disposal. All work would be done in accordance with applicable regulations. Construction and demolition debris associated with proposed projects would be recycled to the greatest extent practicable.

6.8 is toric, Archaeological, and Cultural Resources

This section discusses the potential effects of the Airport Development Plan on identified historical, architectural, archaeological, and cultural resources at or near the Airport.

6.8.1 Regulatory Setting

Historic properties affected by proposed airport projects or actions are federally regulated under the National Historic Preservation Act (NHPA), the Archaeological Resources Protection Act (ARPA), and other applicable laws and regulations intended to protect historic properties. Section 106 of the NHPA requires federal agencies to take into account the effects of their actions on historic properties, to afford the Advisory Council on Historic Preservation (ACHP) a reasonable opportunity to comment, and include an opportunity for consultation with all interested parties. Historic properties include any prehistoric or historic district or site that is listed or eligible for listing in the NRHP.

Prior to undertaking any airport project, the FAA must determine if the project has the potential to affect historic properties and, if so, for making a determination about the effects of the project on historic properties. As the lead federal agency, the FAA is responsible for consulting with the Guam State Historic Preservation Office (SHPO), which oversees the NRHP program on Guam. The process by which the FAA decides whether a project or action affects historic properties is called a Section 106 review.

6.8.2 FAA Significance hreshold

The FAA has not established a significance threshold for the full range of historic, architectural, archaeological, and cultural resources; however, the FAA has identified a factor to consider when evaluating the context and intensity of potential environmental impacts for historic, architectural, archaeological, and cultural resources. This factor includes, but is not limited to, situations in which the proposed action or alternative(s) would result in a finding of Adverse f fect through the Section 106 process.

6.8.3 Potential Effects

There are no NRHP-listed or eligible historic resources on existing Airport property. Therefore, no physical disturbances to aboveground historic resources are anticipated from the Airport Development Plan, as none are present on existing Airport property. NRHP-listed or eligible historic resources are located beyond the Airport boundaries, primarily to the north of Airport along the coastline (refer to **Figure 6-1**).

Coordination on a project-specific level may be required with Guam's SHPO, which is responsible for reviewing all federal undertakings related to building permits, private construction, or development projects, to ensure that potential impacts to historic properties are considered.

6.9 Natural Resources and Energy Supply

This section discusses the potential effects of the Airport Development Plan on natural resources (such as water, asphalt, aggregate, wood, etc.) and the use of energy supplies (such as coal for electricity, natural gas for heating, and fuel for aircraft or other ground vehicles) resulting from construction, operation, and/or maintenance of the proposed project.

6.9.1 Regulatory Setting

Applicable federal regulations include the n ergy Independence and Security Act (42 U.S.C. § 17001 et seq.), which requires federal agencies to increase renewable energy production, and increase the energy efficiency of buildings and vehicles, and the n ergy Policy Act (42 U.S.C. § 15801 et seq.), which requires federal agencies to act in a manner that ensures future jobs with secure, affordable, and reliable energy.

6.9.2 FAA Significance hreshold

The FAA has not established a significance threshold for natural resources and energy supply but has identified a factor to consider when evaluating the context and intensity of potential environmental impacts for natural resources and energy supply. This factor includes, but is not limited to, situations in which the proposed project would have the potential to cause demand to exceed available or future supplies of these resources. For most actions, changes in energy demands or other natural resource consumption for FAA projects will not result in significant impacts.

6.9.3 Potential Effects

The Airport Development Plan will likely increase demand on energy resources; however, given the proposed improvements will be developed in phases, project-specific implementation is not expected to strain energy availability or resource consumption either at the Airport or in the territory.

On a project-specific level, the evaluation of impacts on energy supplies and consumable natural resources should consider whether and how a project could directly or indirectly increase demand on the following:

- Utilities servicing the area.
- Water sources (rivers, lakes, aquifers, etc.) and if they have the capacity to support a project’s construction, operation, and maintenance.
- Fuel consumption.
- Consumable materials, especially scarce or unusual materials, in and around the project area.
- Local rules, ordinances, or guidelines that apply to natural resources, energy supply, and any resulting by-products of increased usage of the above resources.

To minimize resource consumption, projects in the Airport Development Plan will incorporate energy efficient technologies into the design and operation (see **Chapter 9: Sustainability** for more information).

The Barrigada Reservoir is the current source of water for the main terminal building, domestic and fire protection water for the fuel farm, and water to the Airport Industrial Park facilities. Guam Power Authority (GPA) provides electricity to the Airport through several substations and distribution power lines. As Master Plan projects are implemented, coordination with utility service providers may be necessary.

6.10 Noise and Compatible and Use

This section discusses the potential noise effects of the Airport Development Plan on compatible land use. The compatibility of existing and planned land uses with proposed aviation development actions is usually determined in relation to the level of aircraft noise.

6.10.1 Regulatory Setting

The Federal Aviation Noise Abatement Policy establishes the noise abatement authority and responsibilities of the federal government, airport proprietors, state and local governments, air carriers, air travelers, shippers, and airport area residents and prospective residents. It emphasizes that the FAA's role is primarily one of regulating noise and its source (the aircraft), plus supporting local efforts to develop airport noise abatement plans. The FAA gives high priority in the allocation of Airport Development Aid Program funds to projects designated to ensure compatible use of land near airports, but it is the role of local governments and airport proprietors to undertake the land use and operational actions necessary to promote compatibility.

6.10.2 FAA Significance hreshold

The FAA defines significance as any location exposed to noise greater than 65 Day-Night Average Sound Level (DNL) or experiencing an increase of 1.5 dBA (A-weighted decibels) in noise as a result of a proposed project.[64]

6.10.3 Potential Effects

Airport development projects have the potential to change community noise levels. These changes may result from differences in aircraft type, approach and departure procedures, and/or the frequency of takeoffs and landings. Ambient noise levels may also be affected by realigned roadways as well as changes in airport traffic volumes and vehicle speeds. In addition, construction activities generate noise impacts, but these are more localized, short-term or temporary in nature, and the effects diminish as projects near completion. Most often, airport noise analysis focuses on how proposed projects may change future airport operations and the levels of aircraft noise affecting communities in areas surrounding the airport.

Projects in the Airport Development Plan that have the potential to change noise levels include the Runway 6L/24R and Runway 6R/24L Safety Standards Compliance projects. During the construction phase, each runway will be required to be closed, thereby shifting operations to the other runway. The N P A analysis for these projects would consider the potential change in noise from the shift in aircraft operations during construction. After construction, the noise effects on the surrounding land use would be less than the existing conditions due to increasing the declared distances and moving the Runway 6L and 6R thresholds closer to the center of the runway.

6.11 Socioeconomics, Environmental Justice, and Children's ealth Safety Risks

This section discusses the potential effects of the Airport Development Plan on communities around the Airport and whether a proposed project would result in disproportionately high or adverse effects to protected populations or pose a disproportionately high or adverse health or safety risk to children.

6.11.1 FAA Significance hreshold

Socioeconomics

The FAA has not established a significance threshold for socioeconomic impacts; however, the FAA has identified factors to consider when evaluating the context and intensity of potential impacts on the surrounding communities including the potential for a project to:

- Relocate people from their homes.
- Move businesses.
- Cause substantial changes in local traffic patterns.
- Disrupt or divide an established community.
- Create a notable change in employment.
- Lead to a disproportionately high and adverse impact to low-income or minority populations.

[64] *DNL means the 24-hour average sound level, in decibels (dB), for the period from midnight to midnight, obtained after the addition of 10 decibels to sound levels for the periods between midnight and 7 a.m., and between 10 p.m., and midnight, local time.*

- Lead to a disproportionate health or safety risk to children.

Environmental Justice

The FAA has not established a significance threshold for nvironmental Justice (J) but has identified factors to consider when evaluating the context and intensity of potential environmental impacts. These factors include a situation in which the proposed project would have the potential to lead to a disproportionately high and adverse impact due to:

- Other environmental impact categories.
- The physical or natural environment that affect an J population in a way that the FAA determines is unique and significant to that population.

Children's ealth and Safety Risks

The FAA has not determined a significance threshold pertaining to impacts to children's environmental health and safety but has identified factors to consider in evaluating the context and intensity of environmental impacts. These factors include situations in which the proposed action would have the potential to lead to a disproportionate health or safety risk to children. This is not intended to be a threshold, but to be evaluated with regard to the context and intensity of the impact.

6.11.2 Potential Effects

The Airport is not planning on releasing or acquiring any property during the Master Plan planning period; therefore, there is no need for the relocating of any residence or business. The proposed projects, a majority of which are airfield improvement projects for compliance with FAA safety standards, would have no off-Airport impacts.

According to the U.S. P A's nvironmental Justice Screening and Mapping Tool (Version 2.11), there are low-income populations northeast and southwest of the Airport.

The closest school to the Airport is the BP Carbullido lementary School campus located approximately 860 feet south of the closest Airport property line.

Airport Development Plan projects that will receive FAA funding or approval will consider the direct and indirect effects on the minority and low-income populations as well as children's health and safety in the vicinity of the Airport.

6.12 Visual Effects

This section discusses whether projects in the Airport Development Plan would contrast with, or detract from, the identified visual resources and/or the visual character of the existing Airport environment.

6.12.1 FAA Significance hreshold

The FAA has not established a significance threshold for visual effects; however, the FAA has identified factors to consider when evaluating the context and intensity of potential environmental impacts for visual effects. Factors considered include the extent to which a project would have the potential to:

- Affect the nature of the visual character of the area, including the importance, uniqueness, and aesthetic value of the affected visual resources.
- Contrast with the visual resources and/or visual character in the study area.
- Block or obstruct the views of visual resources, including whether these resources would still be viewable from other locations.

6.12.2 Potential Effects

The Airport Development Plan includes sources of light emissions, including airfield lighting, that are required for safe and efficient Airport operations at night and during inclement weather conditions. Other types of lighting systems include:

- Visual approach aids.
- Obstruction lighting.
- Commercial passenger terminal and facilities lighting.
- Roadway and parking lot lighting.

All future development would be located on-Airport. No designated scenic resources or views in the area would be adversely impacted. Project-related light emissions or other visual effects are not expected to be a significant issue.

6.13 Water Resources

This section discusses the potential effects of the Airport Development Plan on water resources at or near the Airport. Water resources include surface water, groundwater, floodplains, and wetlands.

6.13.1 FAA Significance hreshold

FAA's significance threshold for surface water is that a significant impact exists if the action would:

- xce ed water quality standards established by federal, state, local, and tribal regulatory agencies.
- Contaminate public drinking water supply such that public health may be adversely affected.

In addition to the significant impact thresholds, FAA provides additional factors to consider when determining if a significant impact exists. These factors include situations in which a project would have the potential to:

- Adversely affect natural and beneficial water resource values to a degree that substantially diminishes or destroys such values.
- Adversely affect surface waters such that the beneficial uses and values of such waters are appreciably diminished or can no longer be maintained, and such impairment cannot be avoided or satisfactorily mitigated.
- Present difficulties based on water quality impacts when obtaining a permit or authorization.

The FAA's significance threshold for groundwater is that a significant impact exists if either of the following are true:

- The action would exceed groundwater quality standards established by federal, state, local, and tribal regulatory agencies.
- The action would contaminate an aquifer used for public water supply such that public health may be adversely affected.

6.13.2 Potential Effects

The construction and operation of airport projects have the potential to affect the quality and quantity of water resources on and near an airport. Potential sources of surface water and groundwater pollution on Airport property are erosion and sedimentation from construction, wastes from fueling and cleaning operations, fuel and oil spills, and fertilizers and pesticides used for insect and vegetation control.

Project-related increases in surface water runoff are expected to be minor compared to the existing area of impervious surface at the Airport. An Airport Stormwater Management Plan should be developed, or updated if one is maintained for Airport operations, to reflect the projects shown on the Airport Layout Plan (ALP). It is expected that increases in runoff can be treated adequately via overland flow and in new and/or expanded swales and detention ponds that can be incorporated into the existing stormwater collection and treatment system.

With proper management and control measures, the construction and operation of projects in the Airport Development Plan would not be expected to have a substantial impact on groundwater resources. To protect surface water features and groundwater from sources of pollution, project-specific best management practices (BMPs) and stormwater pollution prevention plans (SWPPPs) should be developed to prevent or minimize the potential release of contaminants to groundwater. BMPs and SWPPPs often require measures to prevent spills, provide swift response to accidental spills, and define acceptable on-site storage of fuel and lubricants.

6.14 NEPA Compliance Overview

The construction of any project in the Airport Development Plan, as shown on **Figure 6-2**, would require compliance with N P A to receive federal financial assistance. For projects not "categorically excluded" under FAA Order 1050.1F, compliance with N P A is generally satisfied through the preparation of an n vironmental Assessment (A). **able 6-3** presents the likely level of N P A documentation based on the project descriptions in the Airport Development Plan.

able 6-3 NEPA Compliance Summary

Airside Projects	Anticipated NEPA Action
Vegetation Removal	Cat x (Par. 5-6.4.w)
North Apron Improvements and Taxiway G Removal	Cat x (Par. 5-6.4.e)
Wind Cone Relocation (2)	Cat x (Par. 5-6.3.e)
Runway 6R/24L Safety Standards Compliance	A
South Apron Taxiway Connector Improvements	Cat x (Par. 5-6.4.e)
Shift South Apron Taxilane	Cat x (Par. 5-6.4.e)
Upgrade Taxiway D South, Taxiway South, and Taxiway G South	Cat x (Par. 5-6.4.e)
Runway 6L/24R Safety Standards Compliance	A
Upgrade Taxiway A North and Taxiway K Connector	Cat x (Par. 5-6.4.e)
Upgrade Taxiway A Center	Cat x (Par. 5-6.4.e)
Upgrade Taxiway B	Cat x (Par. 5-6.4.e)
Upgrade Taxiway C	Cat x (Par. 5-6.4.e)
Upgrade Taxiway D North	Cat x (Par. 5-6.4.e)
Upgrade Taxiway D Center	Cat x (Par. 5-6.4.e)
Upgrade Taxiway North	Cat x (Par. 5-6.4.e)
Upgrade Taxiway Center	Cat x (Par. 5-6.4.e)
Upgrade Taxiway G Center	Cat x (Par. 5-6.4.e)
Upgrade Taxiway J	Cat x (Par. 5-6.4.e)
Commercial Passenger erminal Projects	
Removal of Moving Walkways in Concourse (2)	N/A[A]
Relocate Outbound CBP Inspection Process	N/A[A]
Arrivals Hall Restroom Access Corridor	N/A[A]
SSCP Queue Area xpansion	N/A[A]
Check-In Facility Upgrades	N/A[A]
Terminal Departure Roadway Canopy	Cat x (Par. 5-6.4.f)
Loading Docks (2)	Cat x (Par. 5-6.4.f)
Upgrade CBP Protection Booths (23)	N/A[A]
Upgrade Guam CQA Booths (11)	N/A[A]
Construction Pods 1, 3, and 6	Cat x (Par. 5-6.4.f)
andside Projects	
Airport Parking Plan	Cat x (Par. 5-6.4.e and h)
Rental Car Parking Structure	Cat x (Par. 5-6.4.e and h)

GA Projects	
Temporary Aircraft Storage Facility	Cat x (Par. 5-6.4.f)
GA Bulk Storage Hangar	A
GA Terminal	Cat x (Par. 5-6.4.h)
Light Aircraft Commuter Terminal	Cat x (Par. 5-6.4.v)
Cargo Projects	
Cargo Apron	Cat x (Par. 5-6.4.e)
Cargo Facilities	A
Support Facilities Projects	
Aircraft Fuel Avgas Tank	Cat x (Par. 5-6.4.u)
North AOA Access Gate	Cat x (Par. 5-6.4.e)
Trash Facility	Cat x (Par. 5-6.4.f)
Aircraft Fuel Jet A Tank	Cat x (Par. 5-6.4.u)
South AOA Access Gate	Cat x (Par. 5-6.4.e)
ARFF GIAA Training Facility, Stair Tower, and Burn Pit	A
Large Aircraft Maintenance Hangar	Cat x (Par. 5-6.4.f)

Notes:

A. *Interior improvement projects may not be subject to NEPA; however, coordination with the FAA on the scope of the project would assist in determining if a CatEx would be required to satisfy funding applications and approvals.*

B. *Acronyms*

NEPA = National Environmental Policy Act
TDG = Taxiway Design Group
CBP = Customs and Border Protection
SSCP = Security Screening Checkpoint
CQA = Customs and Quarantine Agency
GA = General Aviation
AOA = Airport Operations Area
ARFF = Aircraft Rescue and Fire Fighting
GIAA = A.B. Won Pat International Airport Authority, Guam
CatEx = Categorical Exclusion Evaluation
EA = Environmental Assessment

Source: AECOM

All of the projects, except for the five listed below, are potentially eligible for a Cat x , provided there are no extraordinary circumstances that need to be considered, according to FAA Order 1050.1F. These projects meet the criteria in Paragraph 5-6.4, Categorical xcl usions for Facility Siting, Construction, and Maintenance. This category includes the list of Cat xs for FAA actions involving acquisition, repair, replacement, maintenance, or upgrading of grounds, infrastructure, buildings, structures, or facilities that generally are minor in nature. The projects that may require an A include:

- Runway 6R/24L Safety Standards Compliance
- Runway 6L/24R Safety Standards Compliance
- GA Bulk Storage Hangar
- Cargo Facilities
- The ARFF GIAA Training Facility, Stair Tower, and Burn Pit

As are prepared for an airport development project when the initial review of the proposed action indicates that it is not categorically excluded, involves at least one extraordinary circumstance, or the action is not one known to normally require an environmental impact statement (I S). As typically take longer to prepare than Cat xs , as they require more detailed analysis and agency consultation. The purpose of an A is to document the FAA determination as to whether a proposed action has the potential for significant environmental impacts. If none of the potential impacts are likely to be significant, then the responsible FAA official prepares a Finding of No Significant Impact (FONSI), which briefly presents, in writing, the reasons why an action, not otherwise categorically excluded, will not have a significant impact on the human environment and the approving official may approve it. Issuance of a FONSI signifies that the FAA will not prepare an I S and has completed the N P A process for the project.

6.15 hreatened and Endangered Species

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Pacific Islands Fish And Wildlife Office
300 Ala Moana Boulevard, Box 50088
Honolulu, HI 96850-5000
Phone: (808) 792-9400 Fax: (808) 792-9580

In Reply Refer To: March 23, 2023
Project Code: 2022-0012271
Project Name: Antonio B. Won Pat International Airport Master Plan Update

Subject: List of threatened and endangered species that may occur in your proposed project location or may be affected by your proposed project

To Whom It May Concern:

The enclosed species list identifies threatened and endangered species, as well as designated critical habitat that may occur within the boundary of your proposed project and that may be affected by project related actions. The species list fulfills the requirements of the U.S. Fish and Wildlife Service (Service) under section 7(c) of the Endangered Species Act (Act) of 1973, as amended (16 U.S.C. 1531 *et seq.*). Please contact the Service's Pacific Islands Fish and Wildlife Office (PIFWO) at 808-792-9400 if you have any questions regarding your IPaC species list.

The purpose of the Act is to provide a means whereby threatened and endangered species and the ecosystems upon which they depend may be conserved. Under sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may adversely affect threatened and endangered species and/or designated critical habitat.

Please note that under 50 CFR 402.12(e) of the regulations implementing section 7 of the Act, the accuracy of this species list should be verified after 90 days. New information based on updated surveys, changes in the abundance and distribution of species, changed habitat conditions, or other factors could change this list. This verification can be completed formally or informally as desired. The Service recommends that verification be completed by visiting the IPaC website at regular intervals during project planning and implementation for updates to species lists and information. An updated list may be requested through the IPaC system by completing the same process used to receive the enclosed list.

A Biological Assessment is required for construction projects (or other undertakings having similar physical impacts) that are major Federal actions significantly affecting the quality of the human environment as defined in the National Environmental Policy Act (42 U.S.C. 4332(2) (c)). For projects other than major construction activities, the Service suggests that a Biological

Evaluation, similar to a Biological Assessment, be prepared to determine whether the project may affect listed or proposed species and/or designated or proposed critical habitat. Recommended contents of a Biological Assessment or Biological Evaluation are described at 50 CFR 402.12.

Due to the significant number of listed species found on each island within PIFWO's regulatory jurisdiction, and the difficulty in accurately mapping ranges for species that we have limited information about, your species list may include more species than if you obtained the list directly from a Service biologist. We recommend you use the species links in IPaC to view the life history, habitat descriptions, and recommended avoidance and minimization measures to assist with your initial determination of whether the species or its habitat may occur within your project area. If appropriate habitat is present for a listed species, we recommend surveys be conducted to determine whether the species is also present. If no surveys are conducted, we err on the side of the species, by regulation, and assume the habitat is occupied. Updated avoidance and minimization measures for plants and animals, best management practices for work in or near aquatic environments, and invasive species biosecurity protocols can be found on the PIFWO website at: https://www.fws.gov/office/pacific-islands-fish-and-wildlife/library.

If a Federal agency determines, based on the Biological Assessment or Biological Evaluation, that a listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. More information on the regulations and procedures for section 7 consultation, including the role of permit or license applicants, can be found in the "Endangered Species Consultation Handbook" at: http://www.fws.gov/endangered/esa-library/index.

Non-federal entities can also use the IPaC generated species list to develop Habitat Conservation Plans (HCP) in accordance with section 10(a)(1)(B) of the Act. We recommend HCP applicants coordinate with the Service early during the HCP development process. For additional information on HCPs, the Habitat Conservation Planning handbook can be found at https://www.fws.gov/sites/default/files/documents/habitat-conservation-planning-handbook-entire.pdf.

Please be aware that wind energy projects should follow the Service's wind energy guidelines (http://www.fws.gov/windenergy) for minimizing impacts to migratory birds. Listed birds and the Hawaiian hoary bat may also be affected by wind energy development and we recommend development of a Habitat Conservation Plan for those species, as described above. Guidance for minimizing impacts to migratory birds for projects including communications towers can be found at:

- http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/towers
- http://www.towerkill.com
- http://www.fws.gov/migratorybirds/CurrentBirdIssues/Hazards/towers/comtow

We appreciate your concern for threatened and endangered species. The Service encourages Federal agencies to include conservation actions that benefit threatened and endangered species into their project planning to further the purposes of the Act in accordance with section 7(a)(1). Please include the Consultation Tracking Number associated with your IPaC species list in any request for consultation or correspondence about your project that you submit to our office. Please feel free to contact us at PIFWO_admin@fws.gov or 808-792-9400 if you need more current information or assistance regarding the potential impacts to federally listed species and federally designated critical habitat.

Attachment(s):

- Official Species List

OFFICIAL SPECIES LIST

This list is provided pursuant to Section 7 of the Endangered Species Act, and fulfills the requirement for Federal agencies to "request of the Secretary of the Interior information whether any species which is listed or proposed to be listed may be present in the area of a proposed action".

This species list is provided by:

Pacific Islands Fish And Wildlife Office
300 Ala Moana Boulevard, Box 50088
Honolulu, HI 96850-5000
(808) 792-9400

PROJECT SUMMARY

Project Code: 2022-0012271
Project Name: Antonio B. Won Pat International Airport Master Plan Update
Project Type: Airport - Maintenance/Modification
Project Description: Master Plan UPdate
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@13.4849967,144.80187665417367,14z

Counties: Guam County, Guam

ENDANGERED SPECIES ACT SPECIES

There is a total of 21 threatened, endangered, or candidate species on this species list.

Species on this list should be considered in an effects analysis for your project and could include species that exist in another geographic area. For example, certain fish may appear on the species list because a project could affect downstream species.

IPaC does not display listed species or critical habitats under the sole jurisdiction of NOAA Fisheries[1], as USFWS does not have the authority to speak on behalf of NOAA and the Department of Commerce.

See the "Critical habitats" section below for those critical habitats that lie wholly or partially within your project area under this office's jurisdiction. Please contact the designated FWS office if you have questions.

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1. NOAA Fisheries, also known as the National Marine Fisheries Service (NMFS), is an office of the National Oceanic and Atmospheric Administration within the Department of Commerce.

MAMMALS

NAME	STATUS
Mariana Fruit Bat (=mariana Flying Fox) *Pteropus mariannus mariannus* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/2415	Threatened

BIRDS

NAME	STATUS
Guam Micronesian Kingfisher *Halcyon cinnamomina cinnamomina* There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/6	Endangered
Guam Rail *Rallus owstoni* Population: Wherever found, except where listed as an experimental population No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5112	Endangered

REPTILES

NAME	STATUS
Slevin's Skink *Emoia slevini* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9767	Endangered

SNAILS

NAME	STATUS
Fragile Tree Snail *Samoana fragilis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/4835	Endangered
Guam Tree Snail *Partula radiolata* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/1530	Endangered
Humped Tree Snail *Partula gibba* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/61	Endangered

INSECTS

NAME	STATUS
Mariana Eight-spot Butterfly *Hypolimnas octocula marianensis* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6540	Endangered
Mariana Wandering Butterfly *Vagrans egistina* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/7121	Endangered

FLOWERING PLANTS

NAME	STATUS
Aplokating-palaoan *Psychotria malaspinae* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9759 General project design guidelines: https://ipac.ecosphere.fws.gov/project/ZW24JT3SA5GFTKJRDZ3YWWDCT4/documents/generated/7051.pdf	Endangered
Berenghenas Halomtano *Solanum guamense* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9761 General project design guidelines: https://ipac.ecosphere.fws.gov/project/ZW24JT3SA5GFTKJRDZ3YWWDCT4/documents/generated/7051.pdf	Endangered
Cebello Halumtano *Bulbophyllum guamense* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9753 General project design guidelines: https://ipac.ecosphere.fws.gov/project/ZW24JT3SA5GFTKJRDZ3YWWDCT4/documents/generated/7051.pdf	Threatened
Dendrobium guamense No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9754 General project design guidelines: https://ipac.ecosphere.fws.gov/project/ZW24JT3SA5GFTKJRDZ3YWWDCT4/documents/generated/7051.pdf	Threatened
Eugenia bryanii No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9752 General project design guidelines: https://ipac.ecosphere.fws.gov/project/ZW24JT3SA5GFTKJRDZ3YWWDCT4/documents/generated/7051.pdf	Endangered
Maesa walkeri No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9756 General project design guidelines: https://ipac.ecosphere.fws.gov/project/ZW24JT3SA5GFTKJRDZ3YWWDCT4/documents/generated/7051.pdf	Threatened
Nervilia jacksoniae No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9757 General project design guidelines: https://ipac.ecosphere.fws.gov/project/ZW24JT3SA5GFTKJRDZ3YWWDCT4/documents/generated/7051.pdf	Threatened
Tabernaemontana rotensis	Threatened

NAME	STATUS
No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2542 General project design guidelines: https://ipac.ecosphere.fws.gov/project/ZW24JT3SA5GFTKJRDZ3YWWDCT4/documents/generated/7051.pdf	
Tinospora homosepala No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10503 General project design guidelines: https://ipac.ecosphere.fws.gov/project/ZW24JT3SA5GFTKJRDZ3YWWDCT4/documents/generated/7051.pdf	Endangered
Tuberolabium guamense No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9762 General project design guidelines: https://ipac.ecosphere.fws.gov/project/ZW24JT3SA5GFTKJRDZ3YWWDCT4/documents/generated/7051.pdf	Threatened
Ufa-halomtano *Heritiera longipetiolata* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2526 General project design guidelines: https://ipac.ecosphere.fws.gov/project/ZW24JT3SA5GFTKJRDZ3YWWDCT4/documents/generated/7051.pdf	Endangered

CONIFERS AND CYCADS

NAME	STATUS
Fadang *Cycas micronesica* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9763 General project design guidelines: https://ipac.ecosphere.fws.gov/project/ZW24JT3SA5GFTKJRDZ3YWWDCT4/documents/generated/7051.pdf	Threatened

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

IPAC USER CONTACT INFORMATION

Agency: AECOM
Name: Lynn Keeley
Address: 1700 Market Street
Address Line 2: Suite 1600
City: Philadelphia
State: PA
Zip: 19103
Email lynn.keeley@aecom.com
Phone: 2156963524

LEAD AGENCY CONTACT INFORMATION

Lead Agency: Federal Aviation Administration

6.16 Guam GCMP Policies

Reference: "Procedures Guide for Achieving Federal Consistency with the Guam Coastal Management Program," Bureau of Statistics and Plans.

Authority: Governor of Guam E.O. No. 78-37

Enforceable Policies

Effective as of the 1994 amendment to the original Guam Coastal Management Program, enforceable policies are:

A. Governmental Processes Policy (GPP):

Policy: More effective administration of natural resources related laws, programs, and policies shall be achieved through:

- revision of unclear and outdated laws and regulations,
- improved coordination among local agencies,
- improved coordination between territorial and federal agencies, and
- educational and training programs for local government personnel, and refinement of supporting technical data.

B. Development Policies (DP):

DP 1. Shore Area Development

Intent: To ensure environmental and aesthetic compatibility of shore land uses.

Policy: Only those uses shall be located within the Seashore Reserve which:

- enhance, are compatible with or do not generally detract from the surrounding coastal area's aesthetic and environmental quality and beach accessibility; or
- can demonstrate dependence on such a location and the lack of feasible alternative sites.

DP 2. Urban Development

Intent: To cluster high impact uses such that coherent community design, function, infrastructure support and environmental compatibility are assured.

Policy: Commercial, multi-family, industrial and resort-hotel zone uses and uses requiring high levels of support facilities shall be concentrated within urban districts as outlined on the Land Use Districting Map.

DP 3. Rural Development

Intent: To provide a development pattern compatible with environmental and infrastructure support suitability and which can permit traditional lifestyle patterns to continue to the extent practicable.

Policy: Rural districts shall be designated in which only low density residential and agricultural uses will be acceptable. Minimum lot size for these uses should be one-half acre until adequate infrastructure including functional sewering is provided.

DP 4. Major Facility Siting

Intent: To include the national interest in analyzing the siting proposals for major utilities, fuel and transport facilities.

Policy: In evaluating the consistency of proposed major facilities with the goals, policies and standards of the Comprehensive Development and Coastal Management Plans, the Territory shall recognize the national interest in the siting of such facilities including those associated with electric power production and transmission, petroleum refining and transmission, port and air installations, solid waste disposal, sewage treatment, and major reservoir sites.

DP 5. Hazardous Areas

Intent: Development in hazardous areas will be governed by the degree of hazard and the land use regulations.

Policy: Identified hazardous lands, including floodplains, erosion-prone areas, air installations, crash and sound zones and major fault lines shall be developed only to the extent that such development does not pose unreasonable risks to the health, safety or welfare of the people of Guam, and complies with the land use regulations.

DP 6. Housing

Intent: To promote efficient community design placed where the resources can support it.

Policy: The government shall encourage efficient design of residential areas, restrict such development in areas highly susceptible to natural and manmade hazards and recognize the limitations of the island's resources to support historical patterns of residential development.

DP 7. Transportation

Intent: To provide transportation systems while protecting potentially impacted resources.

Policy: The Territory shall develop an efficient and safe transportation system, while limiting adverse environmental impacts on primary aquifers, beaches, estuaries and other coastal resources.

DP 8. Erosion and Siltation

Intent: To control development where erosion and siltation damage is likely to occur.

Policy: Development shall be limited in areas of 15% or greater slope by requiring strict compliance with erosion, sedimentation, and land use districting guidelines, as well as other related land use standards for such areas.

C. <u>Resource Policies:</u>

RP 1. Conservation of Natural Resources—Overall Policy

Policy: The value of Guam's natural resources as recreational areas, critical marine and wildlife habitats, the major source of drinking water, and the foundation of the island's economy shall be protected through policies and programs affecting such resources.

RP 2. Air Quality

Intent: To control activities to ensure good air quality.

Policy: All activities and uses shall comply with all local air pollution regulations and all appropriate Federal air quality standards in order to ensure the maintenance of Guam's relatively high air quality.

RP 3. Water Quality

Intent: To control activities that may degrade Guam's drinking, recreational, and ecologically sensitive waters.

200

Policy: Safe drinking water shall be assured and aquatic recreation sites shall be protected through the regulation of uses and discharges that pose a pollution threat to Guam's waters, particularly in estuarine, reef and aquifer areas.

RP 4. Fragile Areas

Intent: To protect significant cultural areas, and natural marine and terrestrial wildlife and plant habitats.

Policy: Development in the following types of fragile areas shall be regulated to protect their unique character:

- historical and archeological sites,
- wildlife habitats,
- pristine marine and terrestrial communities,
- limestone forests, and
- mangrove stands and other wetlands.

RP 5. Living Marine Resources

Intent: To protect marine resources in Guam's waters.

Policy: All living resources within the territorial waters of Guam, particularly corals and fish, shall be protected from over harvesting and, in the case of marine mammals, from any taking whatsoever.

RP 6. Visual Quality

Intent: To protect the quality of Guam's natural scenic beauty.

Policy: Preservation and enhancement of, and respect for the island's scenic resources shall be encouraged through increased enforcement of and compliance with sign, litter, zoning, subdivision, building and related land-use laws. Visually objectionable uses shall be located to the maximum extent practicable so as not to degrade significant views from scenic overlooks, highways and trails.

RP 7. Recreation Areas

Intent: To encourage environmentally compatible recreational development.

Policy: The Government of Guam shall encourage development of varied types of recreational facilities located and maintained so as to be compatible with the surrounding environment and land uses, adequately serve community centers and urban areas and protect beaches and such passive recreational areas as wildlife and marine conservation areas, scenic overlooks, parks and historical sites.

RP 8. Public Access

Intent: To ensure the right of public access.

Policy: The public's right of unrestricted access shall be ensured to all non-federally owned beach areas and all territorial recreation areas, parks, scenic overlooks, designated conservation areas and their public lands; and agreements shall be encouraged with the owners of private and federal property for the provision of releasable access to and use of resources of public nature located on such land.

RP 9. Agricultural Lands

Intent: To stop urban types of development on agricultural land.

Policy: Critical agricultural land shall be preserved and maintained for agricultural use.

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7 Facilities Implementation Plan

Executive Summary

The Facilities Implementation Plan chapter of the Antonio B. Won Pat International Airport (Airport) Master Plan documents the projected phasing, timing, and cost of the projects proposed in the Airport Development Plan developed in **Chapter :** *Alternatives Development and Evaluation*. This chapter breaks out these projects into short- (0-5 years), mid- (6-10 years), and long-term (11-20 years) phases based on specific factors such as the critical nature and Airport need for each project. Additionally, each term is broken out into airfield, commercial passenger terminal, landside, General Aviation (GA), cargo, and support facilities projects. Preliminary cost estimates for each project were created and a project implementation schedule was developed.

The short-term projects range from a redesign of the vehicle parking lots based on the Route 10A widening and minor airfield improvements and commercial passenger terminal expansion projects. The mid-term projects include safety standard improvements to both runways and the south apron, as well as expansion, training, and safety projects for various support facilities throughout Airport property. Lastly, long-term projects range from safety standard improvements for the entire taxiway system to expansion of the commercial passenger terminal and a new light aircraft commuter terminal.

In all, there were 16 short-term projects (three airfield, seven commercial passenger terminal, one landside, and five GA/cargo/support facilities) totaling more than $87 million; 12 mid-term projects (five airfield, two commercial passenger terminal, one landside, and four GA/cargo/support facilities) totaling more than $320 million; and 15 long-term projects (10 airfield, one commercial passenger terminal, and four GA/cargo/support facilities) totaling $355 million. Combined, proposed Airport improvements amount to a total of 43 projects costing nearly $763 million during the 20-year planning horizon. These projects are anticipated to start in 2024 and run through 2043.

7.1 Introduction

This chapter describes preliminary phasing for the overall Airport Development Plan shown in **Figure -1**, **Figure -2**, and **Figure -3**. The plan covers the 20-year planning horizon, and the projects have been divided into three segments:

- Short-term, or projects to be implemented in years 1 through 5
- Mid-term, or projects to be implemented in years 6 through 10
- Long-term, or projects to be implemented in years 11 through 20

The recommended project phasing plan evolved from analysis of facility requirements, described in **Chapter :** *Facility Requirements,* and development of the Airport Development Plan shown in **Chapter :** *Alternatives Development and Evaluation.* To meet current and projected needs of the Airport, proposed projects address compliance with Federal Aviation Administration (FAA) airport design standards, improve airfield safety, increase operational efficiency, meet current and projected demand, and improve various elements of existing Airport infrastructure.

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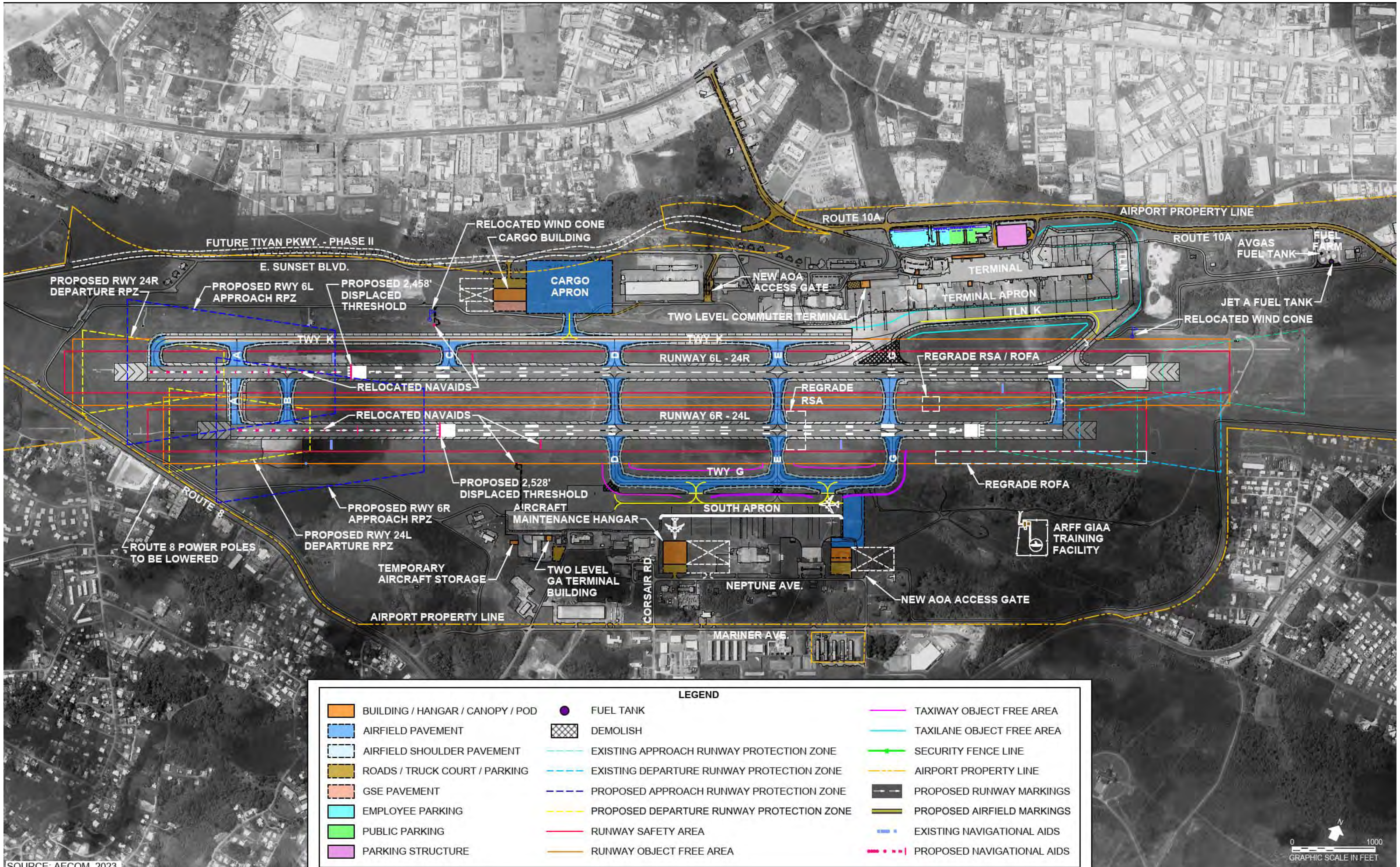

Figure 7-1. Airport Development Plan (1 of 3)

Source: AECOM

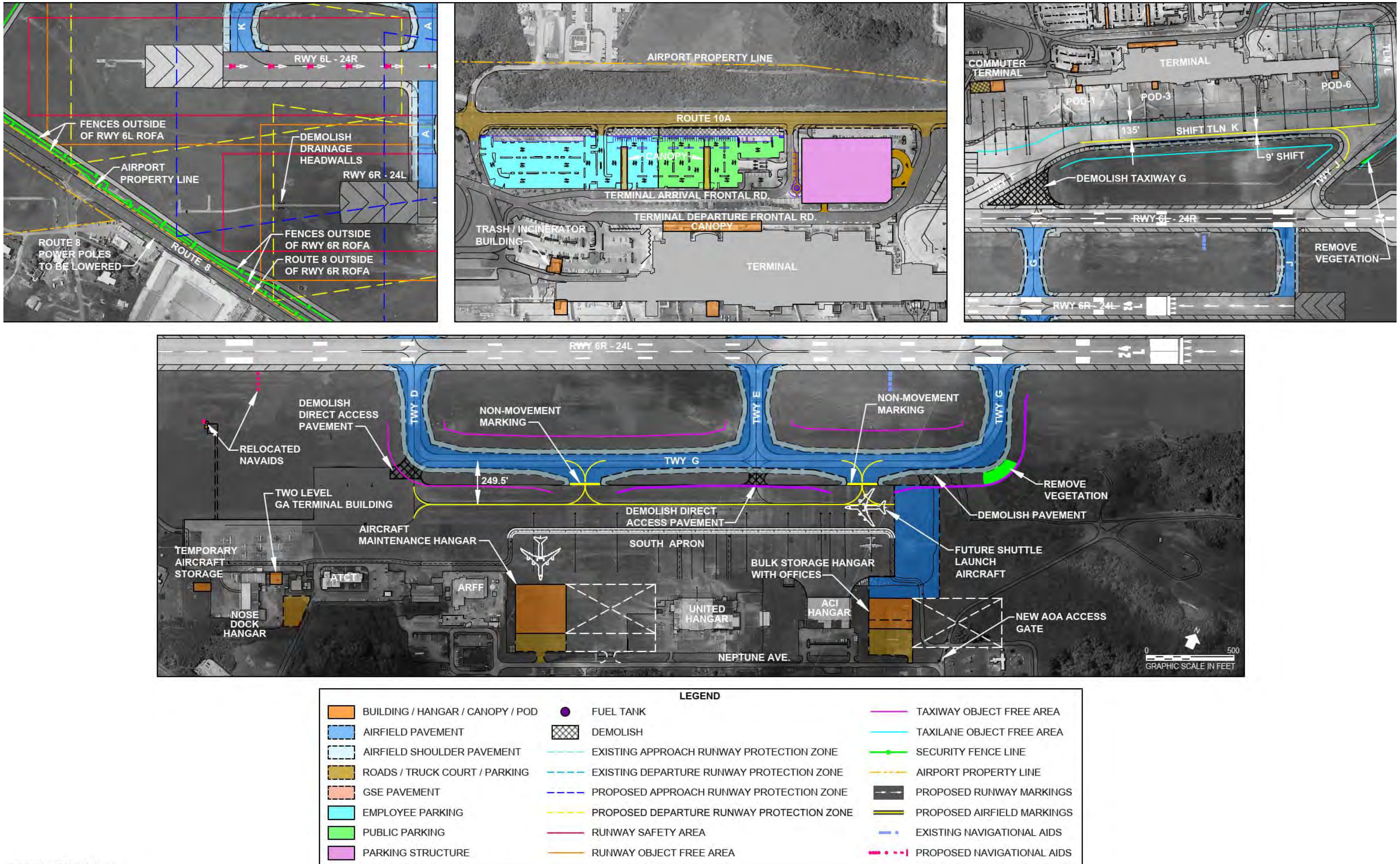

Figure 7-2. Airport Development Plan (2 of 3)

Source: AECOM

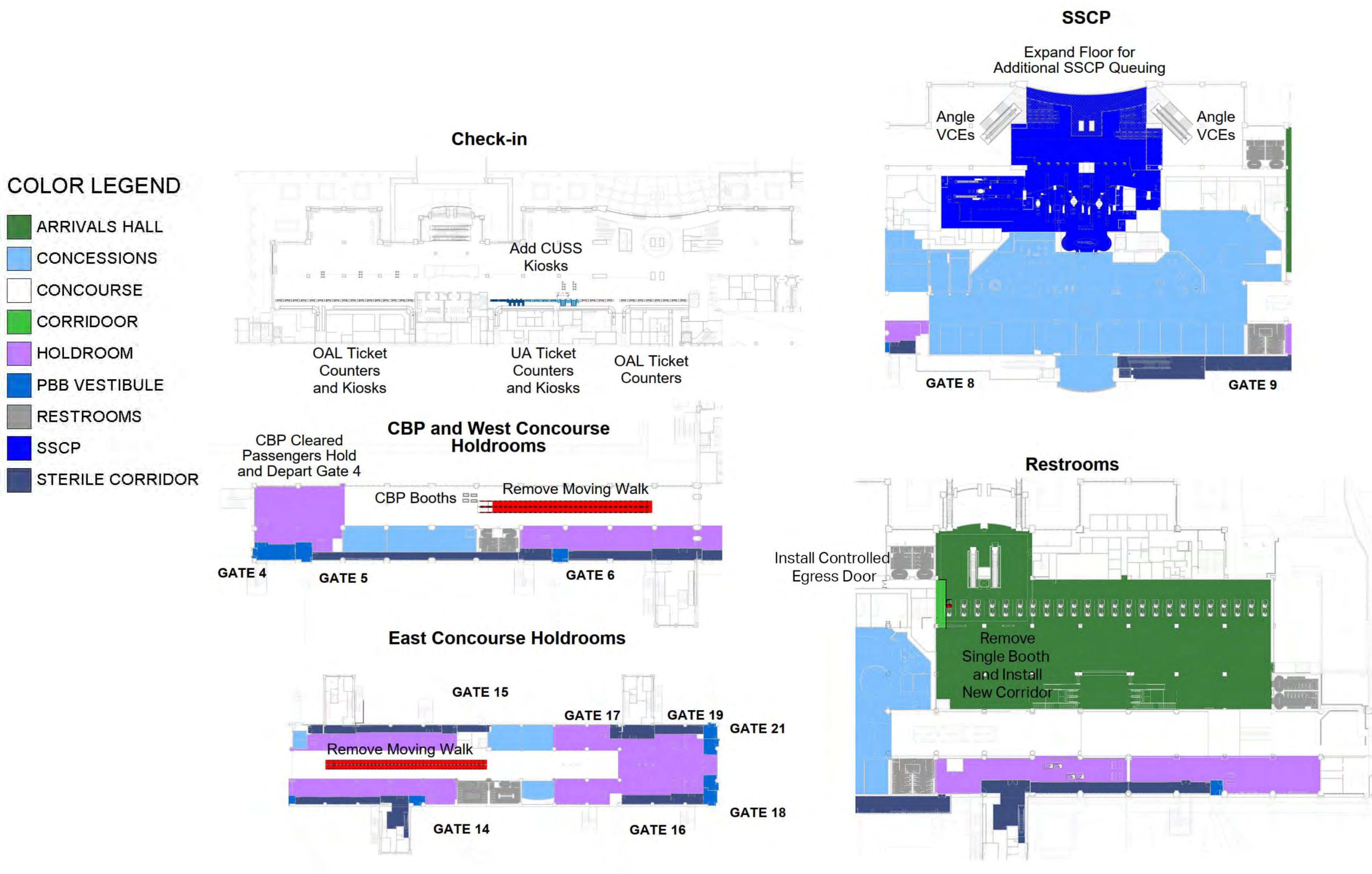

Figure 7-3. Airport Development Plan (3 of 3)

Source: AECOM

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7.2 Factors Affecting Implementation and Phasing

A.B. Won Pat International Airport Authority, Guam (GIAA) is committed to maintaining and developing the Airport into a facility that serves the air transportation needs of the island, as well as commercial and GA user needs. Planning is a continuous process, and changes in the aviation industry, economic environment, and numerous other factors may require adjustments to the timing of planned airport facility improvements. The elements addressed in this Master Plan will assist GIAA in responding to the continued need for a modern and efficient air transportation facility.

The timing of project implementation requires an understanding of the factors that prompt the need for improvements. It is anticipated that recommended projects will be constructed as demand materializes, or as the Airport needs to replace or modernize older facilities as they reach the end of their useful life.

Implementation trigger points determine when a threshold is reached and an action is required to maintain the safe and efficient operation of the Airport. Trigger points typically result from one or more of the following four categories:

- Growth and congestion
- Facility life cycle
- Policy and regulation changes
- Facility optimization and/or revenue generation opportunities

7.2.1 Growth and Congestion

Growth and congestion is the most common trigger that occurs when demand approaches or exceeds the capacity of an existing facility. Measures of growth and congestion trigger points may include:

- Aircraft operations, passenger, and/or cargo tonnage growth
- Airfield/airspace congestion
- Tenant demand to expand their operations and facilities
- Inadequate Level of Service (LoS)

An example of a project implemented due to growth is the construction of a dedicated cargo apron and associated facilities. As cargo demand at the Airport grows and increased demand is projected to continue, a larger dedicated space is needed to adequately accommodate the demand.

7.2.2 Facility ife Cycle

A facility life cycle trigger occurs when an existing facility reaches or exceeds its useful life (e.g., facility is in need of rehabilitation) or when a facility no longer conveniently or efficiently serves its purpose (e.g., site reuse or lack of passenger amenities or infrastructure). An example of a facility life cycle trigger is the need to replace an aging light aircraft commuter terminal.

7.2.3 Policy and Regulation Changes

Changes in policy and regulations regarding airport design and/or operations may originate from local, state, and/or federal regulatory bodies. New or updated regulations may trigger the need to replace or modify an existing facility to accommodate airport activities. An example of regulatory change affecting the timing of facility improvements is the recent regulation revisions to taxiway design and configuration standards stated in Federal Aviation Administration (FAA) Advisory Circular (AC) 150/5300-13B, *Airport Design*, which are intended to mitigate potential runway incursion risks.

7.2.4 Facility Optimization and/or Revenue Generation

Projects are occasionally implemented to optimize existing facility space rather than construct a new facility. Underutilized or inefficient facilities are often renovated to maximize passenger/tenant convenience and airport revenues. An example of facility optimization includes improvements to increase efficiency in the commercial passenger terminal by creating more flexibility within the existing space. Construction of a new, large aircraft maintenance hangar and GA bulk storage hangar is an example of an improvement triggered by the need for potential revenue generation.

The end of this chapter includes a schedule for the projects triggered by facility optimization and revenue generation purposes. However, since these projects are not triggered by demand, the actual timing for implementation is at the Airport's discretion depending on availability of funding and staff resources.

7.3 Implementation Plans

The three implementation plans encompass a variety of projects including those needed to meet current safety and design standards, maximize operational efficiency, and meet current and future demand. The proposed phasing of individual projects within the implementation plans has been prepared after evaluation of relative project priority and based on the four triggers discussed above (growth and congestion, facility life cycle, policy and regulation changes, and facility optimization and/or revenue generation). Many projects are not triggered by demand and are not dependent on other projects; therefore, they can be implemented based on funding availability and as the needs of the Airport fluctuate. a ch project is categorized as one of the following project types: Airfield, Terminal, Landside, Cargo, GA, or Support.

7.3.1 Short- erm Implementation Plan - Years

The short-term phase includes projects from the start of implementation to year 5. The projects included in this phase focus on airfield safety and updates to the commercial passenger terminal to increase operational efficiency and enhance the passenger experience. The projects, shown in **able -1** and **Figure -** , include:

- Airfield projects focusing on meeting current FAA safety and design standards.
- A variety of commercial passenger terminal projects that increase efficiency such as the addition of two loading docks and removal of moving walkways in the concourse, and those that enhance the passenger LoS with projects such as the addition of a canopy above the departures roadway.
- A landside project that includes reconfiguring parking lot layouts to accommodate the impacts of the Route 10A widening project.
- Cargo, GA, and support facility projects that are demand driven including a dedicated cargo apron for increased cargo operations, a temporary aircraft storage facility, and replacement of the Avgas fuel tank.

able -1 Short- erm Implementation Plan Projects

Project ID	Projected Project Initiation	Project	Project Description	Project Purpose
Airside				
I-A-01	2024	Vegetation Removal	Removal of vegetation located in the TOFAs of Taxiway G and J	TOFA safety standard compliance
I-A-02	2026	North Apron Improvements and Taxiway G Removal	Shifting portion of the Taxilane K centerline and pavement removal of Taxiway G connector	TLOFA safety standard compliance and removal of direct access taxiway
I-A-03	2025	Wind Cone Relocation (2)	Relocate two wind cones outside of the ROFAs	ROFA safety standard compliance
erminal				
I-T-01	2028	Removal of Moving Walkways in Concourse (2)	Removal of two moving walkways within the concourse	Increase concourse space flexibility

Project ID	Projected Project Initiation	Project	Project Description	Project Purpose
I-T-02	2025	Relocate Outbound CBP Inspection Process	Relocation of Outbound CBP at Gate 7 to the vicinity of Gate 4	Increase space in holdroom
I-T-03	2028	Arrivals Hall Restroom Access Corridor	Provide access to the existing SSCP restroom from the international arrivals hall	Additional restroom for arriving international passengers
I-T-04	2026	SSCP Queue Area xpansion	xpansion of mezzanine	Increase SSCP queue area
I-T-05	2027	Check-in Facility Upgrades	Removal of 12 check-in counters and the addition of check-in kiosks	liminate ticketing counters and reduce passenger queuing
I-T-06	2027	Terminal Departure Roadway Canopy	Addition of a canopy to the terminal departure roadway	Protection from weather elements for departing passengers
I-T-07	2024	Loading Docks	Addition of two loading docks	Loading dock efficiency
andside				
I-L-01	2026	Airport Parking Plan	Reconfiguring the employee and public parking lots and the addition of canopies (2) above sidewalks within the parking lots	Reconfigure Airport parking based on the Route 10A widening project
Cargo, GA, and Support Facilities				
I-C-01	2024	Cargo Apron	Construction of a new cargo apron	Consolidate cargo functions
I-GA-01	2026	Temporary Aircraft Storage Facility	Construction of a temporary aircraft storage facility	Increase amount of covered aircraft parking
I-S-01	2025	Aircraft Fuel Avgas Tank	Replacement of Avgas fuel tank within the fuel farm	Replace aging Avgas tank
I-S-02	2024	North AOA Access Gate	New access road and AOA access gate near integrated cargo facilities	Addition of new AOA gate closer to the integrated cargo facilities
I-S-03	2024	Trash Facility	Construction of a trash facility with two dumpsters	Allows expansion of the existing loading dock area

Note:

A. Abbreviations
TOFA = Taxiway Object Free Area
TLOFA = Taxilane Object Free Area
ROFA = Runway Object Free Area
CBP = Customs and Border Protection
SSCP = Security Screening Checkpoint
GA = General Aviation
AOA = Aircraft Operations Area

Source: AECOM

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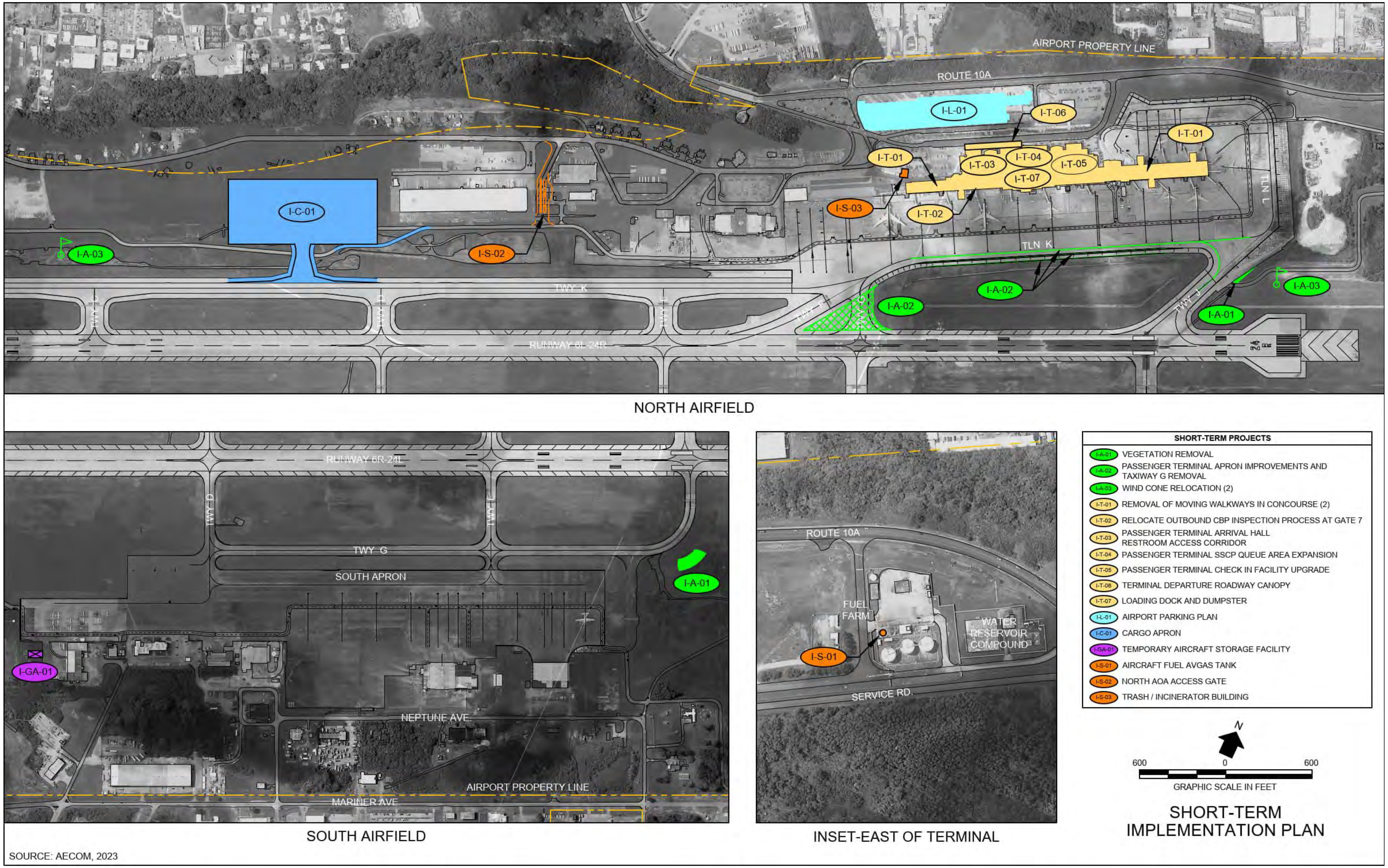

Figure 7-4. Short-Term Implementation Plan

Source: AECOM

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7.3.2 Mid- erm Implementation Plan 6-1 Years

The mid-term phase includes projects implemented between year 6 and year 10. The projects included in this phase focus on airfield safety and support facilities. The projects, shown in **able -2** and **Figure -** , include:

- Airfield projects focusing on meeting current FAA safety standards including displacing the thresholds for Runway 6L and 6R to meet current Runway Protection Zone (RPZ) safety and land use compatibility standards.
- A new GA bulk storage hangar and south AOA access gate based on demand and potential revenue generation.
- Support facility projects such as the addition of a new Jet A fuel tank and a new combined Aircraft Rescue and Firefighting (ARFF) and GIAA training facility.

able -2 Mid- erm Implementation Plan Projects

Project ID	Projected Project Initiation	Project	Project Description	Project Purpose
Airside				
II-A-01	2029	Runway 6R/24L Safety Standards Compliance	Displacement of Runway 6R threshold, NAVAID relocation, regrading potions of the RSA and ROFA, removal of drainage headwalls, and lowering power poles	Meet current safety and design standards
II-A-02	2030	South Apron Taxiway Connector Improvements	Construction of two new connector taxiways between the South Apron and Taxiway G, and demolition of Taxiway D and Taxiway connectors to South Apron	Remove direct access taxiways to the runway
II-A-03	2029	Shift South Apron Taxilane	Shift South Apron taxilane	Meet standard separation requirements
II-A-04	2032	Upgrade Taxiway D South, Taxiway South, and Taxiway G South to TDG 6 Standards	Upgrade taxiway to current TDG 6 standards	Upgrade taxiway geometry to current TDG 6 standards
II-A-05	2032	Runway 6L/24R Safety Standards Compliance	Displace Runway 6R threshold and relocate NAVAIDs	Meet current design safety standards
erminal				
II-T-01	2029	Upgrade CBP Protection Booths (23)	Upgrade CBP booths	Reconstruct CBP booths to meet current design standards
II-T-02	2030	Upgrade Guam CQA Booths (11)	Upgrade Guam CQA booths	Reconstruct Guam CQA booths to meet current design standards
andside				
II-L-01	2028	Rental Car Parking Structure	Construct a two-story parking structure for rental cars, tour buses, and tour vans	Replace the existing rental car parking lot based on the Route 10A widening project
Cargo, GA, and Support Facilities				
II-GA-01	2029	GA Bulk Storage Hangar	Construction of a new bulk storage hangar for GA aircraft	Increase amount of covered aircraft parking
II-S-01	2029	Aircraft Fuel Jet A Tank	Additional Jet A fuel tank	Additional Jet A fuel tank for future proofing

Project ID	Projected Project Initiation	Project	Project Description	Project Purpose
II-S-02	2030	South AOA Access Gate	New AOA access gate from Neptune Road near the ACI hangar and new bulk storage hangar	Addition of a new AOA gate closer to the proposed GA aircraft storage hangar
II-S-03	2029	ARFF GIAA Training Facility	New training facility, stair tower, and burn pit	New multi-purpose training facility (e.g., ARFF, Airport police)

Note:

A. Abbreviations
NAVAID = Navigational Aid
RSA = Runway Safety Area
ROFA = Runway Object Free Area
TDG = Taxiway Design Group
CBP = Customs and Border Protection
CQA = Customs and Quarantine Agency
GA = General Aviation
AOA = Aircraft Operations Area
ACI = Aviation Concepts, Inc.
ARFF = Aircraft Rescue and Firefighting
GIAA = A.B. Won Pat International Airport Authority, Guam

Source: AECOM

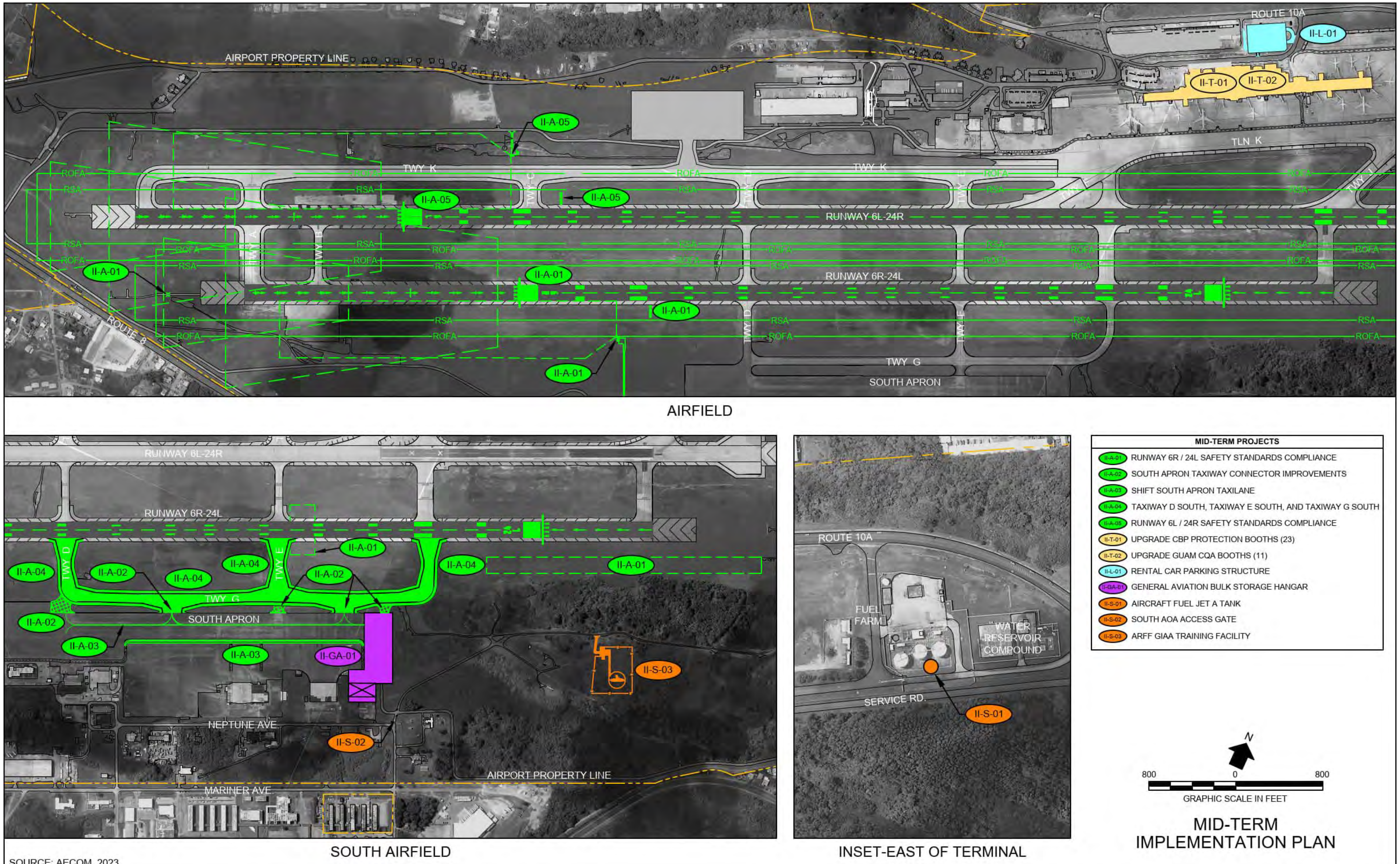

Figure 7-5. Mid-Term Implementation Plan

Source: AECOM

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7.3.3 ong- erm Implementation Plan 11-2 Years

The long-term phase includes projects implemented between year 11 and year 20. The projects included in this phase focus on airfield safety and potential revenue generating facilities. The projects, shown in **able -3** and **Figure -6**, include:

- Airfield projects focusing on upgrading taxiways to current FAA TDG 6 standards.
- Addition of pods to the commercial passenger terminal façade for vertical circulation for international arrivals.
- Cargo, GA, and support facilities projects are not necessarily demand driven and could be implemented based on funding availability or as demands change. These projects are based on facility life cycle and include replacement of the cargo facilities and the light commuter aircraft terminal, which are potentially revenue generating.

able -3 ong- erm Implementation Plan Projects

Project ID	Projected Project Initiation	Project	Project Description	Project Purpose
Airside				
III-A-01	2034	Upgrade Taxiway A North and Taxiway K Connector	Upgrade taxiway to current TDG 6 standards	Upgrade taxiway geometry to current TDG 6 standards
III-A-02	2034	Upgrade Taxiway A Center	Upgrade taxiway to current TDG 6 standards	Upgrade taxiway geometry to current TDG 6 standards
III-A-03	2035	Upgrade Taxiway B	Upgrade taxiway to current TDG 6 standards	Upgrade taxiway geometry to current TDG 6 standards
III-A-04	2036	Upgrade Taxiway C	Upgrade taxiway to current TDG 6 standards	Upgrade taxiway geometry to current TDG 6 standards
III-A-05	2036	Upgrade Taxiway D North	Upgrade taxiway to current TDG 6 standards	Upgrade taxiway geometry to current TDG 6 standards
III-A-06	2037	Upgrade Taxiway D Center	Upgrade taxiway to current TDG 6 standards	Upgrade taxiway geometry to current TDG 6 standards
III-A-07	2038	Upgrade Taxiway North	Upgrade taxiway to current TDG 6 standards	Upgrade taxiway geometry to current TDG 6 standards
III-A-08	2039	Upgrade Taxiway Center	Upgrade taxiway to current TDG 6 standards	Upgrade taxiway geometry to current TDG 6 standards
III-A-09	2040	Upgrade Taxiway G Center	Upgrade taxiway to current TDG 6 standards	Upgrade taxiway geometry to current TDG 6 standards
III-A-10	2040	Upgrade Taxiway J	Upgrade taxiway to current TDG 6 standards	Upgrade taxiway geometry to current TDG 6 standards
erminal				
III-T-01	2037	Construction of Pods 1, 3, and 6	Vertical circulation for international arrivals up to the sterile corridor	Improves the gate management system and vertical circulation to the sterile corridor
Cargo, GA, and Support Facilities				
III-C-01	2034	Cargo Facilities	Construction of a new cargo building	New integrated cargo facility
III-GA-01	2038	GA Terminal	Construction of new GA terminal facility	Accommodate GA pilots, passengers, crew, and vehicle parking

Project ID	Projected Project Initiation	Project	Project Description	Project Purpose
III-GA-02	2035	Light Aircraft Commuter Terminal	Light aircraft commuter terminal building replacement	Replace old facility and increase vehicle parking
III-S-01	2036	Large Aircraft Maintenance Hangar	Construction of a maintenance hangar that could accommodate wide body aircraft	Accommodate larger aircraft for aircraft maintenance

Note:

A. Abbreviations
TDG = Taxiway Design Group
GA = General Aviation

Source: AECOM

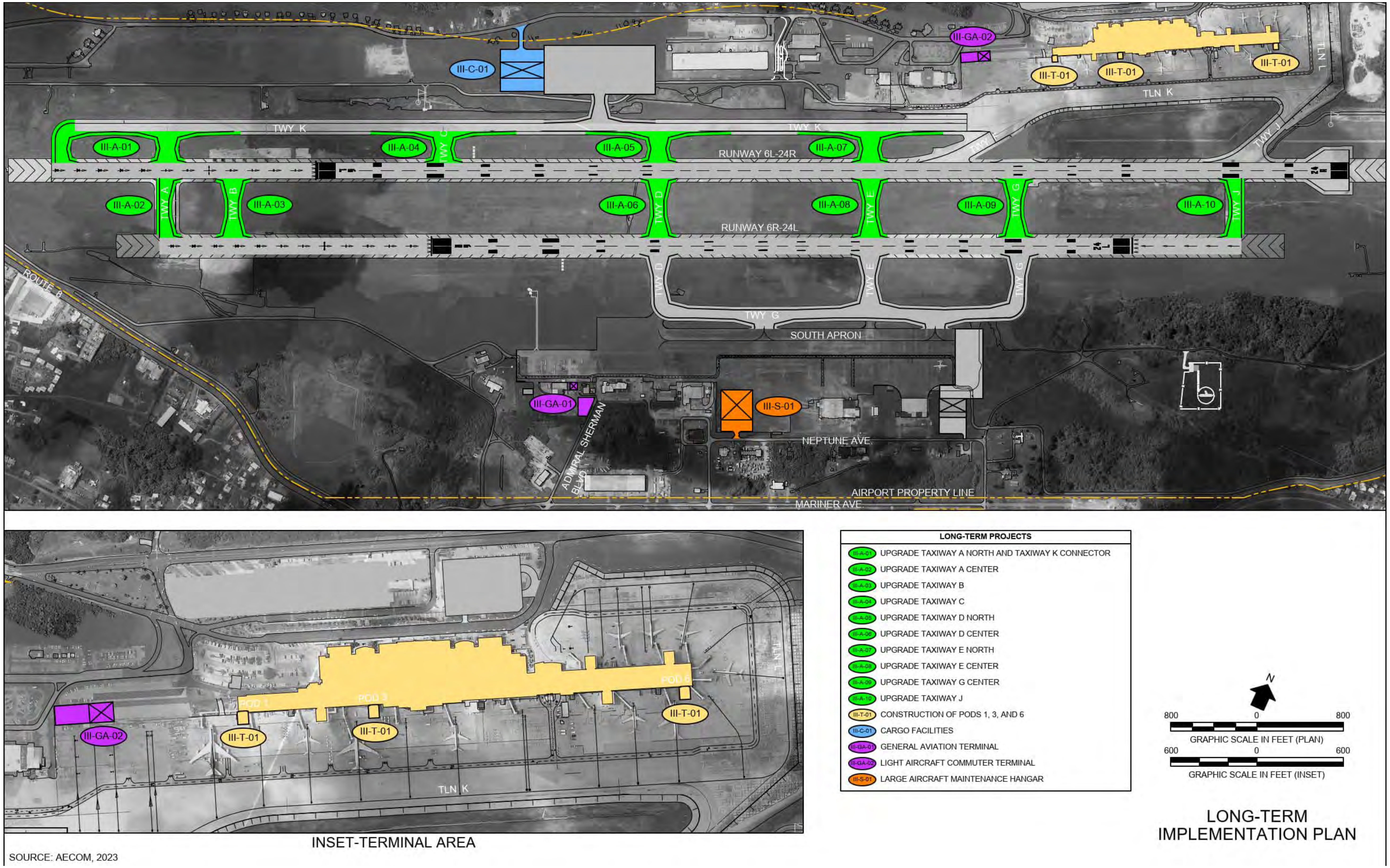

Figure 7-6. Long-Term Implementation Plan

Source: AECOM

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7.4 Cost Estimates

Preliminary cost estimates for each project were developed to determine the approximate overall program cost, calculated in 2023 dollars. The methodology used to develop the cost estimates includes:

- Total project cost markups and contingencies, which include:
  - Utilization of a Guam location factor of 2.6 x the U.S. National Average
  - Assumed construction markups of 30 percent
  - Assumed design risk contingency of 25 percent
  - Contractor markups, which are applied to the direct cost to yield an estimated construction cost, and soft costs, which are applied to the construction costs to yield an estimated project cost
- General construction and labor cost assumptions include:
  - Work will be bid competitively by three or more competent contractors
  - All work will be performed during normal work hours
  - Adequate experienced craft labor is available
  - Normal productivity rates as historically experienced are utilized
  - No strike impacts will be experienced by the project
  - There are sufficient experienced contractors available to perform the work
  - xi sting state-of-the-art construction technology will be utilized
- Site and material cost assumptions include:
  - Operation of the station facility is maintained during construction
  - Demolition and/or site preparation costs as required
  - No contaminated soil
  - Airfield lighting is included in pavement pricing
  - Items such as mobilization, contractor QC per FAA, temporary construction Items (signs, barricades, temp AOA fence, etc.), erosion and sediment control measures, Soil Management Plan measures are covered in General Conditions/General Requirements
  - Compatible trade agreements exist in the region
- The cost estimate is classified as Association for the Advancement of Cost n gineering Class V
- st imate excludes escalation
- Assumes cooperation between stakeholders

See **able -** for a summary of the facilities implementation plan cost estimates by project type and **able -** for a summary of the implementation plan cost estimates by Project ID.

It is anticipated that the funding sources for these projects will include the FAA, bonds, Airport funds, third-party contributors such as the Fixed Base Operators (FBOs) and other tenants, and local sources. The proposed financial plan to fund these projects is presented in **Chapter :** *Financial Feasibility Analysis*.

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able - Implementation Plan Cost Estimates Summary by Project ype

Project ype	Short- erm - years	Mid- erm 6-1 years	ong - erm 11-2 years
Airside	$1,780,400	$54,603,000	$69,291,000
Terminal	$18,760,000	$630,000	$43,840,000
Landside	$6,690,000	$141,870,000	$0
Cargo	$41,140,000	$0	$77,110,000
General Aviation	$5,660,000	$84,310,000	$74,620,000
Support	$12,220,000	$39,050,000	$90,420,000
Total	**$87,250,400**	**$320,463,000**	**$355,281,000**

Source: AECOM

able - Implementation Plan Cost Estimates Summary by Project ID

Project ID	Project	Project Description	Project Cost
Short- erm - years			
I-A-01	Vegetation Removal	Removal of vegetation located in the TOFA of Taxiway G and J	$5,000
I-A-02	North Apron Improvements and Taxiway G Removal	Shifting portion of the Taxilane K centerline and pavement removal of Taxiway G connector	$1,765,000
I-A-03	Wind Cone Relocation (2)	Relocate two wind cones outside of the ROFAs	$10,400
I-T-01	Removal of Moving Walkways in Concourse (2)	Removal of two moving walkways within the concourse	$1,860,000
I-T-02	Relocate Outbound CBP Inspection Process	Relocation of Outbound CBP at Gate 7 to the vicinity of Gate 4	$70,000
I-T-03	Arrivals Hall Restroom Access Corridor	Provide access to the existing SSCP restroom from the international arrivals hall	$330,000
I-T-04	SSCP Queue Area xpansion	xpansion of mezzanine	$14,270,000
I-T-05	Check-in Facility Upgrades	Removal of 12 check-in counters and the addition of check-in kiosks	$680,000
I-T-06	Terminal Departure Roadway Canopy	Addition of a canopy to the terminal departure roadway	$1,150,000
I-T-07	Loading Docks (2)	Addition of two loading docks	$400,000
I-L-01	Airport Parking Plan	Reconfiguring the employee and public parking lots and the addition of canopies (2) above sidewalks within the parking lots	$6,690,000
I-C-01	Cargo Apron	Construction of a new cargo apron	$41,140,000

Project ID	Project	Project Description	Project Cost
I-GA-01	Temporary Aircraft Storage Facility	Construction of a temporary aircraft storage facility	$5,660,000
I-S-01	Aircraft Fuel Avgas Tank	Replacement of Avgas fuel tank within the fuel farm	$3,610,000
I-S-02	North AOA Access Gate	New access road and AOA access gate near integrated cargo facilities	$7,770,000
I-S-03	Trash Facility	Construction of a trash facility with two dumpsters	$1,840,000
Mid- erm 6-1 years			
II-A-01	Runway 6R/24L Safety Standards Compliance	Displacement of Runway 6R threshold, NAVAID relocation, regrading potions of the RSA and ROFA, removal of drainage headwalls, and lowering power poles	$3,020,000
II-A-02	South Apron Taxiway Connector Improvements	Construction of two new connector taxiways between the South Apron and Taxiway G, and demolition of Taxiway D and Taxiway connectors to South Apron	$7,914,000
II-A-03	Shift South Apron Taxilane	Shift South Apron taxilane	$213,000
II-A-04	Upgrade Taxiway D South, Taxiway South, and Taxiway G South	Upgrade taxiway to current TDG 6 standards	$40,436,000
II-A-05	Runway 6L/24R Safety Standards Compliance	Displace Runway 6R threshold and relocate NAVAIDs	$3,020,000
II-T-01	Upgrade CBP Protection Booths (23)	Upgrade CBP booths	$480,000
II-T-02	Upgrade Guam CQA Booths (11)	Upgrade Guam CQA booths	$150,000
II-L-01	Rental Car Parking Structure	Construct a two-story parking structure for rental cars, tour buses, and tour vans	$141,870,000
II-GA-01	GA Bulk Storage Hangar	Construction of a new bulk storage hangar for GA aircraft	$84,310,000
II-S-01	Aircraft Fuel Jet A Tank	Additional Jet A fuel tank	$26,150,000
II-S-02	South AOA Access Gate	New AOA access gate from Neptune Road near the ACI hangar and new bulk storage hangar	$340,000
II-S-03	ARFF GIAA Training Facility	New training facility, stair tower, and burn pit	$12,560,000
ong - erm 1 -2 years			
III-A-01	Upgrade Taxiway A North and Taxiway K Connector	Upgrade taxiway to current TDG 6 standards	$11,497,000
III-A-02	Upgrade Taxiway A Center	Upgrade taxiway to current TDG 6 standards	$5,507,000
III-A-03	Upgrade Taxiway B	Upgrade taxiway to current TDG 6 standards	$6,573,000
III-A-04	Upgrade Taxiway C	Upgrade taxiway to current TDG 6 standards	$6,752,000
III-A-05	Upgrade Taxiway D North	Upgrade taxiway to current TDG 6 standards	$6,749,000
III-A-06	Upgrade Taxiway D Center	Upgrade taxiway to current TDG 6 standards	$6,649,000
III-A-07	Upgrade Taxiway North	Upgrade taxiway to current TDG 6 standards	$6,749,000
III-A-08	Upgrade Taxiway Center	Upgrade taxiway to current TDG 6 standards	$6,622,000
III-A-09	Upgrade Taxiway G Center	Upgrade taxiway to current TDG 6 standards	$6,679,000

Project ID	Project	Project Description	Project Cost
III-A-10	Upgrade Taxiway J	Upgrade taxiway to current TDG 6 standards	$5,514,000
III-T-01	Construction of Pods 1, 3 and 6	Vertical circulation for international arrivals up to the sterile corridor	$43,840,000
III-C-01	Cargo Facilities	Construction of a new cargo building	$77,110,000
III-GA-01	GA Terminal	Construction of new GA terminal facility	$23,940,000
III-GA-02	Light Aircraft Commuter Terminal	Light aircraft commuter terminal building replacement	$50,680,000
III-S-01	Large Aircraft Maintenance Hangar	Construction of a maintenance hangar that could accommodate wide body aircraft	$90,420,000

Note:

A. Abbreviations

TOFA = Taxiway Object Free Area
TLOFA = Taxilane Object Free Area
ROFA = Runway Object Free Area
CBP = Customs and Border Protection
SSCP = Security Screening Checkpoint
GA = General Aviation
AOA = Aircraft Operations Area
NAVAID = Navigational Aid
RSA = Runway Safety Area
TDG = Taxiway Design Group
CQA = Customs and Quarantine Agency
ACI = Aviation Concepts, Inc.
ARFF = Aircraft Rescue and Firefighting
GIAA = A.B. Won Pat International Airport Authority, Guam

Source: AECOM

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7.5 Implementation Schedule

The implementation schedule, depicted in **Figure - **, is provided for general guidance on the phasing of the Airport Development Plan. The schedule includes a project identifier, project title, and approximate duration (including estimated National n vironmental Policy Act [N P A] processes, design/permitting, and construction periods). The construction period includes a 3-month procurement and bid process. As previously stated, the actual timing for implementation is at the Airport's discretion depending on availability of funding and staff resources and projects may not be completed until the following phase. Accordingly, funding for the project will need to be available in the phase in which it begins. The implementation plan is an iterative process, and any deviations of actual activity or funding availability may require modifications to the overall schedule.

Project ID	Project	Duration
		Year
	Short-Term (0-5 Years)	
I-A-01	Vegetation Removal	6 months
I-A-02	North Apron Improvements and Taxiway G Removal	30 months
I-A-03	Wind Cone Relocation (2)	6 months
I-T-01	Removal of Moving Walkways in Concourse (2)	12 months
I-T-02	Relocate Outbound CBP Inspection Process	9 months
I-T-03	Arrivals Hall Restroom Access Corridor	9 months
I-T-04	SSCP Queue Area Expansion	24 months
I-T-05	Check-in Facility Upgrades	12 months
I-T-06	Terminal Departure Roadway Canopy	9 months
I-T-07	Loading Docks (2)	6 months
I-L-01	Airport Parking Plan	24 months
I-C-01	Cargo Apron	24 months
I-GA-01	Temporary Aircraft Storage Facility	6 months
I-S-01	Aircraft Fuel Avgas Tank	9 months
I-S-02	North AOA Access Gate	18 months
I-S-03	Trash Facility	6 months
	Mid-Term (6-10 Years)	
II-A-01	Runway 6R/24L Safety Standards Compliance	60 months
II-A-02	South Apron Taxiway Connector Improvements	24 months
II-A-03	Shift South Apron Taxilane	24 months
II-A-04	Upgrade Taxiway D South, Taxiway E South, and Taxiway G South	24 months
II-A-05	Runway 6L/24R Safety Standards Compliance	36 months
II-T-01	Upgrade CBP Protection Booths (23)	6 months
II-T-02	Upgrade Guam CQA Booths (11)	6 months
II-L-01	Rental Car Parking Structure	24 months
II-GA-01	GA Bulk Storage Hangar	42 months
II-S-01	Aircraft Fuel Jet A Tank	9 months
II-S-02	South AOA Access Gate	18 months
II-S-03	ARFF GIAA Training Facility	24 months
	Long-Term (11-20 Years)	
III-A-01	Upgrade Taxiway A North and Taxiway K Connector	24 months
III-A-02	Upgrade Taxiway A Center	24 months
III-A-03	Upgrade Taxiway B	24 months
III-A-04	Upgrade Taxiway C	24 months
III-A-05	Upgrade Taxiway D North	24 months
III-A-06	Upgrade Taxiway D Center	24 months
III-A-07	Upgrade Taxiway E North	24 months
III-A-08	Upgrade Taxiway E Center	24 months
III-A-09	Upgrade Taxiway G Center	24 months
III-A-10	Upgrade Taxiway J	24 months
III-T-01	Construction of Pods 1, 3 and 6	30 months
III-C-01	Cargo Facilities	48 months
III-GA-01	GA Terminal	48 months
III-GA-02	Light Aircraft Commuter Terminal	60 months
III-S-01	Large Aircraft Maintenance Hangar	60 months

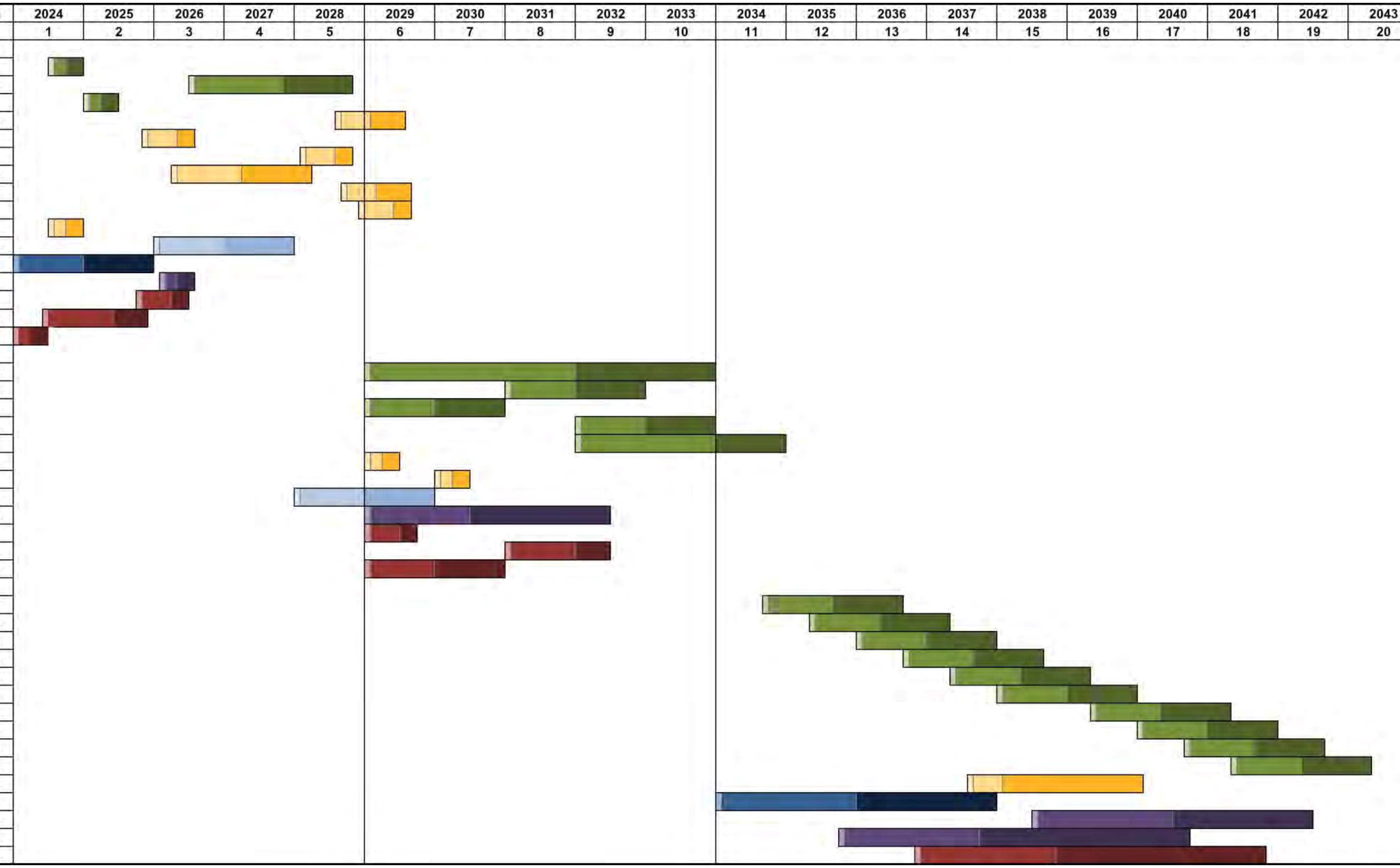

Figure 7-7. Implementation Plan Preliminary Schedule

Note: The three shades of colors are designated for NEPA coordination (lightest), design and permitting (middle), and construction (darkest) timing.
Source: AECOM

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7.6 Airport Capital Improvement Plan

In addition to the Facilities Implementation Plan, GIAA has developed a list of capital improvement projects prior to the completion of this Master Plan Update. Those projects and their descriptions and need are displayed in **able -6** Airport Capital Improvement Projects below.

able -6 Airport Capital Improvement Projects

Number	Project Name	Description and Need
1	Terminal Apron Rehabilitation – Package B,C, D - NTP 1	Commencement of rehabilitation of terminal aprons (Package B, C, & D construction)
2	Terminal Roof Replacement – Phase I	Commencement of terminal roof replacement – Construction.
3	Terminal Apron Rehabilitation – Package A, NTP 2	Rehabilitation improvements to terminal aprons (Package A - Completion Phase)
4	Terminal Roof Replacement – Phase II	Completion phase for roof replacement project primarily for the solar panels procurement and installation. BIL ATP
5	Cargo Apron & Fuel System xtension – Construction; Phase 2	Construction of new cargo aprons adjacent to cargo facilities with fueling capability.
6	Main Gate Improvements (AOA Access) – Construction	Single access for air carriers and support partners that requires replacement due to flooding and multiple outages.
7	Conduct nergy fficiency Study	The study will identify GIAA's most energy-intensive activities, recommend improved energy distribution, and propose cost-effective technologies for a sustainable, long-term renewable energy program.
8	Zero missions Vehicle Acquisitions	The Zero missions Vehicle Program will commence the modernization of the airport's fleet with all-electric or hydrogen-powered vehicles, reducing emissions and supporting a greener environment.
9	Information Technology Infrastructure and Financial Management Systems Integration Assessment and Design	The project assesses and designs the integration of IT infrastructure with financial management systems to streamline data flow and improve efficiency. It will create a plan to align technology with financial processes for enhanced system performance.
10	Improve Airfield Lighting Vault	The project will upgrade the airfield lighting vault at the Airport to modernize equipment and integrate renewable technology, improving efficiency and sustainability.
11	Airport Microgrid Feasibility Study	valuate the practicality, benefits, and challenges of implementing a self-contained microgrid system to enhance energy resilience, reduce costs, and minimize GUM's environmental impact.
12	Rehabilitate Terminal Building – Fire Alarm/Fire Suppression System	To modernize and fully integrate fire alarm/fire suppression infrastructure of airport facilities into one centralized management system.
13	Construct Terminal Building – Miscellaneous Airport Projects For xpanded Access to Airport Facilities By Individuals with Disabilities	The project aims to enhance accessibility for individuals with disabilities at Guam's commercial airport, complying with the ADA of 1990 and FAA's AC 150/5360-14A.
14	Modify Terminal Building – xpand Security Screening Queuing Area – Design	The project involves expanding the queuing area for the 7-8 lane security checkpoint on the 2nd floor to improve passenger flow and reduce congestion.
15	PFAS Removal And Destruction From Airport Granular Activated Carbon Water System	This project addresses PFAS contamination at the Airport in line with the FAA Reauthorization Act of 2024 by evaluating mitigation strategies, testing destruction technologies, safely disposing of legacy materials, and studying granular activated carbon's effectiveness in removing PFAS from water.
16	Passenger Loading Bridge Rehab/Replacement	Replacement and modernization of all 17 passenger loading bridges.
17	Noise Mitigation Measures For Residences – Construction	Noise mitigation measures for residences within 65-69 DNL Noise mitigation.

Number	Project Name	Description and Need
18	Runway Lighting Upgrades	This is the first phase of a comprehensive initiative to improve operational efficiency and sustainability in line with industry goals.
19	Public Conveyance Systems Upgrade	Improve efficiency and passenger experience with modern and expanded public conveyance systems (moving walkways, escalators, and elevators).
20	Underground Utility Infrastructure Relocation - Design - Phase I	This project relocates above-ground power utility infrastructure underground to promote safety, improve efficiency and resiliency while minimizing service disruptions.
21	Zero missions Runway Sweeper And Striping Machine Acquisition	The project involves acquiring a Zero missions Airport Sweeper and Runway Striper as part of GIAA's fleet modernization and commitment to environmental sustainability and high safety standards.

Note:

A. Abbreviations
NTP = Notice to Proceed
AOA = Air Operations Area
BIL = Bipartisan Infrastructure Law
ATP = Airport Terminals Program
GIAA = A.B. Won Pat International Airport Authority, Guam
ADA = Americans with Disabilities Act
FAA = Federal Aviation Administration
AC = Advisory Circular
PFAS = Per- and Polyfluoroalkyl Substances
DNL = Day-Night Average Sound Level

Source: GIAA

8 Financial Feasibility Analysis

Executive Summary

This chapter of the Master Plan Update presents the financial plan for the Antonio B. Won Pat International Airport (Airport) to implement the recommended capital projects identified in **Chapter :** *Facilities Implementation Plan*, based on the proposed timing and cost of the development alternatives and financial analysis. The financial analysis includes consideration of the annual financial results of the A.B. Won Pat International Airport Authority, Guam (GIAA) and the anticipated funding sources for individual projects.

The following sections in this chapter present:

- Available funding sources
- Financial overview and outlook
- Capital project funding plan

Chapter : *Facilities Implementation Plan* identifies projects in three phases of the 20-year planning horizon, including:

- Short-term, or projects to be implemented in years 1 through 5
- Mid-term, or projects to be implemented in years 6 through 10
- Long-term, or projects to be implemented in years 11 through 20

The analysis of funding sources is focused on the projects in the short-term and mid-term phases, where there is more certainty regarding project timing and cost. Beyond 10 years, there are more general conclusions regarding project funding.

8.1 Available Funding Sources

GIAA has a variety of funding sources available to fund capital projects. The following sections describe the funding sources, and considerations such as funding capacity and eligibility of projects.

8.1.1 Federal FAA Grants

The Federal Aviation Administration (FAA) provides funds to airports for capital improvements through the federal Airport Improvement Program (AIP), in the form of entitlement grants and discretionary grants. n titlement grants are based on a formula related to airport enplanements, while discretionary grants are awarded according to FAA priority of projects, on a competitive basis. Within the past 5 years (Fiscal Years [FYs] 2017–2022), GIAA received an average of $10 million to $15 million per year in AIP funding.

In 2021 the U.S. federal government passed the Infrastructure Investment and Jobs Act (IIJA), otherwise known as the Bipartisan Infrastructure Law (BIL), that includes significant funds for airport capital projects over the next 5 years. GIAA expects to receive approximately $30 million in BIL funds over a 5-year period (FY2022–2026), some of which would be for pre-existing projects (prior to the funding of Master Plan projects), and some of which would be available for short-term projects identified in this Master Plan Update.

8.1.2 Passenger Facility Charge

Passenger Facility Charge (PFC) revenue is collected on a per-ticket basis and is available to fund airport capital projects with airline consultation and FAA approval. PFC revenue can be used to cash-fund projects ("pay-as-you-go") and to pay debt service on bonds issued to pay for capital projects ("financing").

In recent years, GIAA has used PFC revenue to help pay the debt service for bonds issued to finance the prior terminal expansion project. As of 2022, GIAA's approved use of PFC revenue to pay such debt service for the prior passenger terminal project had a balance of approximately $100 million, which is projected to account for all the annual PFC revenue collected for at least another 10 years, and therefore, is not anticipated as a material source of funding for new Master Plan projects in the short-term and mid-term phases in the baseline case. If GIAA chooses to apply to revise the approved use of PFC revenue, there could be changes in the application of annual PFC revenue.

8.1.3 Customer Facility Charge

Customer Facility Charge (CFC) revenue is collected from rental car companies to pay for capital and operating expenses of rental car facilities at the rate of $0.50 per contract day. CFC revenue will be available to fund rental car improvements in the Master Plan. CFC revenue is reported as part of commercial passenger terminal concession revenue.

8.1.4 Airport Funds

Airport funds, including proceeds of revenue bonds and retained cash, are available as a source of funds for capital projects, but limited by the amount of net revenue that is generated each year.

Airport net revenues (revenues net of operating expenses) are used to pay annual debt service on bonds issued to fund capital projects and make other required fund deposits, and remaining balances (retained cash) are available to cash-fund capital projects, including local matching funds. The availability of Airport funds is limited by the ability of GIAA to increase user charges and generate increased net revenue.

8.1.5 hird-Party Funds

Third-party funds are frequently used to fund airport projects outside of the “core areas” that are funded by airline charges. It is anticipated that there could be interest from third-party developers and investors to invest in the general aviation (GA) and cargo projects that have been proposed for the Airport. In the event that there are no third-party funds available, some projects could be re-scoped and/or re-phased to align with funding availability.

8.2 Financial Overview and Outlook

The Airport is operated by GIAA as an autonomous agency of the Government of Guam. In accordance with the U.S. Department of Transportation (DOT) and FAA regulations, all revenue generated by GIAA from operations at the Airport, is required to be used for lawful airport purposes, including paying annual operating expenses, annual debt service, and re-investment in Airport facilities. GIAA’s financial operations are also subject to the terms of the Bond Indenture, tenant lease agreements, and various policy resolutions.

GIAA receives revenue from airline charges, non-airline sources, PFC receipts, and federal grants for reimbursement of operating expenses.

The Airport incurs expenses for annual operations and maintenance, as well as annual debt service on bonds issued to finance airport improvements.

8.2.1 Annual Financial Results

Figure -1 shows the financial results from FY2018–2022. The net revenue result has fluctuated annually due to factors such as the 2019 Novel Coronavirus (COVID-19) pandemic, federal operating grants, and agreements with tenants; but in general, the net positive result is indicative of GIAA’s ability to generate sufficient revenue to cover operating expenses and payment of debt service on bonds.

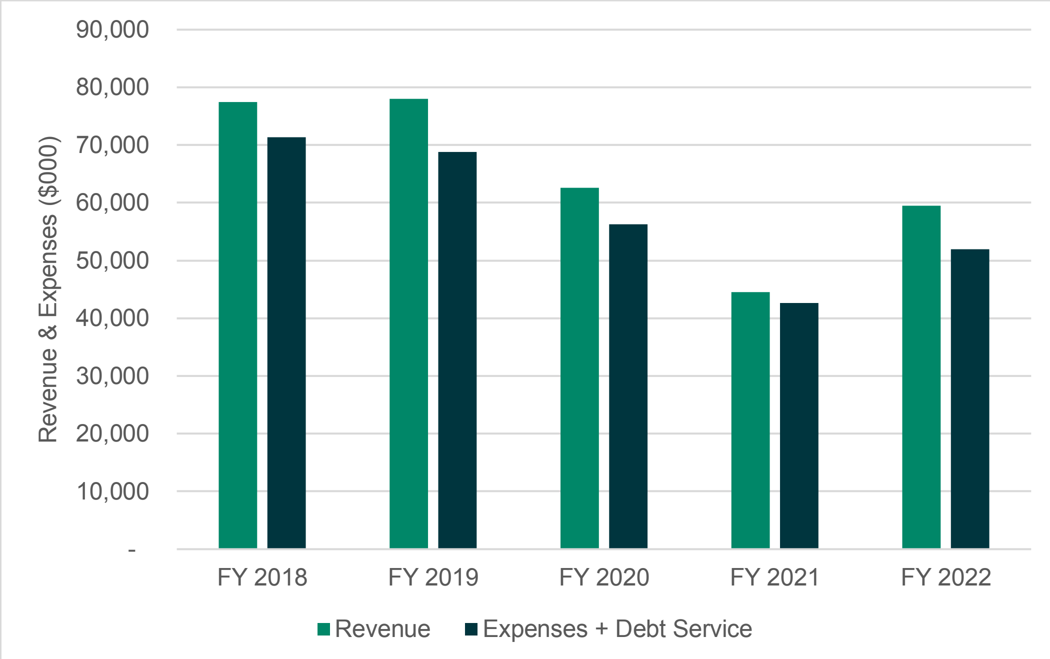

Figure 8-1. Historical Revenues and Expenses

Note: Revenues and expenses are in thousands of dollars.
Source: GIAA

Figure -2 shows a pro forma projection of total revenue and expenses. This pro forma projection was used to evaluate sources of funding for the Master Plan projects. The following sections provide more detail on the primary sources of revenue and expenses. It was assumed that there would be increases in both airline and non-airline revenue to support the 10-year development program.

The pro forma projection of operating expense and debt service does not include any potential new bond debt service, in order to show the capacity for future Master Plan capital project funding.

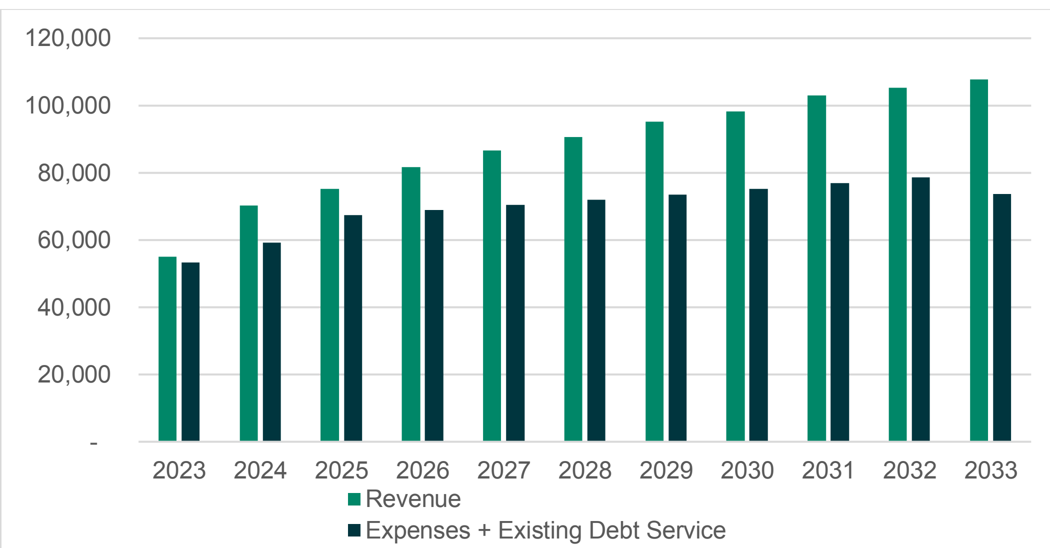

Figure 8-2. Pro Forma Revenues and Expenses

Note: Revenues and expenses are in thousands of dollars.
Sources:

1. *GIAA*
2. *InterVISTAS*

Figure -3 shows the historical and projected sources of revenue. Primary sources of revenue and assumptions include:

- Airline revenue: Assumed trend in reasonable cost per enplanement.
- Non-airline revenue: va luation of non-airline revenue agreements and expected trends in revenue per passenger.
- Other revenue: A return to pre-pandemic trends after receiving federal operating grants for operating expenses in the 2020–2022 pandemic years.

a ch primary source of revenue is discussed in the following sections.

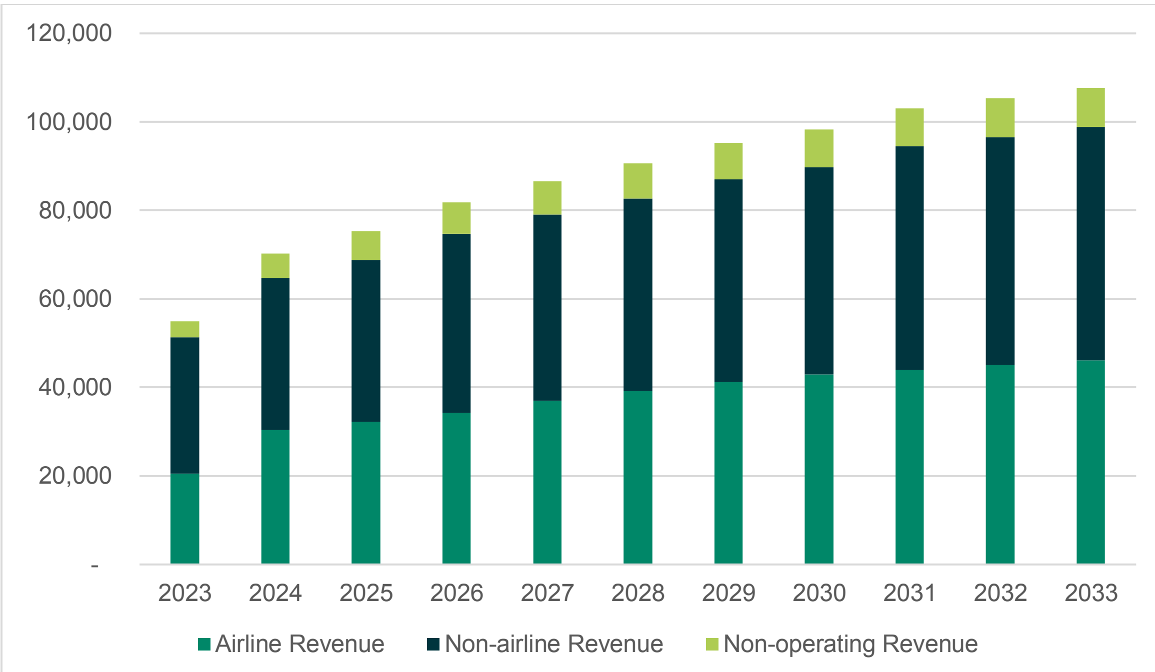

Figure 8-3. Projected Sources of Revenue

Note: Revenues and expenses are in thousands of dollars.
Sources:
1. *GIAA*
2. *InterVISTAS*

8.2.2 Airline Revenue

Airline revenue is composed of passenger airline revenue (airline landing fees and commercial passenger terminal rent) and non-passenger airline revenue (primarily fuel flowage fees and cargo airline landing fees). Airline revenue charges are established each year in relation to the cost of providing facilities and services to the airlines and other users at the Airport, and to ensure financial stability.

The passenger airline revenue charges are documented in the agreements between GIAA and the airlines. GIAA periodically re-negotiates the terms of airline agreements and expects that the general terms will be substantially similar to the historical experience and will in addition support financing future capital improvements.

Figure - shows the forecast trend in airline revenue per enplaned passenger. In recent years, the average airline cost increased due to the significant decline in passengers after 2020. With the recovery of passenger traffic, it is assumed that the average airline revenue per enplaned passenger would decrease over the next few years, and then increase gradually over time, within the range of $20 to $25.

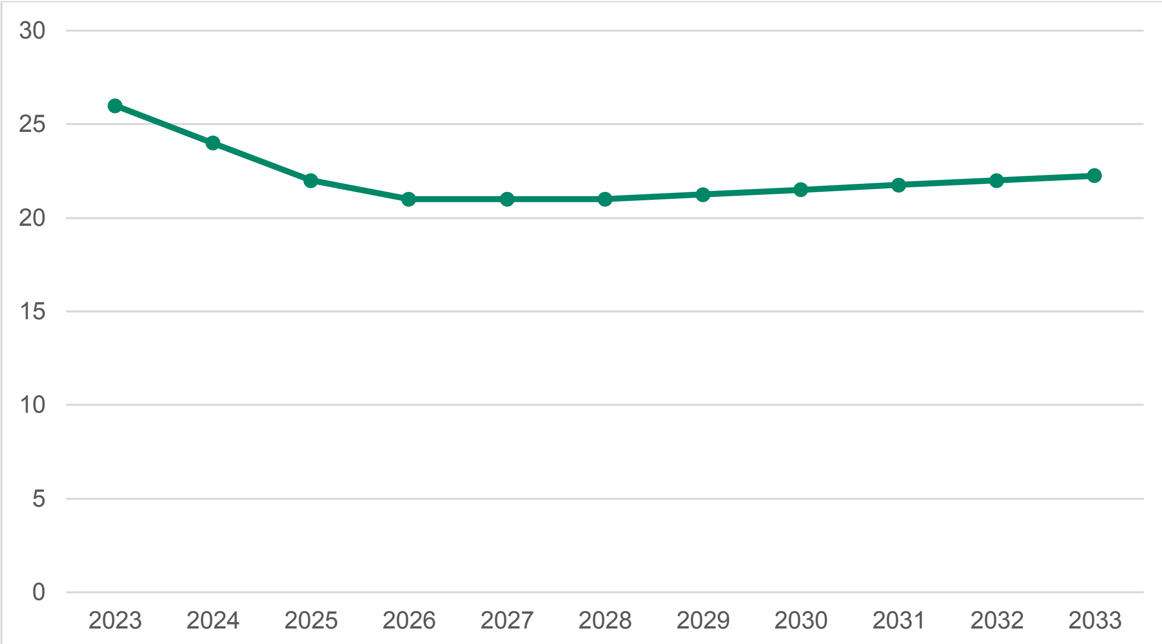

Figure 8-4. Airline Revenue per Enplaned Passenger

Source: InterVISTAS

8.2.3 Non-Airline Revenue

The primary sources of non-airline revenue are commercial passenger terminal concessions and space rentals, ground transportation, and land and building leases. GIAA has agreements with tenants providing for the payment of revenue directly to the authority. There was interruption in some of the business terms during the COVID-19 pandemic, to provide relief to tenants, and recognizing federal aid to GIAA to replace tenant revenue.

Going forward, as traffic recovers to pre-pandemic levels, it is expected that non-airline business terms will also return to historical norms.

Figure - shows the projection of the primary sources of non-airline revenue from 2023 to 2033.

General trends and assumptions are as following:

- Commercial Passenger Terminal Concessions: General merchandise revenues will return to pre-pandemic levels of minimum guarantee and passenger revenue per passenger. Rental car revenues will increase to support the financing of a new ground transportation center, including an assumed increase in the CFC rate. Trend increases in other concession sources are related to passenger growth.
- Commercial Passenger Terminal Space Rentals: Moderate increases in annual space rental rates.
- Ground Transportation: Increase in revenues with resumed growth in passengers. It was assumed that the unit rates of revenue per passenger would increase to support the financing of a new parking plan.
- Land Leases: Moderate increase in land rental rates.
- Other Revenues: Changes on a trend basis.

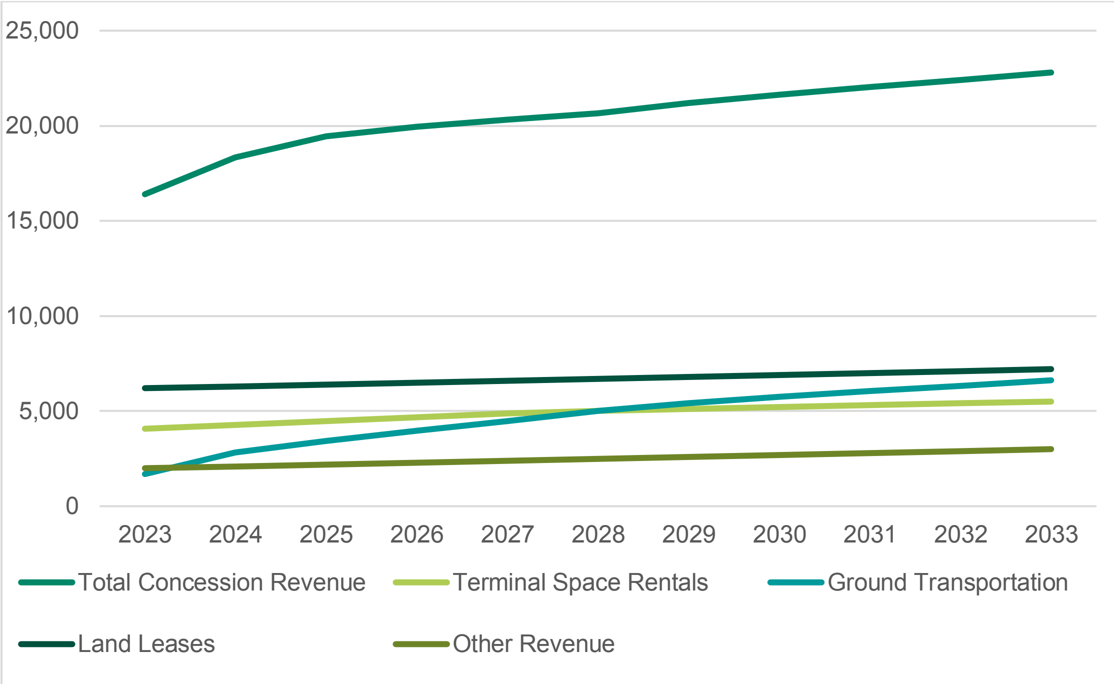

Figure 8-5. Sources of Non-Airline Revenues

Note: Revenues and expenses are in thousands of dollars.
Sources:

1. *GIAA*
2. *InterVISTAS*

8.2.4 Other Revenue

The primary sources of non-operating revenue are PFCs and the proceeds of federal grants for operating expenses during the pandemic. The PFC revenues are restricted as to use and are currently applied to annual debt service for prior projects.

Prior to the pandemic, this source of revenue was about $8 million per year, primarily from PFC revenue. From 2020 to 2022, GIAA received an additional $60 million in federal relief grants for operations. Beginning in 2023, this source is expected to return to historical trends.

8.2.5 Operating Expenses

Operating expenses are based on GIAA's annual budget, and resulting actual expenses, for personnel, materials and supplies, and various contractual services. It was assumed that operating expenses would increase approximately 3 percent per year.

8.2.6 Debt Service

GIAA pays an annual debt service on the bonds issued to finance Airport improvements. This obligation is considered in reviewing annual airline rates and charges. The current obligation for annual debt service is about $18 million per year over the forecast period.

8.3 Capital Project Funding Plan

The Airport's proposed Implementation Plan is summarized in **Chapter :** *Facilities Implementation Plan* and was developed based on the analysis conducted during the Master Plan development, including demand forecasts, capacity analyses, and alternatives analysis. This section presents a summary of the proposed funding of the first 10-year capital improvement projects.

able -1 presents a summary of the estimated cost of capital projects in the 10-year, short-term and mid-term phases, in terms of unescalated and escalated project cost, assuming a 4 percent escalation. After escalation of project cost, there is approximately $96 million in project cost in the short-term, and approximately $430 million in project cost in the mid-term.

able -1 Summary of 1 -Year Capital Project Cost

Phase	Unescalated	Escalated
Short-Term Projects	$87,250	$96,239
Mid-Term Projects	$320,463	$430,059

Sources:
1. *AECOM Cost Estimates*
2. *InterVISTAS Analysis*

able -2 summarizes the assumed funding of the short-term phase capital projects. Key assumptions include:

- Airfield projects are funded approximately 90 percent with FAA grants.
- Commercial passenger terminal projects, specifically the Security Screening Checkpoint passenger queue expansion, are funded 75 percent with FAA grants.
- The north cargo apron construction is funded with FAA grants.
- The Airport parking plan will require bond financing, supported by increased ground transportation fees.

able -2 Short- erm Capital Improvement Project Funding

Projects	Escalated Cost	FAA AIP Grants	Bonds	Airport Funds	3rd Party	otal
Airfield						
Taxiway/Runway Maintenance	$1,964	$1,767		$196		**$1,96**
erminal						
Security Screening Checkpoint	$15,740	$14,166		$1,574		**$1 ,**
Other Improvements	$4,953	$2,476		$2,476		**$,9 3**
andside						
Airport Parking Plan	$7,379		$6,641		$738	**$,3 9**
Cargo						
Cargo Apron	$45,378	$40,840		$4,538		**$,3**
General Aviation						
Temporary Storage Hangar	$6,243				$6,243	**$6,2 3**
Support						
Various	$14,582	$10,936		$3,645		**$1 , 2**
otal	**$96,239**	**$,1**	**$6,6 1**	**$12, 3**	**$6,9 1**	**$96,239**

Notes:
- A. *Funding is in thousands of dollars.*
- B. *Abbreviations*
  FAA = Federal Aviation Administration
  AIP = Airport Improvement Program

Sources:
1. *AECOM Cost Estimates*
2. *InterVISTAS Analysis*

able -3 presents the assumed funding for the mid-term phase capital projects. Key facts and assumptions include:

- Airfield projects are funded approximately 90 percent with FAA grants, primarily for taxiway upgrades.
- Rental car structure is funded with Airport bonds supported by increased ground transportation fees.
- GA Hangar is funded primarily with third-party funds.
- Available Airport funds are utilized for multiple support projects.

able -3 Mid- erm Capital Improvement Project Funding

Projects	Escalated Cost	FAA AIP Grants	Bonds	Airport Funds	3rd Party	otal
Airfield						
Runway Modifications	$8,106	$7,295		$811		**$,1 6**
Taxi/Apron Connectors	$10,906	$9,816		$1,091		**$1 ,9 6**
Taxiway/Taxilane Upgrades	$54,265	$48,838		$5,426		**$,26**
erminal						
CBP/CQA Booths	$845	$845				**$**
andside						
Rental Car Structure	$190,388		$171,350		$19,039	**$19 ,3**
General Aviation						
Storage Hangar	$113,143	$10,000			$103,143	**$113,1 3**
Support						
Jet A Fuel Tank	$35,093		$31,584	$3,509		**$3 , 93**
South AOA Access Gate	$456	$228		$228		**$ 6**
ARFF GIAA Training Facility	$16,855	$15,170		$1,686		**$16,**
otal	**$ 3 , 9**	**$92,193**	**$2 2,933**	**$12, 1**	**$122,1 2**	**$ 3 , 9**

Notes:

A. *Funding is in thousands of dollars.*

B. *Abbreviations*
FAA = Federal Aviation Administration
AIP = Airport Improvement Program
CBP = Customs and Border Protection
CQA = Customs and Quarantine Agency
AOA = Air Operations Area
ARFF = Aircraft Rescue and Firefighting
GIAA = A.B. Won Pat International Airport Authority, Guam

Sources:

1. *AECOM Cost Estimates*
2. *InterVISTAS Analysis*

9 Sustainability

Executive Summary

The A.B. Won Pat International Airport Authority, Guam (GIAA) seeks to tie sustainable development into its Master Plan process by developing clear sustainable strategies to guide decision making for improvements at the Antonio B. Won Pat International Airport (Airport).

GIAA has already implemented several initiatives addressing sustainability and climate resilience at the Airport. Prior actions focused on infrastructure hardening and decarbonization and include strategies such as electrification of passenger boarding bridges (PBBs), commercial passenger terminal lighting and air conditioning unit upgrades, and hardening infrastructure against severe storms.

While GIAA's 2021 Annual Report includes objectives for advancing sustainability at the Airport, there are no official statements or policies established that outline sustainability targets or goals. As a part of the Master Plan process, stakeholder visioning meetings identified the need for clearly defined sustainability initiatives that address climate change mitigation and adaptation. Additionally, GIAA has expressed a desire to uphold international standards for sustainability and stay ahead of climate-related risks and impacts. GIAA has identified water and waste management, environmental justice (J) , and national and regional standards and regulations as additional areas of interest.

There are a variety of organizations within the aviation industry that work to develop standards and drive progress within the industry, including the International Civil Aviation Organization (ICAO), the Airports Council International (ACI), the National Air Transportation Association (NATA), and the Airport Carbon Accreditation (ACA). These organizations are placing an increased focus on helping airports reduce overall emissions and implement a variety of sustainability initiatives that aim to save costs, drive innovation, and develop quality and healthy environments to achieve high levels of safety and customer/employee satisfaction.

Additionally, in the United States and the territory of Guam, there are several regional and regulatory programs that are relevant to sustainability initiatives at the Airport. On a federal level, the Infrastructure Investment and Jobs Act and the Inflation Reduction Act aim to invest in clean energy production to strengthen the economy, meet federal decarbonization and emissions reduction targets, harden and advance infrastructure, and improve the lives of those living in the United States and neighboring territories. On a local and regional level, the Guam Power Authority's (GPAs) Clean n ergy Master Plan, Guam Green Growth, and Local2030 Islands Network are advancing sustainability and decarbonization goals and solutions using a local lens, ensuring that solutions are tailored to meet Guam's specific needs as an island nation in the North Pacific Ocean.

The island of Guam experiences a tropical marine climate, which is warm and humid, moderated by seasonal trade winds and a wet and dry season. Climate change in Guam is an increasingly pressing issue for the country. As an island territory, Guam is already vulnerable to sea level rise, flooding, drought, tropical storms, and typhoons. In the coming years, climate change will exacerbate these hazards, putting Guam at greater risk from sea level rise, coastal erosion, rising temperatures, and increased extreme weather events that are likely to damage or destroy Guam's coral reef ecosystems, impact freshwater supply management during the dry season, and damage island infrastructure. Climate change and the associated risks can impact GIAA assets and operations and thus should be considered when identifying and implementing sustainability initiatives.

Throughout the Master Plan process, GIAA has regularly engaged stakeholders to gain input on key concerns to address. Stakeholders identified several recommendations for sustainability such as mass transit and public transportation infrastructure improvements, electrification, electric vehicles (Vs) and V infrastructure growth, sustainable building design, renewable energy source identification, emergency storm alert systems, better waste management systems, solar energy infrastructure, environmental stewardship, water runoff and stormwater management, and an overall improved approach to sustainability.

A C OM has identified 36 initial sustainability strategies and initiatives GIAA can consider implementing within the following focus areas: n ergy and Fuels (Decarbonization), Sustainable Buildings and Infrastructure, Airport Sustainability Governance, Social Sustainability, Climate Resilience, Water

Conservation and Management, and Waste and Materials Management. The strategies outlined in this report are intended to provide a starting point for integrating sustainability objectives into the Airport's Master Plan. The strategies include reducing emissions through energy conservation and using less fossil fuel, using design decisions to improve sustainability performance for buildings and infrastructure, establishing appropriate governance structures and an Airport-wide sustainability vision statement and policy, identifying strategies to engage the community in sustainability, considering and incorporating J considerations into Airport actions and initiatives, building resilience against physical climate risk, identifying opportunities to conserve water use and manage stormwater, and reducing the amount of waste destined for landfills and incineration.

There are a variety of opportunities that may be available to GIAA for funding the implementation of many of the identified strategies. These include grants, rebates, and tax incentives and are funded by federal agencies such as the Federal me rgency Management Agency (F M A) and the Federal Aviation Administration (FAA). The chapter concludes with recommended next steps and actions GIAA can consider to begin further evaluating and implementing the potential sustainability strategies.

9.1 Introduction

As part of the Master Plan update, GIAA is working to identify a variety of potential strategies and initiatives that could be considered for implementation to continue to build a strong and effective sustainability program at the Airport. GIAA's 2021 Annual Report[65] includes the following sustainability objectives:

- Continue to include and tie sustainable development into planning processes, specifically the Master Plan process.
- Develop a clear sustainable strategy to help guide, and not constrain, decision making and position GIAA to access capital and grow without comprising future generations.
- Use a systemic approach to understand and accommodate the needs of its stakeholders from a social, environmental, and economic perspective.
- Reduce GIAA's carbon footprint while continuing development to optimize and increase capacity in a safe and healthy Airport environment.
- st ablish a sustainability policy.
- Drive initiatives to preserve resources and achieve long-term sustainability through capital improvement projects (to include the financing, design, construction, and operations).
- n hance the passenger experience by improving processes and efficiencies through workforce development and community engagement.

This chapter is organized to provide the sustainability context for existing sustainability goals and initiatives, industry and regional trends, and a high-level analysis of key climate-related risks, as well as identify Airport stakeholders and engagement efforts around sustainability. Starting in **Section 9** , potential sustainability strategies and initiatives are identified that GIAA could implement to build and integrate sustainability programs at the Airport, including during the implementation of the Airport Development Plan. Potential strategies are organized by focus area and include strategies related to decarbonization of Airport operations, developing sustainable buildings and infrastructure, integrating sustainability into GIAA governance structures, advancing social sustainability, building resilience against physical climate risks, reducing water use and managing stormwater, and reducing waste generation by implementing sustainable materials management.

9.1.1 Airport Development Plan

The Airport Development Plan includes general improvements to Airport operations and strategies to increase passenger efficiency and capacity, but does not include specific sustainability actions geared toward decarbonization or building climate resilience. As such, this chapter is structured to provide GIAA with the tools needed to implement a sustainability program at the Airport and does not specifically

[65] A.B. Won Pat International Airport Authority, Guam 2022

analyze the Airport Development Plan within a sustainability setting. For more information on the Airport Development Plan, see **Chapter :** *Alternatives Development and Evaluation*.

9.2 Sustainability Context

The following sections describe the sustainability context for existing sustainability goals, targets, and initiatives, as well as industry and regional trends. Key physical climate risks are also identified and evaluated for potential impacts to the Airport's assets and operations.

9.2.1 GIAA Sustainability Goals and argets

Although GIAA's 2021 Annual Report includes general objectives for advancing sustainability at the Airport, there are not any official statements or policies outlining goals or targets regarding sustainability; however, sustainability considerations have been integrated into the Master Plan process. One of the goals and objectives identified during the Master Plan Stakeholder Advisory Committee Visioning Meeting included, "Identify sustainability initiatives (e.g., renewable energy, ecologically friendly vehicles, charging stations, and other features)" that coincide with the objectives of the November 2021 Infrastructure Investment and Jobs Act (IIJA). During a Master Plan status meeting on January 17, 2023, GIAA expressed a desire to uphold international standards for sustainability and implement climate change mitigation and adaptation actions to stay ahead of potential climate-related impacts. GIAA noted additional sustainability areas of interest including waste and water, J, climate resilience, and other regional and national industry regulations and standards.

9.2.2 GIAA Sustainability Initiatives

GIAA has implemented several actions at the Airport to harden infrastructure and decarbonize operations. xi sting and past initiatives that have been implemented are outlined in **able 9-1**.

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able 9-1 Prior Airport Actions for Infrastructure ardening and Decarbonization

Category	Action	Description
nergy & Fuels	Commercial Passenger Terminal Generators Fueling System	The commercial passenger terminal has 100 percent coverage with four emergency generator units for a total of 7.44 MW. The units are configured to be powered by jet fuel, eliminating the need for added building area and tanks for fuel storage. The units are connected to the apron fuel system. Using jet fuel instead of diesel also reduces the carbon footprint.
	lectrification of Preconditioned Air and 400 HZ Aircraft Services	Airlines and ground handling agents previously used diesel-powered GS on the ramp to service their aircraft. The Airport installed electrical point-of-use units at all 17 passenger boarding bridges. In addition to reducing the carbon footprint, the electrified units improve safety by reducing the amount of GS on the ramp.
	Commercial Passenger Terminal Lighting Upgrade/Conversion	The Airport retained an SCO to implement energy conservation measures. This included a conversion of terminal lighting fixtures by replacing the old ballasts with premium electronic ballast and lower wattage fluorescent lamps. Approximately 11,332 fixtures were converted resulting in an estimated average annual savings of $524,429.
	Commercial Passenger Terminal Air Conditioning System Upgrade	Under the same SCO program as above, the terminal air conditioning system was replaced with newer and energy efficient equipment. The system consisted of four chillers, four cooling towers, and 20 air handling units. These improvements were funded by a local U.S. Department of Agriculture guaranteed loan with debt service paid from power savings guaranteed by the SCO.
Climate Resilience	Ramp Lights	Roof-mounted ramp lights were consistently damaged by typhoon force winds so the Airport purchased mobile light carts to provide suitable and safe lighting for ramp operations. The Airport had separate fixed posts and light fixtures designed to withstand the higher wind loads. These hardened lights were installed at all commercial passenger terminal gates and interim cargo aprons.
	Metal Shutter Installation for xterior Doors	Utilizing F MA hazard mitigation funding, the Airport installed metal shutters on each exterior door. During typhoons, the shutters will minimize wind damage to the doors and reduce wind-driven rain infiltration into the terminal building. This will also minimize the post-typhoon recovery period.
	Concrete Fence Post Modification to Standard	The Airport is surrounded by 40,594 linear feet of security and safety fencing. Standard fencing materials typically include metal posts, which are unable to withstand typhoon wind loads and have minimal debris coverage. The Airport submitted a modification to standard that changed the fencing to concrete posts and foundations. The FAA-approved modification resulted in the Airport fencing being able to withstand typhoon force winds and provide some debris coverage. This would also reduce the Airport's post-typhoon recovery period.
	Underground Power Transmission Lines	One of the major impediments to post-typhoon recovery is the repair or replacement of damaged power poles and aerial transmission lines, which are critical facilities for Airport/airlines operations and security. The baseline power provider installed substation/switching station underground distribution lines from the island power provider's distribution system. The Airport extended this mitigation effort to serve all critical facilities and substantially reduce Airport down time.

Category	Action	Description
Water	Airport xclusive Water System	As part of a U.S. military base closure, the Airport received the bulk of its facilities including the airfield. The Airport was obligated to remediate contaminants in the groundwater aquifer below the Airport property. Rather than focus only on “pump and clean,” the Airport decided to also construct wells, reservoirs, remediation systems, and generation and transmission water lines. In addition to multipurpose efficiencies, the Airport became more self-sufficient by having a reliable supply and pressure for fire suppression facility requirements and public health purposes.

Note:

A. Abbreviations

ESCO = Energy Services Company
GSE = Ground support equipment
FAA = Federal Aviation Administration
FEMA = Federal Emergency Management Agency
HZ = Hertz
MW = Megawatts

Source: GIAA (2023)

9.2.3 Industry Context

To meet the current federal government's goal of net zero greenhouse gas (GHG) emissions economy-wide by 2050, the FAA launched the Airport Climate Challenge in April 2022.[66] In September of 2022, three U.S. government agencies; the U.S. Department of Transportation (DOT), U.S. Department of Agriculture (DOA), and U.S. Department of n ergy (DO), began developing the Sustainable Aviation Fuel Grand Challenge as a strategy to scale up technologies to produce sustainable aviation fuel (SAF) on a commercial scale.[67] Over 470,000 commercial flights have operated using SAFs since 2011, and nine airlines have off-take agreements to begin purchasing SAFs.[68] SAF has been used at the Los Angeles International Airport (LAX) since 2016 and at San Francisco International Airport (SFO) since 2020.[69] According to the Air Transport Action Group, switching to SAF has the potential to reduce carbon emissions by 80 percent across the aviation industry.[70]

The Airport Climate Challenge has identified best practices for GHG emissions reduction including low or zero emission vehicles, renewable energy production, and energy efficiency assessments. These specific initiatives are eligible for Airport Improvement Program (AIP) grant funding, which is discussed further in **Section 9** .

9.2.3.1 International Civil Aviation Organization ICAO

ICAO is a specialist agency of the United Nations (UN) set up to define international safety, environmental, and operating standards for civil aviation. ICAO is funded and directed by 193 governments. Its core function is to maintain an administrative and expert bureaucracy to support these diplomatic interactions, and to research new air transport policy and standardization innovation as directed and endorsed by governments.[71]

As part of its strategic objective to minimize the adverse environmental effects of civil aviation activities, ICAO is working to facilitate the development and deployment of SAF. ICAO defines SAF as renewable or waste-derived aviation fuels that meet sustainability criteria.[72]

ICAO is enabling SAF development through four main streams:

1. Globally accepted environmental standards for SAF
2. SAF goals, policies, and measures
3. Capacity building and assistance to ICAO member states through the Assistance, Capacity-building and Training for Sustainable Aviation Fuels (ACT-SAF) Programme
4. Outreach of SAF information and best practices

9.2.3.2 Airports Council International ACI

ACI represents the collective interests of airports around the world to promote excellence in the aviation industry; this is achieved by working with governments, regional ACI members, experts, and international organization to develop policies, programs, and best practices that advance airport standards globally.[73] ACI objectives include:

- Promoting industry excellence by providing members with innovative tools and expertise.
- Representing the interests of airports to international and national policymakers.
- Maximizing cooperation and assistance between airports.
- Increasing public awareness of the social and economic importance of airports.

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[66] *Federal Aviation Administration, 2022*
[67] *U.S. Department of Energy, 2022*
[68] *Aviation Benefits Beyond Borders, n.d.*
[69] *U.S. Department of Energy, n.d.a*
[70] *International Air Transport Association, 2019*
[71] *International Civil Aviation Organization, n.d.a*
[72] *International Civil Aviation Organization, n.d.b*
[73] *Airports Council International, 2023*

- Fostering collaboration between airports, governments, industry stakeholders, and international organizations.

Currently, ACI serves 712 members, operating in 1,925 airports in 171 countries, including GIAA. Membership is open to airports and aviation-related businesses around the world; members benefit from the latest news, data-driven trends and forecasts, resources, programs and training opportunities, and insights from industry experts.[74]

9.2.3.3 Airport Carbon Accreditation ACA

ACA is a global carbon management certification program owned and governed by ACI U ROP designed specifically for airports. ACA was started in 2009, one year after the Annual Assembly of ACI U ROP adopted a resolution whereby member airports committed to reduce carbon emissions from their operations, with the goal of becoming carbon neutral. After growing into several regions, ACA is now a global program, with North America joining in September 2014.

ACA independently assesses and recognizes the efforts of airports to manage and reduce emissions through six levels of certification (**Figure 9-1**).[75] These levels are meant to acknowledge the different stages that airports are at in terms of carbon management. ACA is used as an effective and forward-facing tool to support airports of all sizes globally to reduce their climate impact.

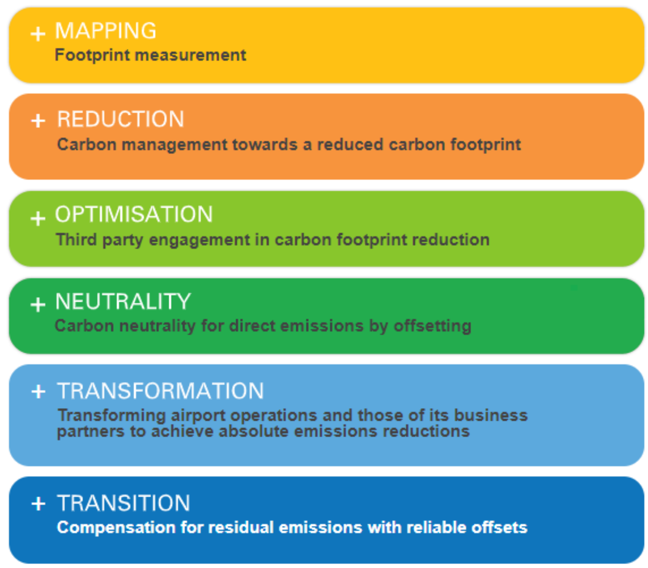

Figure 9-1. ACA Certification Levels

Source: ACA

The levels are as followed: Level 1 (Mapping), Level 2 (Reduction), Level 3 (Optimisation), Level 3+ (Neutrality), Level 4 (Transformation), and Level 4+ (Transition). xa mples of small island nation airports that have achieved ACA certification include:

- Level 1: Faa'a International Airport, Tahiti (PPT); Curaçao International Airport, Curaçao (CUR); Grand Case Airport, Saint Martin (SFG)
- Level 2: Sir Seewoosagur Ramgoolam International Airport, Mauritius (MRU); Malta International Airport, Malta (MLA); Daniel K. Inouye International Airport, Hawaii, U.S. (HNL)
- Level 3: Nadi International Airport, Fiji (NAN); Reina Beatrix International Airport, Aruba (AUA); and Roland Garros Airport, Réunion (RUN)
- Level 3+: Aeropuerto Internacional del Cibao, Dominican Republic (STI); Galápagos co logic Airport, Galápagos Islands, cu ador (GPS); Paphos International Airport, Cyprus (PFO); and Larnaka International Airport, Cyprus (LCA).

There are no island airports that have achieved Level 4 or 4+ certification at this time.

9.2.3.4 National Air ransportation Association NA A

NATA is the leading national trade association representing the business interests of general aviation (GA) service companies on legislative and regulatory matters at the federal level, while also providing education, services, and benefits to members to help ensure their long-term economic success.[76]

[74] Airports Council International, 2023a
[75] ACI EUROPE, 2023
[76] National Air Transport Association, n.d. a

Additionally, the NATA Sustainability Standard for Aviation Businesses is a sustainability initiative, created to provide fixed-base operators (FBOs) and other aviation businesses with a self-certification process for pursuing flexible, cost-effective options to lower their carbon footprint. The NATA Sustainability Standard for Aviation Businesses is a free industry standard designed to reduce GHG emissions (including carbon dioxide), increase use of more environmentally friendly energy sources, reduce waste, and encourage sustainability operation-wide. The standard is voluntary, flexible in both implementation and certification methods, operationally focused, and consistent with existing environmental and sustainability standards for establishing and reducing a company's carbon footprint.[77]

9.2.3.5 International Air ransport Association IA A

IATA is the trade association for the world's passenger and cargo airlines, representing over 300 airlines in 120 countries, or 83 percent of total air traffic.[78] IATA supports many areas of aviation activity and helps formulate industry policy on critical aviation issues like the development of SAF. As part of IATA's mission to support the aviation industry's long-term climate goal, the Association engages with a wide range of industry and policy stakeholders on all SAF topics and promotes partnerships between them. IATA supports the creation of the framework for the commercialization of SAF and is working to remove barriers to the realization of a cost competitive SAF market.

Additionally, IATA collaborates with airports to ensure infrastructure development and charges adhere to established principles. For example, IATA, in partnership with ACI, and the Worldwide Airport Coordinators Group published the Worldwide Airport Slot Guidelines, which is the foundation of the global slot allocation process. IATA also provides planning expertise to ensure that airport projects gain early airline community involvement and produce facilities that are demand-let, fit-for-purpose, and cost effective to develop and operate.

9.2.3.6 Peer Airport Review

During Fiscal Year (FY) 2019, the Airport experienced 1,885,108 passenger enplanements.[79] **able 9-2** summarizes the sustainability initiatives currently being undertaken at four peer airports within the region. Other regional peer airports, such as Benjamin Taisacan Manglona (Rota) International Airport (GRO), Tinian International Airport (TNI), Francisco C. Ada/Saipan International Airport (GSN), Roman Tmetuchl International Airport (ROR), and Pohnpei International Airport (PNI), do not publicly report information regarding sustainability targets or initiatives.

able 9-2 Peer Airport Sustainability Initiatives

Name	ocation	Passenger Count[80]	Sustainability Initiatives
Lihue Airport (LIH)	Hawaii, U.S.	1,039,607 (2021)	Lighting upgrades • Air conditioning • Upgrades to reduce energy losses from older systems • Building Automation System: advanced controls of HVAC, water, and lighting systems to reduce unnecessary energy consumption • New transformers to increase annual savings and efficiently transfer incoming power.[81]
llison Onizuka Kona International Airport (KOA)	Hawaii, U.S.	1,404,584 (2021)	Lighting upgrades • Air conditioning • Upgrades to reduce energy losses from older systems • Building Automation System: advanced controls of HVAC, water, and lighting systems to reduce unnecessary energy consumption • New transformers to increase annual savings and efficiently transfer incoming power.[82]

[77] National Air Transport Association. n.d. a
[78] International Air Transport Association. n.d.
[79] A.B. Won Pat International Airport Authority, 2023
[80] Federal Aviation Administration, 2022b ; Fiji Airports, n.d.; Airport Nouméa - La Tontouta, 2018a
[81] State of Hawaii, 2023
[82] State of Hawaii, 2023

Name	ocation	Passenger Count[80]	Sustainability Initiatives
La Tontouta International Airport (NOU)	New Caledonia	~530,000 annually	Level 2 Airport Carbon Accreditation • Developed a carbon management plan • Set targets for reducing GHG emissions[83]
Nadi International Airport (NAN)	Fiji	~2,400,000 annually	Level 3 Airport Carbon Accreditation • Published environmental policy • Indoor sustainability improvements like efficient lighting, use of natural light, and use of alternative energy • Mangrove Replanting Initiative • Stakeholder engagement in environmental policy development • Development of master plan • Public sustainability target – net zero by 2050[84]

Note:
A. Abbreviations
GHG = Greenhouse gas
HVAC = Heating, ventilation, and air conditioning

9.2.4 Regional and Regulatory Context

There are several regional and regulatory programs that are relevant to sustainability initiatives at the Airport, which are described below.

Infrastructure Investment and Jobs Act IIJA , also known as the bipartisan infrastructure deal, was signed into law on November 15, 2021. The law authorizes $1.2 trillion for transportation and infrastructure spending with $550 billion of that figure going toward new investments and programs.[85] A key focus area for this legislation includes upgrading airports and ports to strengthen the supply chain, build resilience, and reduce emissions. This IIJA will invest $25 billion in airports to address repair and maintenance backlogs, reduce congestion and emissions near airports, and drive electrification and other low-carbon technologies.[86] Investment will also fund modernization, sustainability, and resilience initiatives that strengthen supply chains and support U.S. competitiveness by removing bottlenecks and expediting commerce and reducing the environmental impact on neighboring communities. Additionally, this legislation aims to:

- xp and access to clean drinking water, invest in water infrastructure, and eliminate lead service pipes.
- Invest in broadband infrastructure deployment to ensure access to reliable high-speed internet.
- Repair and rebuild roads and bridges with a focus on climate change mitigation, resilience, equity, and safety.
- Invest in public transit to improve transportation options and reduce GHG emissions.
- Invest in passenger rail to eliminate maintenance backlog, modernize, and bring rail service to areas outside the northeast and mid-Atlantic.
- Build a network of electric vehicle (V) chargers.
- Upgrade power infrastructure by building new resilient transmission lines, and funding new programs to support the development and deployment of clean energy technologies.
- Make infrastructure resilient against climate change, cyber-attacks, and extreme weather.
- Tackle legacy pollution by cleaning up Superfund and brownfield sites, reclaiming abandoned mines, and capping orphaned oil and gas wells.[87]

[83] Airport Nouméa - La Tontouta, 2018b
[84] Fiji Airports, 2021
[85] The White House, 2021
[86] The White House, 2021
[87] The White House, 2021

The **Inflation Reduction Act IRA** was signed into law on August 16, 2022. The IRA will invest a total of $370 billion to lower energy costs for families and small businesses, accelerate private investment in clean energy solutions, strengthen supply chains for everything from critical minerals to efficient electric appliances, and create jobs and new economic opportunities for workers.[88] Within the total investment amount, the IRA has allocated $300 million to establish a competitive grant program for projects that develop, demonstrate, or apply low-emission aviation technologies; or produce, transport, blend, or store SAFs.[89] Additionally, this legislation aims to:

- Advance and deploy American-made clean energy technologies.
- Protect communities from harmful air pollution.
- Make homes and buildings cleaner and more efficient to save money and cut pollution.
- Invest in a sustainable, lower-carbon federal government.
- Harness nature-based solutions and climate-smart agriculture to deliver economic, climate, and resilience benefits.
- Increase the resilience of communities in a changing climate.
- Make permitting of energy infrastructure more efficient and effective.[90]

Guam Power Authority's GPA's Clean Energy Master Plan CEMP is a comprehensive plan for transitioning Guam from legacy fossil fuel-fired generation to a renewable energy and non-GHG emissions electric energy supply.[91] The C MP outlines targets for renewable energy, energy resilience and security, energy efficiency, grid transformation, energy affordability, digital transformation, and transportation electrification. GPA aims to provide 50 percent of the island's electric power from renewable or non-GHG emissions sources by 2030, and 100 percent by 2040.

Guam Green Growth G3 is a public-private partnership that "develops tangible solutions to sustainability challenges and contributes to a green economy for the island region."[92] The G3 Working Group, a 99-member group that represents all sectors of society, developed the G3 Action Framework, which was signed into effect by Governor Leon Guerrero and Lt. Governor Tenorio in September 2020. The G3 Action Framework is a 10-year plan composed of goals, objectives, metrics, action items, action leads, and partnerships to achieve a sustainable future for Guam.[93] The G3 Action Framework focuses on five categories:

1. Healthy and Prosperous Communities
2. d ucated, Capable, and Compassionate Island
3. Sustainable Homes, Utilities, and Transportation
4. Thriving Natural Resources
5. Sustainable Alliances

ocal2 3 Islands Network is the world's first global, island-led peer-to-peer network devoted to advancing the UN's Sustainable Development Goals (SDGs) through locally driven solutions. The Network unites diverse island nations, states, and communities from all regions of the world, and allows island leaders and experts from across jurisdictions to meet as peers, working to develop and share innovative solutions to achieving a more resilient future. The Network's strategy focuses on four principles:

1. Identify local goals to advance the SDGs and strengthen long-term political leadership on sustainable development and climate resilience
2. Strengthen public-private partnerships that support diverse stakeholders in integrating sustainability priorities into policy and planning

[88] *The White House, 2022*
[89] *The White House, 2022*
[90] *The White House, 2022*
[91] *Guam Power Authority, 2022*
[92] *Guam Green Growth, n.d.a*
[93] *Guam Green Growth, n.d.b*

3. Measure SDG progress through tracking and reporting on locally and culturally informed indicators
4. Implement concrete initiatives that build resilience and circular economy through locally appropriate solutions, particularly at the water-energy-food nexus[94]

Guam was a founding member of the Local2030 Island Network in 2019. Joining was a critical step in expediting Guam's progress in sustainable development. Membership has expedited Guam's progress in sustainable development by providing international recognition and increased access to resources, programs, and collaborative projects.

9.2.5 Physical Climate Risk

Climate change and the associated risks have the potential to impact GIAA assets and operations and should be considered when implementing sustainability initiatives to obtain a more holistic picture of the potential risks. Understanding the climate risks helps to identify key sensitivities where adaptive capacity can be built and mitigation actions can be taken, which ultimately builds resilience for GIAA to continue growth and create a more sustainable system.

ropical Cyclone Impacts: Guam lies within one of the most active regions for tropical cyclones, a term that refers collectively to severe storms, tropical storms, typhoons, and tropical depressions.[95] Tropical cyclones have the potential to damage the Airport's aboveground assets, such as airfields, runways and taxiways, transit systems, refueling facilities, buildings, Navigational Aids (NAVAIDs), and associated mechanical and electrical infrastructure. They can also cause a multi-day disruption of utility services, such as electricity and water, which can impact GIAA's ability to maintain Airport operations. Tropical cyclone events bring intense wind, heavy rains, high waves, storm surges, flooding, flying debris, and possible tornadoes to islands in or near their path. In the western Pacific Ocean, future tropical cyclone activity is expected to decrease; however, topic cyclone *intensity* is expected to increase.[96] This means that any tropical cyclones that do form in the area are more likely to be of a higher category, delivering higher wind speeds, more rain, and larger storm surges.[97] This increased intensity is also expected to amplify the potential for severe damage and loss of life from these storms.

Flooding Impacts: Observations indicate Guam sea levels are rising and will continue to rise at an accelerated rate in the future. Projections for global mean sea level rise are 0.3 to 0.6 feet by 2030.[98] For 2050, the projected range of global mean sea level rise is 0.5 to 1.2 feet, and by 2100, the projected range is 1.0 to 4.3 feet.[99] For Guam, which is distant from the decreasing gravitational attraction of melting land ice, sea level rise is predicted to be higher than the global average. Guam is expected to see up to 3.9 feet of rise by 2100.[100] While sea level rise is not projected to impact Airport property on its own,[101] the closest Airport boundary is just over a half-mile away from the coastline, and increasing sea levels could make Airport property more susceptible to flooding from storm surges.

ve n small changes in average sea level around Guam, when coupled with tropical cyclone occurrence and high wind activity, can have large effects on "high-water frequency."[102] High-water days (also called tidal flooding) affect coastal areas when exceptionally high tides combine with high waves. The number of high-water days in Guam has increased from 2 days per year on average in the 1960s, to 21 days per year between 2005 and 2014.[103] Although not as damaging as floods that occur from big storms, the cumulative impact of multiple high-water days, storm surges, and coastal erosion have the potential to damage natural and built assets (including buildings and surrounding roads and other infrastructure).

Any Airport assets located on the coast or within floodplains could be impacted if this trend in increased flooding continues in the future. Flooding at the Airport can shut down operations and damage equipment, as well as make it difficult for employees to get to work. Additionally, if there is not sufficient infrastructure

94 Guam Green Growth, n.d.b
95 Grecni et al., 2020
96 Grecni et al., 2020
97 Grecni et al., 2020
98 Grecni et al., 2020
99 Grecni et al., 2020
100 Oppenheimer et al., 2019
101 National Oceanic and Atmospheric Administration, 2023
102 Grecni et al., 2020
103 Marra and Kruk, 2017

at the Airport to address flooding risk, continued sea level rise could create cascading health, safety, and economic concerns.

emperature Impacts: Daily average high and low temperatures have risen in Guam. The annual number of hot days[104] has increased, while the frequency of cool nights[105] has decreased. Under a scenario where reliance on fossil fuels and annual GHG emissions continue to increase throughout the century, the annual number of days with temperatures over 90 degrees Fahrenheit (°F) is projected to increase to up to 257 days per year (or 70 percent of days in the year) by the end of the century.[106]

Increasing average temperatures are expected to increase demand for cooling in Airport terminals and other buildings like airport traffic control towers, resulting in an increase in energy consumption. Increased cooling demands have the potential to overwhelm the grid, resulting in power interruptions and outages. High temperatures also impact the health and productivity of Airport employees working outdoors. Workers exposed to hot and humid conditions are at risk for heat stress and resulting heat-related illnesses (e.g., heat stroke).

Additionally, an increase in average daytime temperatures in Guam has the potential to impact flight schedules and demand. Hotter temperatures can affect aircraft takeoff performance due to air density. The amount of lift an airplane wing generates is affected by the density of the air, and higher temperatures reduce air density.[107] The lower the air density, the faster an airplane must travel to produce enough lift to take off. This could result in the need to implement weight restrictions (removal of passengers, luggage, or cargo), which may result in revenue loss. Regions with consistent high temperatures, such as Phoenix, Arizona, and Dubai, as well as at airports with short runways like LaGuardia Airport in New York, have already had to establish weight restrictions as a result of extreme heat, and research suggests this practice may become more common in the future.[108]

Drought Impacts on Water Availability: Historic observations of average daily and annual rainfall show no statistically significant change from the 1950s to present; however, Guam is expected to become drier in the long term, with a projected island-wide decrease in rainy season precipitation.[109] Additionally, rainfall patterns in the region are linked to monsoons and l Niño-Southern Oscillation (i.e., l Niño and La Niña); thus, Guam's rainfall is highly variable from year to year.[110] Airports rely on a consistent water supply to maintain daily infrastructure and operations on the airfield and in the terminals. Because rainfall is the primary source of all fresh water in Guam, any long-term changes to rainfall patterns can be detrimental. Uncertainty around water availability could impact operations and lead to increased water costs.

9.3 Airport Stakeholders and Engagement

able 9-3 provides a list of those that have been identified as Key, Operational, and Internal, and stakeholders. These stakeholders were chosen because of the value and crucial role their organization, company, or department plays in the future of the Airport.

[104] Hot days are defined as days with maximum temperatures over 88 °F, or 31.1 °C (Grecni et al., 2020)
[105] Cool nights are defined as days with minimum temperatures below 74 °F, or 23.3 °C (Grecni et al., 2020)
[106] Grecni et al., 2020
[107] Coffel et al., 2017
[108] Coffel et al., 2017
[109] Grecni et al., 2020
[110] Grecni et al., 2020

able 9-3 Airport Stakeholders

ey Stakeholders				
Air Busan	Air Seoul	Airport Police	Asia Pacific Airlines	Atkins Kroll, Inc.
China Airlines	CTSI Logistics	Federal Aviation Administration (FAA)	Guam Customs & Quarantine Agency	Japan Airlines
Jeju Air	Jin Air	Korean Air	Philippine Airlines	T'way Air
Transportation Security Administration (TSA)	United Airlines	U.S. Customs and Border Protection (CBP)		
Operational Stakeholders				
ACI Pacific LLC	Airport Tentekomai	Atkins Kroll, Inc.	Aviation Concepts, Inc.	AVIS
Burger King	Cabras Marine	Denny's of Guam	Dominos/Golden Bowl	Fed x Guam
Guam Flight Services	Hertz	JMC Guam, Inc.	Lotte Duty Free	LSG Sky Chefs
Menzies Aviation	Micronesia Air Cargo	Micronesia Munchies	National	Nissan Rent-A-Car
Oasis Café	PacAir Properties	Sissie's Café	Skydive Guam	Stroll Guam
Sunleader	Supreme Group	United Parcel Service (UPS)		
Internal Stakeholders				
Jean M. Arriola, Airport Services Manager	Audie Artero, ngineer Supervisor	Brian J. Bamba, Chairman of the Board	Danielle Camacho, General Accounting Supervisor	Rolenda L. Faasuamalie, Airport Marketing Administrator
Artemio "Ricky" Hernandez, Ph.D., Deputy xecutive Manager	Joe Javellana, Property Management Office (PMO)	Raymond Mantanona, ARFF Chief	Ken McDonald, Properties and Facilities Superintendent	Vincente Naputi, Chief of Airport Police
Debbie Ngata, General Accounting Supervisory	John "JQ" M. Quinata, xecutive Manager	Raymond Quintanilla, Airport Operations Superintendent	Juan M. Reyes, Air Terminal Manager	Frank Santos, Transportation Management Group (TMG) Guam

Note:
A. Abbreviations
ACI = Aviation Concepts, Inc.
LSG = Lufthansa Service Holding
Source: GIAA

Stakeholders participated in visioning and realization workshops throughout 2022 to define program and stakeholder group roles; review forecasts, facility requirements, and alternatives; and provide input and ideas for the Master Plan efforts during the planning period.

Based on the outcomes of these workshop sessions, stakeholders provided the following input regarding sustainability at the Airport:

- How do you see the island of Guam changing over the next 5 to 10 years?
  - Infrastructure improvements of mass transit and public transportation.
  - l ectrification as we are moving toward a more environmentally friendly world.
  - l ectric vehicle growth.
- How to you see these changes influencing the Airport?
  - Sustainability/sustainable building design/renewable energy sources.

- Need for vehicle chargers with the increase of electric vehicles; growing demand for vehicle charging stations for electric vehicles.
- What are some key Airport needs? Safety issues? Infrastructure? Development?
  - Improved approach to sustainability as a whole.
  - Storm alerts to prepare for adverse weather.
  - New loading dock or trash collection area; the existing area is unpleasant and undersized for truck deliveries.
- What are potential opportunities to grow the Airport?
  - Opportunities for sustainability such as solar panels on top of facilities.
  - n vironmental stewardship such as green walls and refillable water fountains to be more eco-friendly.
  - Public benefits such as walking trails, bike trails, etc.
- What are potential development changes? n vironmental? Cost?
  - Water runoff/drainage/stormwater issues on the airfield during heavy rainstorms.

9.4 Potential Sustainability Strategies

This section identifies potential strategies and initiatives GIAA can implement to build a sustainability program at the Airport. Strategies are organized by focus area and are evaluated based on high-level metrics and criteria to aid in the prioritization of strategy implementation.

9.4.1 Sustainability Focus Areas

The identified potential sustainability strategies and initiatives fall within seven overall categories including n ergy and Fuels (Decarbonization), Climate Resilience, Water Conservation and Management, Social Sustainability, Airport Sustainability Governance, Waste and Materials Management, and Sustainable Buildings and Infrastructure. The focus areas were chosen based on GIAA's existing sustainability efforts and sustainability objectives from the 2021 Annual Report, and alongside reviews of peer airport sustainability management plans and best practices identified among industry standard groups. a ch focus area is described further in **able 9-** below.

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able 9- Focus Area Categories

Category		Code	Description
	nergy & Fuels (Decarbonization)	F	lectricity, natural gas, and other fossil fuels like diesel and gasoline, are consumed at the Airport to power facilities and vehicles. This focus area includes strategies that could be implemented to decarbonize operations and lead to overall reductions in Scope 1 and 2 emissions. These strategies focus on methods for implementing more sustainable energy sources, improving energy efficiency, electrification, and replacing fossil fuels with lower carbon or clean alternatives.
	Sustainable Buildings & Infrastructure	SBI	Sustainable buildings and infrastructure are sited and designed with sensitivity to the social and natural environments; promote the efficient use of energy, water, and other resources during construction and operation; incorporate renewable energy initiatives; support waste pollution reduction; enable the reuse and recycling of materials and waste; and improve the health and well-being of building occupants. This focus area addresses the planning, design, construction, and operation of GIAA's facilities and infrastructure to improve sustainability performance.
	Airport Sustainability Governance	GOV	stablishing appropriate governance structures within Airport operations provides a pathway for successful sustainability programs. This includes engaging with internal and external stakeholders and developing systems to better track and report GHG and sustainability performance metrics. This focus area provides a suite of recommended strategies to help integrate sustainability plans, policies, and programs within existing or new governance structures at the Airport.
	Social Sustainability	SS	With hundreds of GIAA employees, over 400,000 annual passengers in 2022, and a variety of restaurants, vendors, stores, and suppliers, the airport provides a wealth of services to numerous stakeholder groups. This focus area identifies key strategies GIAA could implement to engage the community, customers, employees, and tenants to drive positive social impact in the region while also leveraging regional resources and innovative practices to implement a successful sustainability program.
	Climate Resilience	CR	Climate resilience is the ability to withstand and recover from a range of climate-related events that could disrupt Airport operations and threaten human health and safety. This focus area addresses the ability to protect against extreme weather events, such as typhoons, extreme heat, and flooding from extreme precipitation events, sea level rise, and storm surges. It investigates opportunities to enhance continuity of service by minimizing vulnerabilities to critical infrastructure.
	Water Conservation & Management	WAT	A secure and long-term water supply is essential to the Airport's operations, while sustainable stormwater management protects water quality, minimizes erosion, and prevents flooding and damage to facilities and infrastructure. This focus area addresses opportunities to conserve water use, capture rainwater and use recycled or greywater for non-potable uses, and implement best practices in stormwater management to minimize flooding and erosion while protecting regional water quality.
	Waste & Materials Management	WMM	Sustainability for materials and waste is primarily focused on reducing the amount of waste destined for landfills. Landfills represent the third-largest source of human-related methane emissions, which is categorized as a GHG. Reducing waste to landfills also conserves land resources. This focus area addresses establishing a comprehensive waste management program that focuses on the waste management hierarchy—reduce, reuse, recycle, and compost—to use materials more responsibly over their lifecycle. It emphasizes consuming and using less through more sustainable procurement and supply chain decisions.

Note:

A. Abbreviations
B. GHG = Greenhouse gas
C. GIAA = Antonio B. Won Pat International Airport Authority, Guam

Source: AECOM

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9.4.2 Proposed Sustainability Strategies

The following sustainability strategies and initiatives have been identified as potential actions for GIAA to consider in building and implementing a sustainability program. a ch strategy includes a description and key considerations for implementation.

9.4.2.1 Energy and Fuels Decarbonization

EF-1: Energy Audit

A key sustainability objective for GIAA is to reduce the Airport's carbon footprint while continuing development to optimize and increase capacity in a safe and healthy airport environment. The first step in the process of decarbonization and reducing energy use is to understand the existing operations and energy performance. The most common energy uses at an airport include:[111]

- **andside:** Lighting, cooling, ventilation, refrigeration, computing, miscellaneous applications and appliances (baggage handling systems [BHSs], PBBs, point-of-sale [POS] systems, ticketing and reservation systems), and transportation (trams and rail systems, as well as passenger electric vehicle charging).
- **Airside:** Runway lighting, auxiliary power units (APUs), aircraft ground energy systems, ground vehicles (from airport operators, ground-handling companies, and firefighting services), ground power units (GPUs), ground support equipment (GS), preconditioned air units (PCAs), and airside facilities, such as hangars.

An energy site audit, performed internally or by a third-party contractor, can assist GIAA in better understanding the distribution of Airport energy usage to make strategic decisions for reducing energy use and overall emissions. f forts could be made to meet with various department managers, tenants, and other key stakeholders to discuss daily operations and obtain relevant energy consumption data for the entire Airport portfolio. Data reviewed typically includes historical and existing energy use. These sources of information can then be aggregated to analyze seasonal trends and identify changes in energy consumption trends. The outcomes of the audit would identify the operational processes with the largest energy consumption that can be targeted and prioritized for reducing energy use.

EF-2: On-Site Renewables

GIAA is currently planning to pursue on-site renewable energy options, specifically solar, through an SC O. GIAA is considering solar energy options, but other sources of renewable energy, such as wind, hydroelectric, biomass, and geothermal can also be considered. The Airport could discuss with the SC O either expanding on the existing project or requesting an additional project if the objective is to maximize the quantity of renewable energy for the terminal and other facilities. For solar, consideration could be given to glare analysis (impacts to pilots), typhoon resilience, and battery storage. The plan could consider future facilities resulting in a potential rough order of magnitude that could range from 12 to 20 MW in additional demand.

Rooftop solar photovoltaic (PV) cells are one of the lowest-cost options for adding on-site electricity generation and have been installed at airports globally. The cost of installation can be estimated based on a cost per kilowatt (kW) metric and scaled based on the number of solar panels that can be supported by a given roof. Ground- or canopy-mounted solar could be considered in addition to rooftop-mounted systems. Solar PVs could be mounted on the new parking lot canopies or installed in the airfield where current non-aeronautical-designated ground topography has resulted in unused space. The use of solar panels would supplement any purchased electricity, and PV systems on parking lot canopies could be used to power the charging stations for Vs . When planning new renewable projects, projected climate trends could be considered in the design, capacity needs, and operational processes of the development.

[111] *International Civil Aviation Organization, n.d.c*

EF-3: Fuel Switching

This measure involves switching all fossil fuel sources, such as boilers and emergency generators, to biofuels or renewable sources. This would allow GIAA to reduce carbon emissions from fossil fuel heating sources and its backup power system. While switching to biofuels would negate emissions from fossil fuels, it would leave biogenic emissions in its place. For purposes of tracking an inventory, biogenic emissions can be considered abated emissions, as they would occur naturally without anthropogenic influences.

EF- : Alternative Aviation Fuels

Implementing alternative fuels in airline operations would reduce the life cycle emissions generated, as compared to those of conventional Jet A fuel. GIAA could ensure the Airport's infrastructure is capable of storing and transporting alternative aviation fuels for airlines to utilize. Alternative fuel options GIAA could consider include, but are not limited to:

- **Sustainable Aviation Fuels SAFs :** SAFs are made from renewable biomass and waste resources. They are also known as renewable jet fuel, alternative jet fuel, or biojet. These fuels are required to meet American Society for Testing and Materials (ASTM) D7566 and can be up to, but not exceed, a 50/50 blend of biomass and petroleum jet fuel, depending on the feedstock.[112] The choice of feedstock and method of converting the chosen feedstock into aviation fuel determine the life cycle emissions generated from the use of SAF. A few examples of feedstock that could be used to generate SAF are corn grain, oil seeds, algae, other fats/oils/greases, and agricultural residues.[113] According to the Commercial Aviation Alternative Fuels Initiative, there are seven SAFs that have gone through the ASTM D4054 process to evaluate new aviation turbine fuels and fuel additives and are qualified for commercial use.[114]
- **ydrogen:** When burned, hydrogen produces water vapor as a by-product and has zero carbon emissions; however, hydrogen must be obtained from a low-carbon source (i.e., solar or wind power vs. natural gas or coal), which is referred to as green hydrogen, to reduce life cycle emissions. Hydrogen can replace both liquid fuel and electrical power in the form of fuel cells. Hydrogen fuel cells are commonly found in other modes of transportation, such as cars and buses, but their use in the aviation sector is still under development.[115] While the potential for future use of hydrogen in the aviation industry is promising, it also has its drawbacks. Due to hydrogen's lower volumetric density, the amount of space needed for on-board aviation storage is significant, and there are safety concerns that arise from its use. Additionally, the current level of green hydrogen production coupled with increased global interest could impact the availability of the supply.

EF- : Equipment Electrification

l ectrifying equipment used for airport operations would reduce emissions from fossil fuel use. Key equipment that could be electrified includes APUs and GS . APUs are on-board generators that provide air conditioning and electrical power to an airplane when the engine is off. APUs, like a typical airplane engine, run on jet fuel. Instead of solely using jet fuel-powered APUs, if not doing so already, GIAA could use a combination of APUs, PCAs, and gate electrification. PCAs provide cooling, heating, and ventilation to an aircraft and can either be connected to the terminal's electricity supply via the gate or as mobile GS .[116]

l ectric gate equipment that is supplied from the Airport's electricity supply, as discussed in **EF-2**, could be powered by renewable energy. ve n when gate electrification is available, the APUs would operate during transition at the gate. If PCAs and gate electrification are available, run-times of the APUs, which contribute to emissions generated, could decrease.[117] Furthermore, GS , such as tugs and belt loaders, traditionally run on diesel fuel, but could be electrified to reduce emissions; charging for electrified GS would need to be connected to the grid.

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[112] U.S. Energy Information Administration, 2022
[113] U.S. Department of Energy, n.d.b
[114] Commercial Aviation Alternative Fuels Initiative, 2023
[115] International Air Transport Association, 2019
[116] Greer et al., 2021
[117] The National Academies Press, 2019

EF-6: Energy Conservation Measures ECMs

Implementing C Ms, is an economic and efficient strategy for reducing airport energy usage. C Ms can include both short-term operational changes, such as nighttime shutdowns and demand response, and long-term infrastructure improvements. These may include light-emitting diode (L D) lighting system and HVAC upgrades, smart controls for lighting and HVAC systems, and building insulation and sealing improvements.

- **VAC Upgrades:** The following upgrades could be made to an HVAC system.
  - Rooftop Units (RTUs): GIAA could upgrade existing natural gas and electric heating equipment to heat-pump RTUs, which could reduce heating energy use by up to 80 percent. RTUs typically have a rated useful life of 15 to 20 years, so this strategy could be implemented immediately for all equipment exceeding that lifespan. The drawback of this upgrade is the lower overall cost of natural gas energy compared to electricity. GIAA could also prioritize upgrading existing heat pump RTUs that are older than 10 years. The energy savings for implementation would be based on an improvement in compressor seasonal energy efficiency ratio, resulting in lower overall energy use.
  - Chillers: GIAA could install heat recovery chillers to replace any remaining natural gas boilers. This strategy focuses on offsetting the existing natural gas boiler energy usage with recycled heat from the chilled water-cooling systems. This strategy is design intensive, and buildings would need to undergo detailed energy audits of the existing systems to determine appropriate design and costing to implement.
  - Water Heaters: GIAA could install heat pump water heaters. Heat pump water heaters use heat from the air in the space in which the unit is located and moves the heat into the stored hot water tank. Heat pump water heaters typically use a fraction of the energy of traditional electric water heaters and natural gas water heaters.
  - Demand Control Ventilation on xh aust Fans: Demand control ventilation is a control method that uses sensors inside occupied spaces to control the status and/or speed of the exhaust fan motors to only provide ventilation if needed or based on the usage of the space. At the most basic level, this would require scheduling fan operation based on occupancy times; however, occupancy sensors can also be used to cycle fans on or off based on occupancy or use air quality sensors to control exhaust air volume based on maintaining code-required air quality levels.
  - Variable Frequency Drives (VFDs): GIAA could install VFDs on pumps to control motor speed to meet system demand. This could produce substantial overall energy savings for individual pumping systems. This strategy would require installing speed control on all the hot water and chilled water pumps, as well as controlling the speed based on the heating and cooling valve positions of the HVAC equipment receiving hot and chilled water.
- **ighting Upgrades:** Airfield lighting must meet FAA requirements, and as of May 2022, the FAA has been testing solar-powered airfield lighting at smaller airports without centralized electrical systems.[118] The FAA is researching if solar-powered lights would not only have a positive environmental impact but also a positive impact on safety.[119] GIAA could continue to monitor the progress of this research and perform a cost-analysis of converting the older airfield lighting to solar power.
  - GIAA has already retained an SC O to implement C Ms, including lighting upgrades. This included a conversion of terminal lighting fixtures by replacing the old ballasts with premium electronic ballasts and lower-wattage fluorescent lamps; 11,332 fixtures were converted, resulting in estimated average annual savings of $524,429.33.[120]
  - Since the fluorescent upgrades, GIAA has begun implementing L D lighting upgrades, as well. L D lighting is a high efficiency, easily controllable, and low maintenance solution for upgrading facility lighting. L D light fixtures can provide lighting output equivalent to other lighting types at a fraction of the total energy usage. Under the SC O, GIAA has identified an additional

[118] Federal Aviation Administration, 2022c
[119] Federal Aviation Administration, 2022d
[120] GIAA, 2023

opportunity for the runway edge lights to also be converted to L D s; however, paybacks for exterior lighting are lower than interior lighting due to the increase fixture cost and labor cost for installation.

- **Smart Controls:** Implementing smart lighting controls can reduce the total energy usage of the lighting systems. Advanced lighting controls include occupancy sensing, leveraging existing skylights and daylight sensors, and dimming L D lights to reduce the overall energy consumption. This strategy would install occupancy sensors, daylight sensors, and fixture dimmers in existing spaces and use the sensor data to control lighting output. This strategy could be implemented in parallel with the interior lighting upgrade projects. The cost to implement this measure would be based on dollars per square foot of controlled space metric.
- **VAC Optimization:** Optimizing the control sequences for each piece of HVAC equipment will require additional analysis of building usage and equipment capabilities. This strategy involves performing a control system optimization study and using the findings to maximize the efficiency of the existing equipment. Control system optimization includes both the implementation of advanced control sequences, such as temperature and pressure resets, and the installation of new sensors to provide actionable data to the system.

EF- : Carbon Offsetting and Reduction Scheme for International Aviation CORSIA

The Carbon Offsetting and Reduction Scheme for International Aviation, or CORSIA,[121] is a global market-based measure that establishes ways in which the international aviation industry can reduce emissions and minimize market distortion through technological and operational improvements, as well as using SAFs.

To be considered an eligible SAF or Lower Carbon Aviation Fuel, CORSIA sustainability requirements must be met and certified by a Sustainability Certification Scheme.[122] These sustainability requirements address land use and land cover change in accordance with the Intergovernmental Panel on Climate Change land categories, GHG and criteria pollutant reduction requirements, water quality and availability, soil health, conservation, responsible waste management, environmental justice, and food security. Once a fuel is determined to be compliant with these standards, aircraft operators can claim CORSIA compliance and claim emission reductions from the use of these fuels.[123] GIAA can consider developing fuel use and sustainability programs that engage with individual airlines and encourage them to align with the CORSIA guidelines and industry best practices.

EF- : EVs and Charging Infrastructure

Fleet electrification involves transitioning some or all of an organization's fleet to run partially or completely on electric battery power. An V fleet can include battery electric vehicles and plug-in hybrid electric vehicles. By running partially or fully on energy from the electricity grid or on-site renewable energy sources, an V fleet can have a lower carbon profile compared to internal combustion engine vehicles, depending on the energy mix on the grid. Vs also typically save costs on maintenance and fuel. While barriers associated with the current supply chain have made it difficult to obtain Vs since the beginning of the 2019 Novel Coronavirus (COVID-19) pandemic, technology is quickly advancing, and the market is expected to improve in the coming years.

GIAA is currently planning to pursue a transition to V fleet vehicles and implementation of charging stations. GIAA recognizes Vs are likely to transition quickly into industry operations, security, and maintenance functions for airports, airlines, and other users. These are expected to include ramp equipment like ground service vehicles, road-eligible vehicles, and privately owned employee vehicles. GIAA maintenance staff would need to be trained to work on electric vehicles, which may cause a slight increase in upfront cost to GIAA. Strategic placement and the number of charging stations are keys to success. V charging stations could be located in the terminal apron area, the commercial parking lot, employee and public parking areas, and in rental car parking lots. A best industry practice would be to

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[121] International Civil Aviation Organization (CORSIA), 2023a

[122] Organizations that certify economic operators against the sustainability criteria, and ensure that economic operators calculate actual life cycle emissions values (if default values are not applied) using the agreed methodology. Sustainability certification requirements set requirements for certification bodies, auditors, and accreditation bodies, and monitor effectiveness of the assurance system (International Civil Aviation Organization (CORSIA), 2023b).

[123] International Civil Aviation Organization (CORSIA), 2023a

electrify the charging stations from renewable energy sources. Additionally, GIAA could encourage Airport rental car agencies to transition to V fleets.

In 2012, the FAA established the Airport Zero mi ssions Vehicle and Infrastructure Pilot Program, which allows eligible airports to use AIP funds to purchase zero emissions vehicles (Z V s) and to construct or modify infrastructure needed to use Z V s.[124] As a publicly owned airport under the National Plan of Integrated Airport Systems (NPIAS), GIAA would be eligible for receiving these funds and could consider using this as a method for obtaining Z Vs. This funding mechanism is further discussed in **Section 9** below.

9.4.2.2 Sustainable Buildings and Infrastructure

SBI-1: Sustainability Rating Systems

GIAA could consider and adopt, where feasible, sustainability in all phases of project development and maintenance activities. There are a variety of certification programs that serve as frameworks, tools, and approaches to understanding and measuring sustainability performance in buildings and other infrastructure assets. GIAA could determine if projects are suitable for Leadership in n ergy and n vironmental Design (L D) certification or other sustainability rating systems. The use of sustainability rating systems for larger construction projects enhances the design process by providing guidance and standards that improve economic, environmental, and social benefits while reducing risk and building resilience. L D ® and n vision® are the most consistently used certification programs in airports; others include N R GY STAR® as well as the W L L® and Fitwel® programs (both of which are focused on health and occupant experience). a ch of these programs are further described below.

- **EED®:** This is a green building certification program that is administered by the United States Green Building Council (USGBC) and includes several rating systems that can be used for different building types at different stages of construction or operation. Recently, the USGBC and stakeholders in the aviation industry have been working to develop guidance for the adoption of L D ® in an airport-specific setting.[125]
- **Envision®:** The Institute of Sustainable Infrastructure created the n vision framework “for assessing sustainability, resiliency, and equity in civil infrastructure.” The infrastructure that applies to n vision includes horizonal infrastructure, such as runways. The criteria and performance objectives and guidance address the entire life cycle of existing and new infrastructure projects. There are 64 credits organized around five categories: quality of life, leadership, resource allocation, natural world, and climate and resilience. To receive a certification, a project goes through a third-party verifier who assesses the project against the n vision framework. Based on points received, a project can either be n vision verified, silver, gold, or platinum.[126]
- **ENERGY S AR®:** This is a joint program of the U.S. n vironmental Protection Agency (P A) and U.S. DO to help consumers, businesses, and industries save money and protect the environment through the adoption of energy-efficient products and practices.[127] To be N R GY STAR certified, a building must achieve at least 75 points, out of 100, on P A’s energy performance standards. An application must be verified by a licensed Professional n gineer or Registered Architect to be eligible for approval. Certifications are given on an annual basis, so a building must maintain energy performance each year to remain certified.[128]
- **WE ® and Fitwel®:** These two certifications promote occupant health and wellness. W L L®[129] is administered through the International W L L Building Institute with a mission to “improve human health and wellbeing through the built environment.”[130] Fitwel® was created by the U.S. Centers for Disease Control and Prevention and the U.S. General Services Administration to strengthen health and well-being.[131]

[124] *Federal Aviation Administration, 2022e*
[125] *LEED Rating System, n.d.*
[126] *Institute for Sustainable Infrastructure, n.d.*
[127] *U.S. Department of Energy, n.d.c*
[128] *ENERGY STAR, n.d.*
[129] *International WELL Being Institute, n.d.*
[130] *U.S. Green Building Council, 2015*
[131] *Fitwel, 2023*

SBI-2: Green Building Materials

Airport buildings range from terminals for passenger use and office space for administration to hangars for aircraft; each can have an impact on the environment in their construction as well as operational aspects. Green building is an environmentally responsible construction method that seeks to reduce waste and use natural resources more efficiently.[132] Switching to green or sustainable building materials limits environmental impacts, improves energy efficiency, reduces carbon dioxide emissions, and boosts public perception. Whenever possible, GIAA could use green building materials such as bamboo, reclaimed wood, cork, ferrock, mycelium, recycled steels, and Low- windows in new construction projects as well as building upgrades and improvements. Basic criteria for green building material selection include resource efficiency, indoor air quality and toxicity, energy efficiency, water conservation, and affordability.

Additionally, the IRA is focusing investment efforts on lowering the levels of embodied carbon and other GHG emissions associated with all relevant stages of production, use, and disposal of construction materials and products including steel, concrete, asphalt, and glass. Low embodied carbon materials have less climate impact associated with mining, manufacturing, and transportation.[133]

SBI-3: Asset Management Program

GIAA could consider developing a cloud-based asset management program in accordance with ISO standards, which contributes to a few of the UN's SDGs.[134] An asset management program will facilitate inventory and condition assessment of existing infrastructure and facility operations, including fleet management, on Airport property and provide guidance for ongoing preventive maintenance. LoS scores and key performance indicators can be developed as part of the program to effectively maintain these assets, which can help control costs, optimize asset performance, and prolong asset lifecycles. The program can prioritize any repairs and rehabilitations needed to maintain the LoS This approach protects existing investments in infrastructure while facilitating the proper function as intended during design. Having more precise operational data can also assist in identifying areas of inefficiencies, improve maintenance cycles, and help to conserve energy and water use. Furthermore, GIAA could also conduct a Reserve Study, which is a long-term capital budget planning tool that would assist the Airport in assessing and analyzing the health of physical assets. **Appendix B**: *Facility Conditions Assessment*[135] which was conducted to inform portions of the Airport's Master Plan, could be used to inform the development of this program.

9.4.2.3 Airport Sustainability Governance

GOV-1: Sustainability Vision Statement and Policy

GIAA's sustainability objectives include developing a sustainability policy for the Airport. When developing this policy, GIAA could consider including an official sustainability vision statement that includes the development of net zero targets and goals. The vision statement should convey enduring values and a lasting higher-order purpose to guide all stakeholders toward realizing the vision. GIAA could align its sustainability goals and policies with environment, social, and governance (SG) frameworks such as the Task Force on Climate-Related Financial Disclosures (TCFD) or Science-Based Targets initiative (SBTi) (see **GOV-** for additional detail).

GOV-2: ACA Certification

The ACA certification program under ACI is a method for airports to track their carbon emissions and set targets toward emissions reductions (see **Section 9 2 3 3** for more information). ACA certification includes six levels of certification. GIAA could first work toward meeting Level 1, which requires companies to calculate annual carbon emissions to develop a GHG inventory from within the Airport operational boundary, as well as make a public commitment to reducing emissions. With a key sustainability objective of reducing GIAA's carbon footprint, developing a GHG inventory helps a company understand its carbon footprint and identify key sources of emissions and potential for emissions reductions. It also helps create

[132] International Civil Aviation Organization, 2019
[133] U.S. EPA, 2023a
[134] ISO Asset management, 2016
[135] GIAA, 2022

a method for tracking energy usage and positions the Airport for continual improvement to higher ACA certification levels.[136]

GOV-3: Contractor and Design Requirements

The cost of restoring and replacing infrastructure is expected to increase as physical climate risks become more disruptive. Considering climate change and resiliency during the initial planning and design for all capital improvement projects could help avoid large expenditures made on repairs/replacements after a disruption or disaster occurs. One of GIAA's key sustainability objectives is to drive initiatives to preserve resources and achieve long-term sustainability through capital improvement projects (to include the financing, design, construction, and operations). GIAA could review and update its capital design guidelines for infrastructure and operations to integrate future climate projections.

Potential climate risk can also inform decision making when acquiring, leasing, and building new facilities. Climate risks could be integrated into "force majeure" contract language, and GIAA could require contractors to incorporate sustainable design considerations and materials during the design and construction of projects, where possible. GIAA could also create policies that favor the procurement of contractors and suppliers with sustainable practices, as well as materials with a lower carbon footprint. Considering climate change and resilience as a part of the initial planning and design for all future capital projects could help to avoid increased costs associated with investments in infrastructure improvements made after a disruption or disaster occurs. A 2019 World Bank Group study found that the investment in more resilient infrastructure can return a $4 benefit for each $1 invested.[137]

GOV- : Establish a Sustainability and ESG Working Group/Department/Staff

GIAA could consider how to best integrate sustainability into its existing governance structure where there are explicit responsibilities when it comes to Airport sustainability, decarbonization, climate risk and resiliency, and other relevant focus areas to GIAA. This could include a Sustainability Working Group within the company that meets on a regular basis to implement and monitor these efforts.

There are many benefits to establishing a sustainability and SG working group or department. These staff members could be champions for sustainability initiatives and play key roles in implementing strategies and conducting additional sustainability research. This team would streamline the data gathering process and assist in identifying gaps, barriers, ways around barriers, and areas of improvement in GIAA's sustainability initiatives. This group could then participate in developing an annual sustainability report for the public.

Once this team is established, they could develop short-, medium-, and long-term goals and priorities for progressing Airport sustainability initiatives. One such initiative could be to be engage tenants in a "green tenant program" to aid in achieving a higher environmental operational standard. GIAA could include tenant representatives in SG planning meetings, and provide no cost support in the areas of energy and water conservation, waste reduction, pollution prevention, etc. Furthermore, the GIAA SG working group could consider creating a checklist of measures required for new Airport tenants in the terminal. This checklist could mirror GIAA's sustainability goals and priorities, and GIAA could help legacy tenants integrate sustainability using the same checklist of requirements.

GOV- : Annual Sustainability Report and ESG Disclosures

GIAA could prepare and publish an annual sustainability report to disclose GIAA's current sustainability initiatives, as well as future strategies. Developing a GHG inventory before writing a sustainability report is suggested, as the GHG inventory will inform GIAA of areas for continual improvement (see **GOV-2**). Publishing an annual report shows the public that GIAA is willing to be transparent about sustainability metrics and goals like emission and waste reduction, and water and energy conservation. Any unique and innovative initiatives and projects at the Airport could be presented to the public to disclose key sustainability initiatives at the Airport.

Additionally, developing an annual sustainability report would provide GIAA with a method for publicly disclosing sustainability metrics in alignment with S G frameworks such as TCFD and SBTi, as well as others including the Global SG Benchmark for Real Assets (GR SB), Sustainability Accounting

[136] *Airport Carbon Accreditation, 2023*
[137] *Hallegatte et al., 2019*

Standards Board (SASB), Global Reporting Initiative (GRI), and SDGs. These frameworks provide a variety of structured methodologies for measuring sustainability performance of any initiatives that have been implemented.

- **CFD** disclosure recommendations are structured around four thematic areas that represent core elements of how companies operate: governance, strategy, risk management, and metrics and targets.[138] The four recommendations are interrelated and supported by 11 recommended disclosures that build out the framework with information that could help stakeholders understand how reporting organizations think about and assess climate-related risks and opportunities.
- **SB i** drives ambitious climate action in the private sector by enabling organizations to set science-based emissions reduction targets.[139] It does this by defining and promoting best practices in emissions reductions and net zero targets in line with climate science. Key requirements of SBTi's net zero standard include focusing on rapid emission cuts, setting near- and long-term targets, and investing in outside science-based targets to help mitigate climate change elsewhere.
- **GRESB** is an independent organization providing validated SG performance data and peer benchmarks to improve business intelligence, industry engagement, and decision making.[140] The GR SB assessment collects, validates, scores, and independently benchmarks SG data; the resulting benchmark scores are based on a rigorous, consistent methodology so stakeholders can evaluate SG performance.
- **SASB** standards identify the subset of environmental, social, and governance issues most relevant to financial performance and enterprise value for 77 industries.[141]
- **GRI** is the independent, international organization that helps businesses and other organizations take responsibility for their sustainability impacts. The GRI Standards enable organizations to understand and report on their impacts on the economy, environment, and people in a comparable and credible way, thereby increasing transparency on their contribution to sustainable development.[142]
- **SDGs** include 17 goals and 169 targets developed by the UN to address global challenges including poverty, inequality, climate change, environmental degradation, and peace and justice.[143]

GOV-6: Environmental Management System EMS

An MS is a set of management principles that assist organizations in reducing their negative environmental impacts, identifying any gaps in a company's environmental management or assessment program, and reducing the cost and time of environmental analysis, and can help improve public relations.[144] According to the U.S. P A, "an MS is a set of processes and practices that enables an organization to reduce its environmental impacts and increase its operating efficiency."[145] Airports with an MS have reduced frequency and severity of environmental incidents and improved compliance with regulatory requirements.[146]

GOV- : ocal Network Support

As previously discussed, changing climate patterns continue to present risks across the globe from a variety of climate variables. At a local or regional scale, agencies, organizations, and communities are collaborating in the development of disaster and hazard mitigation planning programs. GIAA played a key role in the development of Guam's hazard mitigation plan and should continue to engage with island organizations, and throughout the region, to further drive relevant climate disaster and hazard planning. n gaging as a stakeholder with regional, national, and other local organizations can help GIAA to proactively mitigated concerns related to climate hazard response and resource allocation. Increased involvement in local planning efforts to mitigate threats, hazards, and vulnerabilities will continue to

[138] *Task Force on Climate-Related Financial Disclosures, n.d.*
[139] *Science Based Targets, n.d.*
[140] *Global ESG Benchmark for Real Assets, n.d.*
[141] *Sustainability Accounting Standards Board, 2023*
[142] *Global Reporting Initiative, 2023*
[143] *United Nations, n.d.*
[144] *U.S. EPA, 2022*
[145] *U.S. EPA, 2022*
[146] *U.S. National Academy of Sciences, 2013*

establish GIAA as a leading community member on the island. GIAA should continue its local involvement in the G3 working group and expand participation if possible. Increased involvement allows the entity convening the planning process to be keyed into GIAA's organizational and facility level needs if a climate or hazard event were to occur. Lastly, engagement with communities can help GIAA build more reliable and resilient systems while strengthening community resilience against disasters and could provide GIAA with a larger role in future island development programs.

9.4.2.4 Social Sustainability

SS-1: Institutionalizing EJ Considerations into Airport Decision Making

J seeks to protect minority and low-income populations from environmental health hazards while giving impacted communities decision making power; therefore, it requires approaches that identify and address disproportionate harm to low-income and minority communities. In terms of aviation, impacts due to aircraft noise, air quality degradation, direct and induced socioeconomic effects, degraded water quality, and effects to cultural resources, community disruption and cohesion, and traffic need to be specifically considered in the context of J.[147]

The development of additional GIAA sustainability programs and initiatives provides an opportunity to incorporate J considerations into Airport actions. It would also support GIAA's key sustainability objective to enhance the passenger experience by improving processes and efficiencies through workforce development and community engagement. Some ways that GIAA could integrate J into sustainability programs and initiatives at the Airport include:

- GIAA identified J as a concern regarding hazardous materials on site and on adjacent parcels at the South Tiyan facilities and during the Navy transfer of property south of Runway 6R. As any cleanup program is developed and implemented, the surrounding community should be made aware of the plans and have an opportunity to weigh in on the execution.
- GIAA could create a framework to review impacts of Airport activities focused on identifying areas, communities, and people groups that have been disproportionately harmed or disproportionately excluded from participating in the benefits of Airport services and activities. Impacts could be assessed for past and current Airport activities, while potential impacts could be identified and addressed in the planning process for future Airport activities. Potential areas of concern to include in an impacts assessment could include environmental health, human health, community cohesion and/or disruptions, and historic or cultural resources.
- GIAA could partner with the expanded community stakeholder advisors to identify the actions that can be implemented to reverse or mitigate the harms already done either by reducing the impact or by conferring offsetting benefits. Offsetting benefits could be identified by the impacted community. GIAA could also co-create a path forward with community stakeholder advisors to screen Airport decision making in planning and implementation for appropriate actions to mitigate potential harms or expand opportunities to confer benefits as the airport continues to operate and expand.
- GIAA could establish a method to track the environmental, social, and health impacts and the strides being taking to address them. This tracking can be used as a tool for accountability and has the added benefit of providing transparency to communities and stakeholders.
- Meaningful involvement of impacted communities is foundational to a thorough approach to J. GIAA could expand current stakeholders to include representation directly from Airport-adjacent communities and communities adjacent to any off-site operations. This may include civic organizations, community groups or leaders, and cultural associations. GIAA could include mechanisms to make reporting from community stakeholder advisors accessible and significant in decision making processes. This also ties into action **SS-2** below on stakeholder engagement.

SS-2: Stakeholder Engagement

One of GIAA's primary sustainability objectives is to understand and accommodate the needs of its stakeholders from a social, environmental, and economic perspective. Collaboration is key to promoting a culture that values sustainability, improves passenger and customer experience, improves relationships

[147] *Federal Aviation Administration, n.d.*

with customers, tenants, employees, and the community, and demonstrates GIAA's commitment to sustainability.

GIAA should continue to be transparent and engage with previously identified stakeholders as well as additional stakeholders, such as suppliers, on sustainability initiatives. GIAA could leverage stakeholders' knowledge and expertise on topics via established regular sustainability meetings. This could help target Scope 3 emissions, the largest source of emissions for airports. GIAA could also develop a sustainability survey to understand what airlines and tenants are doing to progress sustainability, and use the results to create a more targeted engagement strategy.

All engagement, specifically with the community, should be tailored to the audience and be as equitable and inclusive as possible to ensure meaningful participation. This ties into action **SS-1** above on J considerations.

SS-3: Public ransportation and Outdoor Spaces

Ground transportation is a significant source of emissions at airports. Because requirements for ground access and parking are primarily driven by passenger demand, GIAA could promote connections to the Airport using high-occupancy and/or low-emission ground transportation, including public transit, and prioritize the use of commercial shared-ride services over private single-occupancy vehicles. Some ways that GIAA could disincentivize single-passenger ground transportation are as follows:

- Provide prioritized short- and long-term parking for electric or hybrid vehicles (e.g., locate charging infrastructure close to elevators and/or terminals access doors).
- Reduce the per vehicle cost of short- and long-term parking for electric or hybrid vehicles, and cars transporting three or more passengers.
- Offer in-Airport dining and/or shopping discounts for passengers arriving by public transportation.
- Designate safe and convenient on-property ride share pick-up locations; for example, designate multiple pick-up and drop-off locations at departures and arrivals/baggage claim to reduce traffic congestion and increase ease of ordering and pick up.
- Coordinate with the Guam Regional Transit Authority to ensure there are sufficient and frequent public transportation (e.g., bus) routes that include stops at the Airport.

GIAA could also introduce bike-sharing programs to reduce the number of vehicles on the road. In addition to bike-sharing, GIAA could encourage walking and biking commutes by installing paths that connect adjacent communities to the Airport. These paths, coupled with the use of native, non-wildlife-attracting plants and trees along the route, have the added benefit of helping with soil erosion, stormwater, and drought management, and can aid in reducing the urban heat island effect that can occur in developed areas surrounded by pavement and concrete, such as the Airport.[148] GIAA could also build safe and free short- and long-term bike storage for passengers and employees to encourage alternative transportation use.

SS- : Indoor Sustainability Improvements

There are several actions GIAA could take to implement sustainable features into the indoor check-in and commercial passenger terminal spaces. While some specific energy, water, and wastewater strategies are discussed under other focus areas, some additional opportunities include:

- **Water Catchment and Refill Stations:** GIAA could improve overall user experience within the Airport through indoor sustainability improvements. For instance, curbside and pre-security water catchment stations are an easy strategy to reclaim additional water for irrigation. It also provides passengers a convenient, hassle-free water depository. After passenger security screening, abundant touch-free, sensor-operated water bottle refill stations encourage the conservation of natural resources and preservation of the environment by reducing the solid waste created from single-use plastic water bottles. They also act as a cost and time saving mechanism for passengers, crews, and Airport employees. GIAA could also place water refill stations in ticketing

[148] *The tendency for higher air temperatures to persist in urban and developed areas as a result of heat absorbed and emitted by buildings and asphalt, tending to make these areas warmer than the less developed surrounding areas. U.S. Global Change Research Program, n.d.*

areas, baggage claim, and other office locations to provide a sustainable potable water source for Airport staff and employees, as well as deplaning passengers.

- **iving or Green Walls:** GIAA could use green walls (also known as plant walls, living walls, vertical gardens, or green mosaics) to display the vibrant and diverse culture of the island. Living walls or green mosaics made from native plant species that are locally sourced provide sustainable, low-maintenance, aesthetically pleasing art to Airport passengers and employees alike. As well as being beautiful, the wall acts as a biofilter, removing harmful particles and pollutants like carbon dioxide, benzene, and volatile organic compounds from the air.[149] Living walls also reduce temperatures within buildings by intercepting solar radiation and though evaporative cooling, and they reduce noise levels by reflecting, refracting, and absorbing acoustic energy.[150] Living wall technology such as the d monton International Airport installation can earn buildings L D points, assisting in future certification.[151]
- **Building Design Features:** GIAA building upgrades and new construction could integrate energy efficiency measures into building design such as installing skylights and windows to boost natural light in the Airport and reduce the need for lighting during the day. Motion sensor lighting is another option for reducing the cost of electricity and increasing indoor sustainability. Finally, installing mechanical shades that open and close in reaction to the building's heat levels can decrease daily air conditioning run time.

SS- : Emergency Alert Systems

F M A has multiple emergency alert systems such as the me rgency Alert System (AS) and the Wireless me rgency Alerts (W A) system. The AS alerts authorities to send warnings for emergency weather and security situations, and Guam residents receive AS messages via television and radio. W A alerts are sent by authorized government authorities through a mobile carrier; however, Guam currently does not have U.S.-based cellular carriers and cannot use W A. [152] GIAA could work with other local and national agencies to consider championing an effort to make this service available to Guam citizens.

Alternatively, GIAA could purchase an emergency notification mass communication intelligence system. These software firms notify stakeholders and personnel via phone application if there is an emergency in their area, including weather-related emergencies, and provides real-time updates as the situation develops.

9.4.2.5 Climate Resilience

CR-1: Additional Infrastructure ardening

GIAA has already implemented several actions to harden infrastructure and build resilience against typhoon-related damage, such as implementing mobile light carts for continued and safe ramp operations, installing separate fixed posts and light fixtures designed to withstand higher wind loads, installing metal shutters on exterior doors to minimize wind damage and rain infiltration into buildings, modifying the standard to change fencing to concrete posts and foundations that can better withstand typhoon-force winds, and working with GPA to install underground distribution lines that serve all critical facilities and substantially reduce Airport down time.

To mitigate infrastructure damage from flooding because of sea level rise, extreme precipitation, and storm surges, GIAA could elevate key infrastructure and equipment to be above projected future flood levels. Important hard copy files and smaller equipment or devices could be stored in waterproof storage containers, and applicable records and data could be backed up to a cloud or GIAA's internal network.

As previously mentioned, extreme heat can affect aircraft takeoff performance. An alternative to implementing weight restrictions would be to increase the length of takeoff run and distance available to provide aircraft with sufficient time to reach takeoff speed. Depending on the type of aircraft operating and the magnitude of temperature increase realized, a combination of lengthening takeoff run and distance

[149] Goel et al., 2022
[150] Goel et al., 2022
[151] Edmonton International Airport, 2023
[152] Guam Homeland Security Office of Civil Defense, 2018

available and/or implementing weight restrictions could be considered. However, as depicted in the Airport Development Plan, physical runway length would remain the same, but operational length would be reduced for both runways. An additional mitigation option would be to adjust flight times to occur during the cooler hours of early morning, late evening, and overnight, and coordination with the FAA and Airport operations would be required.[153] If GIAA determines extreme heat to be a significant climate risk to operations, GIAA would need to further analyze the feasibility of these options to determine which actions could be implemented.

Increased cooling demands due to extreme heat have the potential to overwhelm the grid, resulting in power interruptions and outages. The Airport could use a microgrid, a local energy grid with control capability, as an independent source of power. GIAA should continue to evaluate microgrid technology to verify whether it aligns with FAA standards.[154]

Hardening infrastructure against potential physical climate risks is especially important for assets that may be deemed highly vulnerable, including those identified by any future detailed climate vulnerability assessments.

CR-2: Emergency Plans/Policies

It is important to continuously update operations and maintenance, emergency, continuity of operations, and other facility plans to actively address new and emerging risks. GIAA could consider how to integrate the consideration of climate risks into future updates of these plans to mitigate potential impacts. GIAA could also review equipment maintenance procedures and evaluate whether any equipment requires adjustments to the maintenance schedules based on projected changes to climate conditions.

CR-3: Climate Vulnerability Assessment and Adaptation Planning

Performing downscaled and detailed climate vulnerability assessments of critical assets and infrastructure would provide GIAA with the data to understand how different climate variables may impact specific operations, as well as identify adaptive capacity and key asset sensitivities prior to the occurrence of a damaging event. While some degree of risk to natural hazards may be known, future climate projections could alter the current risk profiles for assets, which further emphasizes the need to reevaluate asset vulnerability.

The list below provides examples of assessments and the part of the vulnerability assessment components to which the information would contribute:

- Review detailed flood mapping with updated climate change projections through national, regional, or local precipitation-based models. By looking at more detailed models at the facility level, GIAA would have additional insight into how floodwaters could impact various assets that are a part of and ancillary to the facility.
- Conduct interviews with department leads and other facility personnel to provide additional insight into existing conditions and past failures/impacts due to extreme weather that could be exacerbated by climate change.
- Review applicable regulatory requirements, such as those related to building codes, that could impact facility renovations and upgrades. When integrating climate risk considerations into planning and operations, it is important to understand how local, state, and federal regulatory requirements could impact the implementation and design of individual facility or infrastructure improvements.

9.4.2.6 Water Conservation and Management

WA -1: Water Conservation Measures

The U.S. PA estimates that high-efficiency toilets, faucets, showerheads, and urinals are at least 20 percent more efficient than standard products on the market.[155] GIAA could consider converting existing water fixtures including toilets, faucets (kitchen and bathroom), urinals, showers, and washing machines to low-flow or high-efficiency and could also install automatic-off fixtures (such as sinks and water

[153] Airport Development Plan
[154] FAA, 2021
[155] U.S. EPA, 2013

fountains), where applicable. Upgrading fixtures at the Airport will contribute to more water use reductions.

GIAA could also partner with Airport tenants to develop innovative water conservation strategies for Airport businesses. For example, Airport rental car facilities could use reclaimed or greywater for car washing activities (for more information on gray and recycled water, see **WA -**).

WA -2: Native andscaping and Xeriscaping

Landscape design, plant choice, and maintenance all contribute to the amount of water that is required for irrigation. Water applied to the landscape can account for a significant portion of a site's overall water use.[156] Xeriscape is a style of landscaping that uses slow-growing, drought-tolerant, native, or other regionally appropriate species that require little to no irrigation to conserve water and reduce yard waste. If irrigation is required, it is installed using efficient system elements such as drip irrigation and smart irrigation controls. GIAA could evaluate all Airport site landscaping and evaluate opportunities to convert sites with landscaping to xeriscape-type landscaping that will contribute to water reductions.

WA -3: Stormwater and Drought Management

Increased extreme precipitation events and/or poor stormwater drainage can result in flash flooding. Surfaces with low permeability, that can often be associated with runways, large buildings, and parking lots, can cause issues with stormwater management and efficient drainage. GIAA plans to integrate stormwater runoff and drainage improvements during construction of Tiyan Parkway. It would include the construction of a major ponding basin to manage stormwater runoff from the parkway, as well as other water runoff on Airport property, and will replace existing drainage systems away from the runways and Airport Operations Area (AOA). Implementing additional green infrastructure such as rain gardens, bioswales, green roofs, and permeable pavement or concrete in parking lots and sidewalks can help to manage and store stormwater, as well as assist with drainage and absorb excess water. Green infrastructure can also facilitate groundwater aquifer infiltration/recharge within the region.

The use of native, non-wildlife-attracting plants can aid in water management, as they help reduce runoff. Additionally, their root systems are stabilizing and can reduce soil erosion. Native plants are also drought tolerant for their native regions and are typically able to grow without additional watering.

WA - : Rainwater Capture, Storage, and Use

Replacing some, or all, of the current potable water used for outdoor irrigation with collected rainwater can contribute significantly to overall water use reduction, depending on the type and condition of landscaping at the Airport. Rain barrels or rainwater collecting cisterns collect water during rainy periods and can provide irrigation water in dry periods, thereby reducing the use of potable water for outdoor irrigation and reducing annual water use.

Rooftop collection is another way to harvest rainwater. It entails collecting rainwater on the rooftop of a structure, conveying it to an on-site treatment system, then to a non-potable water tank, and then pumping it into the building for use at non-potable fixtures. Collected rainwater is a viable alternative water source for providing water to use within the building that is not derived from freshwater sources. It can be used to offset total annual water use. A rooftop collection system can be a simple gutter system that collects then conveys water into a harvesting and treatment system, or it can be combined with a green roof. A green roof is a vegetated rooftop system that reduces runoff volumes and rate, treats stormwater pollutants through filtration and plant uptake, provides an additional landscape amenity, and creates a wildlife habitat. Furthermore, green roofs can improve heating and cooling efficiencies for the building. GIAA intends to replace and improve the terminal area roof membrane to create more energy efficiencies and cost savings and to mitigate any leaks or damage to the roofing structure. This future improvement could provide an opportunity to consider simultaneous installation of a green roof and/or a rooftop stormwater collection system, as well as rooftop solar.

WA - : Greywater and Recycled Water

Greywater is defined as the wastewater from showers, bathtubs, sinks, washing machines, HVAC systems, and other appliances, and greywater reuse is one of the main alternatives for reducing potable

[156] *U.S. EPA, 2021*

water consumption in households, industries, and commercial buildings.[157] Airport complexes need large amounts of water to maintain their operation routine; however, a large part of this volume is destined for non-potable activities such as landscape irrigation, toilet flushing, washing of vehicles and paved areas, and fire control testing.[158] Replacing potable water with greywater could provide GIAA significant savings of financial and environmental resources.

There are multiple methods for greywater collection that range from manual to completely automated. For GIAA, plumbing connections between greywater sources and the Airport's irrigation system is the simplest greywater capture infrastructure. This method has a low cost of materials but does require some maintenance to ensure plumbing does not become clogged with residue. Another option for greywater capture involves integrating the Airport's plumbing into a greywater collection system. This method connects sources to a system that dispenses greywater into a collection tank. Once in the tank, the water can be treated with chlorine or iodine to allow for longer storage.

Another strategy for greywater is to capture condensate from HVAC systems, which has increasingly been considered as a resource to replace or alleviate current outdoor irrigation water use.[159] This strategy would typically include condensate collection, storage, and treatment systems that would feed into existing irrigation systems or be distributed through flood irrigation. Reconfiguration and/or installation of piping would be required if GIAA has no existing greywater systems.

9.4.2.7 Waste and Materials Management

WMM-1: Conduct a Waste Audit

A waste audit is a study that characterizes the types of airport wastes, where they come from, and where they end up.[160] This study would identify key waste generators and evaluate the effectiveness of current infrastructure and practices used to handle materials when disposing of municipal solid waste (MSW) as well as source-separated, recyclable, and compostable materials. Conducting a waste audit is an important first step in developing or refining a waste management plan. It can inform the patterns of facility users, as well as their use and distribution of everyday items throughout the Airport property.

WMM-2: Waste Receptacles System

Design and placement of waste receptacles plays a key role in improving waste reduction and diversion efforts. Waste receptacles should be set up in visible, accessible, and high-traffic areas, including curbside, pre-security, food court, holding/boarding areas, bathrooms, and concourses. Separate waste receptacles for other waste streams, such as recycling and composting, should be strategically placed to encourage waste sorting. To optimize the effectiveness of waste diversion efforts, all waste receptacles could use consistent waste signage (colors, icons, and terms) to help users quickly identify and sort their waste streams; this in turn can reduce contamination and increase recycling rates. The color and general signage should be easily identifiable by Airport passengers, staff, and others. Separating waste streams at the collection point allows for the cleanest possible streams to be delivered to waste haulers, ensuring that they can be handled with the intended recycling processes.

In addition to indoor waste receptacle design and placement, proper management and disposal of waste at Airport dumpster sites can increase overall Airport sustainability by reducing waste sent to landfills, and water and air pollution.[161] Some general dumpster site best practices include:

- Designate a waste collection area on site that does not receive a substantial amount of stormwater flow from upland areas and does not drain directly into the ocean or other waterbodies.
- n sure that containers have lids to cover them, with latches that are resistant to high winds.
- Schedule regular waste collection to prevent dumpsters from overfilling.

[157] Aguiar do Couto et al., 2013
[158] Aguiar do Couto et al., 2015
[159] King and Pfaller, 2018
[160] International Civil Aviation Organization, n.d.d
[161] International Civil Aviation Organization, n.d.d

- Clean up spills immediately. Use absorbent materials such as sawdust to contain spills or add a spill pad to prevent grease, petroleum, or other waste from leeching into the ground or waterbodies.
- Collect, remove, and dispose of all wastes at authorized disposal areas. Contact a local environmental agency to identify appropriate disposal sites.

Finally, while both dumpster sites and incinerators are effective for managing airport waste, incinerators must comply with technical requirements, industry standards, and regulations. GIAA should follow all federal, state, and local rules and regulations that apply to the placement and operation of on-site incinerators.

WMM-3: Organics/Compostable Waste Collection

GIAA could consider creating and implementing processes for the collection of source-separated compostables. Separate collection could take place at front and back of house food service operations (e.g., food courts, kitchens, and restaurants), break areas, and all other locations where organics are generated. Paper towel receptacles in bathrooms could switch out clear plastic bags to compostable bags and be labeled for paper towels only, with other bins to handle non-compostable waste. Composting bins could also be housed on site for green waste from landscaping efforts. Simultaneously, GIAA could identify a composter that can accept the materials generated at the Airport (soiled paper, food, and/or green waste) for off-site composting. While implementing compostable waste collection practices, GIAA would need to verify that all parties (e.g., janitorial and food service) handling and disposing of materials are trained in the process, and that adequate collection and hauling schedules are in place to correctly handle the materials generated to ensure organic materials remain properly separated from the waste stream to promote the beneficial use of the materials and minimize contamination of other materials.

GIAA could also participate in an animal feed program for food past its expiration date for human consumption. The first step would be to identify applicable food products that are safe for animal consumption, then locate organizations in the area that could utilize it for animal feed and arrange for them to take the food scraps. GIAA could identify the generation points of food waste and determine where food fit for animal consumption could be preserved and redistributed, and work directly with farms, livestock operations, zoos, sanctuaries, animal feed manufacturers or other organizations providing animal care.

WMM- : Sustainable Supply Chain and Green Procurement

- **Complete Review of GIAA Supply Chain** Before establishing green purchasing practices, GIAA could complete an evaluation of its supply chain by cataloguing suppliers and materials purchased and reviewing purchasing records and supply chain agreements to determine opportunities to design out or eliminate waste from vendors.
- **Establish an Environmentally Preferable Purchasing EPP Program** Reducing and diverting waste that goes into landfills starts well before the product is used and disposed of. Looking further up the value chain and making green purchasing decisions can help to reduce the overall amount of waste being generated, and subsequently sent to the landfill. PP is generally defined as purchasing a product that has a lesser or reduced negative effect or increased positive effect on human health and the environment, as compared to other products serving the same purpose.[162] GIAA can establish an PP program, also known as green purchasing or green procurement, to evaluate suppliers for materials being purchased and reduce waste through more sustainable purchasing decisions. By incorporating PP into the procurement process, GIAA can consider the life cycle and environmental impact of products by looking at the raw materials from acquisition through the packaging, distribution, reuse, and disposal of the products. Considering these factors before purchasing can allow GIAA to source more recycled, recyclable, and reusable products. Several directives can be utilized for green purchasing programs, including:
    - Adopt a precautionary principle.
    - Give preference to vendors who embrace zero waste goals.

[162] National Association of State Procurement Officials, 2023

- Request vendors to use 100 percent recyclable packaging, or work with vendors to reduce non-recyclable packaging.
- Require durable material containers for shipping or transporting items and supplies.
- Return wasteful packaging to vendors.
- Reduce packaging and buy in larger units.
- Use reusable shipping containers.
- Purchase products and services that create no waste or minimize waste.
- Give preference to sustainably produced paper and wood products.
- Avoid single-use products and packaging.
- Purchase reused, recycled, and compost products.
- Buy remanufactured equipment, or lease, rent, and share equipment.

WMM- : Construction and Demolition Waste

The Master Plan process provides numerous opportunities to minimize waste generated from construction and demolition (C&D) activities. C&D materials consist of the debris generated during construction, renovation, and demolition of buildings, roads, and bridges. C&D materials often include bulky, heavy materials such as concrete, wood, asphalt, gypsum, metals, bricks, glass, plastics, and salvaged building components, and trees, stumps, earth, and rock from clearing sites.[163] GIAA can divert C&D materials from disposal by practicing source reduction, salvaging, recycling, and reusing existing materials, and buying used and recycled materials and products. The P A gives highest priority to source reduction. While reuse and recycling are important methods to sustainably manage C&D waste, source reduction prevents waste from being generated in the first place. Some examples of C&D source reduction measures include:

- Optimizing new building sizes.
- Designing new buildings for adaptability to prolong their useful lives.
- Using construction methods that allow disassembly and facilitate reuse of materials.
- mp loying alternative framing techniques.
- Reducing interior finishes.
- Incorporating C&D source reduction into purchasing agreements that prevent excess materials and packaging from arriving at the construction site.

In addition to material source reduction, GIAA could recycle C&D materials whenever possible. Many building components can be recycled: asphalt, concrete, and rubble are often recycled into aggregate or new asphalt and concrete products. Wood can be recycled into engineered-wood products. Metals, including steel, copper, and brass, are valuable commodities to recycle. To ensure the Airport's C&D waste is being properly managed, GIAA could ensure its recycler is complying with federal and local regulations, licensing, and registration, and/or third-party certification. This can ensure the proper and intended management for C&D materials.

Finally, whenever possible, GIAA could buy used C&D materials and recycled content products for use in new construction. This strategy lowers construction and renovation costs while maintaining building function and performance; it also boosts the local economy if recovered materials are locally sourced.

[163] U.S. EPA, 2023b

9.4.3 Sustainability Strategies Summary

able 9- provides a high-level summary of the sustainability strategies identified above for potential consideration and implementation.

able 9- Sustainability Strategies Summary

Focus Area	Code	itle	Description
nergy & Fuels (Decarbonization)	F -1	nergy Audit	An energy site audit, performed internally or by a third-party contractor, can assist GIAA in better understanding the distribution of Airport energy usage to make strategic decisions for reducing energy use and overall emissions.
	F -2	On-Site Renewables	GIAA is currently planning to pursue on-site renewable energy options, specifically solar, through an SCO. GIAA is considering solar energy options, but other sources of renewable energy, such as wind, hydro, biomass, and geothermal, can also be considered.
	F -3	Fuel Switching	This measure involves switching all fossil fuel sources, such as boilers and emergency generators, to biofuels or renewable sources. This would allow GIAA to reduce carbon emissions from fossil fuel heating sources and its backup power system.
	F -4	Alternative Aviation Fuels	Implementing alternative fuel use into airline operations would reduce the life cycle emissions generated, as compared to those of conventional jet fuel. Alternative fuel options GIAA could consider include, but are not limited to, SAFs and hydrogen.
	F -5	quipment lectrification	quipment used for Airport operations can be electrified as a method for reducing emissions from fossil fuel use.
	F -6	CMs	Implementing CMs is an economic and efficient strategy for reducing airport energy usage. CMs can include both short-term operational changes, such as nighttime shutdowns and demand response, as well as long-term infrastructure improvements. These may include lighting system L D and HVAC upgrades, smart controls for lighting and HVAC systems, and building insulation and sealing improvements.
	F -7	CORSIA	CORSIA is a global market-based measure that establishes ways in which the international aviation industry can reduce emissions and minimize market distortion through technological and operational improvements, as well as through the use of SAFs.
	F -8	Vs And Charging Infrastructure	Fleet electrification involves transitioning some or all of an organization's fleet to run partially or completely on electric battery power. By running partially or fully on energy from the electricity grid or on-site renewable energy sources, an V fleet can have a lower carbon profile compared to internal combustion engine vehicles. GIAA is currently planning to pursue a transition to V fleet vehicles and implementation of charging stations.
Sustainable Buildings & Infrastructure	SBI-1	Sustainability Rating Systems	GIAA could consider and adopt, where feasible, sustainability in all phases of project development and maintenance activities. There are a variety of certification programs that serve as frameworks, tools, and approaches to understand and measure sustainability in building and infrastructure assets. L D® and nvision® are the most consistently used certification programs in the airport industry; others include N RGY STAR® as well as the W LL® and Fitwel® programs.
	SBI-2	Green Building Materials	Green building is an environmentally responsible construction method that seeks to reduce waste and use natural resources more efficiently. Switching to green or sustainable building materials

Focus Area	Code	itle	Description
			limits environmental impacts, improves energy efficiency, reduces carbon dioxide emissions, and boosts public perception.
	SBI-3	Asset Management Program	An asset management program will facilitate inventory and condition assessment of existing infrastructure and facility operations, including fleet management, on airport property and provide guidance for ongoing preventive maintenance.
Airport Sustainability Governance	GOV-1	Sustainability Vision Statement & Policy	GIAA could construct an official sustainability vision statement that includes the development of net zero targets and goals. The vision statement could convey enduring values and a lasting higher-order purpose, to guide all stakeholders toward realizing the vision.
	GOV-2	ACA Certification	The ACA certification program under ACI is a method for airports to track their carbon emissions and set targets toward emissions reductions. GIAA could first work toward meeting Level 1, which requires companies to calculate annual carbon emissions to develop a GHG inventory from within the AOA, as well as make a public commitment to reducing emissions.
	GOV-3	Contractor and Design Requirements	GIAA could consider making more formal climate task forces or other internal governing groups with specific responsibilities related to identifying, reporting, and managing climate risk. Additionally, GIAA could review and update its capital design guidelines for infrastructure and operations to integrate future climate projections. Potential climate risk can also inform decision making when acquiring, leasing, and building new facilities.
	GOV-4	stablish A Sustainability and SG Working Group/Department/Staff	These staff members could be champions for sustainability initiatives and play key roles in implementing strategies and conducting additional sustainability research. Once this team is established, they could develop short-, medium-, and long-term goals and priorities for progressing Airport sustainability initiatives.
	GOV-5	Annual Sustainability Report and SG Disclosures	GIAA could prepare and publish an annual sustainability report to disclose GIAA's current sustainability initiatives. Publishing an annual report shows the public that GIAA is willing to be transparent about sustainability metrics and goals like emission and waste reduction, and water and energy conservation. Additionally, developing an annual sustainability report would provide GIAA with a method for publicly disclosing sustainability metrics in alignment with SG frameworks such as TCFD, SBTi, GR SB, SASB, GRI, and SDGs.
	GOV-6	MS	MS is a set of management principles that assist organizations in reducing their negative environmental impacts, identifying any gaps in a company's environmental management or assessment program, and reducing the cost and time of environmental analysis, and can help improve public relations. Airports with an MS have reduced frequency and severity of environmental incidents, and improved compliance with regulatory requirements.
	GOV-7	Local Network Support	ngaging as a stakeholder with regional, national, and other local organizations can help GIAA to proactively mitigate concerns related to climate hazard response and resource allocation. Increased involvement in local planning efforts to mitigate threats, hazards, and vulnerabilities can also establish GIAA as a leading community member on the island.
Social Sustainability	SS-1	Institutionalizing J Considerations into Airport Decision Making	J requires approaches that identify and address disproportionate harms to low-income and minority communities. In terms of aviation, impacts due to aircraft noise, air quality degradation, direct and induced socioeconomic effects, degraded water quality, and effects to cultural resources, community disruption and cohesion, and traffic need to be specifically considered in the context of J.

Focus Area	Code	itle	Description
	SS-2	Stakeholder ngagement	Collaboration is key to promoting a culture that values sustainability, improves passenger and customer experience, improves relationships with customers, tenants, employees, and the community, and demonstrates GIAA's commitment to sustainability. GIAA should continue to be transparent and engage with previously identified stakeholders as well as additional stakeholders, such as suppliers, on sustainability initiatives.
	SS-3	Public Transportation and Outdoor Spaces	Because requirements for ground access and parking are primarily driven by passenger demand, GIAA could promote connections to the Airport using high-occupancy and/or low-emission ground transportation, including public transit, and prioritize the use of commercial shared-ride services over private vehicles.
	SS-4	Indoor Sustainability Improvements	There are several actions GIAA could take to implement sustainable features into the indoor terminal spaces. While some specific energy, water, and water strategies are discussed under other focus areas, some additional opportunities include water catchment and refill stations, living or green walls, and building design features.
	SS-5	mergency Alert Systems	F MA has multiple emergency alert systems; however, Guam currently does not have U.S.-based cellular carriers and does not have access to all systems. GIAA could work with other local and national agencies to consider championing an effort to make this service available to Guam citizens. Alternatively, GIAA could purchase an emergency notification mass communication intelligence system.
Climate Resilience	CR-1	Additional Infrastructure Hardening	GIAA has already implemented several actions to harden infrastructure and build resilience against typhoon-related damage. GIAA can consider additional potential physical climate risks and mitigate infrastructure damage from flooding as a result of sea level rise, extreme precipitation, and storm surges, as well as potential impacts from extreme heat to aircraft takeoff performance and increased cooling demands adding stress to the energy grid.
	CR-2	mergency Plans/Policies	It is important to continually update operation and maintenance, emergency, and other facility plans to actively address new and emerging risks. GIAA could consider how to integrate the consideration of climate risks into future updates of these plans to mitigate potential impacts.
	CR-3	Climate Vulnerability Assessment and Adaptation Planning	Performing downscaled and detailed climate vulnerability assessments of critical assets and infrastructure would provide GIAA with the data to understand how different climate variables may impact specific operations, as well as identify adaptive capacity and key asset sensitivities prior to the occurrence of a damaging event. While some degree of risk to natural hazards may be known, future climate projections could alter the current risk profiles for assets, which further emphasizes the need to reevaluate asset vulnerability.
Water Conservation & Management	WAT-1	Water Conservation Measures	GIAA could consider converting existing water fixtures (including toilets, faucets [kitchen and bathroom], urinals, showers, and washing machines) to low-flow or high-efficiency and could install automatic-off fixtures (such as sinks and water fountains), where applicable.
	WAT-2	Landscape Design	Water applied to the landscape can account for a significant portion of a site's overall water use. Xeriscape is a style of landscaping that uses slow-growing, drought-tolerant, native, or other regionally appropriate species that require little to no irrigation to conserve water and reduce yard waste.
	WAT-3	Stormwater and Drought Management	Surfaces with low permeability, that can often be associated with runways, large buildings, and parking lots, can cause issues with stormwater management and efficient drainage. Implementing additional green infrastructure such as rain gardens, bioswales, green roofs, and permeable

Focus Area	Code	itle	Description
			pavement or concrete in parking lots and sidewalks can help to manage and store stormwater, as well as assist with drainage and absorb excess water.
	WAT-4	Rainwater Capture, Storage, and Use	Rain barrels or rainwater collecting cisterns collect water during rainy periods and can provide irrigation water in dry periods, thereby reducing the use of potable water for outdoor irrigation and reducing annual water use. Rooftop collection is another way to harvest rainwater. Collected rainwater is a viable alternative water source for providing water to use within a building that is not derived from freshwater sources. It can be used to offset total annual water use.
	WAT-5	Greywater and Recycled Water	Airport complexes need large amounts of water to maintain their operation routine; however, a large part of this volume is destined for non-potable activities such as landscape irrigation, toilet flushing, washing of vehicles and paved areas, and fire control testing. Replacing potable water with greywater could provide GIAA significant savings of financial and environmental resources.
Waste Materials & Management	WMM-1	Conduct a Waste Audit	A waste audit would identify key waste generators and evaluate the effectiveness of current infrastructure and practices used to handle materials when disposing of MSW as well as source-separated, recyclable, and compostable materials. Conducting a waste audit is an important first step in developing or refining a waste management plan.
	WMM-2	Waste Receptacle System	Design and placement of waste receptacles plays a key role in improving waste reduction and diversion efforts. Waste receptacles should be set up in visible, accessible, and high-traffic areas, including curbside, pre-security, food court, holding/boarding areas, bathrooms, and terminal concourses. Separate waste receptacles for other waste streams, such as recycling and composting, could be strategically placed to encourage waste sorting.
	WMM-3	Organics/Compostable Waste Collection	GIAA could consider creating and implementing processes for the collection of source-separated compostables. Separate collection could take place at front and back of house food service operations (e.g., food courts, kitchens, and restaurants), break areas, and all other locations where organics are generated. Composting bins could also be housed on site for green waste from landscaping efforts.
	WMM-4	Sustainable Supply Chain & Green Procurement	Before establishing green purchasing practices, GIAA could conduct a complete evaluation of its supply chain by cataloguing suppliers and materials purchased. Reducing and diverting waste that goes into landfills starts well before the product is used and disposed of. Looking further up the value chain and making green purchasing decisions can help to reduce the overall amount of waste being generated, and subsequently sent to the landfill.
	WMM-5	Construction and Demolition Waste	C&D materials consist of the debris generated during construction, renovation, and demolition of buildings, roads, and bridges. GIAA can divert C&D materials from disposal by practicing source reduction, salvaging, recycling, and reusing existing materials, and buying used and recycled materials and products. While reuse and recycling are important methods to sustainably manage C&D waste, source reduction prevents waste from being generated in the first place.

Note:

A. Abbreviations

ACA = Airport Carbon Accreditation
C&D = Construction and Demolition
EJ = Environmental Justice
ESG = Environmental, social, and governance
GHG = Greenhouse gas
GRI = Global Reporting Initiative
LEED = Leadership in Energy and Environmental Design
SASB = Sustainability Accounting Standards Board
ACI = Airports Council International
CORSIA = Carbon Offsetting and Reduction Scheme for International Aviation
EMS = Environmental Management System
EV = Electric vehicle
GIAA = A.B. Won Pat International Airport Authority, Guam
HVAC = Heating, ventilation, and air conditioning
MSW = Municipal solid waste
SBTi = Science-Based Targets Initiative
AOA = Airport Operations Area
ECM = Energy conservation measure
ESCO = Energy services company
FEMA = Federal Emergency Management Agency
GRESB = Global ESG Benchmark for Real Assets
LED = Light-emitting diode
SAF = Sustainable aviation fuel
SDGs = Sustainable Development Goals
TCFD = Task Force on Climate-Related Financial Disclosures

Source: AECOM

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9.5 Funding and Financing Opportunities

Identifying applicable funding opportunities is the first step in building and managing a successful sustainability program.

able 9-6 summarizes a selection of funding and financing mechanisms that may offer opportunities to support GIAA's implementation of sustainability initiatives. a rly identification of funding and financing opportunities can help guide project phasing and strategy implementation. Federal, state, and local grant opportunities and cost-saving opportunities such as tax rebates and incentives for which GIAA may be eligible were evaluated. Additional analysis would be required to confirm GIAA's eligibility and to assess the feasibility of pursuing these potential financing opportunities.

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able 9-6 Potential Funding Mechanisms for Sustainability Strategies

Funding/Financing Mechanism	ype	Eligible Entities	Description	Considerations
F MA Hazard Mitigation Funding[164]	Grant	Hazard Mitigation Grant Program funds are available <u>only</u> within a presidentially declared disaster area. State, territorial, and tribal governments and certain non-profits may apply. Homeowners and businesses may not apply, but a community may apply on their behalf.	F MA's hazard mitigation assistance provides funding for eligible mitigation measures that reduce disaster losses.	Utility projects must meet the following criteria: conform to the state's Hazard Mitigation Plan, benefit the disaster area, meet all environmental requirements, solve a problem, be cost-effective.
F MA Pre-Disaster Mitigation (PDM)[165]	Grant	ligible applicants include state governments, native American tribal governments, and U.S. territory governments.	The PDM grant program makes federal funds available to state, local, tribal, and territorial governments to plan for and implement sustainable cost-effective measures designed to reduce the risk to individuals and property from future natural hazards, while also reducing reliance on federal funding from future disasters.	NOFO posted on March 1, 2023. Deadline to apply is April 14, 2023. Funding is renewed annually.
F MA Building Resilient Infrastructure and Communities (BRIC)[166]	Grant	Applicants may include states, the District of Columbia, U.S. territories, and federally recognized tribal governments. Sub-applicants must have a F MA-approved local or tribal HMP in accordance with 44 CFR Part 201 by the application deadline. They must also have one at the time of obligation of grant funds for hazard mitigation projects and Capability and Capacity Building activities. Hazard mitigation planning and planning-related activities, partnerships, and building codes are exempt from the HMP requirement.	BRIC supports states, local communities, tribes, and territories as they undertake hazard mitigation projects, reducing the risks they face from disasters and natural hazards. The BRIC program guiding principles are supporting communities through capability- and capacity-building; encouraging and enabling innovation; promoting partnerships; enabling large projects; maintaining flexibility; and providing consistency.	States, territories and federally recognized tribal governments can submit applications on behalf of sub applicants for BRIC funding ach state, territory, federally recognized tribal government and the District of Columbia shall designate one agency to serve as the applicant for BRIC funding. ach agency may submit only one BRIC grant application to F MA. An application can be made up of an unlimited number of sub applications.

[164] *Federal Emergency Management Agency, 2022a*
[165] *Federal Emergency Management Agency, 2023a*
[166] *Federal Emergency Management Agency, 2023b*

Funding/Financing Mechanism	ype	Eligible Entities	Description	Considerations
Airport Terminals Program (ATP)[167]	Grant	ligible applicants are those airport sponsors normally eligible for AIP discretionary grants as defined in 49 U.S.C. 47115. This includes a public agency, private entity, state agency, Indian tribe or pueblo owning a public-use NPIAS airport, the Secretary of the Interior for Midway Island airport, the Republic of the Marshall Islands, Federated States of Micronesia, and the Republic of Palau.	Through the Bipartisan Infrastructure Law,[168] $5 billion has been granted to provide competitive grants for airport terminal development projects that address the aging infrastructure of the nation's airports. These grants will fund safe, sustainable, and accessible airport terminals, on-airport rail access projects, and airport-owned airport traffic control towers. Projects may also include multimodal development.	All projects funded from the ATP must be: Airport terminal development, defined in 49 U.S.C. 47102(28) as development of an airport passenger terminal building, including terminal gates, access roads servicing exclusively airport traffic that leads directly to or from an airport passenger terminal building, and walkways that lead directly to or from an airport passenger terminal building. Under the ATP, the FAA may consider projects that qualify as "terminal development" (including multimodal terminal development), as that term is defined in 49 U.S.C. 47102(28), or on-airport rail access projects as set forth in PFC Update 75-21 (86 FR 48793, August 31, 2021), or ATCT that includes relocating, reconstructing, repairing, or improving the ATCT, and justified based on civil aeronautical demand.
FAA Contract Tower Competitive Grant Program[169]	Competitive Grant	ligible applicants are those airport sponsors approved in the FAA's contract tower program or contract tower cost share program as defined in 49 U.S.C. 47124, and normally eligible for AIP discretionary grants as defined in 49 U.S.C. 47115. The eligible applicants include a public agency, private entity, state agency, Indian tribe or pueblo owning a public-use NPIAS airport, the Secretary of the Interior for Midway Island airport, the Republic of the Marshall Islands, the Federated States of Micronesia, and the Republic of Palau.	The FAA will make available $20 million annually from the Bipartisan Infrastructure Law funds to modernize air traffic control towers at many small town and municipal airports. These funds will allow airports to sustain, construct, repair, improve, rehabilitate, modernize, replace, or relocate non-approach control towers; acquire and install air traffic control, communications, and related equipment to be used in those towers; and construct in remote areas.	The FY 2023 application period is closed; however, this program will run annually though FY2026.

[167] *Federal Aviation Administration, 2023a*
[168] *The Bipartisan Infrastructure Law allocates money to the FAA and U.S. Department of Transportation. These agencies then award airports project funding through grant programs such as the FAA Contract Tower Grant Program and the Airport Terminals Program.*
[169] *Federal Aviation Administration, 2023b*

Funding/Financing Mechanism	ype	Eligible Entities	Description	Considerations
Airport Improvement Program (AIP)[170]	Grant	Public-use airports that are publicly owned or privately owned but designated by FAA as a reliever, or privately owned but having scheduled service and at least 2,500 annual enplanements, are eligible. Further, to be eligible, an airport must be included in the NPIAS. ligible projects include those improvements related to enhancing airport safety, capacity, security, and environmental concerns. Sponsors can get AIP funds for most airfield capital improvements or rehabilitation projects, and in some specific situations, for terminals, hangars, and nonaviation development.	The AIP provides grants to public agencies—and in some cases, to private owners and entities—for the planning and development of public-use airports that are included in the NPIAS.	For large and medium primary hub airports, the grant covers 75 percent of eligible costs (or 80 percent for noise program implementation). For small primary, reliever, and general aviation airports, the grant covers a range of 90-95 percent of eligible costs, based on statutory requirements.
Voluntary Airport Low missions Program (VAL)[171]	Grant	An eligible airport must be a commercial service airport that is in a "non-attainment" or "maintenance" area for one of the NAAQS. The proposed project must not be included in any State Improvement Plan in order to be eligible to receive credits for any proposed project.	VAL helps airport sponsors meet state-related air quality responsibilities under the Clean Air Act. Through VAL , airport sponsors can use AIP funds and PFCs to finance low emission vehicles, refueling and recharging stations, gate electrification, and other airport quality improvements.	The annual deadline for pre-applications is ***November 1*** each year. Airports must submit pre-applications to their FAA ADO (or FAA Regional Office for Regions without ADOs) by that date.
Airport nvironmental Mitigation Pilot Program (MPP)[172]	Grant	Projects funded through this pilot program: Should introduce new environmental mitigation techniques or technologies that have been proven in laboratory demonstrations; should propose methods for efficient adaptation or integration of new concepts into airport operations; must measurably reduce or mitigate aviation impacts on noise, air quality, or water quality at the airport or within 5 miles of the airport; and must demonstrate whether new techniques or new technologies are practical to implement at or near public-use airports.	The MPP allows the FAA to provide grants for environmental mitigation projects that will measurably reduce or mitigate aviation impacts on noise, air quality, or water quality at the airport or within 5 miles of the airport.	Selected projects may receive up to $2.5 million in federal funding through grants from the AIP's noise and environmental set-aside. Grants will cover 50 percent of project costs, and airports must provide 50 percent in airport matching funds. Airports must complete projects within 24 months of receiving the grants. The deadline for this grant has passed; however, this program may receive additional funding if the pilot program is deemed successful.

[170] *Federal Aviation Administration, 2023c*
[171] *Federal Aviation Administration, 2022f*
[172] *Federal Aviation Administration, 2023d*

Funding/Financing Mechanism	ype	Eligible Entities	Description	Considerations
		The law prioritizes projects implemented by joint teams of at least two of the following types of organizations: businesses, educational or research organizations, state or local government, and federal laboratories.		
Passenger Facility Charge (PFC) Program[173]	Fee Approval	The applicant must be a commercial service airport to be eligible. Commercial service airports are public-use airports that enplane 2,500 or more passengers a year. Airports electing to impose a PFC may use the revenues for one or more of the following: Pay all or part of the allowable cost of an FAA-approved project; pay debt service and financing costs associated with bond issuance; combine PFC funds with federal grant funds (e.g., AIP) to accomplish an approved project; and apply PFC funds to meet the non-federal share of the cost of projects funded under the Federal Airport Grant Program.	The PFC Program allows the collection of PFC fees up to $4.50 for every eligible passenger at commercial airports controlled by public agencies. PFCs are capped at $4.50 per flight segment with a maximum of two PFCs charged on a one-way trip or four PFCs on a round trip, for maximum of $18 total. Airports use these fees to fund FAA-approved projects that enhance safety, security, or capacity; reduce noise; or increase air carrier competition.	Commercial service airports may request authority to impose a PFC of $1-$4.50 on revenue passengers enplaned at their airport.
FAA Airports Climate Challenge[174]	Competitive Supplemental Discretionary Grant	ligible applicants are those airport sponsors normally eligible for AIP discretionary grants, which includes a public agency, private entity, state agency, Indian tribe or pueblo owning a public-use NPIAS airport, the Secretary of the Interior for Midway Island Airport, the Republic of the Marshall Islands, Federated States of Micronesia, and the Republic of Palau.	FAA seeks to fund projects that align with the President's GHG reduction goals, promote energy efficiency, support fiscally responsible land use and efficient transportation design, support terminal development compatible with the use of sustainable aviation fuels and technologies, increase climate resilience, incorporate sustainable and less emissions-intensive pavement and construction materials wherever possible, and reduce pollution.	At least $25,000,000 will be made available for the VAL Program and the Z V and Infrastructure Program. Grants have federal shares ranging from 70 percent to 95 percent under 49 U.S.C. 47109. The federal share percentage is based on the airport size and type of project. The 2023 deadline for this grant has passed; however, this challenge may be available again in the future.

Note:

A. Abbreviations

AIP = Airport Improvement Program
ATCT = Airport Traffic Control Tower
ADO = Airports District Office
ATP = Airport Terminals Program
CFR = Code of Federal Regulations

[173] *Federal Aviation Administration, 2023e*
[174] *Federal Aviation Administration, 2023f*

FAA = Federal Aviation Administration
FEMA = Federal Emergency Management Agency
FR = Federal Register
FY = Fiscal year
GHG = Greenhouse gas
HMP = Hazard Mitigation Plan
NAAQS = National Ambient Air Quality Standards
NPIAS = National Plan of Integrated Airport Systems
NOFO = Notice of Funding Opportunity
PFC = Passenger Facility Charge
U.S.C. = United States Code
ZEV = Zero emissions vehicles

Source: AECOM

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9.6 Next Steps

To facilitate continued sustainability program development, **able 9-** includes a series of immediate next steps and actions GIAA can consider to further evaluate and implement the potential sustainability strategies.

able 9- Recommended Next Actions for GIAA Consideration

Action for Consideration	Description
Identify priority sustainability strategies to implement	It is important to integrate sustainability into all GIAA planning processes and begin implementing actions for emissions reductions. GIAA can immediately move forward with the SCO for on-site solar and L D lighting upgrades, and continue to pursue the procurement of Vs and installing the associated infrastructure. Additionally, a key first step would be to identify specific sustainability targets and emissions reduction goals.
Develop an nergy Management Dashboard	ngage a vendor to support developing a company-wide nergy Management Dashboard that provides real-time visibility into, at a minimum, site-level energy use and other key performance indicators. The dashboard would aid GIAA in bringing a GHG lens to its operations and help standardize data collection and reporting. GIAA can utilize the dashboard to identify anomalies in energy use to implement solutions more efficiently.
mbed sustainability-related considerations in all new construction	All new construction at the Airport, whether related to the identified sustainability strategies or not, could consider the carbon content of materials and the energy makeup of the local grid, and prioritize energy, water, and material conservation in the construction process, and sustainability practices of contractors and suppliers.
Perform energy audit	Perform an energy audit to measure the potential interaction between sustainability strategies. The audit would assess the potential impact of the various mechanical systems on one another, their impact on overall energy demand, and the optimal application of each sustainability strategy.
Conduct feasibility studies	ngage a vendor to support a more in-depth study of the costs, potential carbon and emissions savings, potential energy savings, installation requirements, and operational requirements of each identified sustainability strategy.
Develop a budget	Develop a budget for sustainability initiatives and integrate it into GIAA's forecasted spend for short-, medium-, and long-term planning.
Assign roles & responsibilities	Develop clearly defined roles and responsibilities for the data gathering, implementation, and monitoring of sustainability initiatives.
Implement & monitor sustainability progress; re-evaluate and optimize targets and measures	Develop evaluation criteria and a framework to install, operate, maintain, and track performance of sustainability investments. stablish emissions reduction targets and related plans in response to changes in airport operations, availability of new technologies, changes to the regulatory environment, and adapting to market demands. For example, ensure on-site solar can support increasing electricity demand. Additionally, GIAA can develop a sector-specific emissions reduction target aligned with SBTi. A sector-specific target is more granular and takes the nuances of individual sectors into account and would more closely align with the aviation industry.
valuate SG frameworks for measuring sustainability performance	valuate the various SG frameworks available for measuring sustainability performance metrics to determine which methodologies may be most applicable to GIAA's current management and reporting structures. These frameworks can provide GIAA with specific guidelines for developing sustainability programs and identify key areas of data to begin tracking to measure progress.
Conduct a detailed assessment of climate risk	Complete a climate risk assessment for GIAA assets and infrastructure to identify and analyze limitations and risks for both implementing abatement measures and for the organization at large. Performing a climate vulnerability assessment would provide GIAA with the data to understand how different climate variables may impact specific operations and critical assets and infrastructure, as well as identify adaptive capacity and key asset sensitivities that may need to be addressed before implementing some carbon abatement measures. TCFD can also be used as a guideline for assessing climate risk.

Action for Consideration	Description
Develop a GHG Inventory	Develop a comprehensive GHG inventory to quantify Scope 1 and 2 emissions and obtain a holistic picture of GIAA's carbon footprint. Calculated emissions can help to identify priority areas for emissions reductions. Additionally, as Scope 3 emissions comprise the majority of an airport's GHG emissions, GIAA could complete an analysis of Scope 3 emissions within GIAA's carbon footprint and evaluate strategies for reducing Scope 3 emissions.

Note:

A. Abbreviations

ESCO = Energy services company
ESG = Environmental, social, and governance
EV = Electric vehicle
LED = Light-emitting diode
GHG = Greenhouse gas
SBTi = Science-Based Targets Initiative
TCFD = Task Force on Climate-Related Financial Disclosures

Source: AECOM