PORT AUTHORITY OF GUAM

2023 Master Plan

FINAL REPORT (SUBJECT TO APPROVAL PURSUANT TO 5 GCA, CHAPTER 1, ARTICLE 2, §1205 AND §1206)

March 31, 2023

This study was prepared under contract with the Port Authority of Guam (PAG), with financial support from the Office of Local Defense Community Cooperation (OLDCC). The content reflects the views of the PAG and does not necessarily reflect the views of the OLDCC.

Jose D. Leon Guerrero Commercial Port of Guam

2023 Master Plan

FINAL REPORT (SUBJECT TO APPROVAL PURSUANT TO
5 GCA, CHAPTER 1, ARTICLE 2, §1205 AND §1206)

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Submitted Pursuant to Consultant Agreement No. PAG 015-003 between Jose D. Leon Guerrero Commercial Port (Port Authority of Guam) and WSP acting as Owner's Agent and Engineer.

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List of Acronyms

A/C	Air Conditioning
ARRA	American Recovery and Reinvestment Act
ATS	Automatic Transfer Switch
CAGR	Compound Annual Growth Rate
CBP	Customs and Border Protection
CC	Corrosion Control
CFS	Container Freight Station
CIA	Central Intelligence Agency
CIP	Capital Improvement Plan
CM	Crane Maintenance
CMU	Concrete Masonry Unit
CNMI	Commonwealth of the Northern Mariana Islands
CPI	Consumer Price Index
CTCM	Container Terminal Capacity Model
DAR	Defense Access Roads
DGM	Deputy General Manager
DHS	Department of Homeland Security
DOD	Department of Defense
DPRI	Defense Policy Review Initiative
DPW	Department of Public Works
DWT	Deadweight Tonnage
EDI	Electronic Data Interchange
EOC	Emergency Operations Center
ESQD	Explosive Safety Quantity Distance
EQMR	Equipment Maintenance and Repair
FMS	Financial Management System
FSM	Federated States of Micronesia
FY	Fiscal Year
GCA	Guam Code Annotated
GCPI	Guam Commercial Port Improvement
GEDA	Guam Economic Development Authority
GEPA	Guam Environmental Protection Agency
GHPO	Guam Historic Resources Division
GM	General Manager
GOS	Gate Operating System
GPA	Guam Power Authority
GRT	Gross Register Tonnage
GWA	Guam Waterworks Authority
HP	Horsepower
HR	High Roof

IP&E Isla Petroleum and Energy
ISPS International Ship and Port Facility Security
JGPO Joint Guam Program Office
LAN Local Area Network
LC Load Center
LOA Length Overall
LPG Liquefied Petroleum Gas
LR Low Roof
MARAD U.S. Maritime Administration
MARSEC Maritime Security
MELL Marianas Express Lines Limited
MEP Mechanical, Electrical and Plumbing
MLLW Mean Lower Low Water
MOA Memorandum of Agreement
MP Master Plan
MPC Maximum Practical Capacity
MPH Miles per hour
MSA Marianas Steamship Agencies
MT Metric Tons
MTSA Maritime Transportation Security Act of 2002
NEPA National Environmental Policy Act
NM Nautical miles
NOAA National Oceanic and Atmospheric Administration
OAE Owner's Agent/Engineer
OCR Optical Character Recognition
OOG Oversized (Out-of-Gauge) Containers
PAG Port Authority of Guam
PCE Personal Consumer Expenditures
PCS Permanent Change of Station
PFSP Port Facility Security Plan
PL Public Law
PM Preventative Maintenance
PMC Performance Management Contractor
PMP Port Modernization Program
PMT Program Management Team
POLA Port of Los Angeles
PSF Pounds per square foot
PSGP Port Security Grant Program
PSI Pounds Per Square Inch
PUC Public Utilities Commission
PUGG Port Users Group Guam
RC Reinforced Concrete
RFID Radio Frequency Identification

RO/RO Roll-on/Roll-off
ROD Record of Decision
RTG Rubber-Tyred Gantry Cranes
SDDC Surface Deployment and Distribution Command
SHPO State Historic Preservation Office
SIAS Socioeconomic Impact Assessment Study
SLE Service Life Extension
SPC Sustainable Practical Capacity
SPPC South Pacific Petroleum Corporation
STS Ship to Shore Crane
TBD To Be Determined
TEU Twenty-foot Equivalency Unit
TGS Terminal Ground Slot
TIGER Transportation Investment Generating Economic Recovery Grants
TLT Terminal Layout Tool
TOS Terminal Operating System
TGS Twenty-foot Ground Slot
TWIC Transportation Worker Identification Credential
UBC Uniform Building Code
USCBP U.S. Customs and Border Protection
USCG U.S. Coast Guard
USDA U.S. Department of Agriculture
USWC U.S. West Coast
VHF Very High Frequency
WAMS Waterway Analysis and Management System
WH Warehouse
WIM Weigh-In-Motion
WYE 3-Phase Electrical Power Wiring Configuration

EXECUTIVE SUMMARY

PURPOSE AND BACKGROUND

The Jose D. Leon Guerrero Commercial Port Authority of Guam (PAG) is the largest deep-water seaport in the Western Pacific Region. As the only commercial port on the island, it provides marine transportation services to local, private, federal, and military customers. In addition, it is the primary transshipment hub for neighboring islands in the region serving a population of over 400,000.

With over 90% of containerized and breakbulk commodities passing through its wharves and the lifeline between Guam, the region, and the rest of the world, it is critically important that the Port Authority of Guam (PAG) invests in initiatives that will upgrade its infrastructure, facilities, and equipment to achieve resiliency, ensure supply chain sustainability, and enhance operational capacity and services.

Over the past decade, the Port has grown and evolved into a world-class commercial port and has successfully implemented past master plans, evidenced with the recent completion of the $50 Million Port Modernization Program, ground-breaking for the Hotel Wharf Rehabilitation Project, federal funding to repair Golf Pier and F1 – F6 wharves, and bond funding for several critically important capital improvement projects. Looking forward, the Port continues to develop its maintenance and capital improvement projects and further develop the strong partnership with the Department of Defense's Indo-Pacific Strategy and the Pacific Deterrence Initiatives.

Shifting from a modernization mode to a now more pronounced resiliency and readiness mode of management, infrastructure hardening and operation, the Port has established improved relationships with key stakeholders. This aggressive networking direction that the Port has undertaken since 2019 has allowed current Management to capitalize on past successes while vocalizing the Port of Guam's challenges in its efforts to replace aged Ship-To-Shore (STS) Gantry Cranes, upgrade revenue generating wharves that are in dire need of repair, replace facilities and equipment that have exceeded their useful life, and increase capacity in areas that will better serve its commercial customers and the DOD's readiness plans in the Indo-Pacific theater.

In upgrading and replacing aging infrastructure and equipment, the PAG proactively supports not only local but also federal policy goals, such as Executive Orders 13985 and 14008, Advancing Racial Equity and Support for Underserved Communities Through the Federal Government and Tackling the Climate Crisis at Home and Abroad, respectively. Repairing and maintaining the facilities at the Port of Guam is essential in ensuring that all residents and indigenous population of the island and region continue to have access to the services it provides.

Additionally, the resiliency upgrades allow for the implementation of environmentally sustainable equipment and infrastructure, such as cargo handling equipment with emission reduction technology and vapor recovery systems at the island's two (2) fuel facilities – Golf Pier and Pier F1, which will dramatically improve air quality as a result of cleaner operations.

Because the Port receives about 90% of all goods imported for the island's residents, military personnel, and travelers visiting the island, these initiatives are critical to ensuring the cost of living in Guam is not unnecessarily or further elevated due to supply chain issues caused by loss of functions at the island's only commercial seaport.

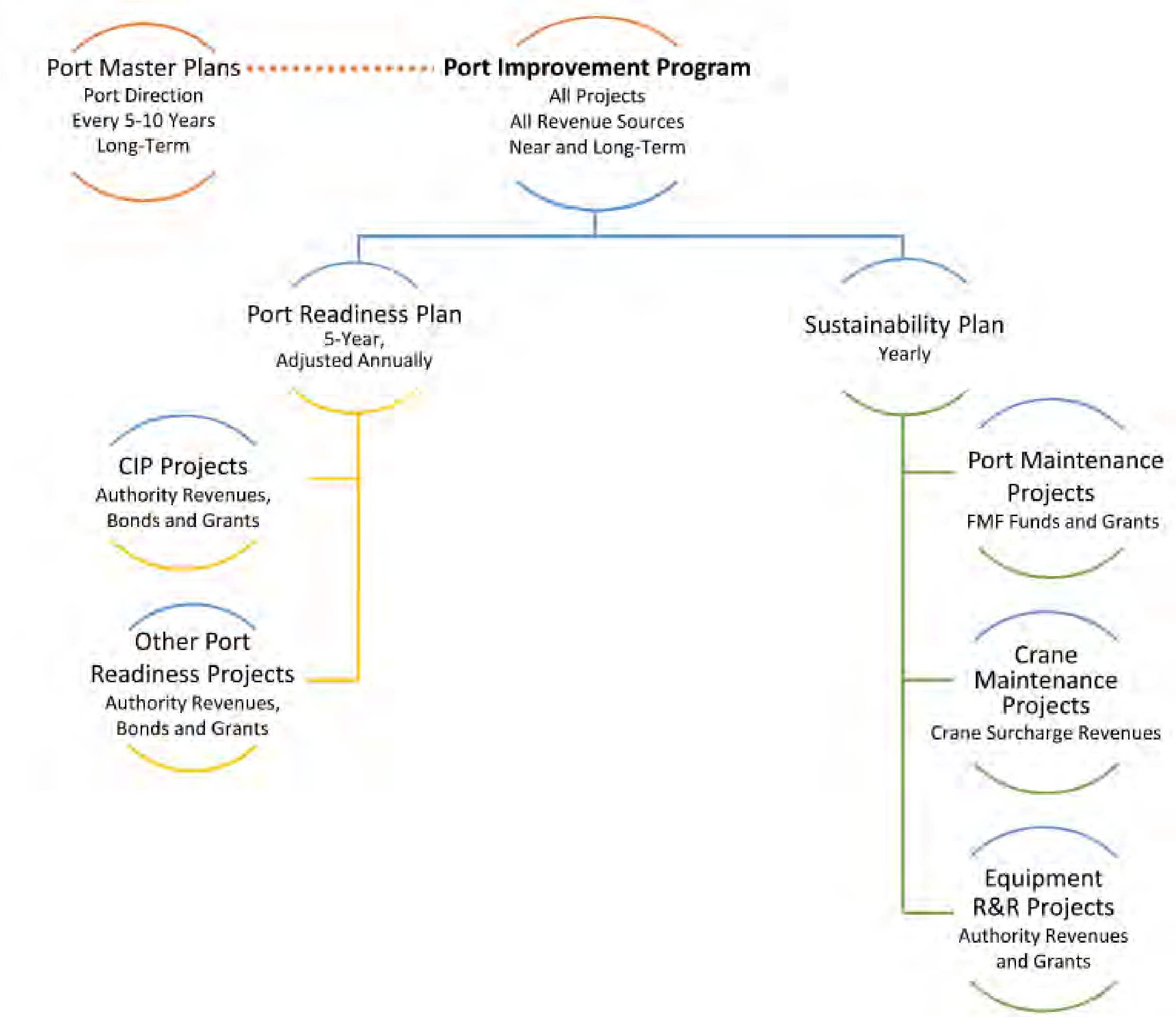
The Master Plan includes four elements of validation, review and coordination:

1. Analyze and update, as appropriate, the assumptions and criteria that underlie the previous Master Plan Update 2013 Report;
2. Validate and integrate key elements of the following reports that were developed since the previous Master Plan was released.
    - Master Plan Approval Documents
    - Cargo Forecast Updates
    - Terminal Development and Operations Plans
    - Terminal Operating System and Gate Operating System Reports
    - The 2016 PUC Tariff Report
    - The 2018 Consulting Engineer's Report in support of the CIP Revenue Bond issuance
3. Expand the scope of the Master Plan to include an implementation strategy based on restructured facilities, updated cargo and revenue projections, planned staffing adjustments, and a coordinated funding approach involving a potential combination of grants, bonds and self-financing; and
4. Validate and incorporate decisions and outcomes of various initiatives and policy changes that have occurred over the past nine years that include the following:
    - The Military Buildup Program and schedule has been delayed and resized
    - The Port responded to the PUC in 2016 by issuing a new 5-Year Tariff, which will be reviewed and updated as appropriate
    - A simplified tariff structure is being developed to facilitate more efficient electronic Terminal Operating System (TOS) data interfacing and invoicing with stakeholders
    - TOS improvements are being incorporated to improve operational efficiencies, data accuracy, and facilitate electronic data sharing
    - A new Performance Maintenance Contractor (PMC) contract has been issued to improve equipment maintenance
    - A new Information Technology Consulting Firm (ITCF) contract is being issued to augment port TOS/IT development and improve terminal operations and improve security
    - The Port is developing a more structured Maintenance Program for Facilities and Equipment

- The Port is planning on procuring three new STS container cranes to replace older equipment and to increase operating efficiencies
- The MARAD funded H-Wharf upgrade program is commencing
- The Revenue Bond Projects are moving ahead and will become part of the Port's infrastructure over the next three years
- Guam Customs has a feasibility study to assist in the development of a new inspection facility adjacent to the terminal gate which will be integrated with the cargo operations

Consequently, this Master Plan culminates with a Port Improvement Program (PIP) comprised of two categories: The Port Readiness Plan (PRP) and the Sustainability Plan (SP). The Port Readiness Plan is subdivided into Capital Improvement Projects and Other Port Readiness Projects while the Sustainability Plan addresses continued professional and technical services oversight and support to address port sustainability and resiliency, environmental initiatives to reduce the port's carbon footprint and reduce its greenhouse effects, and strategic goals toward zero waste improvements. The PIP is focused on ensuring the future readiness and resiliency of a modernized facility through the hardening of Port of Guam assets and resources to address national security concerns from the current and anticipated geopolitical environment. See Figure ES- 1.

Figure ES- 1: Port Improvement Program and Associated Plans



Source: PAG and WSP Analysis

To achieve an enhanced level of content in the Master Plan, the PAG directed WSP to perform the following supporting planning studies:

- Customs Inspection Facility Study
- Cargo Terminal Study
- Assessment of Agat Marina
- Assessment of Gregorio D. Perez Marina
- Proposed LNG Facility Study
- Area A Feasibility Study
- Solar Power Study
- PUGG Initiative for System Integration Study

- Various Supporting Financial Analyses
- Cyber Security Study

The results of these studies are integrated into this 2023 Master Plan along with strategies to complement the Governor's Transshipment Initiative and the Port's Sustainability Strategy.

ASSETS AND RESOURCES

The PAG's assets and resources are comprised of landside and waterside infrastructure, upland facilities, marine facilities, equipment, port security, operations, environmental health and safety programs, and IT initiatives. These elements play a fundamental role in development and execution of the Port Improvement Plan (PIP). For reference, Port assets and resources are located within Apra Harbor, along the southwestern shoreline, and in the capital city of Hagåtña. See Figure ES- 2, Figure ES- 3, Table ES- 1, and Table ES- 2

Figure ES- 2: PAG Apra Harbor Assets

Source: Google Earth and WSP

Figure ES- 3: Agat Small Boat Marina and Gregorio D. Perez Marina Assets

Source: Google Earth and WSP

Table ES- 1: Port Owned Cranes

Name or Designation	Age	Capacity	Height Above WS Rail
Gantry 4 (POLA 1)	1983 Re-powered and strengthened in 2009	40 LT	85 feet
Gantry 5 (POLA 2)	1983 Re-powered and strengthened in 2009	40 LT	93 feet
Gantry 6 (POLA 3)	1983 Re-powered and strengthened in 2009	40 LT	93 feet

Source: The PAG

Table ES- 2: Port Owned Cargo Handling Equipment

Equipment	No.	Year	Make/Model	Capacity
Top Picks	3	2009	Hyster H50.00XM	40 Short Ton – 5 High
	4	2016	Hyster 1150CH	40 Short Ton – 5 High
	2	2019	Taylor XLC97E	40 Short Ton – 5 High
Yard Tractor	9	2010	Kalmar/Ottowa	YT-50
	16	2017	Kalmar	T2 4x2
Forklift	4	2008	Hyster H5.00DX	5.5 Short Ton
	4	2016	Doosan D50SC-5	5.5 Short Ton
	2	2017	Hyundai 180D-7E	20 Short Ton
	4	2017	Hyundai 110D-7E	10 Short Ton

Source: The PAG

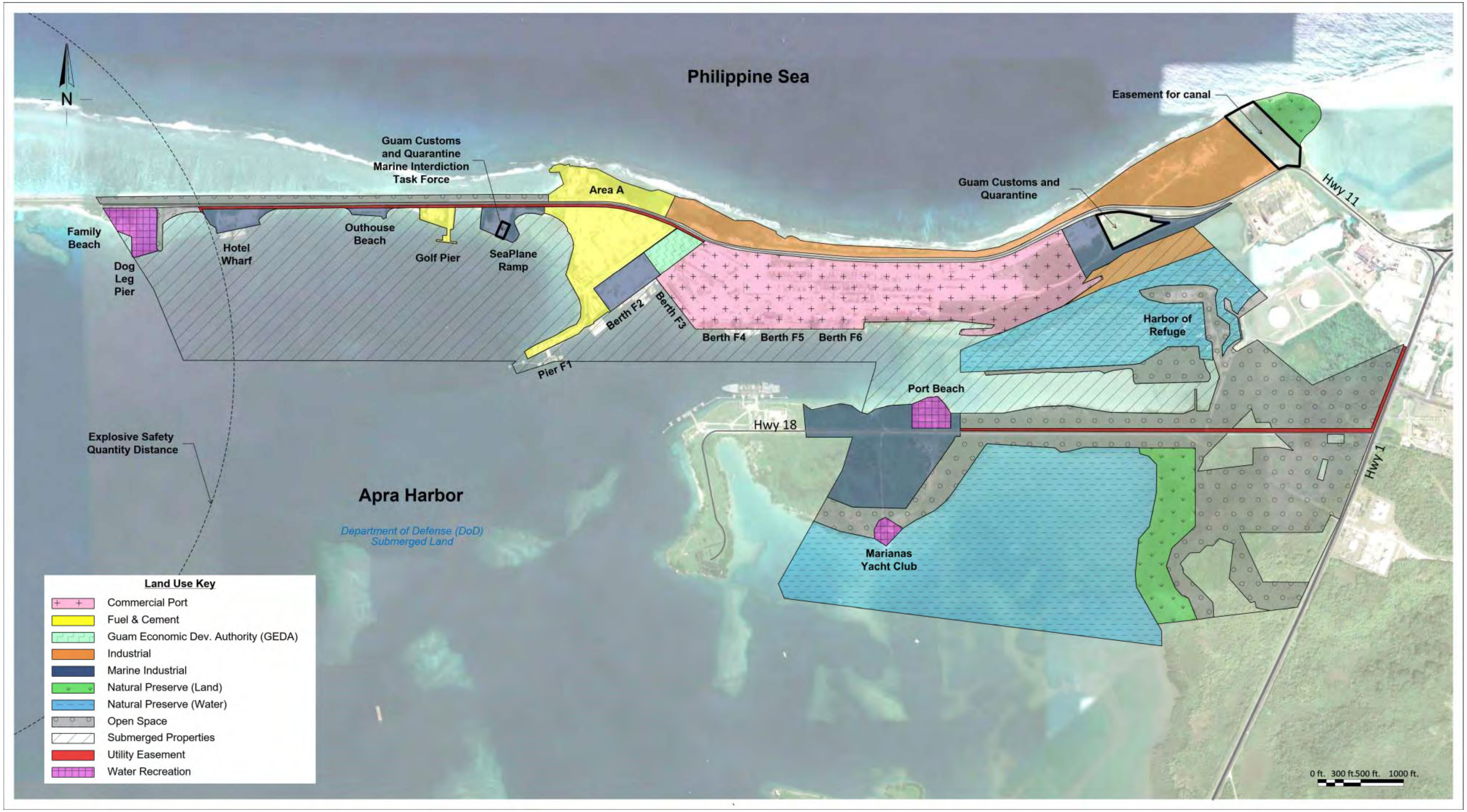
PAG assets and resources evaluated and addressed in this Master Plan include:

- Access channels and vessel berths
- Safety Zones
- Navigation Aids
- Hwy 11 roadway access
- Diversified land uses
- Cargo handling equipment
- Operations
- Marine Industrial Facilities
- Security
- Environmental Health & Safety

These items are depicted and summarized in the PIP figures and tables below. A comprehensive assessment of the current condition of all the port's assets and resources is included in this Master Plan. Results of the assessments were used to identify and define the critical elements of the PIP. Therefore, the PIP is focused on hardening the existing infrastructure, equipment and operations of the port to ensure near- and long-term sustained success.

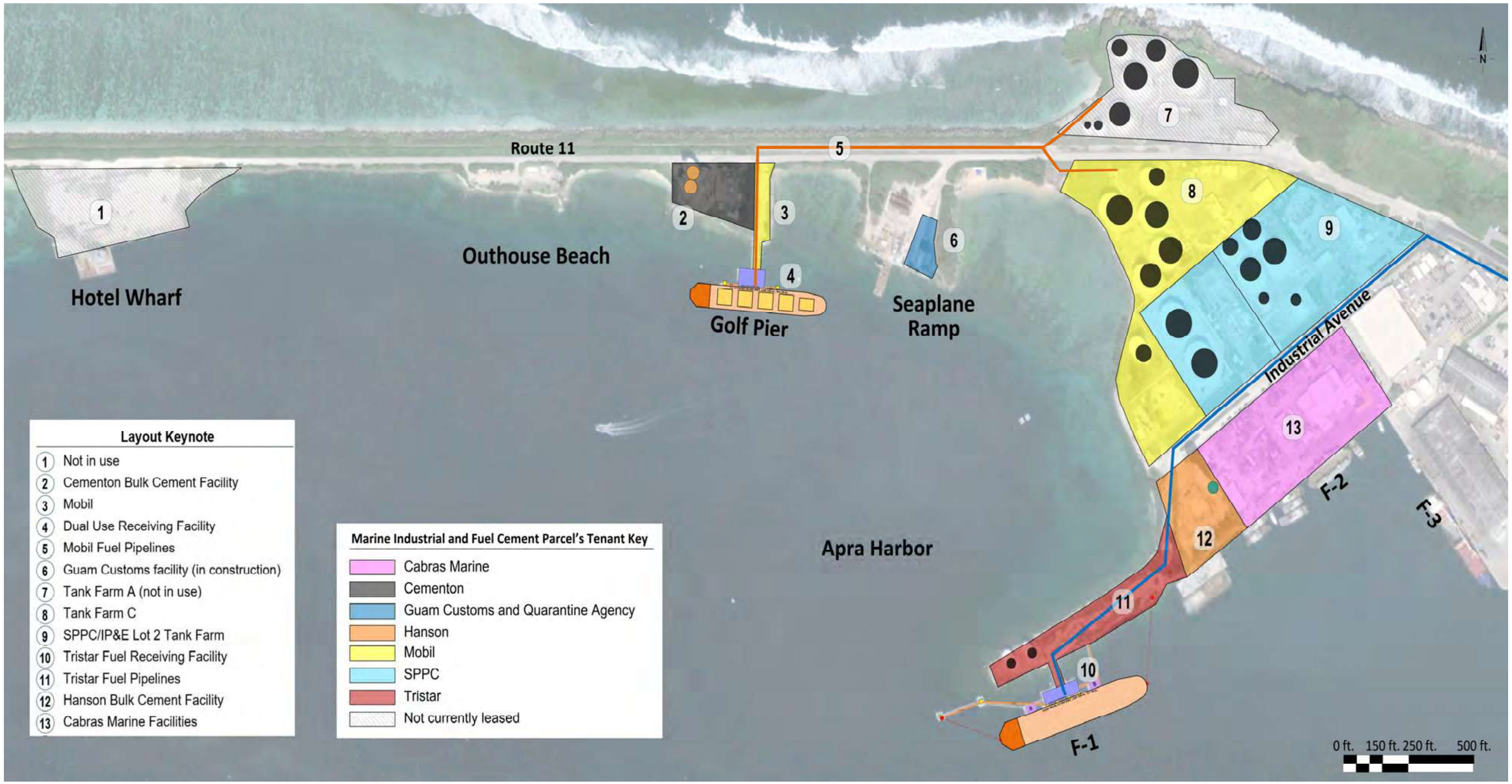
Included in this Master Plan and shown in Figure ES-4 is a land use plan. The land uses in this plan provide the ability for PAG to develop and/or to engage PPP arrangements to develop and operate port related uses on under-utilized port property. Value added facilities that complement the Governor's transshipment initiative and the port's sustainability strategy can be accommodated on these identified parcels.

Figure ES- 4: Land Use Designations



Source: Google Earth and WSP Analysis of PAG Data

Figure ES- 5: Marine Industrial Complex and Fuel/Cement Facilities



Source: Google Earth and WSP Analysis of PAG Data

MARKET ANALYSIS & CARGO DEMAND

The relationship between the Guam economy and historical port cargo throughput provides the basis for forecasting future cargo volumes. Market factors include economic trends that affect cargo throughput such as Guam's population and economic growth, as well as a forward look at expected development in the coming years. The factors informed an analysis of historical cargo throughput at the PAG to forecast port volumes by cargo type.

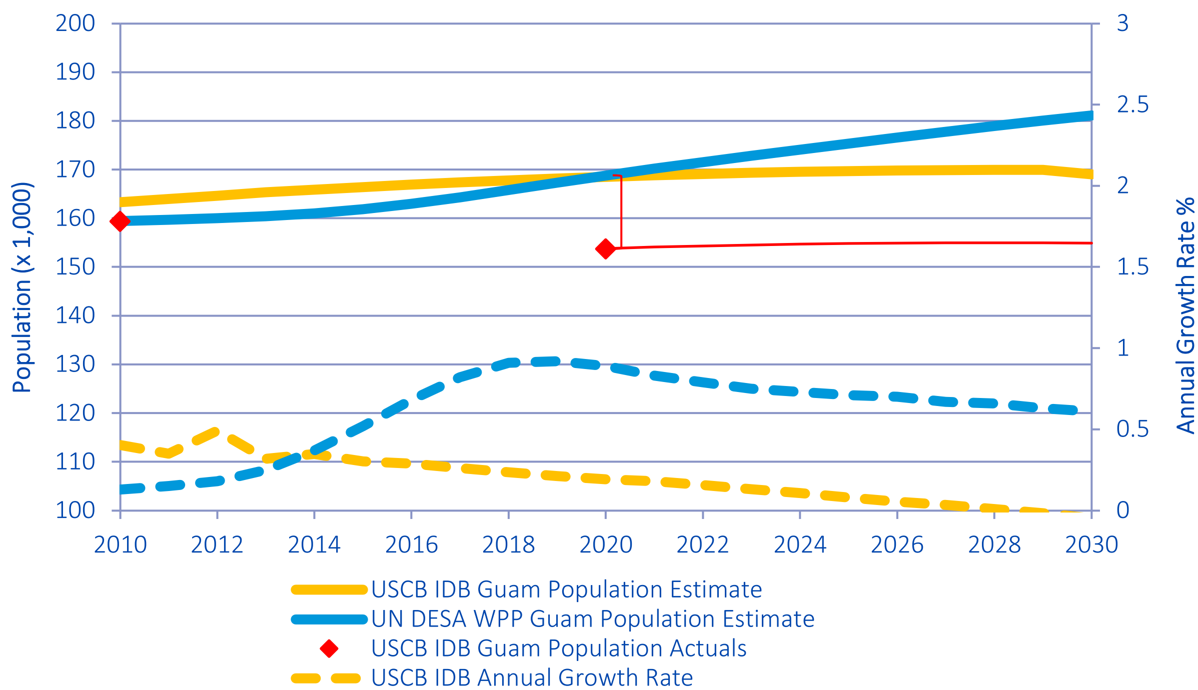
Following several decades of double-digit growth, Guam's population growth slowed to 2.9% between 2000 and the 2010 according to the U.S. Census Bureau (USCB). During the 2020 decennial census (years 2010 through 2020), the USCB reported that Guam's population decreased by 3.5% during the decade to a figure slightly below 2000 levels - an unexpected result given that USCB and the United Nations Department of Economic and Social Affairs (UN DESA) had previously estimated moderate growth during the decade. There is a similar but inverted difference between the two forecasts to 2030. A summary of Guam's population over the past 50 years is provided in Table ES- 3.

Table ES- 3: Guam's Historical Population

Year	1970	1980	1990	2000	2010	2020
Guam Population	84,996	105,979	133,152	154,805	159,358	153,836
% Growth from Previous Census	26.8%	24.7%	25.6%	16.3%	2.9%	-3.5%

Source: U.S. Census Bureau, 2020

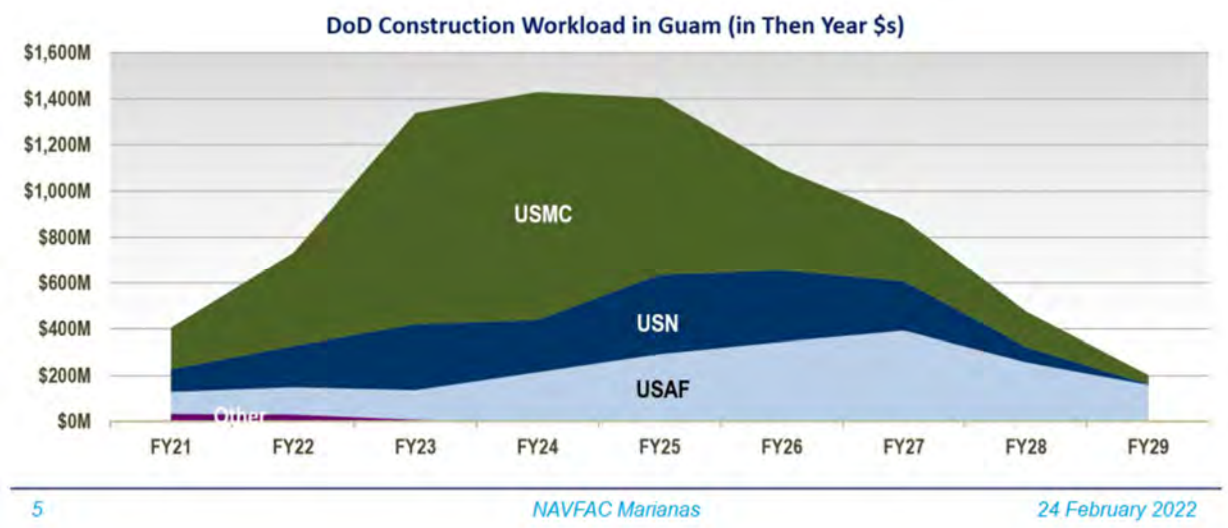
Figure ES- 6: Guam's Estimated and Projected Population and Growth Rates



Source: U.S. Census Bureau IDB; UN DESA Population Division WPP

Approximately 30% of total current cargo moving through the Port is military related. During the peak of the military build-up between FY 2022 and FY 2029, the additional imported military equipment, supplies, and construction related materials are expected to nearly double the Port's military cargo volumes for the Marine Corp, Navy and Air Force construction projects. See Figure ES- 7.

Figure ES- 7: U.S. Marine Corps Build-up Construction Spending Profile, FY 2021-FY2029



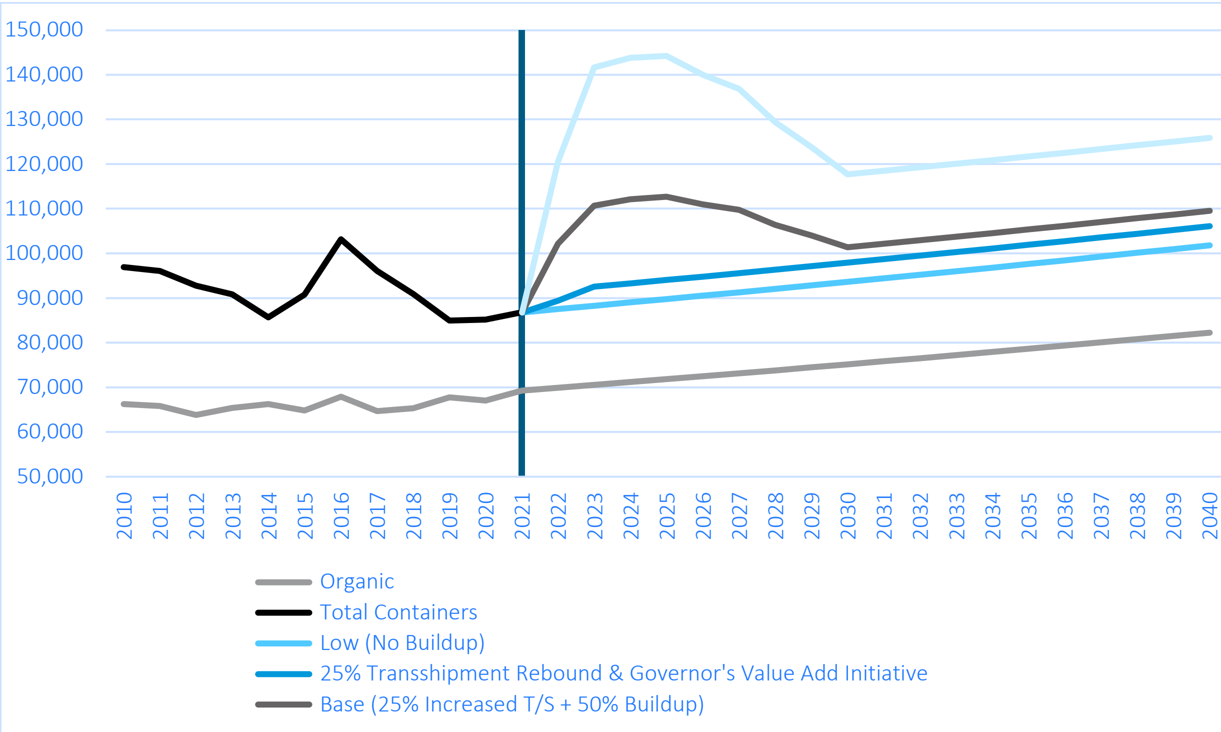
Source: NAVFAC Marianas

The growth of Guam's economy has been, and is expected to continue to be, driven by a combination of the needs of a growing population and military presence, continued expansion and diversification in the tourism industry, and private and public investment in construction projects for the civilian and defense sectors.

Forecasts of expected volumes of containerized, breakbulk and petroleum cargos to be shipped through the Port over the next 20 years are used as the foundation for this update to the Master Plan. Forecasting involves benchmarking against historical trends and performing sensitivity analyses looking forward.

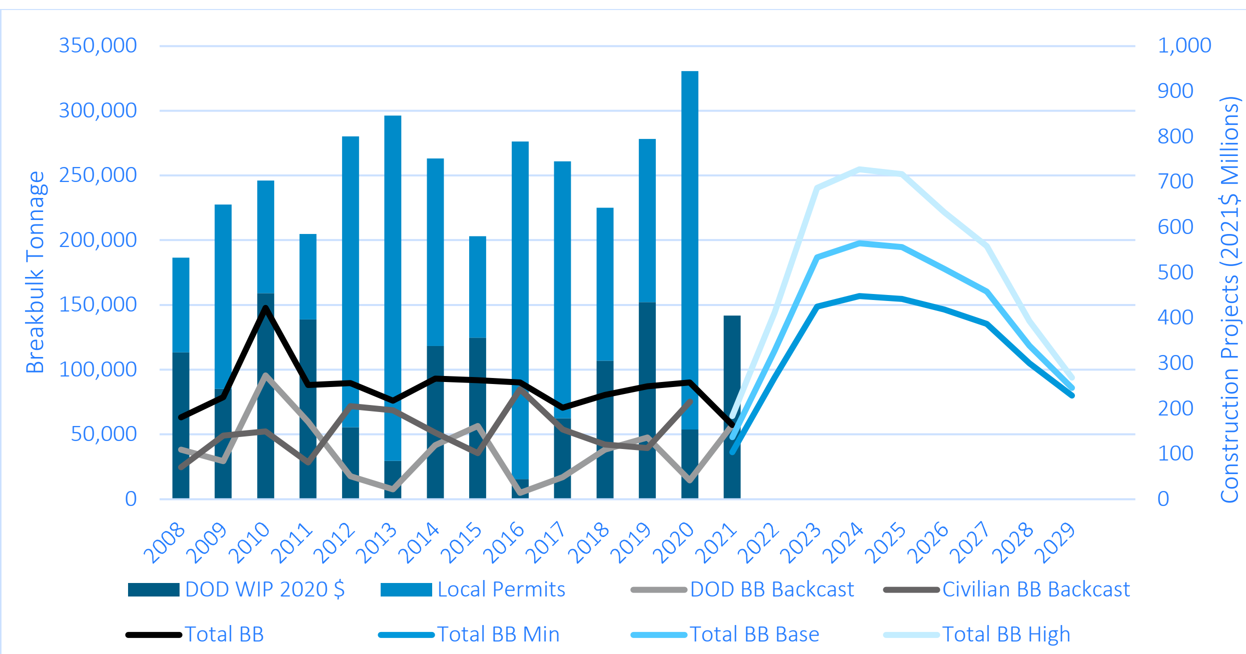
The cargo volumes were forecast based on sustained increases under the Organic Growth Scenario for the anticipated population on Guam and the Micronesian region and supporting three separate scenarios (Organic, Mid Build-up, and Full Build-up) for the proposed military realignment and expansion program on Guam. See Figure ES- 8 through Figure ES- 12 for container, breakbulk, liquid bulk, RO/RO, and cement forecasts.

Figure ES- 8: Container Forecast – Comparison of Growth Scenarios



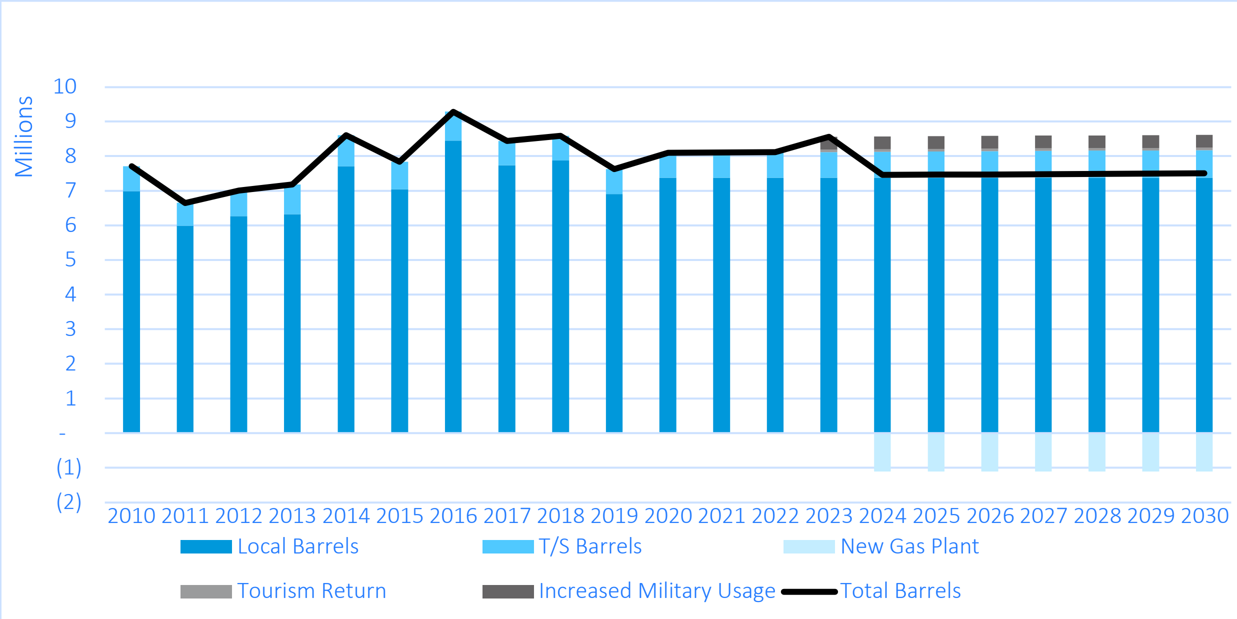
Source: WSP analysis

Figure ES- 9: Breakbulk History and Forecast



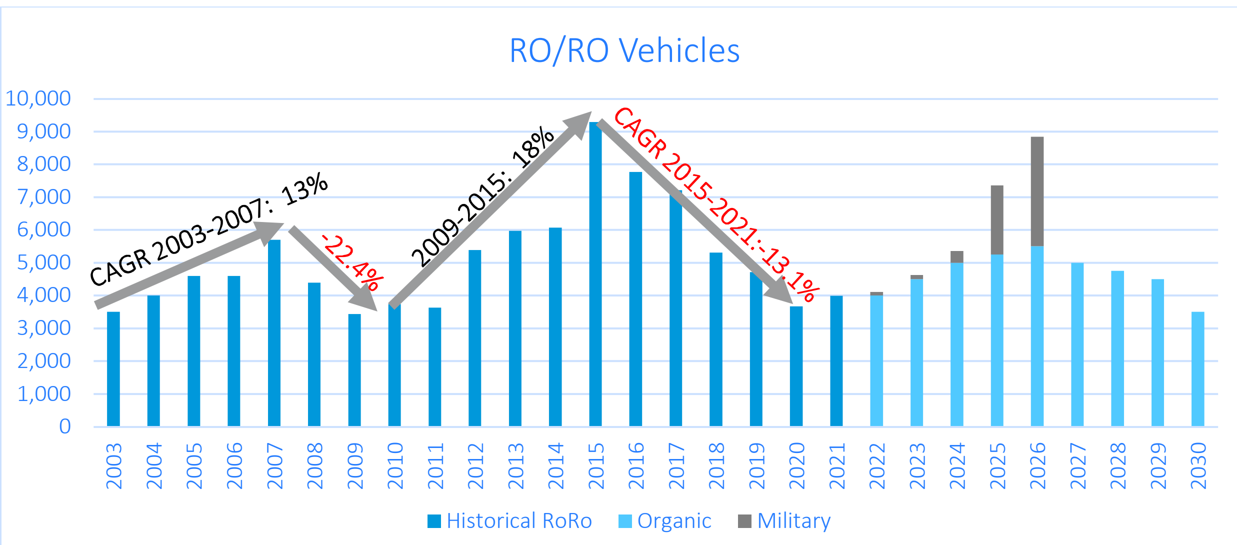
Source: WSP analysis

Figure ES- 10: Liquid Bulk History and Forecast (Barrels)



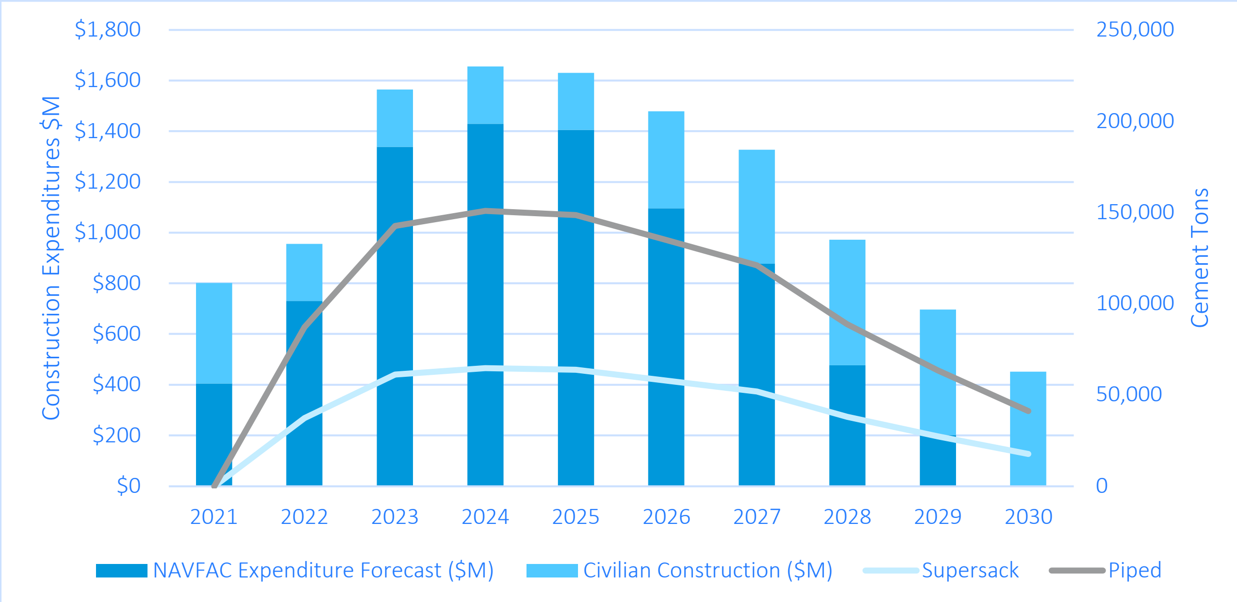
Source: WSP analysis

Figure ES- 11: RO/RO Vehicle Forecast



Source: WSP analysis

Figure ES- 12: Cement Forecast



Source: WSP analysis

CAPACITY & DEMAND

Using the forecasted cargo volumes, a capacity vs. demand analysis was performed for the PAG commercial cargo terminals. To perform this comparison, a capacity analysis was performed using WSP's proprietary Port Rail Intermodal Modeling Environment (PRIME) tool.

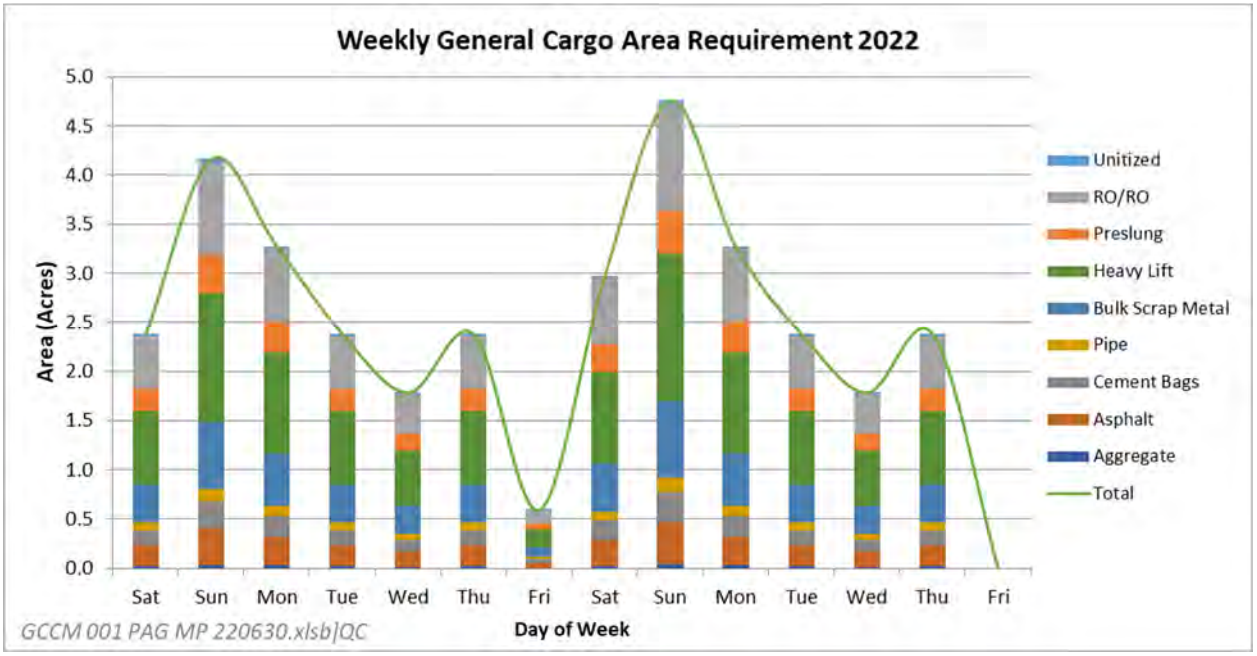
WSP collected operational data for cargo moving in and out of the commercial port. This data was used to perform a vessel movement analysis, container movement analysis and gate movement analysis to identify key inputs into the throughput analysis. Throughput capacity was estimated for the existing container and general cargo facilities. See Table ES- 4.

Table ES- 4: PAG Existing Container Throughput Capacity

Throughput Type	TEU/Yr	Container/Yr
Berth Throughput Capacity	341,000	192,000
Yard Throughput Capacity	225,000	126,000

Source: WSP analysis

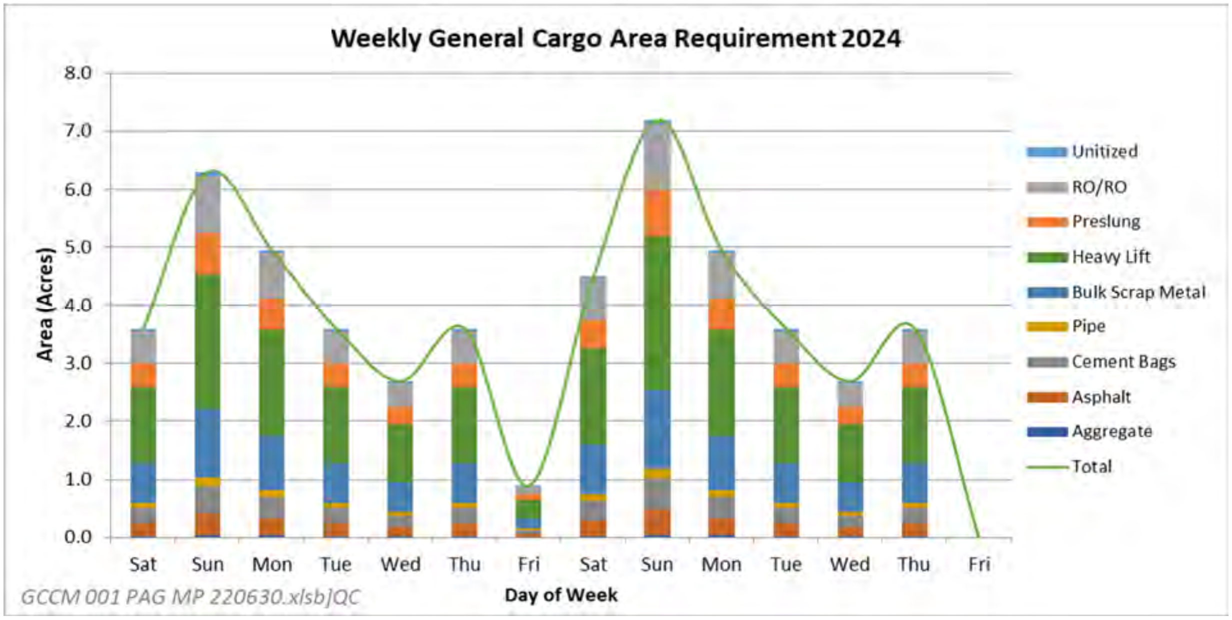
Figure ES- 13: Current General Cargo Storage Requirement



Source: WSP analysis

The Port's cargo facilities are limited to 126,000 containers/yr under the current conditions and operations. This assumes that the required 5 acres of general cargo storage area is maintained in the terminal. General cargo will peak in 2024 at about 251,000 tons. See Figure ES- 14. Approximately 7.2 acres of storage area will be needed during this year. The current 5-acre general cargo storage area will not be sufficient to handle this projected demand. A densified container storage yard with a higher amount of grounded containers will enable to port to accommodate this peak.

Figure ES- 14: General Cargo Storage Requirements - 2024

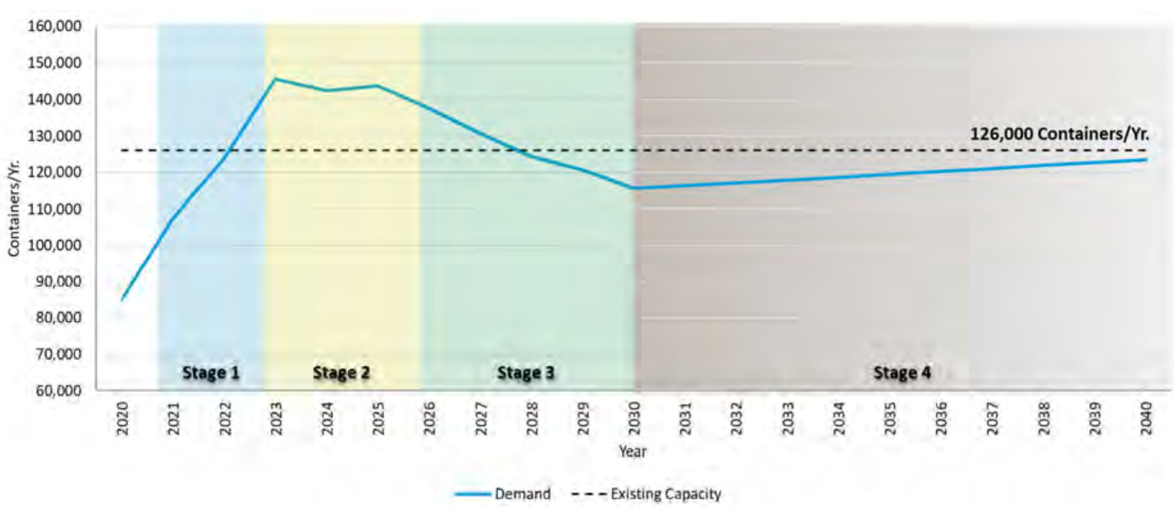


Source: WSP analysis

In 2029, general cargo volume will return to pre-buildup numbers at about 94,000 tons and approximately 4-acres of storage area will be needed that year. The current general cargo storage area will be sufficient to handle this projected demand.

Existing container throughput capacity vs demand for the high growth scenario will exceed capacity around 2023. The container cargo demand is estimated to stay above 140,000 containers per year until 2026, before it starts to normalize to organic growth through 2030. See Figure ES- 15.

Figure ES- 15: PAG Existing Container Capacity vs High Demand



Source: WSP analysis

During peak years when the port's container cargo volume exceeds the 126,000 container/yr capacity, a greater quantity of containers will be grounded in the storage yard to accommodate the excess volumes and provide more area for general cargo. This operational change will require additional equipment but will not require additional infrastructure. The port's recently completed modernization plan resulted in the highest level of efficient capital investment in the container yard and will accommodate the forecasted peak container and general cargo volumes. Therefore, this Master Plan is focused on implementing a Port Improvement Program (PIP) that builds off the successful completion of the Port Modernization Plan (PMP) included in the last Master Plan.

PORT IMPROVEMENT PROGRAM (PIP)

A comparison of the market demand forecast to the throughput capacity estimates verified that the PAGs past PMP has successfully expanded the port's infrastructure to accommodate the anticipated military build-up and long-range cargo growth. The analysis also identify additional equipment needs required to accommodate the future cargo demands. Facility condition assessments were performed and have identified infrastructure and equipment maintenance and replacement needs that comprise the primary recommendations of this Master Plan.

The PIP is a summary of the Master Plan recommendations which are focused on hardening port infrastructure to ensure resiliency, reliability, and supply chain sustainability for all Port users, the DOD mission on Guam, and the local community. The PIP includes a Port Readiness Plan (PRP) comprised of Capital Improvement Projects (CIPs) for maintaining existing facilities and a Port Readiness Projects (PRPs) for hardening the port's existing facilities and equipment. The Sustainability Plan includes projects that enable the port to sustain the current level of operations.

Figure ES- 16: PAG Capital Improvement Project Locations

Source: Google Earth and WSP

Figure ES- 17: PAG Port Readiness Project Locations

Source: Google Earth and WSP

Figure ES- 18: PAG Sustainability Project Locations

Source: Google Earth and WSP

FINANCIAL

The PAG's total FY 21 operating revenue was $55 million, a modest increase compared to FY 2020 and on par with pre-COVID income in FY2019.

Table ES- 5: PAG Operating Revenues and Expenses (2017 – 2021)

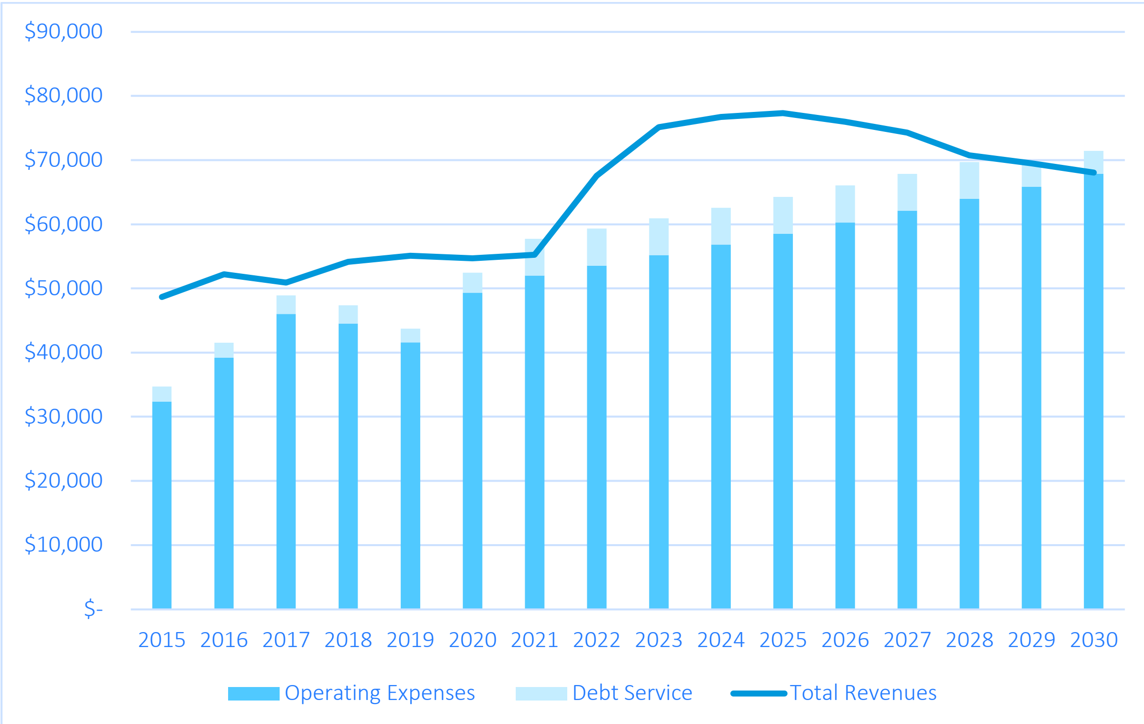
Operating Revenue Category	FY 2017 ($000s)	FY 2018 ($000s)	FY 2019 ($000s)	FY 2020 ($000s)	FY 2021 ($000s)
Total Operating Revenues	**$50,894**	**$54,168**	**$55,092**	**$54,686**	**$55,254**
Change from Prior Year	*-2.5%*	*6.4%*	*1.7%*	*-0.7%*	*1.0%*
Total Operating Expenses	**$46,047**	**$44,534**	**$41,588**	**$49,330**	**$52,007**
Change from Prior Year	*17.5%*	*-3.3%*	*-6.6%*	*18.6%*	*5.4%*

Source: WSP Analysis of PAG Data

The PAG's operating expenses include the cost of operating and maintaining Port facilities and equipment, providing cargo services to shippers and managing and administering the Port's business. Cash operating expenditures (excluding depreciation and other non-cash items) in FY 2021 were approximately $52 million.

Historical and projected revenues, operating expenditures, and debt service comprise the Port's Cash Flows. See Figure ES- 19. The revenue projection assumes the Base Case throughput forecast, with the military buildup growing cargo throughput substantially in 2022-2024 before tapering. Operating expenses are assumed to grow 3% per year. No tariff increase is included in this projection.

Figure ES- 19: Historical and Projected Revenues and Expenditures ($000s)



Source: WSP analysis of PAG data

The PIP provided in Section 7 of this Master Plan details the projects and timing of improvements in the coming years. Any costs not covered by awarded grants or the 2018 bond funds fall to PAG/to determine financing and/or funding. It is expected that future grants and loans may cover portions of these costs to complement the use of the PAG's operating revenues.

Table ES- 6: Capital Plan 2022 – 2032 ($000,000s)

PIP ITEM	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	TOTAL
CIP	$2.6	$7.3	$35.2	$49.9	$9.8	$69.4	$9.4	$8.0	$0.0	$0.0	$0.0	**$191.6**
PRP	$0.0	$0.0	$23.5	$56.3	$64.8	$44.5	$40.0	$45.5	$184.5	$15.0	$15.0	**$489.1**
SUST	$2.4	$4.6	$4.1	$0.4	$0.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$11.9**
TOTAL	**$5.0**	**$11.9**	**$62.8**	**$106.6**	**$75.0**	**$113.9**	**$49.4**	**$53.5**	**$184.5**	**$15.0**	**$15.0**	

Source: WSP analysis of PAG data

The investment schedule shown in Table ES-6 represents the entire PIP. These improvements to PAG's infrastructure, equipment and operations will increase the already essential economic value the port provides to Guam and other West Pacific islands.

The primary economic impact of the PIP is to the construction industry. The Master Plan projects largely focus on ensuring the Port is in a state of good repair for the long term. In other words, the Master Plan projects will not increase port throughput, though certain projects, notably Hotel Wharf reconstruction will facilitate both improved efficiency and the ability to handle military deployments. Therefore, the economic impact focuses on job creation and activity generated by capital expenditures. A summary of the projected direct and indirect jobs through 2032 as a result of the construction industry and military buildup is shown in Table ES-7.

Table ES- 7: Projected Direct and Indirect Jobs Through 2032

Total Jobs	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
Direct Jobs	28	52	296	464	301	611	213	265	1,036	84	84	3,435
Indirect/ Induced Jobs	10	19	105	165	107	217	76	94	369	30	30	1,222
Total Jobs	39	71	402	629	408	828	289	359	1,405	114	114	4,657

Source: WSP analysis of PAG data

As the PAG proceeds with the Governor's transshipment initiative and future resiliency initiatives, additional revenue generating land uses could increase the economic impact the port has on Guam.

1 INTRODUCTION

1.1 PURPOSE AND GOALS

The purpose of the 2023 Port of Guam Master Plan (Master Plan) is to assist the Port Authority of Guam (PAG) to define a near-term and long-term approach to modernize, maintain fiscally sustainable operations, and promote increased awareness and consensus of the plan among all affected stakeholders and the rate payers of Guam. Assets contained within the Master Plan and managed by the PAG include the Jose D. Leon Guerrero Commercial Port of Guam (Port), Marine Industrial Complex, public beaches, marinas, upland properties, submerged properties, and various buildings and equipment.

The goals of this Master Plan include:

- Provide a comprehensive overview of the Port's current conditions including governance, financial, operational, and physical attributes;
- Assess the current and projected cargo opportunities based on Guam's market drivers, which consist of military realignments, tourism, transshipment and organic growth;
- Determine near-term improvements and operational adjustments to accommodate the peak of the military build-up cargo and future deployments of military assets;
- Estimate the Port's capacity and ability to meet the projected demand and tenant requirements;
- Identify long-term modernization efforts targeted towards continuing operational and economic sustainability;
- Establish optimal requirements for operations, maintenance and repair, and capital improvement budgets;
- Validate the efficient and effective use of the Port's resources and assets;
- Present commercial strategies for PAG to diversify revenue base and enhance its financial self-sufficiency including a comprehensive tariff assessment and its economic impact thereof;
- Assess the impact of the recommended strategies on Guam's economic conditions; and
- Prepare an implementation program to support a coordinated approach of continuous Port improvement balanced with sustainability.

The Master Plan involves four elements of validation, review and coordination:

5. Analyze and update, as appropriate, the assumptions and criteria that underlie the previous Master Plan Update 2013 Report;
6. Validate and integrate key elements of the following reports that were developed since the previous Master Plan was released.
    - Master Plan Approval Documents
    - Cargo Forecast Updates
    - Terminal Development and Operations Plans

   - Terminal Operating System and Gate Operating System Reports
   - The 2016 PUC Tariff Report
   - The 2018 Consulting Engineer's Report in support of the CIP Revenue Bond issuance
7. Expand the scope of the Master Plan to include an implementation strategy based on restructured facilities, updated cargo and revenue projections, planned staffing adjustments, and a coordinated funding approach involving a potential combination of grants, bonds and self-financing; and
8. Validate and incorporate decisions and outcomes of various initiatives and policy changes that have occurred over the past nine years that include the following:
   - The Military Buildup Program and schedule has been delayed and resized
   - The Port responded to the PUC in 2016 by issuing a new 5-Year Tariff, which will be reviewed and updated as appropriate
   - A simplified tariff structure is being developed to facilitate more efficient electronic Terminal Operating System (TOS) data interfacing and invoicing with stakeholders
   - TOS improvements are being incorporated to improve operational efficiencies, data accuracy, and facilitate electronic data sharing
   - A new Performance Maintenance Contractor (PMC) contract has been issued to improve equipment maintenance
   - A new Information Technology Consulting Firm (ITCF) contract is being issued to augment port TOS/IT development and improve terminal operations and improve security
   - The Port is developing a more structured Maintenance Program for Facilities and Equipment
   - The Port is planning on procuring three new STS container cranes to replace older equipment and to increase operating efficiencies
   - The MARAD funded H-Wharf upgrade program is commencing
   - The Revenue Bond Projects are moving ahead and will become part of the Port's infrastructure over the next three years
   - Guam Customs is developing a new inspection facility adjacent to the terminal gate which will be integrated with the cargo operations

The original Scope of Work for the execution of this Master Plan Update is presented in Appendix A.

1.2 BACKGROUND

As the only commercial port on the island of Guam, Guam's citizens depend on the Port to provide import and transshipment of essential goods, most notably food products, building materials, and fuel. In addition, the U.S. military relies on the Port to handle nearly all the military cargo and equipment moving in and out of Guam. Currently, more than 90 percent of the total volume of goods and supplies needed to support activities on Guam flows through the Port.

Since its construction in 1969, the Port had remained largely unchanged until 2008. Initiated by the 2007 Master Plan, the PAG began to modernize its facilities to address the forecasted increase in cargo to support anticipated military growth in Guam and throughout the Micronesian region.

The 2007 Master Plan was focused on a U.S. Department of Defense (DOD) realignment of a full Marine Corp Brigade from Okinawa, Japan to Guam (the “military build-up”), which was subsequently delayed, reevaluated, and reduced in scope. The current military build-up is expected to occur over a 9-year period, during which approximately 5,000 Marines and 1,300 dependents are to be relocated to Guam, with an expected peak of about 10,000 additional military and temporary construction personnel in 2024/2025. Refer to Section 5 for further details.

In response to changes in the military build-up, the PAG set its focus on updating its master plan in late 2012, focusing on phasing of Port improvements, budget allocation, and investment priorities. The *2013 Master Plan* included strategic recommendations, a high-level implementation plan, a financial feasibility assessment, and an economic impact assessment, from which the following were specifically recommended.

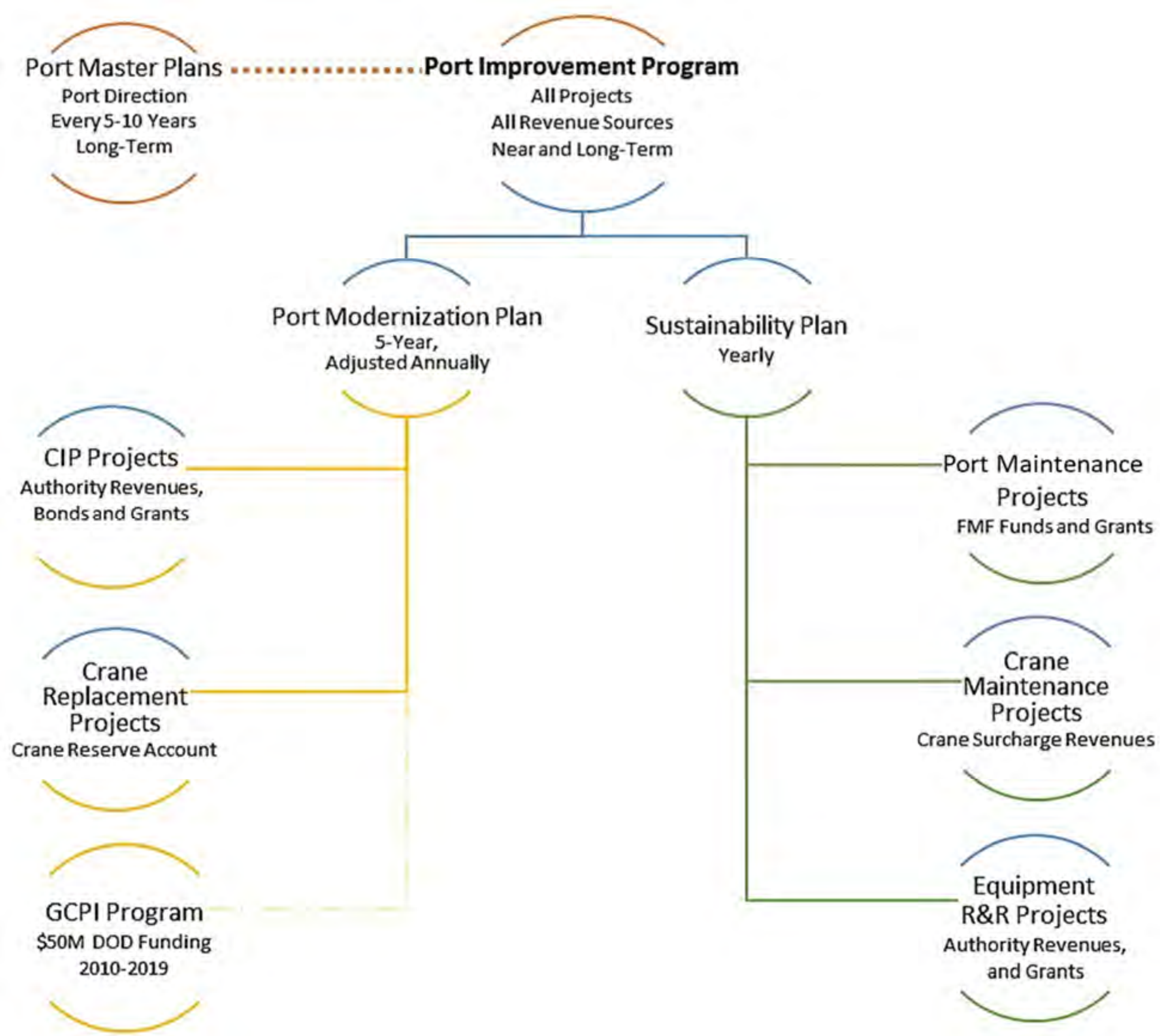
- 5-year near-term improvements to increase Port efficiency and create additional cargo handling capacity to accommodate the future military build-up;
- 20-year long-term focus on additional improvements targeted towards continuing operational and financial sustainability in an organic growth scenario;
- Increased financial self-sufficiency through tariff adjustments to enhance Port opportunities, while continuing to receive complementary or partnering federal assistance (e.g. grants with matching requirements); and
- Issue revenue bonds to take advantage of low-cost financing and compatible alignment of debt service and tariff generated revenues.

Based on the *2013 Master Plan*, the PAG implemented a formalized Port Improvement Program (PIP), which designated projects into the following two categories:

1) Port Modernization Plan: 5-year Capital Improvement Plan (CIP) projects; crane replacement projects funded from the Crane Reserve Account (the “CR Account”); and the Guam Commercial Port Improvement (GCPI) Program projects.
2) Sustainability Plan: Port maintenance projects primarily funded with the Facility Maintenance Fee (FMF) revenues; crane maintenance projects funded from the crane surcharge revenues; and equipment replacement and renewal (R&R) projects.

The structure and relationship of the PAG’s 2013 PIP elements and related plans and projects are depicted in Figure 1-1.

Figure 1-1 : The PAG's Improvement Program and Plans



Source: The PAG and WSP

The DOD provided $50 million to PAG in 2010 to implement the GCPI Program. The program was significantly funded by the DoD to increase Port efficiency and create additional cargo handling areas to accommodate the military build-up, as recommended in the 2007 and 2013 Master Plans. In addition to the $50 million, the Port funded through federal grants and Port revenues approximately $18 million of the modernization projects. With the completion of the GCPI Program projects, the Port's cargo handling facilities have surplus capacity to accommodate the forecasted cargo from an increasing population and tourism industry as well as the military build-up.

1.3 STAKEHOLDER OUTREACH AND DATA COLLECTION

Numerous outreach meetings and interviews provided a means for the project team to engage stakeholders to understand their concerns, perspectives and to obtain data critical to updating the Master Plan. Over the past three years, the project team interviewed and met with numerous individuals, Port tenants, and Port stakeholders. See Table 1-1 and Table 1-2.

Table 1-1: 2020 Stakeholder and Data Collection Meetings

Stakeholder	2020 Meeting Date(s)
Ambyth	Aug. 20
APL	Aug. 13
Cabras Marine / Seabridge	Aug. 20
Commercial	Nov. 5
CTSI / MEL Lines	Aug. 21
Engineering	Sept. 1, Oct. 13
Finance	Sept. 3, Oct. 30, Nov. 5
Guam Contractors Association	Aug. 28
Guam Customs	Aug. 14, Nov. 5, Nov. 19, Dec. 3, Dec. 10
Guam Department of Agriculture	Sept. 9
Guam Economic Development Authority	Sept. 23
Guam Fishermen's Cooperative Assoc.	Aug. 25
Guam Industrial Services dba Guam Shipyard	Sept. 4
Guam Military Buildup Office	Aug. 13
Guam Power Authority	Sept. 1, Dec. 11
Guam Visitors Bureau	Sept. 22
Harbor Master and Port Pilot	Sept. 3
IPE/Shell	Aug. 20
IT	Aug. 31, Nov. 5
Joint Region Marianas (Navy) (USAF)	Aug. 18
Legislative Oversight Chair	Sept. 10
Maintenance	Sept. 1, Sept. 9
Matson	Aug. 18
Mayor's Council - Piti Mayor	Aug. 13
Mobil	Sept. 15
MSA	Aug. 20

Stakeholder	2020 Meeting Date(s)
NAVFAC Marianas	Aug. 14
Norton Lilly	Sept. 11
Office of Economic Adjustment	Jul. 28
Office of Governor/Lt. Governor	Jul. 28, Oct. 19
Operations	Sept. 2, Oct. 27, Dec. 24
Planning	Sept. 4
Police	Aug. 31
Port Board of Directors (3)	Sept. 10-11
Procurement	Sept. 2
South Pacific Petroleum Corporation	Aug. 18
Tidewater Distributors, Inc.	Aug. 21
Tristar Terminals	Aug. 12
U.S. Coast Guard	Aug. 14
U.S. Customs & Border Protection	Sept. 11
USDA, APHIS, PPQ	Sept. 17

Source: WSP and the PAG

Table 1-2: 2021 Stakeholder and Data Collection Meetings

Stakeholder	2021 Meeting Date(s)
APL	Aug. 3
Black Construction	May 27
Cabras Marine / Seabridge	Aug. 3
Commercial	Aug. 2
Engineering	Aug. 4
Environmental, Health and Safety	Aug. 3
Finance	Aug. 3
Guam Bureau of Statistics & Plans	Aug. 3
Guam Economic Development Authority	Aug. 2
Guam International Airport Authority	Jan. 14
Guam Power Authority	Oct. 8
Harbor Master and Port Pilot	Aug. 4
IPE/Shell	Aug. 2
IT	Aug. 4
Maintenance	Aug. 4

Stakeholder	2021 Meeting Date(s)
Matson	Jan. 14, Aug. 3
Mobil	Aug. 2
NAVFAC Marianas	Mar. 5, Apr. 28, Aug. 3
Office of Governor/Lt. Governor	Aug. 5, Dec. 3
Office of Local Defense Community Cooperation	Aug. 5, Dec. 3
Operations	Aug. 2
Planning	Aug. 3
Police	Aug. 4
Port Board of Directors (3)	Dec. 23
Port Users Group Guam (PUGG)	Aug. 4
SDDC	Dec. 15
Smithbridge	May 27
Tristar Terminals	Aug. 2

Source: WSP and the PAG

In 2022, two site visits occurred; the first in February and the second in May. Prior to the site visits, the project team had weekly conference calls with PAG management and staff (terminal operations, planning, etc) and project stakeholders. The purpose of the visits was to update stakeholders and get feedback and confirmation of the initial master planning analyses and findings from PAG management. See Table 1-3 and Table 1-4.

Table 1-3: February 2022 Stakeholder and Data Collection Meetings

Meeting Topic	February 2022 Meeting Date(s)
Management In-Brief	Feb 21
EH&S Status	
IT Master Plan	
Tariff Simplification	Feb 22
Customs Container Facility Plans/Funding Status	
Capital Improvement Plan	
Land Use Plans	
Facility and Equipment Maintenance	
Master Plan Update	Feb 23
Military Buildup Update	

Meeting Topic	February 2022 Meeting Date(s)
Tourism Update	
Tariff Simplification	
Marianas and Harbor of Refuge	
IT Master Plan	
Fuel Pier Status	
Solar Power	
STS Gantry Crane Procurement	Feb 24
Fuel Pier Status	
Prelim Cement Cargo Forecast	
Cargo Forecasts	
Navigation/Dredging	
Office of Local Defense Briefing	Feb 25
Military Buildup Update	
Tariff Simplification	
IT Master Plan	
Military Buildup Update	

Source: WSP and the PAG

Table 1-4: May 2022 Stakeholder and Data Collection Meetings

Meeting Topic	May 2022 Meeting Date(s)
Solar Power	May 16
Engineering	
EH&S Status	
Continuous Improvement Plan	
Management In Brief	
Facility Maintenance	
Golf Pier	May 17
Hotel Wharf	
Land Use Map and Property Map	
Pier F1	
Master Plan	May 18
Military Readiness	
STS Gantry Program	
Cabras Marine	
Management Out-Brief	

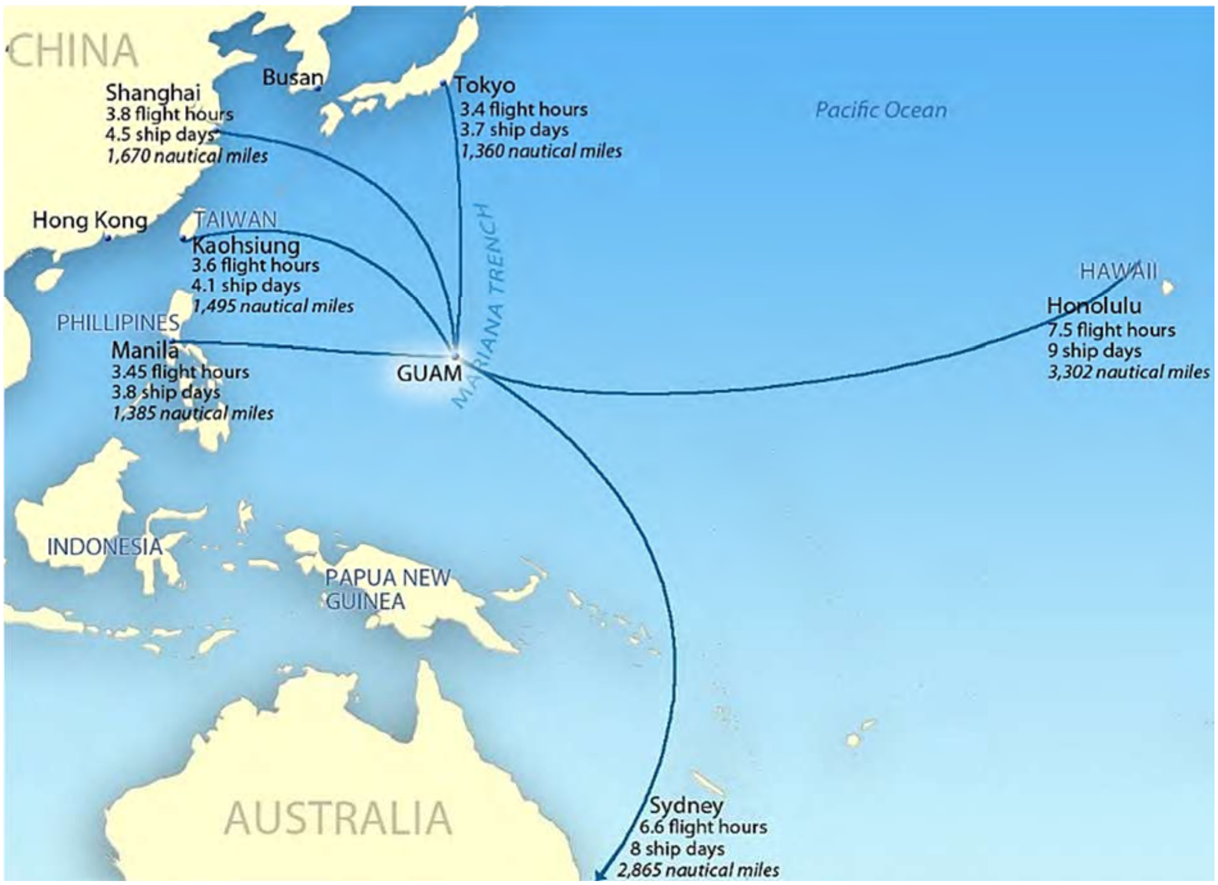
Meeting Topic	May 2022 Meeting Date(s)
Port Security	
TOS Discussions	May 19
Trans-Shipment Initiative	

Source: WSP and the PAG

2 GUAM

The island of Guam is in the western Pacific region and is the largest and southernmost island in the Marianas Archipelago. Guam is 32 miles long, varying from 4 to 12 miles wide, with a total land area of approximately 212 square miles. The island is located 3,300 nautical miles (nm) west-southwest of Hawaii; 2,865 nm north-northeast of Sydney, Australia; 1,495 nm south-southeast of Taiwan; 1,385 nm east of Manila, Philippines; and 1,360 nm south-southeast of Tokyo, Japan, as shown in Figure 2-1.

Figure 2-1: Location of the Island of Guam



Source: WSP

Guam links the expanding Far East and U.S. markets and the rest of the world with the Western Pacific islands; including the Commonwealth of the Northern Mariana Islands (CNMI) of Saipan, Tinian, Rota and other smaller islands; Republic of Palau; the Federated States of Micronesia (FSM) of Yap, Chuuk, Pohnpei and Kosrae; and the Republic of the Marshall Islands (RMI) including Majuro, Ebeye, and Kwajalein. Figure 2-2 depicts the locations of these islands in relation to Guam.

Cargo going to/from the Western Pacific region by water including the CNMI, Palau and FSM has long been moved through Guam by transshipment services. Having the largest cargo demand and population base in this region, Guam serves as a natural transshipment hub within the western Pacific region.

Figure 2-2: Western Pacific Region Islands

Source: WSP

2.1 HISTORY AND GOVERNANCE

Guam was ceded to the U.S. in 1898 under the Treaty of Paris and has remained under U.S. administration, except from 1941 to 1944 when Japanese forces occupied the island during World War II. In August 1944, U.S. forces recaptured Guam and reestablished a naval government. In 1950, the U.S. Congress passed the Organic Act of Guam granting the indigenous Chamorro people U.S. citizenship and establishing a civilian government.

Guam is an organized, unincorporated territory of the U.S. The organization and powers of the Government of Guam are determined by the Organic Act. Residents of Guam are not allowed to vote in U.S. presidential elections and their congressional representative is a non-voting member.

Guam's Government consists of three branches: executive, legislative and judicial. A governor elected at large every four years heads the executive branch. The unicameral Legislature consists of 15 senators elected at large every two years. The judiciary branch consists of the Superior Court of Guam, which is the court of general trial jurisdiction, and the Supreme Court of Guam, the court of highest appeal. Guam also has a Federal District Court and is within the jurisdiction of the Ninth Circuit U.S. Court of Appeals and the U.S. Supreme Court. Guam's one non-voting representative in the U.S. House of Representatives is elected at large every two years.

In some cases, U.S. federal laws do not apply to Guam. For example, U.S. import tariff laws do not apply, and Guam is a duty-free port. However, federal banking and transportation laws and regulations apply to Guam, with some exemptions, to address Guam's unique political, geographical, and social circumstances.

Although Guam receives no foreign aid, it does receive large transfer payments from the general revenues of the U.S. Treasury into which residents do not pay income or excise taxes. Under the provisions of a special law of Congress, the Guam Treasury, rather than the U.S. Treasury, receives the income taxes paid by Guam's residents, as well as federal income taxes paid by military and civilian Federal employees stationed in Guam.

2.2 MILITARY PRESENCE

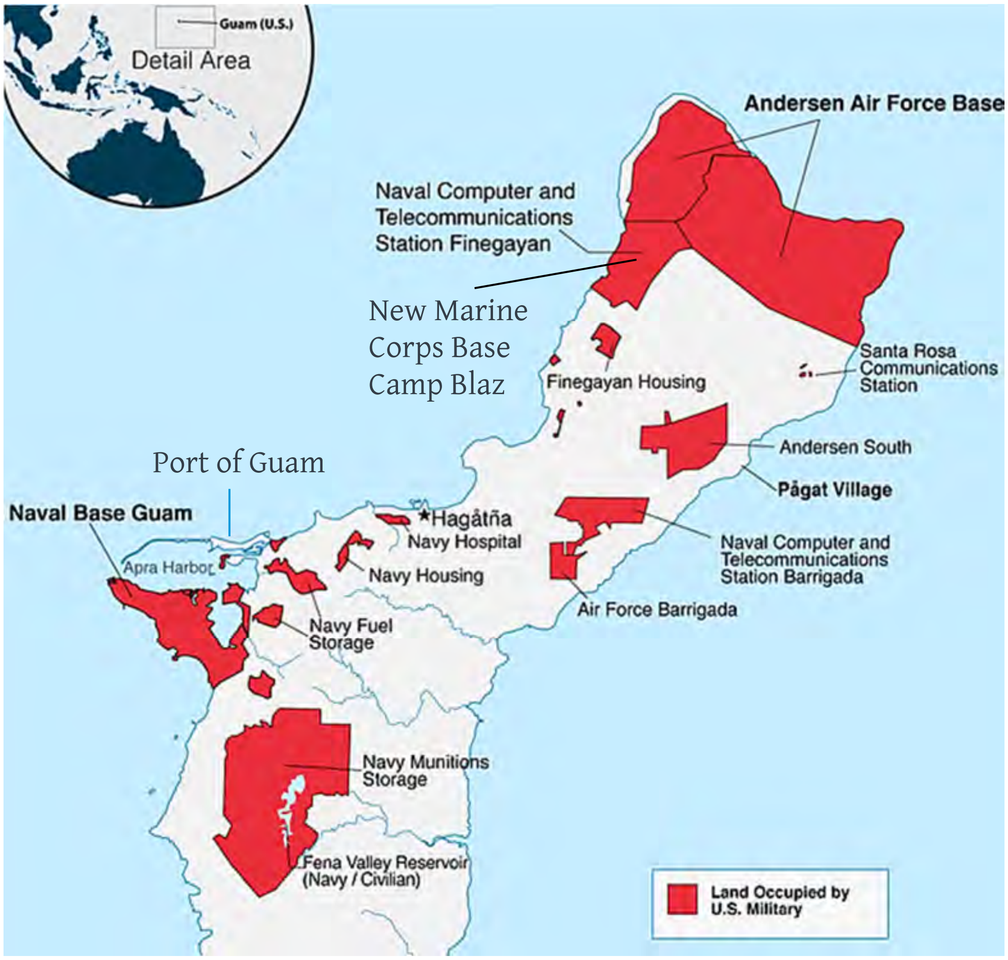
Guam has a large U.S. military presence, which includes U.S. Navy (Navy) and U.S. Air Force (Air Force) bases that occupy nearly 30 percent of Guam's land mass. These military installations are strategically significant U.S. bases in the Pacific.

The Joint Region Marianas, which includes Naval Base Guam, Andersen Air Force Base, and Marine Corps Base Camp Blaz (MCB-CB) shown in Figure 2-3, is home of Commander Naval Forces Marianas, Commander Submarine Squadron Fifteen (CSS-15), U.S. Coast Guard (USCG) Sector Guam, Naval Computer and Telecommunications Station Guam (NCTS) Guam and Naval Special Warfare Unit One. Marine Corps Base Camp Blaz was activated October 2020, becoming the first new Marine Corps facility on island since 1952. The MCB-CB will house Marines relocated from installations in Okinawa, Japan.

The Joint Region Marianas supports 28 other tenant commands and is the home base of three Los Angeles class submarines and dozens of units operating in support of U.S. Pacific Command, U.S. Pacific Fleet, 5th and 7th Fleet.

In the late 1980s, the military population including dependents exceeded 20,000 in Guam, representing approximately 18 percent of Guam's population. The military's presence decreased to range between 11,000 to 13,000 from 1998 to 2017, before increasing to its current level of approximately 21,700 active-duty personnel and their dependents, which represents approximately 14 percent of the resident population.

Figure 2-3: Map of U.S. Military Bases in Guam



Source: U.S. Navy, map designed by Johnny Harris, http://www.basenation.us/maps.html

Since 2006, the DOD has been planning to realign its military forces in the Asia-Pacific region, which involves the relocation of a sizeable contingent of marines to Guam primarily from facilities in Okinawa, Japan. The Guam and CNMI Military Relocation (per the 2012 Roadmap Adjustments) relocates approximately 5,000 marines and about 1,500 dependents from Okinawa, Japan and other locations to Guam by 2028. The first marines would move to the MCB-CB in Guam in 2025. The realignment, or military build-up on Guam, would result in an approximate 5 percent increase to Guam's current population of 169,000 (2022 est.).

3 PORT OF GUAM

Port assets include approximately 1,006 acres of upland, marine, and submerged properties within Apra Harbor. The submerged properties encompass approximately 556 acres and are comprised of both submerged and natural marine preserve lands. The upland and marine properties encompass approximately 450 acres and are comprised of cargo handling/break-bulk terminals, upland, cargo storage, general use wharves, fuel and cement import terminals, marinas, upland industrial and natural preserve land, general industrial land, open space, marinas, and water recreation areas. The PAG also owns and operates a marina in the southern municipality of Agat and the Gregorio D. Perez Marina in Guam's capital city Hagåtña. PAG properties are shown in yellow in Figure 3-1.

Sheltered within the inner reaches of the Outer Apra Harbor, the Port is Guam's only deepwater port and provides the people of Guam with ocean commerce, shipping, recreational and commercial boating as well as sea vessel navigation. It is also the 16th commercial strategic seaport in the U.S. having special consideration and the only commercial port on the island, offering facilities and services to ships of all registries. As the region's primary cargo handling facility, the Port offers four cargo handling berths, 26.5 acres of cargo storage, and repair, maintenance, and storage buildings.

Figure 3-1: Location of the PAG's Properties on Guam

Source: Bing Maps Imagery, Adapted by WSP

3.1 HISTORY AND GOVERNANCE

The island of Guam has served as a port of call since the 16th century, first catering to the ships of Spain and then, after the Spanish-American War, to American interests. Today, the Port performs a crucial and indispensable role in the lives of the civilian and military population of Guam, the military bases and neighboring islands in the region.

The PAG was established by Public Law (PL) 13-87, passed in 1975, as a legal public corporation and an autonomous agency of the Government. The PAG is mandated to provide for the needs of ocean commerce, shipping, recreational, and commercial/boating, as well as navigation of

Guam. The PAG is responsible for the development and/or operation of recreational boating facilities, public harbors, small boat marinas and other associated marine facilities in Guam.

The PAG's activities are administered by a Board of Directors (the "Authority Board") comprised of five non-salaried members, appointed for staggered three-year terms by the Governor of Guam ("the Governor") with the consent and advice of the Legislature of Guam ("the Legislature"). The Authority Board has decision-making authority over the PAG's management strategy, direction, development, construction, and operations, including the operating and financial budgets.

The Legislature approves the PAG's long-term leases (5+ years), approves and adopts the Port's master plans, authorizes the transfer of property under the jurisdiction of the PAG, and authorizes the issuance of Port debt through Public Law.

The PAG has no taxing powers. Its debts and operating costs are paid out of tariff charges, fees, and other revenues from its facilities. The PAG usually raises capital funds for construction projects by pledging its own credit through various debt instruments. Prior to the 2018 Bonds, the PAG's debt instruments were bank loans, which were retired upon the issuance of the 2018 Bonds.

In 2009, the PAG was placed under regulatory oversight of the Guam Public Utilities Commission (PUC) by PL 30-52. This law gave the PUC sole authority to approve the PAG's tariff adjustment petitions. The PUC's supervision is intended to support the PAG in effectively adjusting its tariffs to cover the cost of Port operations and to generate revenues for capital improvements.

The PUC is an independent regulatory commission created in 1984. It serves as a regulatory rate governing body for other Guam public service agencies including the Guam Waterworks Authority (GWA), Guam Power Authority (GPA) and Guam Solid Waste Authority (GSWA). The PUC is comprised of seven commissioners who serve staggered six-year terms. Each of the commissioners is appointed by the Governor and confirmed by the Legislature. In addition to supporting and approving the PAG's tariff adjustments, the PUC, as well as the Authority Board, approves the PAG's issuance of bonds such as the 2018 Bonds.

3.2 ORGANIZATION

The PAG Board's policy decisions are directed by a General Manager, Deputy General Managers and other PAG staff. The General Manager, under the general direction of the PAG Board, serves as Chief Executive Officer for the PAG. The General Manager has charge and control of the planning, organization, staffing, direction and coordination of the Port's operations and business affairs. The General Manager is hired and employed at the pleasure of the PAG's Board.

The Deputy General Manager of Operations and the Deputy General Manager of Administration and Finance are under the general supervision of the General Manager. In the absence of the General Manager, either of the Deputy General Managers serve as Acting General Manager. The positions are hired and employed under the terms and conditions fixed by and at the pleasure of the Authority Board.

The PAG has averaged 362 employees annually over the past five years and, as of July 2022, is staffed at approximately 381 full-time employees (not including Casual, Limited, and Vacant positions). The PAG is organized into four departments: Operations (Stevedoring, Terminal, and Transportation divisions); Maintenance (Equipment Maintenance and Facility Maintenance Divisions); Administration and Finance (Corporate, Finance, Information Technology, Human Resources, General Administration, Commercial, Marketing, and Procurement Supply Divisions); and Compliance and Control (Harbor Master, Occupational Health and Safety, Port Police, Strategic Planning, and Engineering Divisions).

3.3 PARTNERS AND TENANTS

The PAG maintains leases and agreements with more than 40 tenants within the Port's facilities as of June 2022. Many companies hold multiple leases for the use of separate Port facilities. The PAG also receives revenue from more than 140 tenants at its two public marinas. The PAG's total revenues in the past five years from leases has averaged approximately $3 million each year, or approximately 6 percent of total revenue. Table 3-1 includes details on the PAG's major tenants in 2022.

Table 3-1: Summary of the PAG's Major Tenants and Lease Statistics

Lessee	Operation/Facility	Area (sf)	Term of Lease (years)	Lease From/To	Years as Port tenant
[1]Tristar	Marine Industrial Complex, Dogleg Pipeline, GEDA Pumpline Easement, and Main Pipeline	349,955	3 – 5	From: 11/6/2006 To: Pending	11
	F1 Fingertip	78,651	3 – 5	From: 4/1/2014 To: 3/31/2019	3
[1]South Pacific Petroleum	Marine Industrial Complex, Lots 2 and 3A, Associated Pipeline	405,718	20	From: 11/30/2000 To: 10/31/2020	46
Mobil	Marine Industrial Complex, Lot 1	248,873	10	From: 3/20/2020 To: 3/20/2030	47
	Marine Industrial, Lot 3B	82,763	10	From: 3/4/2021 To: 3/4/2031	46
Cabras Marine	Marine Industrial Complex, Lot 5	223,898	10	From: 8/1/2011 To: 4/1/2030	28

Lessee	Operation/Facility	Area (sf)	Term of Lease (years)	Lease From/To	Years as Port tenant
IP&E	New-GEDA easement, F3 Bunker Pits	75,347	25	From: 5/20/2010 To: Pending	7
Hanson Permanente Cement	Marine Industrial Complex	71,874	10	From: 1/14/2021 To: 1/14/2031	46
Aqua World	Tour operator, Harbor of Refuge	65,430	1	From: 1/1/1985 To: present	33
Cementon	Golf Pier	49,290	30	From: 12/1/2009 To: 12/1/2039	8
Marianas Yacht Club	Parcel 1	43,055	TBD	TBD	
-	Hotel Wharf	20,000	Month-to-Month	From: 5/5/2017 To: 12/1/2017	<1
Subcom	Warehouse space, Bay 5/6	7,200	1	From: 1/1/2022 To: 12/31/2022	7
	Warehouse space, Bay 7/8	7,200	1	From: 1/1/2022 To: 12/31/2022	9
OSROCO	Oil Spill Response, Harbor of Refuge	4,000	1	From: 1/1/2022 To: 12/31/2022	
Atlantis Guam	Submarine Tour Facility, Harbor of Refuge	4,000	1	From: 1/1/2022 To: 12/31/2022	29
CTSI Logistics	Office space, Administration Building, Rms 108 and 109	557	1	From: 1/1/2022 To: 12/31/2022	8
	Truckers Lot	2,000	1	From: 1/1/2022 To: 12/31/2022	
Guam Dolphin Marine Sports Club	Water Sports, Family Beach	2,514	1	From: 1/1/2022 To: 12/31/2022	8
Brand Inc.	Hazardous Waste / Parcel 1	2,449	5	From: 9/24/2007 To: present	14
Kals Corp.	Restaurant / Agat Small Boat Marina	2,449	TBD	TBD	2
Charles Marine Sports Club	Family Beach	2,208	1	From: 1/1/2022 To: 12/31/2022	
Ride the Duck LLC	SeaPlane Ramp	2,152	1	From: 1/1/2022 To: 12/31/2022	

Lessee	Operation/Facility	Area (sf)	Term of Lease (years)	Lease From/To	Years as Port tenant
Micronesia Divers Association	Outhouse Beach	2,000	1	From: 7/1/2021 To: 7/1/2022	
V. Angoco	Truckers Parking	2,000	1	From: 1/1/2022 To: 12/31/2022	
Ambyth Shipping	Office space, Administration Building, Rm 205	1,204	1	From: 1/1/2022 To: 12/31/2022	22
	Truckers Lot	700	1	From: 1/1/2022 To: 12/31/2022	22
PSV Corp.	Family Beach / Route 11	1,820	1	From: 7/1/2021 To: 7/1/2022	
Apra Dive and Marine	Family Beach / Parcel 2	1,800	1	From: 10/1/2021 To: 9/30/2022	2
Gently Blue	Outhouse Beach	1,680	1	From: 1/1/2022 To: 12/31/2022	
Axe Murderer Tours	Family Beach / Route 11	1,350	1	From: 1/1/2022 To: 12/31/2022	
Guam Transport and Warehouse	Truckers Parking	1,000	1	From: 1/1/2022 To: 12/31/2022	
Isla Trucking	Truckers Parking	1,000	1	From: 1/1/2022 To: 12/31/2022	
J.L. Baker and Sons	Truckers Parking	1,000	1	From: 1/1/2022 To: 12/31/2022	
Tasi Tours	Harbor of Refuge	990	1	From: 1/1/2022 To: 12/31/2022	
Real World Diving	Family Beach / Dog Leg Pier	870	1	From: 1/1/2022 To: 12/31/2022	
Norton Lilly Int'l	Office space, Administration Building, Rm 115	800	1	From: 1/1/2022 To: 12/31/2022	1
Tropical Island Marine Sports	Adjacent to SeaPlane Ramp	800	1	From: 1/1/2022 To: 12/31/2022	
Paradise Aqua	Family Beach / Echo Pier	720	1	From: 1/1/2022 To: 12/31/2022	
DGX	Truckers Lot	700	1	From: 1/1/2022 To: 12/31/2022	

Lessee	Operation/Facility	Area (sf)	Term of Lease (years)	Lease From/To	Years as Port tenant
Guam Ocean Adventures	Family Beach / Parcel 3	680	1	From: 1/1/2022 To: 12/31/2022	
Unitek Env	Adjacent to Truckers Parking	600	Month-to-Month	From: 5/1/2009 To: present	13
Salt Shaker	Harbor of Refuge	458	1	From: 1/1/2022 To: 12/31/2022	
Churchill	Harbor of Refuge	450	1	From: 1/1/2022 To: 12/31/2022	
Guam Sungwoo Ferry	Harbor of Refuge	400	1	From: 1/1/2022 To: 12/31/2022	
Skoocumchuck	Harbor of Refuge	320	1	From: 1/1/2022 To: 12/31/2022	
Endeavour Inspection	Adjacent to Area A	320	1	From: 1/1/2022 To: 12/31/2022	
Teleguam Com	Admin Bldg	3 Ant	1	From: 1/1/2022 To: 12/31/2022	

Note 1: Leases for Tristar and South Pacific Petroleum are under negotiation
Source: The PAG

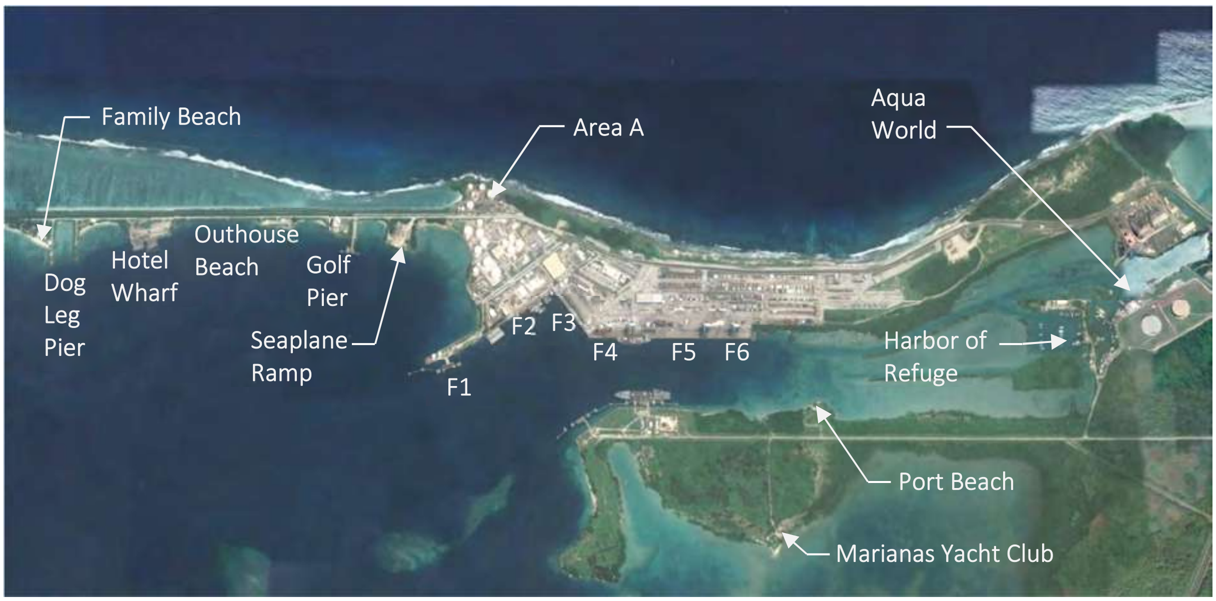
Considering tenants where total years as a PAG tenant is known, approximately 50 percent of the Port's major tenants have maintained leases with the PAG for a decade or longer. Guam law requires legislative approval for any lease agreements that exceed a five-year term. As of 2011, PUC approval is required for a lease agreement with the PAG in which the revenue of the total term exceeds $1 million.

The last long-term lease agreement approved by the Guam Legislature and Governor was Cementon Micronesia, LLC in 2010. In 2020 and 2021, PAG extended the option provisions for lease agreements with South Pacific Petroleum Corporation, Hanson Permanente Cement of Guam, Inc,. Mobil Oil, Tristar Agility, IP&E, and Cabras Marine Corporation. Negotiations are ongoing for land leases with Marianas Yacht Club and KALS Corporation.

4 PORT ASSETS AND RESOURCES

This section includes a summary of the PAG's landside and waterside infrastructure, upland facilities, marine facilities, equipment, Port Security operations, environmental health and safety programs, and IT initiatives. This information plays a fundamental role in development and execution of the Port Improvement Plan, further described in Section 7. For reference, Port assets and resources are located within Apra Harbor, along the southwestern shoreline, and in the capital city of Hagåtña. See Figure 4-1 and Figure 4-2.

Figure 4-1: PAG Assets



Source: Google Earth and WSP

Figure 4-2: Agat Small Boat Marina and Gregorio D. Perez Marina

Source: Google Earth and WSP

4.1 ACCESS

Apra Harbor is divided into an outer and inner harbor. The outer harbor is a natural lagoon enclosed by a submerged coral bank and a barrier reef enhanced with a breakwater. The Commercial Port facilities, Marine Industrial terminals, fuel and cement facilities, and various water recreation facilities are located on the south shoreline of Cabras Island within Outer Apra Harbor. See Figure 4-3.

Figure 4-3: Outer Apra Harbor

Source: Google Earth and WSP

4.1.1 WATERSIDE ACCESS

The main navigation channel, anchorages, the commercial port facilities, marinas, other marine industrial facilities and the Navy's Delta, Echo and Kilo wharves are located in Outer Apra Harbor. Other Navy facilities including the Navy Dry Docks are located within Inner Apra Harbor.

Additional detailed information on the navigational infrastructure around the Island of Guam and Apra Harbor are described in the following National Oceanic and Atmospheric Administration (NOAA) and British Admiralty nautical charts.

- NOAA 81048 Guam
- NOAA 81054 Apra Harbor
- British Admiralty 1109 Apra Harbor

Public Law 26-72 "Harbor Rules and Regulations of the Port Authority of Guam" governs Harbor use. Operations within Outer Apra Harbor are controlled by the PAG through the office of the Harbor Master. The Navy controls all operations in inner Apra Harbor, which is a restricted area.

4.1.1.1 Apra Harbor and Navigation

The main access channel in the Outer Apra Harbor is aligned at 83º (Figure 4-3) from the harbor channel entrance, which is 705 feet wide between Orote Island and Spanish Rocks. Inbound traffic has priority and access is restricted when winds exceed 35 knots. General harbor navigation statistics are provided below.

- Cargo and Vessel Traffic — Approximately 2 million tons of cargo and 530 vessels handled annually
- Maximum Vessel Size — 100,000 DWT
- Maximum Vessel Draft — 51.8 feet
- Pilotage — Compulsory for vessels over 500 GRT and available 24 hours per day

Once inside the harbor, vessels can access the Commercial Port facilities by traveling east through the Cabras Island Channel.

4.1.1.2 Safety Zones

In February 2015, the USCG revised the regulated navigation areas within and approaching Apra Harbor. A safety zone around Hotel Wharf was removed since the facility is not used for explosives cargo handling. Kilo Wharf, located near the entrance to the Harbor, is the DOD's only dedicated ammunition wharf in the Western Pacific Region. The 680-yard permanent safety zone associated with Kilo Wharf was expanded and re-designated as intermittent Safety Zones A and B, with explosive safe distance arcs of 1,000 and 1,400 yard radii respectively. The safety zones shown in Figure 4-4 provide a buffer between explosives regularly handled on Kilo Wharf and the general public and maritime operators. Traffic is still permitted to pass through these zones with the permission of the Captain of the Port (USCG). Six anchorage points are available in Guam as shown in Table 4-1.

Table 4-1: Anchorage Points in Outer Apra Harbor

Number	Latitude	Longitude	Depth (ft)	Notes
501	13°27.2'N	144°37.6'E	141	General anchorage
701	13°26.6'N	144°37.5'E	143	Military explosive anchorage
702	13°27.4'N	144°28.1'E	128	Military explosive anchorage
703	13°27.3'N	144°38.3'E	113	General anchorage
704	13°28.6'N	144°38.5'E	120	Navy anchorage

951	13°26.5'N	144°38.2'E	292	Navy anchorage

Source: Fairplay

Data for tugs available in the harbor from the service provider Cabras Marine are shown in Table 4-2.

Table 4-2: Cabras Marine Tugs

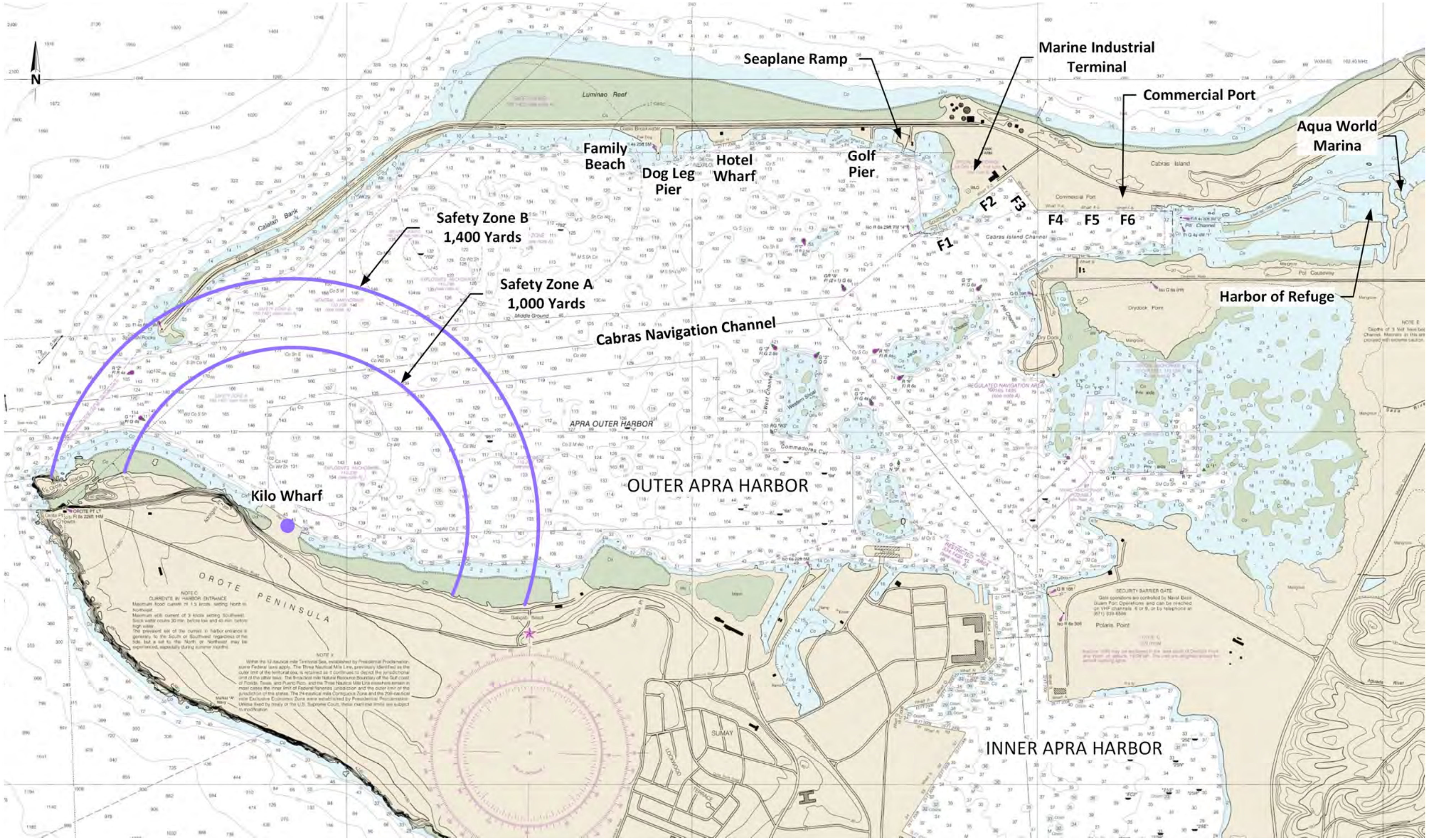
Name	Length (ft)	Breadth (ft)	Horsepower	Gross Tonnage
M.T. Agility	86.2	32.2	3,600	291
M.T. Chamorro	105	30		180
M.T. Endeavor	110		4,300	
M.T. Endurance	89.2	33.2	4,000	292
M.T. Goliath	96	31.2	3,600	264
M.T Hurao	89.2	33.2	4,000	292
M.T. Matua	86.2	32.2	3,600	291
M.T. Talofofo	106	30.2	3,750	295
M.T. Tamaraw	134.5	33.1		191
M.T. Quipuha	96	31.2	3,600	264

Source: Cabas Marine

According to the Harbor Master, two tugs are generally used for navigation of most vessels within the harbor and four tugs for aircraft carrier vessels.

PORT AUTHORITY OF GUAM

Figure 4-4: Apra Harbor NOAA Chart



Source: WSP modification of NOAA Chart 81054

wsp

4.1.1.3 Navigational Aids

The Federal aids to navigation are identified on the nautical charts described in Section 4.1.1.2. The USCG Cutter Sequoia, home-ported in Inner Apra Harbor, is the only vessel responsible for maintenance of navigational aids on Guam and throughout the Marianas Islands and Kwajalein Atoll in the Marshall Islands. Therefore, response times to correct damaged or extinguished navigation aids on Guam may be delayed due to other priorities. The USCG also maintains other navigational aids located at Agat Small Boat Marina, Gregorio D. Perez Marina, and the Harbor of Refuge. Guam Police Department maintains navigational pilings at Agat Small Boat Marina. Other entities such as the Marianas Yacht Club and Aqua World Marina maintain their own navigational aids.

The Fourteenth USCG District, located in Honolulu, Hawaii, publishes a Weekly Notice to Mariners. This publication is distributed via mail, e-mail and internet and advises mariners of navigation matters that may be of immediate concern. Additionally, the USCG broadcasts a Notice to Mariners over Very High Frequency (VHF) radio on navigational issues that are of immediate and local importance.

4.1.1.4 Tidal Elevation and Flow

Station ID 1630000, Apra Harbor, Guam for the 1983 – 2001 Epoch.

- MHHW: 2.34 feet
- MSL: 1.367 feet
- MLLW: 0.00 feet

Flow: At the entrance to Apra Harbor, the flood stream sets between north and northeast and the ebb stream southwest, slack water occurring at 30 minutes before low water and 45 minutes before high water. When combined with the southwest-going current associated with the northeast trade winds, which is greatly affected by the force of the wind and may be sufficient to overcome the northeast-going stream, the resultant flow has maximum rates of 1.5 knots traveling northeast and 3 knots traveling southwest. Strong rip tides may also be encountered.

Swell: Heavy swells from the west can last for several days and result in dangerous operation for small-craft vessels within the harbor. These conditions typically occur from developing typhoons traveling northwest.

4.1.1.5 Condition Assessment

Approximately once every five years the USCG conducts a Waterway Analysis and Management System (WAMS) study for the waters around Guam. Due to other operational commitments, the USCG has been unable to complete the WAMS study in recent years. However, changes to the current aids to navigation system are not expected.

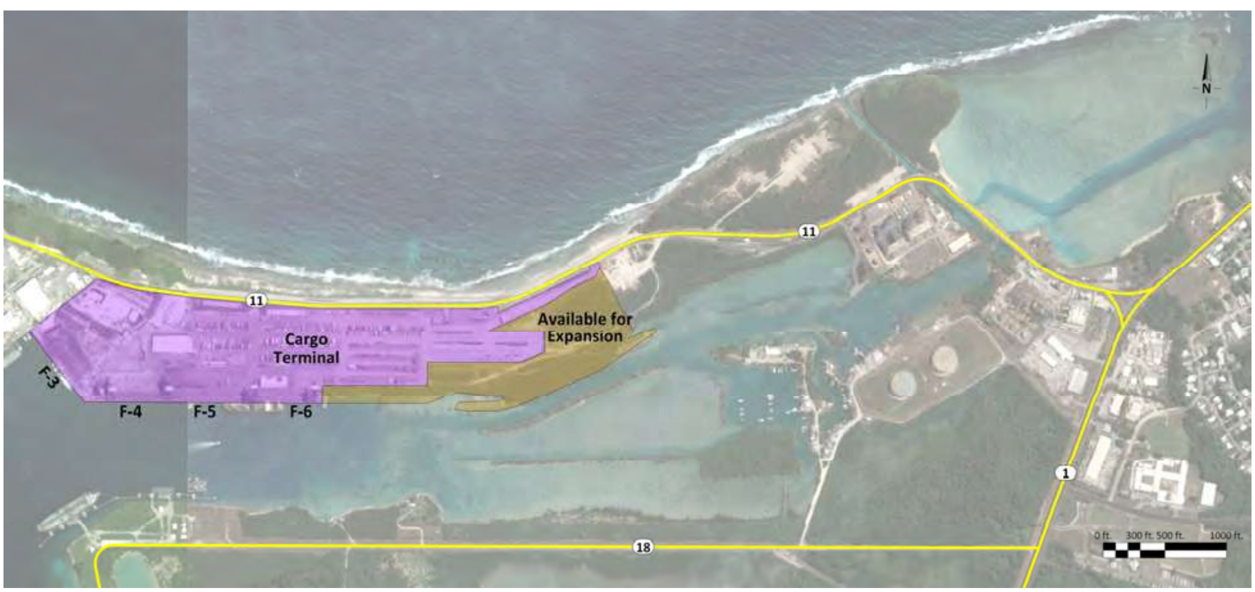
With regard to Apra Harbor, the WAMS study may receive a higher priority in the coming years due to military build-up on the island and additional Naval and commercial vessels that are likely to call on Port facilities. Similarly, home-porting additional vessels on Guam and the construction of new wharves or deepening the channel may also affect the navigation system. Once the WAMS study is performed, it is recommended that the PAG provide input to the USCG on their in-water infrastructure improvements.

4.1.2 LANDSIDE ACCESS

Route 1, also known as Marine Corps Drive, is a four-lane arterial that provides landside access to the Port from Tamuning and other urban areas. From the Port, Route 1 runs southwesterly towards Piti. Access to the Port from Piti is via an intersecting two-lane road, Route 11. On Cabras Island, Route 11 runs west past GPA's Cabras Power Plant Complex, through vacant lands set aside for the Cabras Island Industrial Park, north of the Commercial Port area and dead ends on Glass Breakwater, which forms the northern breakwater for Outer Apra Harbor. The Northern barrier along the Route 11 consists of a low seawall and armored breakwater protection facing the Philippine Sea. See Figure 4-5.

Landside access to the Navy's facilities is via a two-lane road, Route 18 (accessed via Route 1), which is south of the Port and runs parallel to Route 11.

Figure 4-5: Commercial Port Location and Access



Source: Google Earth and WSP

4.1.2.1 Route 11

Route 11 is a two-lane road with 12-foot travel lanes and 8-foot shoulders (both directions) within the 100-foot-wide right-of-way corridor. See Photo 1. It has provision for turning pockets to the existing entrance to the container yard and the truck gate.

Photo 1: Highway 11 Seawall

Route 11 was originally paved with an 8-inch thick base course and a 2-inch thick wearing surface, having a typical 2 percent drain slope outward; double bituminous surface treatment for shoulders with typical five percent drain slope outward. The DOD Defense Access Roads (DAR) program overlaid the road in 2012 with 5 inches of asphalt and maintained the 2 percent crown in the roadway and reinforced the shoulder to 7 inches of asphalt over an 8-inch thick base course. The travel lanes and turn lanes have a 1-inch thick friction course. The traffic flow at the interchange of Route 1 and 11 is controlled by a spanwire traffic signal complete with two left turn lanes from Route 11 onto Route 1, a dedicated right turn lane from Route 11 onto Route 1. Route 11 also includes 2 large culverts that carry Route 11 over the Piti and Tepungan Channel near the GPA Cabras Powerplant that were not improved with the Route 11 road paving project.

<u>Condition Assessment</u>

According to the analysis revealed in the Guam 2010/2020 Highway Master Plan by Department of Public Works (DPW), the capacity to handle anticipated traffic flow will be adequate up to

2020. No short-term or long-term capacity expansion was recommended. With the delay in the military buildup, it is likely that Route 11 traffic capacity will be sufficient well into the future.

According to the 2030 Guam Transportation Plan issued in 2008, the pavement condition for Route 11 is considered acceptable. No planned improvements were identified in the report except for the intersection of Route 11 and Route 1.

There are revisions being considered to increase Guam's maximum weight and height requirements for vehicles. The maximum weights are planned to be increased based on impact to the trucking and construction industry. Route 11 pavement, utilities and culverts should be analyzed based on weight increases and the effect it would have on the service life.

Maintenance and Operational Improvements

Although striping is normally required every two to five years, DPW has not programmed any work on Route 11 through 2030. Pavement preventative maintenance should be performed by at least 2023 to preserve and extend the service life of the pavement.

There is an existing enclosed storm drain system along Route 11 between the Port and the Truck Enforcement Screening Station facility which DPW has not maintained. It is recommended that the storm drain system is cleaned and debris removed to prevent flooding during storm events.

The above referenced study by DPW revealed a large amount of rocks/coral rubble piled up in front of the existing seawall. Some of this has since been cleared, but a substantial portion (from the existing gate to the west end of the container yard) still remains. This poses a continuing threat of increased wave run-up and renders the seawall ineffective against overtopping during large storms/typhoons. Overtopping of the seawall in the future may cause rocks/coral rubble to be deposited on Route 11, resulting in temporary road closures, possible road damage and flooding of the cargo terminal yard.

4.2 LANDSIDE AND MARINE ASSETS

Management and operation of the majority of the Port facilities on Cabras Island was transferred from the Government of Guam to the PAG between 1979 and 1985. GEDA assigned the management of the remaining 32 acres within the site of the existing Marine Industrial Complex to the PAG in 1988. Currently, the eastern end of Cabras Island is under the administrative jurisdiction of the PAG, with the exception of the GPA's Cabras Power Plant Complex and a small parcel of land adjacent to Berths F2 and F3 which is owned by GEDA.

Overall, the PAG has jurisdiction over more than 1,000 acres of land on Guam including 515 acres of submerged land parcels. The PAG's marine and landside assets on Cabras Island include the Harbor of Refuge (East and West Basins), Piti Channel, Cargo Terminal, Marine Industrial Complex, Hotel Wharf, Dog Leg Pier, Seaplane Ramp, Golf Pier, Outhouse Beach, and Family

Beach. Figure 4-6 shows an overview of the PAG's properties and adjacent property owners. The PAG's facilities have been categorized by physical location and, to some extent, function, as shown in Table 4-3 and Table 4-4. The cargo berths are identified by the letter "F" and the corresponding number 1, 2, and so on.

4.2.1 FACILITIES

Table 4-3: Marine Assets and Characteristics

Marine Asset	Length (Ft)	Depth (Ft)	Location	Current Use
Family Beach and Dog Leg Pier	NA	NA	Cabras Island Glass Breakwater	Portions of these assets are leased for water recreation activities (diving, snorkeling, and jet skiing)
Hotel Wharf	500	26	Cabras Island Glass Breakwater	Hotel Wharf and access road scheduled for reconstruction
Golf Pier	370*	40	Cabras Island Glass Breakwater	Managed by Mobil Oil for discharging and bunkering of liquid bulk fuel and discharging of bulk cement products via pipeline
Outhouse Beach	NA	NA	Cabras Island Glass Breakwater	Portions of these assets are leased for water

Marine Asset	Length (Ft)	Depth (Ft)	Location	Current Use
				recreation activities (diving and snorkeling)
Seaplane Ramp	111	10	Cabras Island Glass Breakwater	Leased facility for Guam Customs and Quarantine (MITF). Under construction in August 2021
F1	550	70	Marine Industrial Complex	Managed by Tristar Agility for discharging of liquid bulk fuel and liquefied petroleum gas (LPG) and bunkering of fuel
F2	670	24-26	Marine Industrial Complex	Upland leased to Cabras Marine Corporation. Dock utilized for dry-dock repair activities, discharging of bulk cement products via a pipeline, and berthing of tug boats

Marine Asset	Length (Ft)	Depth (Ft)	Location	Current Use
F3	750	28-30	Cargo Terminal	General cargo, passenger vessels, fishing vessels
F4	665	37	Cargo Terminal	Container, cruise ships and general cargo
F5	665	37	Cargo Terminal	Container, cruise ships and general cargo
F6	665	37	Cargo Terminal	Container and general cargo
Harbor of Refuge	NA	NA	Apra Harbor Piti Channel	Safe harbor for small craft in the event of storms and long-term moorage for vessels unable to berth at Agat Small Boat Marina or Gregorio D. Perez Marina
Aqua World Marina	NA	NA	Apra Harbor Piti Channel	Leased by Aqua World for boat slips and landside facilities
Gregorio D. Perez Marina	NA	NA	Hagåtña	Vessel moorage, boat ramps, and floating slips. Mooring slips leased to

Marine Asset	Length (Ft)	Depth (Ft)	Location	Current Use
				various tenants
Agat Small Boat Marina	NA	NA	Agat	Boat ramp and floating slip. Mooring slips leased to various tenants
Port Beach	NA	NA	Apra Harbor Piti Channel	Water recreation activities
Marians Yacht Club	NA	NA	Sasa Bay	Water recreation activities

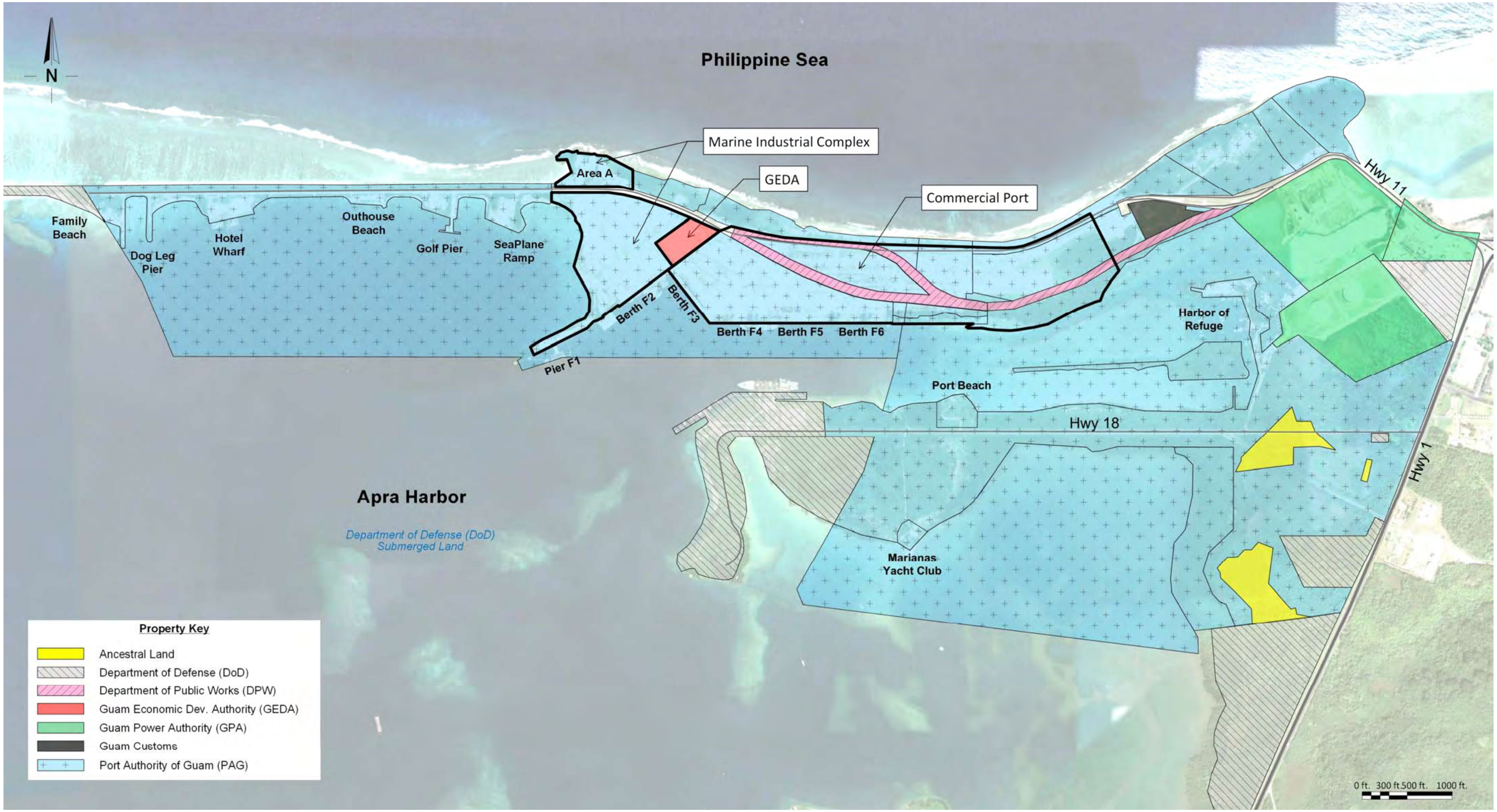
Source: The PAG and WSP

Table 4-4: Commercial Port Cargo Areas

Commercial Port Cargo Areas	Acres	Marine Area	Location	Current Use
Cargo Terminal	91	F3 to F6	Cabras Island	Cargo operations
Marine Industrial Complex	35	F1, F2	Cabras Island, west of Cargo Terminal	Leased to private companies for storage of liquid fuel, cement, and marine industry use
Cabras Island Industrial Park	42	N/A	Cabras Island, east of Cargo Terminal	Undeveloped area where portions are leased to private entities for recycling and parking of container chasis

Source: The PAG and WSP

Figure 4-6: Property Map



Source: Google Earth and WSP

4.2.2 LAND USE DESIGNATIONS

The Guam Legislation approved the 2013 Master Plan Update which contained the current land use designation for properties under the jurisdiction of the Port. Such land use designation map is posted on the Port's website. Using this designation map as a baseline, it is recommended that the land use designation map is revised as described below and shown in Figure 4-7.

4.2.2.1 Industrial

The segment of land nestled between the cargo terminal, the Mobil Tank Farm and the Seawall to the north and the area adjacent to the Route 11 Approach Road is designated for "Industrial" use.

4.2.2.2 Commercial Terminal

This tract designated "Commercial Port" consists of the existing cargo terminal areas and the expansion areas located to the east of the terminal. It consists of approximately 91 acres of land with access to deep navigable waters of the Cabras Navigation Channel in Apra Harbor. This area includes Berth F3 and the adjacent upland area. This tract includes fuel tanks and several bays within Warehouse 1 that are occupied by Port Police, Port Maintenance staff, and leased to private entities.

4.2.2.3 Natural Preserve – Water

These tracts consist of the Piti Channel that flows from the Philippine Sea under the Route 11 bridge past the Harbor of Refuge and into Apra Harbor via the Cabras Island Navigation Channel and Port berths and the submerged property within Sasa Bay and south of Route 18.

4.2.2.4 Open Space Tracts

- The area parallel to Route 11 extending from Seaplane Ramp to Family Beach. Fuel pipelines run partly along this tract between Golf Pier and the western end of the Area A Tank Farm.

- Several tracts north and south of Route 18 and west of Route 1. While a specific use has not been identified for the open space tract that fronts the north side of Route 18 and the west side of Route 1, it may be in the Port's best interest to designate this area as Marine Industrial. This would provide potential development opportunities, both private and public, that would be compatible with marine and Port operations and be a potential source of revenue in the future.

4.2.2.5 Marine Industrial

The various tenant facilities described under "Marine Industrial" include Berth F2, Seaplane Ramp, an upland storage area northeast of Berth F2, Outhouse Beach, Hotel Wharf, approximately 12.5 acres of land east of the Commercial Port, and approximately 28.6 acres adjacent to Port Beach and the Marianas Yacht Club. Hotel Wharf is slated to undergo rehabilitation to support an alternative laydown area for bulk cargo, RO/RO operations, and cruise ship operations.

4.2.2.6 Fuel and Cement

These tracts designated as "Fuel and Cement" include Pier F1, the Hanson cement unloading dock, Area A Tank Farm, Area C Tank Farm, Golf Pier, the Cementon cement unloading dock, and various upland storage facilities. Golf Pier is managed by Mobil Oil Guam as a fueling pier and is also used by Cementon for offloading bulk cement.

4.2.2.7 Water Recreation

These tracts consist of Dog Leg Pier, Family Beach, Port Beach, and the Marianas Yacht Club. Dog Leg Pier and a portion of Family Beach are leased to tenants for water recreational activities, i.e., jet skiing, banana boat rentals, snorkeling, and scuba diving. Other areas of Family Beach are used by local residents and tourists for picnic and swimming activities. A portion of the north-east Family Beach property is under the jurisdiction of the Navy. Similarly, Port Beach and the Marianas Yacht Club provide water recreation activities to the local community.

4.2.2.8 Fishing Facilities

There are no tracts designated as "Fishing Facilities".

4.2.2.9 Submerged Properties

These tracts designated as "Submerged Properties" consist of submerged land from the western end of Family Beach extending to the east shoreline adjacent to Guam Power Authority and the area within Sasa Bay and south of Route 18.

4.2.2.10 Natural Preserve Land

These tracts identified as "Natural Preserve Land" consist of two areas. The southern -most area is located along the western shoreline of Sasa Bay. The northern area (previously designated as Open Space) is located northeast of the Industrial tract.

4.2.2.11 Utility Easement

These tracts consist of land north of Route 18 between Route 1 and Port Beach and land north of Route 11 from Hotel Wharf extending to the east side of the Fuel and Cement tract.

4.2.2.12 Explosive Safety Quantity Distance (ESQD)

The military has designated a number of hazard zones called the "Explosive Safety Quantity Zone" in Apra Harbor. Most ESQD zones are in Inner Apra Harbor, which does not seem to impact Port activities and is not shown on the Port website. However, there is one zone in Outer Apra Harbor, which is demarcated as a circumferential boundary at a specific radius from the source of shipboard ordinance and other explosive material stored. The boundary runs through Outhouse Beach between Dog Leg Pier and Hotel Wharf. In general, the following rules apply to areas within an ESQD arc:

- ESQD arc radii are determined by the military based on the extent and nature of the ordinance stored.
- Inhabited Buildings are prohibited within the designated arc.
- Structures that can collapse onto people and endanger lives are also not permitted.
- Recreational facilities (except facilities for large crowds such as grandstands) are allowed within the outer 40 percent of the ESQD arc.
- Ship anchorages and wharves (which moor ships) are generally not allowed within the arc.
- The above restrictions would apply to Family Beach and Pier Dog, which are within the arc.

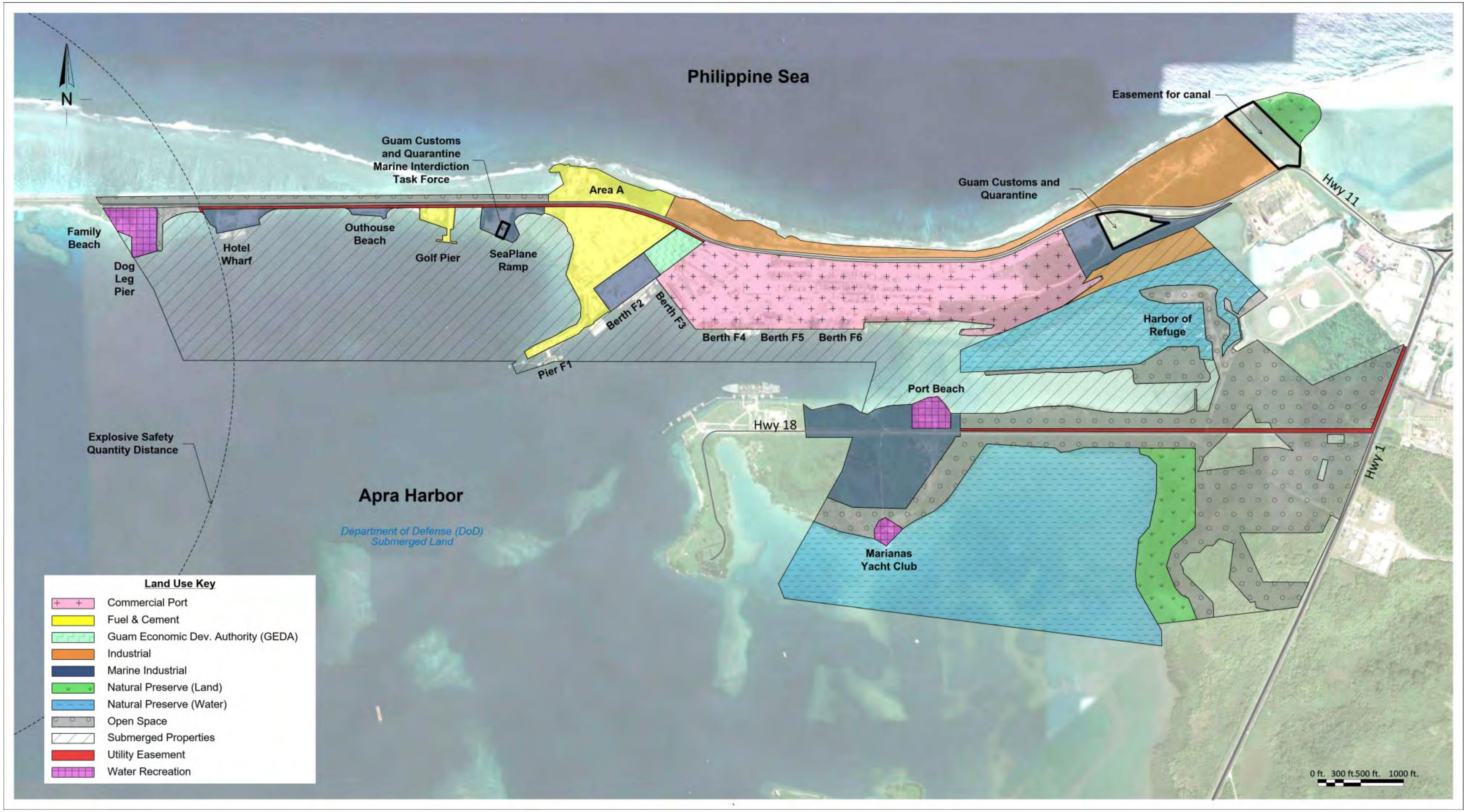
4.2.2.13 Historic Preservation

The Guam Historic Resources Division, also known as the State Historic Preservation Office (SHPO) is responsible for record keeping, monitoring and enforcement of Guam's regulations regarding development at historic sites.

Project activity related to the Hotel Wharf and Access Road Maintenance and Repair project was described to SHPO as part of a requested Section 106 review and consultation. The SHPO responded that an underwater archeological survey was required at Hotel Wharf to confirm there were no archeological items present. The survey was completed by Dr. William Jefferey, and the report was accepted by SHPO in September of 2020.

The PAG has a number of commercial marine facilities that support vessel service for the various types of cargo and civilian marine-industrial activities in Guam. The various users and tenants in these Port areas are described in the following sections of this report. PAG also oversees the Harbor of Refuge, Gregorio D. Perez Marina and Agat Small Boat Marina.

Figure 4-7: Updated Land Use Designations



Source: Google Earth and WSP

4.2.3 CARGO TERMINAL

The Cargo Terminal comprises a total of 91 acres made up of the following: four berths numbered F3 to F6 encompassing 4 acres; 40 acres of storage yard for containers; 9 acres of open storage for breakbulk, vehicles and general cargo; 10 acres for buildings, structures, parking and circulation; 4 acres of gates and terminal access roadways; and 24 acres of undeveloped land reserved for expansion. Containerized cargo is stored north of Berths F5 and F6. Similarly, breakbulk cargo is stored north of Berth F4. See Figure 4-8 and Figure 4-9.

The Cargo Terminal has a throughput capacity of approximately 86,800 containers per year, based on the current configuration of full containers that are predominantly wheeled. The Cargo Terminal capacity can be increased to approximately 149,000 containers per year if the full containers are stacked instead of wheeled. The existing and potential throughput capacity of these components is discussed in the Section 6.

The marine facilities within the Cargo Terminal consist of four berths (F3, F4, F5, and F6) totaling approximately 2,700 linear feet. The berths are bulkhead-type structures consisting of steel sheet pile walls faced with concrete that extends several feet below mean lower-low water. A portion of Berth F5 and Berth F6 (560 feet) is a pile-supported wharf consisting of a concrete slab spanning between concrete pile caps and supported by concrete piles. The pile supported section was constructed in 1998 following an earthquake in 1993 that damaged the bulkhead wharf. Steel sheet pile bulkheads are present on the landside and waterside faces of the pile supported section. The waterside bulkhead is a toe-wall. At F3, the fender system is comprised of regularly spaced rubber tires and cylindrical fenders suspended from the bullrail. At F4, F5, and F6, the fender system is comprised of regularly spaced fender panels backed by rubber arch fenders.

Figure 4-8: Berths F3 Through F6

Source: Google Earth and WSP

Figure 4-9: Cargo Terminal

Source: Google Earth and WSP

4.2.3.1 Berths F3 to F6

Berth F3 is located in the southwest corner of the Cargo Terminal. Long-liner fishing boats with lengths ranging from 75 to 100 feet and drafts of 15 to 20 feet previously called at Berth F3. However, this service has been discontinued in recent years. Vessels calling on Berth F3 currently include cable ships to load cables from Warehouse 1 and bulk vessels for offloading general cargo, e.g. aggregate, gravel, sand, etc.

Berths F4 to F6 are located along a 1,950 foot marginal wharf with a depth of 37 feet that accommodate container ships and general cargo vessels. See Photo 2 for a typical photo of the grounded storage area.

The largest vessels currently calling at the Port are container ships with the following characteristics.

- LOA: 853 feet
- Beam: 115 feet
- Draft: 37 feet
- TEUs: 3,600

Vessel carriers calling on the Port have the option of using excess capacity on current vessels in service, deploying larger vessels and/or increasing the number of vessels in a service to accommodate increased cargo demand.

A majority of containerships currently in the global market can be serviced at Berths F4 through F6. However, the current 120-foot gauge cranes may limit the size of larger vessels. Future crane replacements should accommodate ships such as the C11 class vessels, having beams of 130 feet ± and capacities of approximately 5,100 TEUs.

Photo 2: Grounded Storage Area in Yard

Depending on schedule and availability, cruise ships have called on Berths F3 through F6 in the past. The water depth at F3 is approximately 28 to 30 feet, which is adequate to accommodate some smaller cruise ships. In the past, Guam has received four to six cruise ships per year with approximately 800 passengers per call. More recently, there were three calls in 2018, five calls in 2019, one call in 2020, and zero in 2021. The decrease in cruise ship Port calls was due to the global COVID-19 pandemic.

Cruise vessels typically stay a partial day in Guam (i.e., arrive at 0800 and depart by 1800). The *Cruise Terminal Location Report* provided to the PAG in 2009 recommended that cruise operations be relocated to Hotel Wharf, a multipurpose marine facility located west of the Cargo Terminal, to improve the efficiency of the commercial cargo operation, and to potentially accommodate larger cruise vessels.

Berths F3 through F6 are bulkhead-type structures and have been in service in the 1960’s. The wharf structures consist of tied back sheet pile walls with concrete caps (coping beams). Sheet pile walls are also used as the upland anchor (deadman) below ground level. A wearing surface consisting of asphalt concrete pavement is present on the upland portion of these facilities. Berth F5 is a pile-supported wharf and consists of a concrete slab spanning between concrete pile caps and supported by concrete piles. In addition, steel sheet pile bulkheads are present on the landside and waterside faces of F5; the waterside bulkhead being a toe wall.

The Guam earthquake of 1993 severely damaged sections of the wharf structures. Because of this damage, a 560-foot section of the wharf at Berths F5 and F6 was replaced by a pile-supported structure. Pre-stressed concrete piles were driven to support cast-in-place concrete beams and slabs. New sheet pile walls were driven at each end of the new wharf section to contain the fill laterally. The damaged sheet piles were cut near the seabed to suit the new slope under the wharf section. Rip rap was placed above the new slope. A section of the pile-supported beams that carry the crane rails was replaced after the 1993 earthquake. New pre-stressed concrete piles were driven and new sections of the beams were cast next to the existing ones.

In 2010, during an inspection of the sheet piles at Berths F4 through F6, it was discovered that the soffit of the concrete wharf at Berth F5 was experiencing an accelerated rate of deterioration. In response to this assessment, a marine Service Life Extension (SLE) project was developed. This project was completed in 2015/2016. The project addressed concrete structure and coping beam repairs, routine sheetpile maintenance, fender replacements and cathodic protection; all of which were designed to extend the service life 15-20 years. The condition of the bulkhead should be monitored and repaired as needed to prevent further damage. Preparations should be made for long-term bulkhead replacement when required to preserve this and other waterfront assets from exceeding their current useful life.

4.2.3.2 Marine Cargo Terminal

4.2.3.2.1 Berth F3

Berth F3 is a bulkhead-type structure consisting of a steel sheet pile wall faced with concrete that extends several feet below the mean lower-low water (MLLW) level. The berth face at F3 consists of a concrete bullrail with integrated cleats and mooring bollards. See Photo 3. A wearing surface consisting of asphalt concrete pavement is present on the upland portion.

<u>**Condition Assessment**</u>

Overall, Berth F3 is in **poor** condition. See Photo 3. Previous inspection reports identify holes in the sheet pile wall, open-corrosion spalls along the concrete bullrail, and cracking of the concrete facing at multiple locations. The fender system is non-uniform and consists of a combination of tires, floating pneumatic fenders, and cylindrical fenders. Moderate to major corrosion is present at the mooring hardware. A detailed condition assessment report for Berth F3 is provided in Appendix B.

Photo 3: Berth F3

<u>**Maintenance and Operational Improvements**</u>

The following are repair recommendations for Berth F3:

- Repair Holes in the Sheet Pile Wall: This repair consists of installing steel patches over existing holes and displacing water by pumping cementitious grout into the voids. Due to the age of the structure and severity of damage observed, this repair procedure should be considered a temporary means to extend the life of the sheet pile wall.
- Concrete Bullrail Repairs: At locations where closed- and open-corrosion spalls are present, sawcut and remove concrete. Where steel reinforcement is exposed, remove

corrosion from reinforcement, add supplemental reinforcement as necessary, and remove/replace damage concrete to restore the original thickness.

- Mooring Hardware Rehabilitation: Remove dirt, oil, debris and existing paint/coating systems and apply a high-performance coating system.
- Fender Panel Rehabilitation: Remove fender panels and discard existing chains and shackles. Similarly, remove and discard rubber fender elements with major or severe damage. Remove and salvage UHMW-PE rub strips, clean fender panels and apply a high-performance coating system. Reinstall rub strips, supply new chains shackles, and fenders and reinstall fender panels.
- Crane Rail: Continue monitoring the vertical misalignment of the crane rail at Station 12+44.

4.2.3.2.2 Berth F4

Berth F4 is a bulkhead-type structure consisting of a steel sheet pile wall faced with concrete that extends several feet below the mean lower-low water (MLLW) level. The berth face at F4 consists of a concrete bullrail with integrated cleats and mooring bollards. See Photo 4. A wearing surface consisting of asphalt concrete pavement is present on the upland portion.

Condition Assessment

Overall, Berth F4 is in **fair** condition. See Photo 4. Previous inspection reports identify holes in the sheet pile wall at isolated locations, closed-corrosion spalls along the concrete bullrail, and cracking of the concrete facing at multiple locations. The fender system is in working condition, but in need of extensive repairs due to missing chains and torn rubber fenders. Minor to moderate corrosion is present at the mooring hardware. A detailed condition assessment report for Berth F4 is provided in Appendix B.

Photo 4: Berth F4

Maintenance and Operational Improvements

The following are repair recommendations for Berth F4:

- Repair Holes in the Sheet Pile Wall: This repair consists of installing steel patches over existing holes and displacing water by pumping cementitious grout into the voids. Due to the age of the structure and severity of damage observed, this repair procedure should be considered a temporary means to extend the life of the sheet pile wall.
- Concrete Bullrail Repairs: At locations where closed- and open-corrosion spalls are present, sawcut and remove concrete. Where steel reinforcement is exposed, remove corrosion from reinforcement, add supplemental reinforcement as necessary, and remove/replace damage concrete to restore the original thickness.
- Mooring Hardware Rehabilitation: Remove dirt, oil, debris and existing paint/coating systems and apply a high-performance coating system.
- Fender Panel Rehabilitation: Remove fender panels and discard existing chains and shackles. Similarly, remove and discard rubber fender elements with major or severe damage. Remove and salvage UHMW-PE rub strips, clean fender panels and apply a high-performance coating system. Reinstall rub strips, supply new chains shackles, and fenders and reinstall fender panels.
- Crane Rail: Continue monitoring the vertical misalignment of the crane rail at Station 12+44.

4.2.3.2.3 Berth F5

Berth F5 is a pile-supported wharf and consists of a concrete slab spanning between concrete pile caps and supported by concrete piles. In addition, steel sheet pile bulkheads are present on the landside and waterside faces of F5; the waterside bulkhead being a toe wall. See Photo 5.

Condition Assessment

Overall, Berth F5 is in **satisfactory** condition. See Photo 5. Concrete piles and pile caps are in good condition. Moderate to major corrosion is present at the mooring hardware and fender panels. Moderate to major corrosion is present at the upland sheet pile wall. Several of the rubber fender elements are severely torn. A detailed condition assessment report for Berth F5 is provided in Appendix B.

Photo 5: Berth F5

Maintenance and Operational Improvements

The following are repair recommendations for Berth F5:

- Concrete Pile Cap Repair: Sawcut and remove damaged section of concrete. Where steel reinforcement is exposed, remove corrosion from reinforcement, add supplemental reinforcement as necessary, and remove/replace damaged concrete to restore the original thickness.
- Concrete Bullrail Repairs: At locations where closed- and open-corrosion spalls are present, sawcut and remove concrete. Where steel reinforcement is exposed, remove corrosion from reinforcement, add supplemental reinforcement as necessary, and remove/replace damaged concrete to restore the original thickness.
- Mooring Hardware Rehabilitation: Remove dirt, oil, debris and existing paint/coating systems and apply a high-performance coating system.

- Fender Panel Rehabilitation: Remove fender panels and discard existing chains and shackles. Similarly, remove and discard rubber fender elements with major or severe damage. Remove and salvage UHMW-PE rub strips, clean fender panels and apply a high-performance coating system. Reinstall rub strips, supply new chains shackles, and fenders and reinstall fender panels.
- Overlay Repairs: Remove and replace the damage concrete adjacent to the landside crane rail near Station 16+50. Where steel reinforcement is exposed, remove corrosion from reinforcement, add supplemental reinforcement as necessary, and remove/replace damaged concrete to restore the original thickness.

4.2.3.2.4 Berth F6

Berth F6 is a bulkhead-type structure consisting of a steel sheet pile wall faced with concrete that extends several feet below the mean lower-low water (MLLW) level. The berth face at F6 consists of a concrete bullrail with integrated cleats and mooring bollards. See Photo 6. A wearing surface consisting of asphalt concrete pavement is present on the upland portion of these facilities.

<u>Condition Assessment</u>

Overall, Berth F6 is in **satisfactory** condition. See Photo 6. Minor cracking of the concrete facing was observed at several locations. Rubber fender elements are torn and split at isolated locations. A detailed condition assessment report for Berth F6 is provided in Appendix B.

Photo 6: Berth F6

<u>Maintenance and Operational Improvements</u>

The following are repair recommendations for Berth F6:

- Repair Holes in the Sheet Pile Wall: This repair consists of installing steel patches over existing holes and displacing water by pumping cementitious grout into the voids. Due to the age of the structure and severity of damage observed, this repair procedure should be considered a temporary means to extend the life of the sheet pile wall.
- Concrete Bullrail Repairs: At locations where closed- and open-corrosion spalls are present, sawcut and remove concrete. Where steel reinforcement is exposed, remove corrosion from reinforcement, add supplemental reinforcement as necessary, and remove/replace damaged concrete to restore the original thickness.
- Mooring Hardware Rehabilitation: Remove dirt, oil, debris and existing paint/coating systems and apply a high-performance coating system.
- Fender Panel Rehabilitation: Remove fender panels and discard existing chains and shackles. Similarly, remove and discard rubber fender elements with major or severe damage. Remove and salvage UHMW-PE rub strips, clean fender panels and apply a high-performance coating system. Reinstall rub strips, supply new chains shackles, and fenders and reinstall fender panels.

4.2.3.3 Container Crane Rails at Berths F4, F5 and F6

In 1970, a 50-foot-gauge ship-to-shore crane rail was constructed at Berths F4, F5, and F6. The concrete rail girders, measuring 2 feet x 2’-6” in cross section are supported on vertical steel H piles spaced at nine feet on-center. Piles are located between tie rods which prevent outward deflection of the sheet pile wall. The rail is transversely supported by concrete beams spaced at 54 feet on-center for the full length of the crane rail. The crane rail structure is supported independently of the wharf structure. See Photo 7.

Photo 7: Crane Rail

During the 1993 earthquake, a portion of the crane rail was damaged. The lateral movement of the wharf structure caused the crane rail to move laterally and sustain permanent (plastic) deformation. New piles were added after the earthquake in order to repair the crane rail. Additional piles were installed and spaced at nine feet on-center, staggered between existing piles. The existing concrete rail beams were widened to correct the alignment of the rails. The extent of the repair to the crane rail matched the length of the pile-supported wharf that was built to replace the damaged portion of the original 560-foot sheet pile wall.

The crane rails were replaced in 2009 to remedy the differential movement of the gantry cranes.

A cursory crane rail assessment was performed in August of 2021 and identified vertical settlement of the waterside crane rail at Berth F4 (approximately 1/4 inch). This settlement was observed at an isolated location and does not appear to affect the daily use of the gantry cranes.

As part of the marine SLE project, connectivity to the gantry rail spur that was constructed in 1997 was removed.

4.2.3.4 Container Yard

The Port's container yard originally occupied 12 acres. Over the past three decades, the yard has been expanded several times in accordance with prior Master Plan recommendations, which has allowed the Port to sustain sufficient capacity to exceed the highest projected annual demand. Most recently, as part of the GCPI Program, an additional 7.6 acres was added to the container cargo area on the east side of the terminal and 1.3 acres to the breakbulk cargo area behind the CFS building.

Currently, empty and transshipment containers stored in the yard are stacked on the ground (grounded). Refrigerated containers are placed on chassis and stored in the designated refrigerated cargo area that includes 124 stalls equipped with reefer receptacles. Recently, new receptacles have been installed. The PAG is planning to replace the existing reefer receptacles. All other loaded containers are either placed on chassis or on the ground.

A breakdown of the existing cargo yard's total ground slots (TGS) measured in TEUs is shown in Table 4-5. The container yard as currently configured has an estimated throughput capacity of approximately 126,000 containers per year. However, the storage yard's capacity could be increased by converting wheeled slots to grounded slots. For example, if 78 percent of the wheeled slots were converted to grounded slots, the yard's capacity increases to approximately 149,000 containers due to higher stacking heights for grounded containers. Additional factors that can increase the throughput capacity of the container yard include yard configuration and layout, type and amount of equipment deployed, and capital resources invested.

Table 4-5: Port Existing Terminal Ground Slots

Storage Type	TEU TGS
Wheeled Chassis Slots	1,796
Grounded Slots	1,621

Source: The PAG

The container storage yard's existing capacity falls short of the projected demand for the military build-up forecast. Similarly, for breakbulk cargo, the 5.9 acres of open storage area falls short of the storage area requirements to accommodate the peak breakbulk forecasted cargo volumes associated with the military build-up.

4.2.3.5 Container and Cargo Storage Yard

The container and cargo storage yard area is comprised of 55 net acres used for container and breakbulk storage space, along with maintenance and repair facilities encompassing approximately 27,600 square feet (SF), and two warehouses, CFS and WH1, providing approximately 71,000 SF of floor space. The storage yard provides space for containers, automobiles, and general cargo. The container yard also includes 124 stalls equipped with receptacles to serve refrigerated containers.

The existing operation supports a combination of wheeled and grounded storage for containers. Wheeled storage is currently available for:

- Full standard containers arriving from the U.S. West Coast on Matson vessels
- Reefer containers

- Out-of-Gauge (OOG) containers
- Hazardous cargo containers
- Full standard containers arriving at the terminal for loading onto Matson vessels

Grounded storage is currently available for:

- Full standard containers arriving for transshipment
- Standard Asian service containers
- Empty containers

The first stage was constructed by the Navy in 1969 and is recognizable by the container tie downs behind Berths F4, F5 and F6. The pavement also surrounds the CFS building and continues along the waterfront to Berth F6. The pavement section for this initial phase is 3 inches of asphalt over 8 inches of compacted base material.

The second stage was constructed starting in 1984, and it filled the space between the initial container yard and the area bound by the 1980 relocation of Route 11. The pavement in this phase was constructed of 3 inches of asphalt over 8 inches of compacted base material.

The third stage was constructed starting in 1990. Chassis parking were constructed of 6 inches of asphalt on top of a 4-inch sub-base and 8-inch base course.

The existing terminal yard pavement was designed to support three block-stacked 40-foot containers, and to provide a travelling surface for Port equipment. The pavement adjacent to Berth F5 was partially modified in 1997 due to earthquake damage. This comprised an area of approximately 818 feet by 255 feet and consisted of 24-inch-thick reinforced concrete that was integrated with the beams and piles making up the pier structural system.

Condition Assessment

A condition assessment of the container yard was completed in August 2021. A majority of the yard is in serviceable condition with limited evidence of cracking, spalling, rutting, and ponding. Some areas of the yard contain asphalt pavement that have depressions due to container stacking or chassis landing legs. The trench drain grates consist of older grates that are showing signs of damage. Overall, the condition of the container yard is “Fair.” See Photo 8.

Photo 8: Container Yard Pavement

__Maintenance and Operational Improvements__

All yard pavement should be progressively replaced during the next 20-year planning horizon. Asphalt pavement, where it exists, should be replaced with concrete pavement to withstand the rigor of container handling equipment and container stacking. Trench drains and grates should also be progressively replaced. Maintenance and operational improvements should be accomplished through a series of projects that limit disruption to terminal operations and that integrate with the Capital Improvement Program (CIP) construction projects such as the new water line.

4.2.3.6 Buildings and Structures

The Container Terminal includes administrative facilities encompassing approximately 44,000 sf; 27,600 sf of maintenance and repair (M&R) facilities; a warehouse and container freight station providing approximately 79,000 sf of enclosed floor space; and terminal gates and circulation areas. Most of the PAG's structures on the Cargo Terminal listed in Table 4-6 were built and put into service in the late 1960's. See Figure 4-10 for the location and footprint of buildings within the Container Terminal.

Table 4-6: Major Port Buildings and Structures

Building	SF	Current Use
Administration Building	25,398	The PAG's administrative offices, Board Room, and leased shipping related port users' offices
Horizon Building (Administration Annex Building)	10,400	Port Police, Guam Customs & Quarantine, training/conference rooms, break rooms and other multi-use spaces.
Port Command Center (PCC)	5,050	Port Police, Port's video surveillance, access control, TWIC readers, and communications systems
Warehouse 1	55,144	Stevedoring, Cable Storage (Subcom), and PAG electrical equipment and supply storage
EQMR Building	24,000	Facilities, Supply, and Fleet M&R Staff
Welding Shop	3,660	Welders and equipment shed
New Operations Building (formerly Port Police Building)	2,025	Operations, U.S. Customs & Border Protection Agency
Container Freight Station (CFS)	24,000	Operations, Transportation, Dispatch, Terminal Offices, Stevedoring, Safety, and breakbulk covered storage
Terminal Gates	2,412	Secure entry into and out of the container and breakbulk terminal areas
Annex A	3,400	Engineering and Safety

Source: The PAG

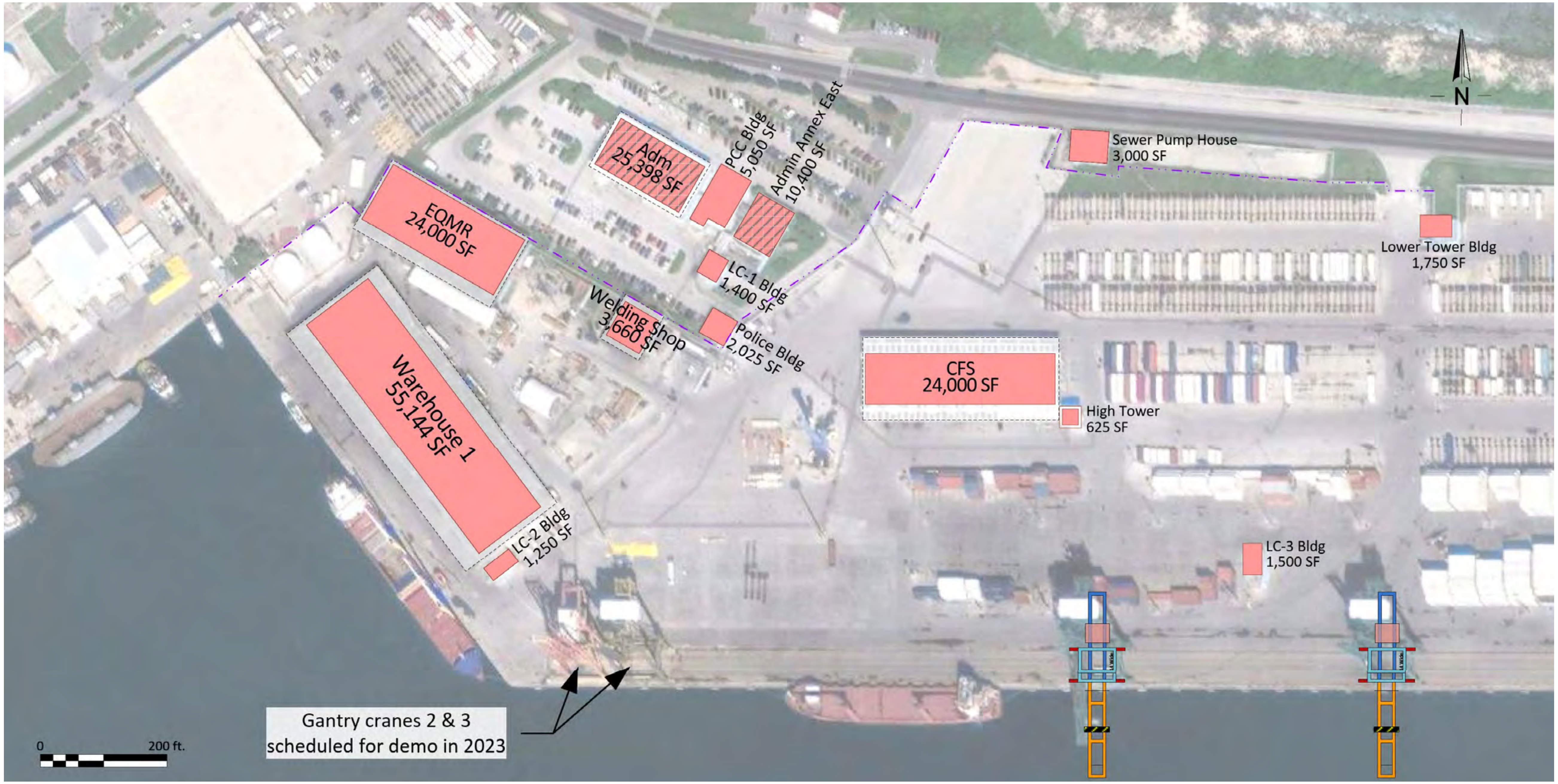
The PAG is renovating several structures under the current Capital Improvement Program (CIP). The CFS Building is being renovated by repairing spalled concrete on the building exterior. Warehouse 1 is being renovated by repairing spalls on the exterior and interior of the building as well as renovating the existing engineering and safety offices. The EQMR Building is being renovated by repairing concrete on the exterior of the building, cleaning and recoating the roof, and numerous interior improvements.

Most of the Port building structures were built in the late 1960's and designed to military standards to withstand the extremely high wind conditions caused by typhoons. The majority of Port buildings are reinforced concrete structures having 3,000 PSI (pounds per square inch) concrete and 20,000 PSI reinforcement steel. The lateral force design loads were dominated either by wind load (160 MPH allowable stress design/200 MPH ultimate strength design) or earthquake load (Zone 3 per the Uniform Building Code 1964 edition).

Building foundations utilize a combination of shallow strip and spread footings located 1'-6" to 3'-0" below the finish floor elevation. Allowable soil bearing pressures of 1,100 PSF were used for the design of footings 2'-6" wide and 2,500 PSF for footings greater than 10'-0" wide. Using this criteria, footings of intermediate widths were designed using straight-line interpolation.

Condition assessments for major buildings within the Container Terminal are summarized in the following sections.

Figure 4-10: Cargo Terminal Area Buildings



Source: Google Earth and WSP

4.2.3.6.1 Port Administration Building

The Port Administration Building was constructed in the 1970's and serves as headquarters for the PAG and accommodates several of the shipping lines' offices and shipping related organizations. See Table 4-7. The PAG is the landlord for these tenants.

The building is a two-story structure built with reinforced concrete arranged in a grid system. Grids 1 through 7 comprise the transverse frames and span 25 feet along an east-west axis. Grids A through D comprise the longitudinal frames and span 25 to 30 feet in the north-south axis with cantilevered eave extended 7.5 feet on four sides. The central stair-core protrudes through the roof to provide access to a small third floor observation area (Harbor Master's Office). See Photo 9.

Source: WSP

Photo 9: Port Administration Building

Table 4-7: Port Administration Building Tenants

Tenant	Room No.	Lease Start Date	Area (SF)	Purpose
Ambyth Shipping & Trading	A205	12/1995	1,204	Agent
CTSI Logistic	A108/A10	12/2009	557	Agent Administration
Norton Lilly International	115	5/2016	800	Agent/Carrier Office

Source: PAG Commercial

Condition Assessment

A condition assessment of the Administration Building was performed in 2021 and found it to be in **poor** condition. This building has reached its design-life expectancy and needs substantial retrofitting (HVAC, plumbing, communications, finishes) internally and substantial envelope repair to remedy spalling concrete and water intrusion. Similarly, major damage to the electrical, mechanical, and plumbing systems is present. See Photo 10.

Renovation of the building would be cost prohibitive due to the extent of deterioration and would be disruptive to operations, even if completed in phases. Restoration of this facility would require all modifications to meet current code requirements.

Construction of a new building adjacent to the existing building is a more practical solution. The new building could be a smaller footprint based on the current number of tenants, A programming study is recommended to determine the most effective size and layout of the building. Once completed, the existing Administration Building should be demolished to provide additional parking for the new building.

Photo 10: Administration Building Concrete Spalling

Maintenance and Operational Improvements

Maintenance activities should focus on safety and security issues and extending the service life of the Administration Building. This includes repairing spalling concrete, especially in areas that are accessible to personnel, repairing damaged or deteriorated sections of roofing and mechanical and electrical systems that are not functional.

PAG buildings such as the Administration that were constructed over 50 years ago, should undergo a detailed structural assessment is recommended to evaluate structural integrity, especially under seismic loading conditions.

4.2.3.6.2 Horizon Building (Known as the Admin Annex)

The Horizon Building was unused after the departure of Horizon Lines in 2012. The building has two sections: the high roof (HR) located on the north side and the low roof (LR) located on the south side. See Photo 11. The electrical LC1 is located behind this building. The building was occupied by Port Operations from 2014 to 2021. Currently, Customs and Port Police share space in this building. See Table 4-8.

Photo 11: Horizon Building

Table 4-8: Horizon Building Tenants

Tenant	Rm. No.	Lease Start Date	Area (SF)	Purpose
Customs	1st and 2nd Floor	N/A	4,155	Office Space
Port Police	1st Floor	N/A		Training and Dispatch Office

Source: The PAG

Condition Assessment

A condition assessment of the Horizon Building was completed in August of 2021 and found it to be in **marginal** condition. Although the building appears to be recently painted, there are areas of spalling concrete and exposed reinforcing on the exterior columns. The roofing appears to be in need of repair.

Maintenance and Operational Improvements

Maintenance of this building should include repairing spalling concrete, damaged or deteriorated portions of roofing and mechanical and electrical systems that are not functional. The maintenance activities should be focused on extending the service life of the building.

4.2.3.6.3 Container Freight Station (CFS)

The CFS is currently occupied by Transportation, Operations, Dispatch, and Stevedoring. The building provides space for storage of breakbulk cargo and a Customs holding area.

Condition Assessment

A condition assessment of the CFS Building was performed in August of 2021 and found it to be in **marginal** condition. Extensive concrete cracking and spalling was observed on the building exterior. Some interior spalling was also observed. There is evidence of prior crack and spall repairs that were completed. The fire protection system is not operational. New bathrooms were installed around 2014 on the east side of the building. New air conditioning units for the office trailers were also observed.

The PAG issued an IFB for concrete repairs in April of 2021 which will improve the exterior condition of the building. The project also includes limited interior crack and spall repairs.

Maintenance and Operational Improvements

The repairs in 2022 will extend the service life of this building. However, for such buildings constructed over 50 years ago, a more detailed structural assessment is recommended to evaluate its structural integrity, especially under seismic loading conditions.

4.2.3.6.4 Equipment Maintenance and Repair (EQMR) Building

The EQMR building is located north of Warehouse 1 and provides space for Superintendents for EQMR & Facility Maintenance, Fleet Maintenance, Supply Technicians assigned to EQMR, Maintenance Control Section, and Facility Maintenance. Also provided to employees are breakrooms, laundry rooms, restrooms and showers. The building is a reinforced concrete structure arranged in a grid system. Grids 1 through 13 comprise the transverse frames and span 20 feet along an east-west axis. Grids A through D comprise the longitudinal frames and span 30 to 40 feet along a north-south axis with a cantilevered canopy extended from the south elevation. Two small areas of mezzanine (440 SF for office and 600 SF for tool room) are located inside the building. An open yard space (100-feet by 60-feet) for equipment storage and staging is located at the east side of the EQMR building. See Photo 12.

Photo 12: EQMR Building

Condition Assessment

A condition assessment of the EQMR Building was completed in August of 2021 and found it to be in **fair** condition. Concrete spalling was observed on the exterior of the building. The roof shows signs of leaking. The interior finishes, plumbing, HVAC, and electrical systems are in fair condition.

Maintenance and Operational Improvements

The PAG issued an IFB for the EQMR Building Repair and Upgrades project in November of 2021. The intent of the project is to repair cracks and spalls along walls, roof slabs, beams, columns and other concrete members; cleaning and recoating of the roof; replacement of the HVAC system; replacement of plumbing fixtures; replacement of existing sprinkler system and a new fire alarm system; and replacement of communication and electrical components. The project came in over budget, so it will be scaled back to focus on essential improvements. Once completed, the condition of the EQMR building will be significantly improved and the service life of the EQMR Building will be extended. A new shelter is being installed in front of the building for the facilities department to work under cover.

4.2.3.6.5 Warehouse 1 (WH1)

Port Police use Bay 1 for storage, Bay 2 is used for office space, Bays 3 and 4 are used by Stevedoring, Subcom LLC uses Bays 5 through 8 for cable storage, and Bays 9 through 15 are Port occupied and used by Maintenance. The Engineering and Safety personnel recently moved out of WH1. See Photo 13.

WH1 is a reinforced concrete structure arranged in a grid system. Grids 1 through 16 comprise the transverse frames and span 30-feet along an east-west axis. Grids A through D comprise the longitudinal frames and span 40-feet along the north-south axis with a cantilevered canopy extending from the north and south elevations.

Source: WSP

Photo 13: Warehouse 1

Condition Assessment

A condition assessment of WH1 was completed in August of 2021 and found it to be in **poor** condition. There is extensive spalling of concrete and concrete masonry units (CMU) on the building exterior and interior. The roof is leaking. Interior finishes are in poor condition, especially in the engineering and safety offices which show signs of mold. The fire protection system is not operational. The plumbing and electrical systems are in marginal condition.

WH1 appears to be acceptable for its current use. However, the building is currently underutilized as stated above. The building can continue to provide space for storage and work areas. Use of the building for office space is not ideal due to the condition of the building and its proximity to other office space such as the Administration Building.

Maintenance and Operational Improvements

The PAG issued an IFB for the Warehouse 1 Upgrades project in September of 2021. The purpose of the project is to repair damaged exterior and interior concrete and CMU, repair the roof, construct a new parts room, construct new bathrooms, and to renovate the office areas. The bid price for this project came in well over the original budget, so the project will be scaled back to focus on essential improvements.

Maintenance and repair of Warehouse 1 should focus on safety and security issues to extend the service life of this building until it is demolished or reconfigured based on future needs.

For buildings such as WH1 that were constructed over 50 years ago, a more detailed structural assessment is recommended to evaluate its structural integrity, especially under seismic loading conditions.

4.2.3.6.6 Welding Shop

The Welding Shop is located on the east side of the EQMR building. The building is a reinforced concrete structure arranged in a grid system. Grids 1 through 4 comprise the transverse frames and span 20-feet along an east-west axis. Grids A through C comprise the longitudinal frames and span 30-feet along the north-south axis with a cantilevered canopy extended from south elevation. See Photo 14.

Source: WSP

Photo 14: Welding Shop

Condition Assessment

A condition assessment of the Welding Shop was performed in August of 2021 and found it to be in **fair** condition. Spalling of the concrete was observed at isolated locations, though not as significant as WH1 or the EQMR Building. Evidence of previous concrete patching on walls and columns was observed.

Maintenance and Operational Improvements

The building appears to be acceptable for its current use. However, for such buildings constructed over 50 years ago, a more detailed structural assessment is recommended to evaluate the structural integrity of the building, especially under seismic loading conditions.

The CIP includes two projects (Phase 1 and Phase 2) for improvements to the Welding Shop. The work includes installation of roll up doors in all three bays, repair of interior and exterior concrete cracks and spalls, interior and exterior painting, upgrading lights to LED, replace exhaust window grills, pressure washing of the roof, repairing roof cracks and spalls, coating the roof with silicon, and repair of the bathroom concrete base.

4.2.3.6.7 New Operations Building

The U.S. Customs and Border Patrol (CBP) occupies 468 square feet on the first floor. The remaining first floor and all of the second floor is occupied by Port Operations personnel. The building is a reinforced concrete structure and estimated to have been built in the 1970's or later. As-built information is not available for this building. See Photo 15.

Photo 15: New Operations Building

Condition Assessment

A condition assessment of the building was completed in August 2021 and found it to be in **marginal** condition. The building exterior exhibits cracking and spalling on columns, soffits, and facia. The roofing has signs of standing water. Repairs and upgrades are needed to extend the service life of this building.

4.2.3.6.8 Electrical Load Centers (LC's)

Five electrical Load Center (LC) buildings are located throughout the Port complex. LC1 is located behind the Horizon Building (Admin Annex) and is the only LC outside the container yard. LC2 is attached to the east side of WH1. LC3 is located on the south side near Berth F5. LC4 is located against the fence wall at the north boundary closest to the reefer stalls. LC5 is located behind the Old Gate Building. See Photo 16 and Photo 17 for photos of LC4 and LC1. All of the LC buildings are reinforced concrete structures and are relatively new (erected between 2003-2004), except LC5 which was constructed in 2015.

Photo 16: Load Center 4

Photo 17: Load Center 1

Condition Assessment

A condition assessment of the load center buildings was performed in August of 2021 and found them to be in **good** condition. No noticeable deficiencies were observed.

Maintenance and Operational Improvements

The Port initiated a program in 2019 to refurbish and harden existing Load Center Buildings 1, 2, 3, and 4. The work included cleaning the buildings, repairing cracks on roofs and ceilings, applying primer and elastomeric paint on roofs, replacing galvanized steel roll-up doors, replacing louvers, replacing aluminium entrance doors, replacing aluminium insect screens, replacing roof vents, and painting interior and exterior walls. In addition, the Primary Transformers at Load Centers 2 and 3 were replaced because they were leaking. This project was completed in 2022.

4.2.3.6.9 High Tower

The High Tower is a three-story reinforced concrete structure located on the east side of the CFS building that has been in service since 1968/1969. The building stands 33 feet tall with a roof coverage area of 31.33 feet square. An exterior stair is attached to the north side of the building. See Photo 18.

Photo 18: High Tower

Condition Assessment

A condition assessment of the High Tower was performed in August of 2021 and found it to be in **fair** condition

4.2.3.6.10 Low Tower

The Low Tower is a two-story reinforced concrete structure located on the northeast end of the Port. See Photo 19.

Condition Assessment

A condition assessment of the Low Tower was performed in August of 2021 and found it to be in **fair** condition. No visible deficiencies were observed.

Source: WSP

Photo 19: Low Tower

4.2.3.6.11 Sewer Pump House

The Sewer Pump House is a single-story reinforced concrete structure located at the northern fence-line, near Route 11 and it is isolated by a concrete masonry unit wall/chain-link fence. This building is owned and maintained by GWA. Therefore, a condition assessment was not performed.

4.2.3.7 Gates and Fencing

4.2.3.7.1 Old Gate House

The original Port entrance (Old Gate House) gate is located at the northeast corner of the container yard and previously served as the primary check point into and out of the container terminal area. The gate was built in 1991. The gate canopy is a reinforced concrete structure, 19 feet in height, and a footprint that is 80 feet wide by 64-feet-long. This structure is currently used by Terminal Division staff. The old gate house is a single floor reinforced concrete building (10-feet-high with a footprint that is 14-feet-wide and 64-feet-long) located at the center of the canopy. Each truck lane is 15-feet-wide and has an overhead clearance of 16 feet. See Photo 20.

Photo 20: Old Gate House and Canopy

Condition Assessment

A condition assessment of the Old Gate House was performed in August of 2021 and found it to be in **fair** condition.

Maintenance and Operational Improvements

Recent upgrades including lighting, panels, internal piping, and paint have been performed.

4.2.3.7.2 New Truck Gate

A new truck gate complex was constructed in 2015. The gate consists of four lanes with a concrete canopy, and three booths under the canopy. The canopy is 67 feet wide by 36 feet long and 6 inches thick. Two lanes are for inbound trucks, one lane is for outbound trucks, and the fourth lane is a bypass lane. The pavement consists of 10 inches of reinforced concrete pavement, See Photo 21.

Photo 21: New Truck Gate

The gate complex provides off-road queuing for trucks entering and existing the terminal. The inbound gate process includes a physical inspection of containers for damages. The Terminal Operating System (TOS) supports the checking process, verifies whether the container data is correct, and confirms the owner has pre-registered the container for delivery or pickup. The Checker has a handheld terminal to perform and approve all required checks. The TOS verifies the truck and container information and provides a route plan to the driver. Once the truck is processed at the gate, the trucker is given an Equipment Interchange Report (EIR) and the TOS issues work orders to equipment. After the truck service has been completed in the container yard, the truck drives to the gate complex and exits at the outbound gate. The departure will be registered in the TOS by swiping the EIR.

The gate complex can be further automated to improve the speed and reliability of gate transactions. The main components may include inbound and outbound Optical Character Recognition (OCR) portals, chassis cameras, radiation scanners, X-ray scanners, weigh-in-motion scales, traffic stop arms, LED lighting, and a Gate Operating System (GOS), all supported by a robust computer system and hardware. The objectives are to give optimum service to truckers and to improve the turnaround time in the container yard, e.g. to a maximum of 30 minutes. The truck drivers would not be required to leave their truck cab for efficiency and safety reasons.

Condition Assessment

A condition assessment of the New Truck Gate was performed in August of 2021 and found it to be in **good** condition. In general, deficiencies were not observed. However, the three booths under the canopy are in marginal condition and are not configured properly.

Maintenance and Operational Improvements

To improve safety and security measures, the PAG is implementing an improvement project to replace the booths. The new booths will be constructed with reinforced concrete, provide additional space, and arranged so that staff have a direct line-of-sight to in-coming trucks.

4.2.3.7.3 Guard Booths

There are two guard booths on either side of the gate complex constructed with reinforced concrete. See Photo 22.

Condition Assessment

A condition assessment of the Guard Booths was performed in August of 2021 and found them to be in **fair** condition. At both booths, damage to the windows was observed.

Photo 22: Guard Booth

4.2.3.7.4 Fencing

Two types of yard fence were observed: (1) CMU wall with one side outrigger with three strands of barbed wire angled outward; and (2) chain-link fence with vinyl coated fabric and galvanized pipe posts.

Some chain-link fence gates, either for vehicles (by-parting type, w=24-60 feet) or for pedestrians (swing type, w=3’-6” feet), were observed along the north and west boundaries.

Condition Assessment

A condition assessment of the fencing was performed in August of 2021 and found them to be in **marginal** condition. Significant corrosion was observed on the metallic part of gates and fences.

Maintenance and Operational Improvements

The chain-link fencing surrounding the eastern end of the container yard were replaced as part of the MARAD program in 2015. Where practical, any remaining chain-link fencing should be replaced with CMU fencing. Future chain-link fencing should incorporate concrete posts and anticipate replacing the chain-link fencing fabric at a regular interval.

4.2.4 TERMINAL UTILITIES

Water supply is provided through a main supply line from the GWA. A dedicated fire suppression water tank with 274,000-gallon capacity and three fire service pumps, was installed at the Port in 2015. The sewage system is a gravity fall system to a GWA sewage pump station. The storm drainage system is also a gravity system. Power is supplied by GPA's 13.8kV underground lines along Route 11 outside of the terminal. Five electrical Load Centers constructed as hardened structures inside the Cargo Terminal store the PAG's seven Prime Power generators, which were installed in 2016. Other utilities such as telephone, internet and radio communications are available at the terminal.

A field survey and interviews with various departments of PAG were conducted in order to obtain the following information and inventory of site utilities at the Port. Findings on the current major site mechanical, electrical, and plumbing (MEP) facilities are listed in Table 4-8 for easy reference. Details of each system are discussed in the following section.

Table 4-8: Major Site Utilities

CONTAINER YARD LIGHTING			
Equipment Details		**Current Capacity**	**Remarks / Comments**
50-foot Steel Pole			In general, 1,000 to 1,500 watt Metal Halide Lamps
5 x Lamps		17 Ea.	
4 x Lamps		11 Ea.	
50-foot Concrete Pole			
5 x Lamps		1 Ea.	
4 x Lamps		2 Ea.	
3 x Lamps		1 Ea.	
2 x Lamps		1 Ea.	
1 x Lamps		1 Ea.	
80-foot Pole			
4 x Lamps		1 Ea.	
3 x Lamps		2 Ea.	
2 x Lamps		1 Ea.	
100-foot Pole			1,000W High Pressure Sodium
30 x Lamps		2 Ea.	
25 x Lamps		1 Ea.	
20 x Lamps		1 Ea.	
15 x Lamps		1 Ea.	
ELECTRICAL SUPPLY			
Equipment Details		**Current Capacity**	**Remarks / Comments**
GPA Supply		13.8kV	Limited by the underground line supplying PAG.
LC1	Tx.	2000kVA 13.8kVDelta 480 v / 277-volt 3ph/4wire wye	
	Gen.	750kVA 480 v / 277-volt 3ph/4wire wye	New Generator installed as part of the Refurbishment and Hardening of Load Centers 1, 2, 3, and 4 project. With separate fuel tank (500Gal) outside LC-1

LC2	Tx.	1000kVA 13.8kVDelta-480 v / 277-volt 3ph/4wire wye	Transformer replaced as part of the Refurbishment and Hardening of Load Centers 1, 2, 3, and 4 project.
	Gen	344kVA 480 v / 277-volt 3ph/4wire wye	
LC3	Tx.	750kVA 13.8kVDelta-480 v / 277-volt 3ph/4wire wye	Transformer replaced as part of the Refurbishment and Hardening of Load Centers 1, 2, 3, and 4 project.
	Gen.	455KVA 480 v / 277-volt 3ph/4wire wye	Installation of new 455KVA generator, automatic transfer switch and AST completed in July FY2022
LC4	Tx1	2000kVA 13.8kVDelta-480 v / 277-volt 3ph/4wire wye	Supplied by GPA
	Tx2	1500kVA 13.8kVDelta-240Volt/3ph./3wire Delta	Supplied by GPA
	Gen1	625kVA 480 v / 277-volt 3ph/4wire wye	At 55% with 280kVA avail. Backup only loads connected to GPA supplied Tx1. load. With separate fuel tank (600 Gal) next to Gen. Only runs the 480V Reefers/ Gate house/ Yard lighting
LC5	Tx1	2000kVA 13.8kVDelta-480 v / 277-volt 3ph/4wire wye	Installed in 2015 as part of the MARAD project.
	Tx2	1500kVA 13.8kVDelta-240Volt/3ph./3wire Delta	Installed in 2015 as part of the MARAD project.
	Gen1	625kVA 480 v / 277-volt 3ph/4wire wye	With separate fuel tank (600 Gal) next to Gen. Runs the new Truck Gate, Guard Shacks, and Yard lighting

LIGHTNING PROTECTION SYSTEM		
No lightning protection system provided to buildings, cranes or lamp poles.		
WATER SUPPLY		
Equipment Details	**Current Capacity**	**Remarks / Comments**
Main Supply Water Pipe from GWA	16 inches	The existing main water lines are over 50 years old. The 16-inch main line distributes to other waterlines throughout the container yard. Existing 16-inch and 10-inch water lines run diagonally though the container yard and return to Route 11. There is a 10-inch looped system that covers the waterfront which feed buildings on the west side of the terminal. The existing waterlines have multiple leaks.
FIRE SERVICES		
Equipment Details	**Current Capacity**	**Remarks / Comments**
Fire Hydrant, Sprinkler and Fire Alarm	Fire Hydrant and Sprinkler systems are direct fed from the GWA water pipe	A new reservoir and pump station was installed as part of the MARAD program in 2015. The system provides service to hydrants in the east expansion area. Remaining hydrants and sprinkler systems are direct fed from the GWA water supply main There is no direct link between the fire alarm system and the local fire station.
Air Conditioning System		
Both air-cooled chiller systems for Administration and former Horizon Buildings are not operational. Current air-conditioning systems for the buildings are split units.		
Sewage System		
Gravity fall system is used and no sewage pumps have been installed. The sewer is fall by gravity to a sewage pump house with the capacity of 150gpm provided by GWA near the main gate.		

Note: This matrix is a compilation of current equipment based on information received from PAG.

PORT AUTHORITY OF GUAM

4.2.4.1 Electrical Service and Load Centers

The power supply to the Port originates from the GPA 13.8kV line along Route 11 outside of the Port, and this line also feeds the other piers and facilities along the road. The line is radial fed and without ring arrangement.

There are two incoming feeders originating from the GPA line to feed the primary electrical substations (Load Centers) of the Port. There are five Load Centers namely LC1 to LC5 installed in and servicing the entire Port. Each Load Center has an emergency diesel generator to back-up the essential loads. Figure 4-11 shows the GPA power supply schematic for PAG.

Incoming Service

PAG receives power by GPA distribution feeder P-003 with a radial fed 13.8kV line routed through an underground system from PITI Substation to the GPA Cabras Facility then to an underground system built in 2012 under Route 11.

Switchgear – Primary Distribution

LC1 is fed from a GPA 600amp, 13.8kV, 15kV manual switchgear and then connected to one un-fused incoming disconnect switch and three fused disconnect switches with one feeding LC1 distribution transformers and the other two switches feeding LC2 and LC3.

LC2 contains one fused disconnect switch

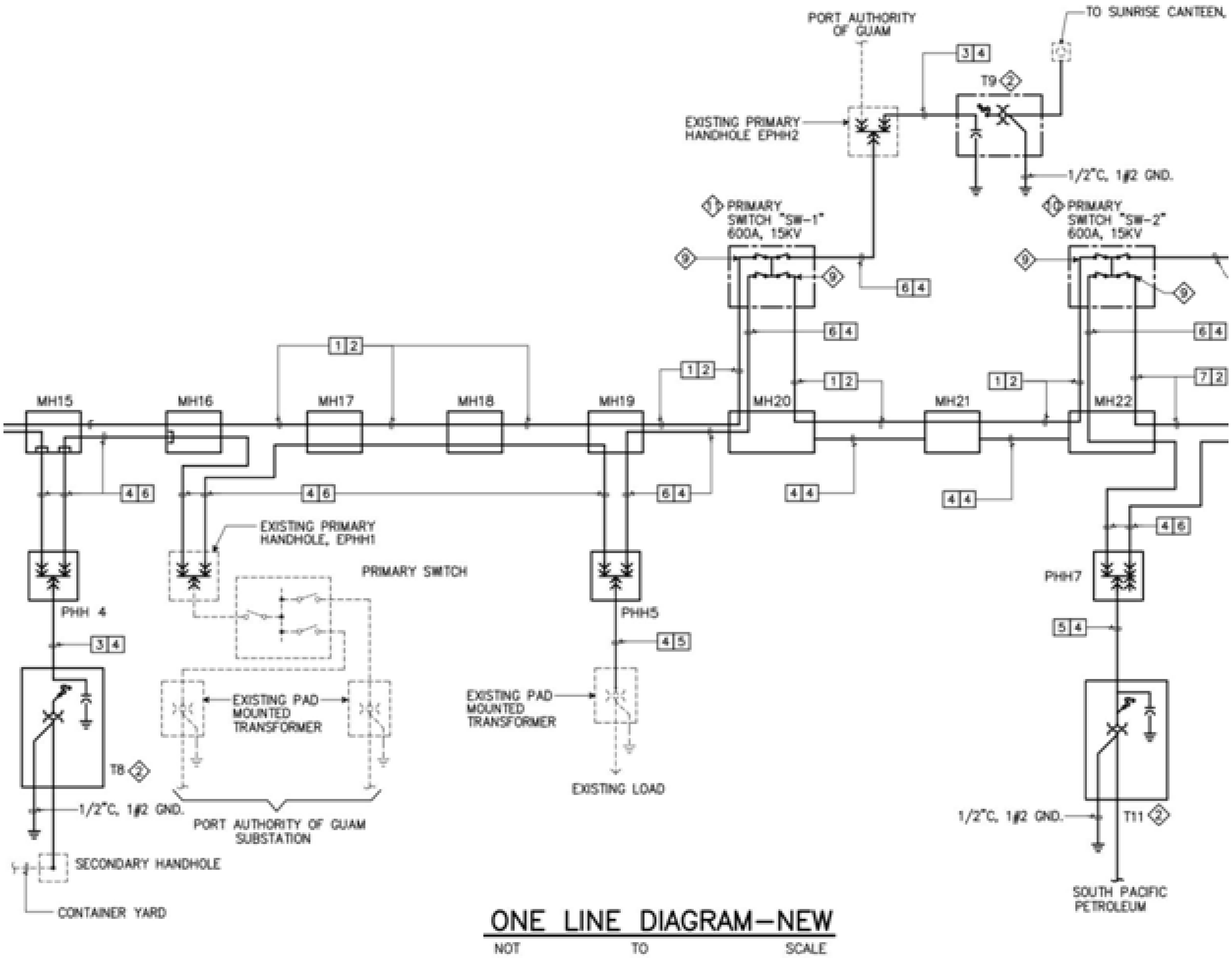
LC3 contains one fused disconnect switch

LC4 is fed from a GPA 600amp, 13.8kV, 15kV manual switchgear

LC5 is fed from Guam Power Authority

wsp

Figure 4-11: GPA Power Supply Schematic for PAG



Source: The PAG

Switchgear – Secondary Distribution

LC1 secondary distribution switchgear contains one 1,200-amp, 480 v/277 volt, 3ph./ 4 wire wye distribution panel completed with one 4-Pole 1,200-amp Automatic Transfer Switch (ATS) connected to the emergency generator. LC1 supplies power to the Administration Building and the vicinity areas including the Port Police Building, the Admin Annex, EQMR parking lightings, etc.

LC2 secondary distribution switchgear contains one 1,200-amp, 480 v/277 volt, 3ph./ 4 wire wye distribution panel completed with one 4-Pole 1,200-amp ATS for the connection of the emergency generator. LC2 supplies power to WH1 and WH2 and vicinity including the service outlets along F3 and F4.

LC3 secondary distribution switchgear contains one 1,200-amp, 480 v/277 volt, 3ph./ 4 wire wye distribution panel completed with one 4-Pole 1,200-amp ATS for the connection of emergency generator. LC3 supplies power to the CFS Building, Low Tower, High Tower and vicinity including the service outlets along F5 and F6 and the container yard lighting.

LC4 secondary distribution switchgear contains one 2,000-amp, 480 v/277 volt, 3ph./ 4 wire wye distribution panel completed with one 4-Pole 2,000-amp ATS for the connection of an emergency generator and one 3,000-amp, 240 volt, 3ph./ 3 wire Delta distribution panel. LC4 is to be upgraded with ATS for 3,000-amp service with 937 kVA, 240 Delta under the current generator set procurement.

LC4 supplies power to the Gate house Building and vicinity including the reefer outlets and container yard lighting.

LC5 supplies power to the Truck Gate complex, guard shacks (2), and future reefer outlets.

Transformers

The transformers in the load centers include the following:

LC1 – one 2,000kVA, 13.8kV Delta-480v/277-volt, 3ph/4 wire wye

LC2 – one 1,000kVA, 13.8kV Delta-480v/277-volt, 3ph/4 wire wye

LC3 – one 750kVA, 13.8kV Delta-480v/277-volt, 3ph/4 wire wye

LC4 – one 2,000kVA, 13.8kV Delta-480v/277-volt, 3ph/4 wire wye and one 3200kVA, Delta/Delta 13.8kV/240-volt.

LC5 - one 2,000kVA, 13.8kV Delta-480v/277-volt, 3ph/4 wire wye

Emergency Generators

Emergency diesel generators are installed in each LC to back-up and maintain the essential service in each LC. The details for generators in the LCs are provided below.

LC1 – one 750 kVA generator.

LC2 – one 344kVA, 480v/277-volt, 3ph./4 wire wye with one set of integral diesel fuel tank. The transformer was replaced in 2022.

LC3 – one 455kVA, 480v/277-volt, 3ph./4 wire wye, with one separate diesel fuel tank in LC3.

LC4 – one 625kVA, 480v/277 volt, 3ph./4 wire wye, with one separate diesel fuel tank (600 Gal) in LC4. It is planned that a 937kVa-240-volt service will be added to the building to accommodate the 240-volt reefers and to replace the current generator set with a 750 kVa-

480-volt generator. The current LC4 generator will move to LC2 when the new generator sets arrive.

LC5 – one 2000kVA 480V/277-volt, 3ph./4 wire, with one separate diesel fuel tank (600 Gal) in LC5.

Generator upgrades were completed in 2022.

Condition Assessment

A condition assessment of Load Centers 1, 2, 3 and 4 was performed in August of 2021 and found them to be in **good** condition. This is a result of the Refurbishment and Hardening project that was completed in 2022. With the upgrade of LC4 and the reduction in demand for LC2 and LC3, a substantial amount of spare capacity in the secondary distribution voltage level (i.e., 480/277 volt) should be available.

4.2.4.2 Yard Lighting

Yard lighting consists of (34) 50-foot and (4) 80-foot-tall pole-mounted flood lights with 1,000W metal halide lamps are installed to luminate the majority of the container yard. See Photo 23. The numbers and configuration of the flood lights on each pole are different to suit the location. Five 100-foot-tall poles were added in 2015; three in the breakbulk area and two in the small container yard expansion area. See Table 4-8 for additional information.

Lighting poles inside the yard are supported by reinforced concrete spread footings measuring 7'-0" square x 1'-6" deep with 28- x 28-inch pedestals. The bottom elevation of the footings is located 6 feet below finished grade. The 100-foot light poles are supported by a drilled shaft (4'-6" foot diameter x 25-feet long). The top of the drilled shafts sit one foot above finished grade.

The Port replaced the 50-foot and 80-foot existing container yard light poles and lights in 2012 as part of a security grant project. These were replaced in their original locations. With the addition of these new poles, all high mast lights (50, 80 and 100 feet) will likely remain where placed for the 20-year planning horizon unless the Port acts to make minor adjustments associated with future pavement replacement.

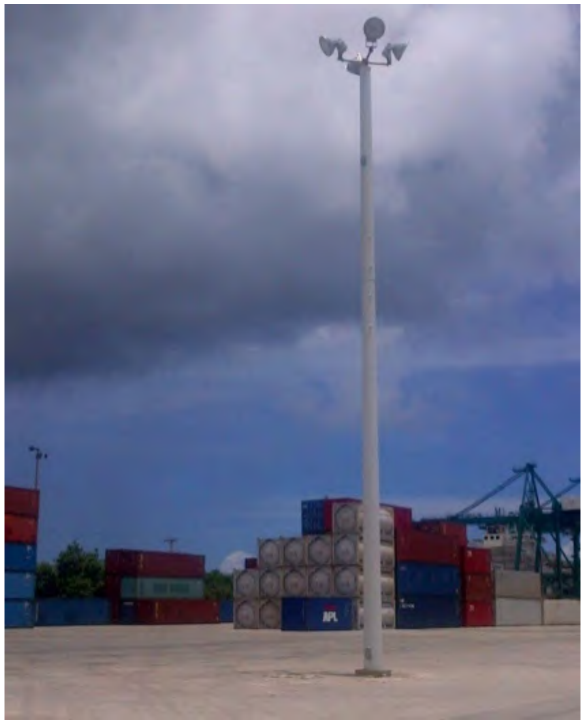


Photo 23: Container Yard Light Pole

Condition Assessment

A condition assessment of light poles was performed in August of 2021 and found them to be in **good** condition.

Maintenance and Operational Improvements

Yard reconfiguration and systems upgrades accomplished over the past several years are expected to address cargo capacity handling demands for the next 20 years. However, the Port will have the option, as it progressively replaces yard pavement, to add flexibility where containers are stacked. In the process of doing that, selected high-mast lighting could be raised to 100 feet to allow higher stacking of containers in selected areas.

4.2.4.3 Storm Water Drainage System

The storm water gravity drainage system consists of 12-inch to 30-inch diameter RCP underground pipes, sump pits, and surface drain channels (36 x 34 inches) which are provided to collect storm water and direct discharge coalescing plate oil water separators that were installed during the MARAD project in 2015 along with flow splitters and manholes at each location. The oil water separators vary in dimension based on the design flow rate of water to be treated. There are two outfalls at Berth F3, four outfalls between Berths F4 and F6 and two in the Piti Channel area. One outfall was constructed as part of the Port Modernization Program south of the expansion area. Four ponding basins were also constructed as part of the 2015

MARAD project; one at the truck gate area and three along Route 11 north of the Administration Building.

Trench drains are used at selected areas of the container yard to capture surface runoff. See Photo 24.

Condition Assessment

The trench drain grates are in **poor** condition.

Maintenance and Operational Improvements

PAG is selectively replacing deficient grates with heavier duty grates.

Photo 24: Container Yard Trench Drains

4.2.4.4 Sanitary Sewer System

The Port is currently served by a gravity sewer system which consists of underground pipes (-2 to -11 feet from grade elevation) and sump pits. The sewage is collected at the central lift station (pump house) provided by GWA, which is located near the main gate. The GWA lift station pumps sewage to the gravity line in Marine Drive which flows to the Hagåtña Treatment Plant. The existing GWA lift station system is designed for a capacity of 150gpm. Port maintenance staff indicated that blockage of the sewage is rare.

4.2.4.5 Domestic Water System

There is one 16-inch main water supply pipe from GWA located at the eastern end of the Port to provide water supply for the Port and properties west of the Port terminal. The 16-inch mainline is reduced to 12 inches and continues to the parking area in front of the Administration Building. After the abandoned water meter chamber located in the southeast corner of the yard, a 12-inch pipe is tapped off from the 16-inch pipe to supply the tenants outside the Port in the Industrial Park and on the Breakwater. It is unknown if the two 12-inch lines connect at the point of convergence west of the Port Administration Building parking area.

The water system included with the original Port buildings in 1970 contained a 10-inch looped system that covered the waterfront and the Port buildings on the west end of the terminal. Six-inch lines were connected from the 10-inch lines to fire suppression systems within the buildings and hydrants in the container yard. Smaller lines were connected to the buildings for potable water service. The previous Master Plan identified that Port maintenance staff stated the piping in the terminal contains asbestos. The pipe materials for this are unknown from drawings reviewed but Asbestos Concrete Pipe were commonly used in the 1970s.

As part of the 2015 MARAD-funded port modernization efforts, domestic waterlines were installed to Warehouse 1, the Administration Building and Berths F3 to F6 in a looped system connecting to the waterline along Route 11. An additional domestic waterline was installed to the Low Tower Building. These waterlines resulted in an upgraded system built to today's drinking water standards.

Condition Assessment

N/A

Maintenance and Operational Improvements

The Port issued an IFB in August of 2021 to relocate the main service feed to a new alignment along Route 11 and adding water lines within the container terminal to replace failing water lines. The new water line network is intended to provide redundancy and improve water pressures to meet local building codes, National Fire Protection Association (NFP) requirements and USCG requirements for firefighting.

4.2.4.6 Fire Protection System

Fire hydrants and sprinklers were originally tapped off the main water supply pipe network (mixed with the domestic water supply system) within the Port. This was rectified in 2015 under the Port Modernization Program where a storage tank and pump station were constructed adjacent to the new truck gate. The tank has an inside diameter of 45-feet and a wall height of 25'-9". This system upgrade brings pressures and flows up to an acceptable level to achieve required fire water capability.

Fire water lines were installed from the new storage task to hydrants in the expansion area. In addition, fire water lines were installed in various locations throughout the yard to improve fire-fighting capabilities. The potable water service was separated from the fire water system under the Port Modernization Program as well.

There is no direct link between the Port fire alarm systems and the local fire station. A Fire alarm raised in the Port would need to be reported to the fire station by telephone. The closest fire station in Piti is approximately 2 miles away.

4.2.4.7 Other Building Services

No lightning protection devices were found in the Port buildings, lamp poles, or cranes. Suitable lightning protection devices should be considered to protect Port facilities and the operators. However, lightning protection was installed on the new high mast light poles in 2015 under the Port Modernization Program.

A central air conditioning (A/C) system with an air-cooled chiller serves the Administration Building and the Admin Annex. Other small buildings are served by split A/C or window A/C systems, many of which were recently replaced based on the August 2021 assessment. This combination of equipment is considered suitable for the current facilities and avoids the need to run extensive services underground to serve isolated small buildings.

4.2.4.8 Container & Cargo Handling Equipment

Cargo is moved between the port and vessels by three rail-mounted ship-to-shore (STS) Gantry cranes (Gantry 4, 5 and 6) or ship gears. Gantry Cranes 2 and 3 will be demolished and removed from Port property in 2023. When completed, additional space will be available at Berth F4. This project also includes demolition and disposal of two RTG cranes and one Mobile Harbor crane.

PAG has instituted a structured maintenance program to ensure that the remaining cranes and cargo handling equipment (CHE) are in good operating condition. PAG awarded a Performance Management Contract (PMC) for the existing STS Gantry cranes in 2022. The objective of the PMC contract is for training of Port crane mechanic staff and performance, operation, maintenance emergency response, trouble shooting, diagnostic and repairs to the gantry cranes on an as-needed basis. The service contract includes performance monitoring and preventative maintenance of equipment and facilities associated with the gantry cranes.

On occasion, selected vessels will use ship’s gear to load and off-load cargo. Roll-on/Roll-off (Ro/Ro) vessels load and offload vehicles using vessel ramps down to the wharf.

Once off the vessel, grounded storage containers are handled by yard tractors/bomb carts and toplifters. Wheeled container cargo is handled by 28-yard tractors and chassis (carrier-supplied). Breakbulk cargo is currently handled using forklifts varying in capacity from 5 to 20 tons.

The maximum reach of the STS cranes from the waterside rail is 115 feet. For additional information regarding cranes and CHE’s, see Table 4-9 and Table 4-10.

Table 4-9: Port Owned Cranes

Name or Designation	Age	Capacity	Height Above WS Rail
Gantry 4 (POLA 1)	1983 Re-powered and strengthened in 2009	40 LT	85 feet
Gantry 5 (POLA 2)	1983 Re-powered and strengthened in 2009	40 LT	93 feet
Gantry 6 (POLA 3)	1983 Re-powered and strengthened in 2009	40 LT	93 feet

Source: The PAG

Table 4-10: Port Owned Cargo Handling Equipment

Equipment	No.	Year	Make/Model	Capacity
Top Picks	3 4 2	2009 2016 2019	Hyster H50.00XM Hyster 1150CH Taylor XLC97E	40 Short Ton – 5 High 40 Short Ton – 5 High 40 Short Ton – 5 High
Yard Tractor	9 16	2010 2017	Kalmar/Ottowa Kalmar	YT-50 T2 4x2
Forklift	4 4 2 4	2008 2016 2017 2017	Hyster H5.00DX Doosan D50SC-5 Hyundai 180D-7E Hyundai 110D-7E	5.5 Short Ton 5.5 Short Ton 20 Short Ton 10 Short Ton

Source: The PAG

Cranes are numbered in sequential order based on purchase history. See Table 4-11. As a result, the designation does not represent the number of cranes the Port currently owns. Gantry Cranes 4, 5, and 6 were upgraded to “as new” condition in 2009 with an estimated remaining service life of 20 years (2029) assuming regular preventative maintenance is performed. Periodic upgrades and parts replacement can extend the useful life of the cranes.

Currently, PAG is in the process of acquiring new STS Gantry cranes to replace the current cranes which are expected to expire in 2029. The IFB is anticipated to be issued in 2023 for acquisition of three new cranes. Currently, Gantry Cranes 2 and 3 are being demolished.

Table 4-11: PAG's STS Gantry Cranes

Name or Designation	Year Built/Upgraded	Capacity	Height Above WS Rail	Remaining Estimated Useful Life
Gantry #4	1983/2009 In Service at the Port in 2023	40 LT	85 feet	4 Years (2026)
Gantry #5			93 feet	4 Years (2026)
Gantry #6			93 feet	4 Years (2026)

Source: WSP analysis. Data provided by the PAG.

While the Port's three gantry cranes can handle the forecasted container volumes associated with the military build-up, there is limited capacity to accommodate additional breakbulk volumes, as well as minimal flexibility for downtime to address crane breakdowns and crane maintenance.

4.2.5 MARINE INDUSTRIAL COMPLEX AND FUEL/CEMENT FACILITIES

Assets within the Marine Industrial Complex and Fuel/Cement include oil tanks and pipelines, warehouses, cement silos, multiple light-gauge sheds, and several marine facilities consisting of piers, wharves, beaches, and a Seaplane ramp. See Figure 4-12. The Marine Industrial and Fuel/Cement areas have been leased to private companies since 1969/1970.

Bulk fuels from Mobil Oil and Tristar Agility are delivered to their storage tanks from the adjacent Golf Pier marine transfer facility or from Pier F1 through terminal piping within the South Pacific Petroleum Corporation (SPPC) facility. Typically, liquid bulk products are delivered in bulk to marine facilities via tanker vessel every 20 days. These products are then distributed by pipeline from their storage tanks to their loading racks, where the products are loaded into tank trucks and distributed to service stations, as well as commercial and government accounts throughout Guam. A portion of the bulk fuels are reloaded at the pier to coastal tankers for distribution to the FSM and CNMI.

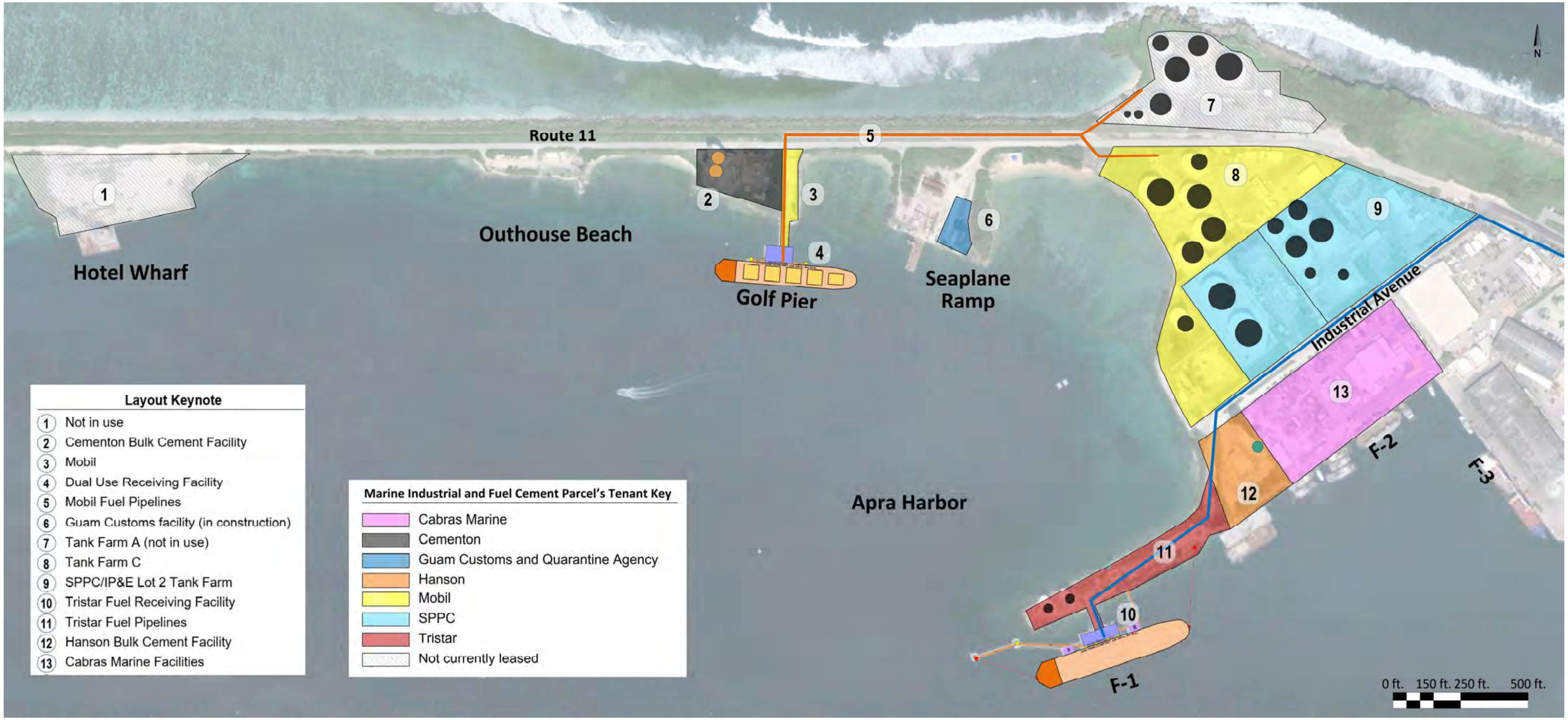
The facilities, including the Oil Tank Farm north of Route 11 (Area A), are located in an area to the northwest of the commercial terminal on about 45 acres of land. The tank farm located on Area A has been abandoned and is no longer in use.

Table 4-12: Marine Industrial and Fuel/Cement Tenants

Tenant	Lot No.	Lease Start Date	Area ± (SF)	Purpose
Mobil Oil Guam	1	3/20/1970	248,873	Oil Company[1]
South Pacific Petroleum	2	10/1/1969	217,800	Oil Company
South Pacific Petroleum	3A	1/8/1971	140,002	Oil Company
Mobil Oil Guam	3B	1971/03/04	82,799	Oil Company
Guam United Warehouse	4		173,217	GEDA-owned area
Cabras Marine Guam	5	4/1/1970	223,865	Small boat dry-dock facility
Hanson Cement Inc.	6	1/4/1971	71,773	Cement Supplier
Tristar Agility	7 / F1 Fingertip	6/13/1969	78,651	Oil Company[1]
Cementon Micronesia	3-1	12/1/2009	78,364	Cement Storage
Guam Customs and Quarantine Agency				

[1] Management Agreement
Source: WSP analysis. Data provided by PAG

Figure 4-12: Marine Industrial Complex and Fuel Cement Facilities



Source: Google Earth and WSP

4.2.5.1 Pier F1 Marine Structures

Pier F1 is located in the Marine Industrial Complex and serves as the primary fuel pier for handling crude oil and liquefied petroleum gas (LPG). The pier is comprised of a main pier, approach trestle, and mooring and breasting dolphins. The main pier is approximately 135 feet long by 45 feet wide and is constructed with a cast-in-place concrete deck supported by concrete pile caps on steel pipe piles. A trestle of similar construction is present north of the main pier and provides direct access to the pier. See Figure 4-13. Mooring Dolphins A and B are located northwest of the main pier and consist of concrete pile caps supported by steel piles. Breasting Dolphins C, D, G and H are located on the southwest and northeast sides of the main pier and are of similar construction to the mooring dolphins. Access to the mooring dolphins is provided by pile-supported walkways that extend from the southwest breasting dolphin. Note that a pile-supported walkway is also present east of the main pier and provides an alternative means of access to the northeast breasting dolphin.

The fuel and product receiving facilities on Pier F1 consist of offloading hoses, piping, pumps, receiving tanks and distribution pipelines to various end users. Typical vessels that call on Pier F1 range in size from the Eco Galaxy at 8,000 DWT to the NS Concept at 110,000 DWT.

Products, annual offload rates and destinations are typically as follows:

- Diesel: 1,063,000 Barrels to Isla Petroleum & Energy (IP&E) and Mobil Oil Guam
- Jet Fuel: 1,428,000 Barrels to Isla Petroleum & Energy, Defense Logistics Agency, Mobil Oil Guam
- Mogas 91: 625,000 Barrels sent to IP&E, Mobil Oil Guam
- Mogas 95: 101,000 Barrels sent to IP&E
- High Sulfur Fuel Oil: 1,600,000 Barrels to Guam Power Authority
- Low Sulfur Fuel Oil: 411,000 Barrels to Guam Power Authority
- LP Gas: 68,000 Barrels to South Pacific Petroleum Corporation

Figure 4-13: Pier F1

Condition Assessment

The pier is in **serious** condition. Several elements have severe damage consisting of spalled concrete, open corrosion spalls, bent piles, sheared piles, split piles, and non-functional fender systems. At multiple locations, failed pile repairs are present at the pile to pile cap interfaces. Open- and close-corrosion spalls were also observed at the main pier and trestle. Slope protection is in fair condition. The peninsula area west of the trestle was constructed on reclaimed land and is founded on sunken barges. Along the south shoreline west of the trestle, approximately 200 feet of rip rap is missing. At this location, portions of corroded steel barges are visible. Along the north side of the peninsula, a void is present beneath the concrete slab-on-grade which has settled. See Photo 25, Photo 26, and Photo 27. A detailed condition assessment report for Berth F1 is provided in Appendix C.

Photo 25: Main Pier (Open Corrosion Spalling)

Photo 26: Breasting Dolphin H (Failed Repair and Damaged Fender System)

Photo 27: Peninsula West of Trestle (Exposed Barge Foundation)

Maintenance and Operational Improvements

Repair recommendations for structural marine components are provided below. Recommendations are based on element level damage ratings for individual elements and the effect that the damaged elements have on the overall use of the Pier. Typically, components rated as poor, serious, or critical are comprised of multiple elements having major or severe damage. For these types of structures, it is recommended that elements are repaired or replaced to avoid temporary load restrictions and to help prevent further damage which may impact the daily use of the facility.

At Pier F1, it is estimated that some components have been in service since the 1940s and are well beyond their design service life; evidenced by corrosion, spalling, breakage, and multiple repair phases. For this reason, it is recommended that deficient structural elements be repaired and/or replaced as described below.

- Replace Mooring Dolphins A and B
- Replace Breasting Dolphins C, D, G, and H
- Repair the Main Pier and Approach Trestle. Prior to performing repairs, a special purpose inspection should be performed to collect detailed damage information and to outline the extent of repairs that are needed.
- Regarding the peninsula area west of the trestle, it is our understanding that the two storage tanks are no longer in use. For this reason, it is recommended that a study is performed to understand the intended use of the peninsula and whether short-term or

long-term repairs are best suited for this area. The design fee to perform this study is not included in the repair cost estimate.

Currently, PAG's tenant (TriStar) is performing a feasibility study that will evaluate multiple repair/replacement alternatives.

4.2.5.2 Berth F2 Marine Structures

Berth F2 is located in the Port's Industrial Marine Complex. Cabras Marine (Cabras) holds a long term lease at this berth and landside property to support their Guam and Saipan based assets and operations. At this location, Cabras operates a floating dry dock for vessel repairs on ships up to 1,000 tons with drafts of 26 feet or less. The Cabras leased area, Berth F2 and their activities are separate from the cargo terminal secure areas and operations.

Berth F2 is approximately 670 feet long and is defined by a reinforced concrete pile cap located at the top of a sheet pile bulkhead. It is estimated that the top 15 feet of the sheet pile wall is faced with unreinforced concrete. The fender system consists of irregularly spaced rubber fenders and floating foam-filled fenders. See Figure 4-14.

Figure 4-14: Berth F2

Source: Google Earth and WSP

Condition Assessment

The berth is in **poor** condition. The concrete facing has delaminated and spalled from the steel sheet pile wall at several locations. At the inner tidal zone, severe corrosion is present at the sheet pile wall. Previous inspection reports identify holes in the sheet pile wall at multiple locations. Open-corrosion spalling of the longitudinal concrete pile cap is present at multiple locations along the length of the berth. In general, Berth F2 lacks a dedicated fender system. Moderate to major corrosion is present at the mooring hardware. See Photo 28. A detailed condition assessment report for Berth F2 is provided in Appendix B.

Photo 28: Berth F2

Maintenance and Operational Improvements

Repair recommendations for structural marine components are provided below. Recommendations are based on element level damage ratings for individual elements and the effect that the damaged elements have on the overall use of the Pier. Typically, components rated as poor, serious, or critical are comprised of multiple elements having major or severe damage. For these types of structures, it is recommended that elements are repaired or replaced to avoid temporary load restrictions and to help prevent further damage which may impact the daily use of the facility.

- Repair Holes in the Sheet Pile Wall: This repair consists of installing steel patches over existing holes and displacing water by pumping cementitious grout into the voids. Due to the age of the structure and severity of damage observed, this repair procedure should be considered a temporary means to extend the life of the sheet pile wall.

- Repair the void in the sheet pile wall at Station 6+76. Remove the existing rip rap and install a sheet pile wall that extends approximately 40 feet to the north. Install grout or concrete at the corner, backfill, and replace the rip rap.
- Mooring Hardware Rehabilitation: Perform coating repairs at the mooring hardware. Remove dirt, oil, debris and existing paint/coating systems and apply a high-performance coating system.
- Overlay Repairs: Remove and replace the asphalt and concrete overlay at areas with significant damage and non-uniform surfaces.
- Concrete Pile Cap and Facing: Repair of the pile cap and removal of damaged/delaminated portions of the concrete facing may result in further damage to concrete at surrounding areas. For this reason and because the berth lacks a dedicated fender system, it is recommended that an in-depth study of Berth F2 be performed. The study should include fender system alternatives and discuss the feasibility of replacing the sheet pile bulkhead or performing a large-scale repair program.

4.2.5.3 Seaplane Ramp

Seaplane Ramp is located on the north side of Apra Harbor adjacent to Golf Pier. The structure consists of a sheet pile bulkhead, concrete pile cap, slope armoring, and a concrete loading/unloading ramp. The ramp originally served as the landing point for military boats and tracked landing vehicles. Utilities and permanent buildings are not present.

Condition Assessment

In general, the ramp is in **poor** condition. Major cracking and delamination of the concrete is present at multiple locations. Similarly, mechanical spalling and closed corrosion spalling were also observed at the top of the bulkhead and adjacent to mooring hardware. See Photo 29 and Photo 30.

Photo 29: Seaplane Ramp Bulkhead

Photo 30: Seaplane Ramp

Maintenance and Operational Improvements

Repair recommendations for structural marine elements at Seaplane Ramp are provided below. Recommendations are based on field observations from the 2021 condition assessment performed by WSP.

- At locations where open- and closed-corrosion spalling is present, remove and replace the concrete. Where exposed steel reinforced is severely deteriorated, install new steel reinforcement.
- Clean and remove corrosion from the sheet pile bulkhead and apply a high-performance coating. Similarly, remove corrosion and loose scale from the mooring hardware and apply a high-performance coating.

4.2.5.4 Golf Pier

Golf Pier is located on the northeast side of Apra Harbor and is operated by Mobil Oil Guam under a use and management agreement. The facility consists of an approach trestle, fuel pier, four breasting dolphins and a mooring dolphin northeast and northwest of the pier. Port-owned fuel lines run the length of the pier and lead to a wye between Port-owned Tank Farm A and Mobile managed Tank Farm C. The fuel lines leading up to the wye junction are in need of replacement.

<u>**Condition Assessment**</u>

Overall, Golf Pier is in **serious** condition. See Photo 31 and Photo 32. Major and severe corrosion of steel piles is present at multiple locations. Open- and close-corrosion spalls are present at multiple concrete pile cap locations. Moderate to major corrosion is present at multiple mooring bollards. At the walkways east and west of the pier leading to the breasting dolphins, severe corrosion of the steel walkway was observed. Walkways leading to the mooring dolphins northwest and northeast of the pier are missing. For this reason and because ladders are not present, crews are unable to use the mooring dolphins to tie off vessels. For these reasons, managers at Mobil Oil Guam have expressed concern related to fire escape paths for crews. If a fire were to occur on the main pier, the distance between the east and west breasting dolphins and the main pier does not provide a sufficient distance for crews to muster.

All utility service facilities including electrical, domestic water supply, and sewer within Golf Pier are ostensibly maintained on a management agreement allowance basis by Mobil Oil Guam (Mobil). In accordance with the agreement, PAG can perform regular inspection of these assets to ensure they are being maintained properly. For repair actions exceeding routine maintenance and repair, PAG works with Mobil to identify CIP projects. For example, PAG issued an IFB for Repair of Mobil Golf Fuel Pier in September of 2021. No bids were received in response to this IFB.

In regard to the fire protection system, Mobil has installed a foam fire extinguishing hydrant system. The fire water is supplied by the main water supply pipe network (mixed with the domestic water supply system) extending from the Tank Farm A and Tank Farm C areas. Three pumps in a networked configuration feed the fire protection system.

The system contains freshwater stored in Tank 8 of Tank Farm A boosted by a diesel-powered pump. If the freshwater supply is depleted, Tank Farm C has one each electric- and diesel-powered saltwater pumps capable of drawing water from Apra Harbor. Periodic cycling of the Tank Farm A pump is done to flush the lines and maintain a ready state. If the fire pumps drawing from Apra harbor are activated, the Tank Farm A pump is used to flush the lines with freshwater.

Source: WSP

Photo 31: Golf Pier (Pier and Breasting Dolphin)

Photo 32: Golf Pier (Non-Functional Mooring Dolphin)

Maintenance and Operational Improvements

Currently, the PAG is evaluating options for repair/replacement of Golf Pier. Golf Pier is suitable for use by other Port tenants and shippers for unloading liquefied petroleum gas (LPG) and cement. Discussions are underway for running a cement line down the pier and installing a motorized valve system to assure there are no safety conflicts between fueling and cement offloading operations.

4.2.5.5 Hotel Wharf

Hotel Wharf is located on the north shore of Apra Harbor and sits directly west of Dog Leg Pier. The wharf is constructed with sheet pile walls that are tied back to a sheet pile anchor wall. The waterside sheet pile wall is faced with concrete and has rubber arch fenders that provide berthing and mooring.

Condition Assessment

Overall, Hotel Wharf is in **serious** condition. Severe open- and closed-corrosion spalling of the concrete facing and longitudinal concrete pile cap are present at multiple locations. Visible from the east and west ends of the wharf, the sheet pile anchor walls are severely deteriorated. For these reasons, it has been recommended that Hotel Wharf is not used to berth large vessels and that it is demolished and replaced with a modern wharf structure. Future dredging to support deeper draft vessels should be considered as the current mudline elevation is approximately -26 feet MLLW. See Photo 33, and Photo 34.

Similar to the marine structure, the building structures on the wharf are **poor** condition. Leaking and corroded potable water supply pipes were observed at multiple locations. It is recommended that the building structures are removed and replaced.

Photo 33: Hotel Wharf (Exposed Anchor Wall)

Photo 34: Hotel Wharf (Open-Corrosion Spalling)

<u>Maintenance and Operational Improvements</u>

Currently, the PAG is negotiating with a local contractor (following a recently awarded IFB) to rehabilitate the wharf structure with a new bulkhead, modern mooring and fendering system, utilities, and pavement. This rehabilitation project will be done in phases.

4.2.5.6 Upland Structures

4.2.5.6.1 Tank Farm A

Tank Farm A is Port-owned and was previously managed by Mobil through a use agreement. It is located on the north side of Route 11, west of Industrial Avenue and within the Marine Industrial Complex. The area is comprised of seven tanks within containment walls. A majority of the tanks date to the 1960s and 1970s and have not had preventative maintenance performed since 2003. The newest tank was installed after Typhoon Paka in 1998 and received its final painting in 2002. The salt spray and the debris that has blown off the adjacent embankment has pitted the paint and accelerated corrosion. See **Error! Reference source not found.**.

Source: WSP

Photo 35: Tank Farm A

Condition Assessment

A cursory visual assessment of Area A was performed in August of 2021 and found the facility to be in **poor** condition. The pipes that supply the tank farm are disconnected at the wye that originates from Golf Pier. Most of the piping internal to the facility has been removed and what remains is not salvageable for use with the exception of the fire water supply lines for the facility. These lines may be salvaged for use in a new and upgraded fire protection system.

The loading rack structure is in **good** condition with isolated areas of concrete spalling. All of the piping has been removed on the rack and the existing piping underground appears to be in **poor** condition. The layout of the facility allows the movement of service vehicles near to the tanks within the internal road network. See Photo 36.

Photo 36: Truck Loading Facility

4.2.5.6.2 Tank Farm C

Tank Farm C is owned by Mobil and located on land leased from the Port across from Tank Farm A on the south side of Route 11 and west of Industrial Avenue within the area of the Marine Industrial Terminal. The area is comprised of five tanks within containment. The pipes that supply the tank farm originate from Golf Pier. The facility is able to receive fuel from F1 through cross piping in the SPPC facility. The fire protection of the facility is described above.

Condition Assessment

A cursory visual assessment of Area C was performed in August of 2021 and found the facility to be in **good** condition.

4.2.5.6.3 Cement Unloading Terminal (Cementon)

Cementon leases and operates the cement unloading terminal located at Golf Pier. The company operates a 161-foot, 9,000-ton-capacity cement silo on the 1.6-acre site. There are some imports of cement in super sacks through the Cargo Terminal, but the majority of their cement is imported through this facility. See Photo 37.

Photo 37: Cementon

4.2.5.6.4 Cement Unloading Terminal (Hanson)

Hanson Permanente Cement of Guam (Hanson) leases and operates a cement unloading facility in the Marine Industrial Complex. The company operates a warehouse and silo on the 1.9-acre site. See Photo 38.

Photo 38: Hanson

4.2.5.6.5 Outhouse Beach

Outhouse Beach is located on the north side of Apra Harbor and is situated between Hotel Wharf and Golf Pier. Outhouse Beach is a public beach and primarily used for water-recreational activities such as snorkeling and scuba diving. See **Error! Reference source not found.**.

<u>Condition Assessment</u>

In general, the beach and associated structures are in **fair** condition. Moderate to severe corrosion is present at the covered pavlion's sheet metal roofing. Moderate corrosion and loss of coating is present at the upland bollard. Loss of slope armoring and erosion is present along the shoreline at isolated areas.

<u>Maintenance and Operational Improvements</u>

It is recommended that severely damaged sections of the pavilion roofing are replaced with in-kind repair material. Along the shoreline, it is recommended that slope armoring is installed to prevent further loss of the shoreline and adjacent pavement.

Photo 39: Outhouse Beach

4.2.6 PAG PUBLIC FACILITIES

PAG Public Facilities include Family Beach, Dog Leg Pier, Port Beach, Marianas Yacht Club, Harbor of Refuge, Aqua World Marina, Gregorio D. Perez Marina, and Agat Small Boat Marina.

4.2.6.1 Family Beach

Family Beach is located on the north side of Apra Harbor and sits east of Dog Leg Pier and Hotel Wharf. Family Beach is a public beach used for family outings, picnics, commercial water-recreational activities, and other water-related public activities. The beach is leased to several operators for picnics, jet skiing and swimming. All utility service facilities including electrical, domestic water-supply and septic options within Family Beach are provided and maintained by these operators. See Photo 40.

Photo 40: Family Beach

4.2.6.2 Dog Leg Pier

Dog Leg Pier is located on the north shore of Apra Harbor and sits directly east of Family Beach. Dog Leg Pier is comprised of two jetties that extend approximately 320 feet to the south. Marine structures at Pier Dog are no longer present but remnants of box-shaped sheet pile walls are present on the south ends of the jetties. The sheet piles are severely corroded and pose a hazard to nearby water recreational activities. It is recommended that appropriate demolition and cleanup be performed to avoid risk and injury to the public. See Photo 41.

Photo 41: Dog Leg Pier (West Jetty)

Dog Leg Pier is now leased to several operators for picnics, jet skiing and swimming. All utility service facilities including electrical, domestic water-supply and septic options within Dog Leg Pier are provided and maintained by these operators.

4.2.6.3 Port Beach

Port Beach is located on the south side of the Piti Channel and sits north of Highway 18. Port beach is used for family outings, picnics, commercial water-recreational activities, and other water-related public activities.

4.2.6.4 Marianas Yacht Club

Marianas Yacht Club (Club) is located on the north side of Sasa Bay and sits south of Highway 18. The club provides its members with vessel mooring, parking, a clubhouse, and access to the grounds.

4.2.6.5 Harbor of Refuge (West Basin)

The Harbor of Refuge, located on the eastern end of Piti Channel provides shelter to boats from wind and wave during typhoon events and is used for long-term moorage to accommodate owners who leave the island for extended periods. Long-term moorage requires a lease that is renewed on a yearly basis and requires the owner to leave their vessel in “super typhoon” ready condition. The Harbor of Refuge has moorage for approximately 52 vessels with each vessel requiring four concrete anchor blocks for moorage.

Marine concessions ring the harbor. The concessions primarily serve the tourism industry and have both in-water and on-land facilities. Sites are leased from the Port and the concessions change over time as a result of market conditions and business successes.

In 2011 and 2012, Oceaneer Enterprises performed two dive inspections and identified several deficiencies. As a result, the Port has issued a procurement solicitation to repair and rehabilitate the anchorage blocks and moorings. Once repairs have been completed, inspections should be performed on a regular interval not to exceed five years. At a minimum, anchorage blocks and marine growth should be removed from chains and attachments prior to typhoon season.

For several years, discussions of adding a boat haul and repair facility at the Harbor of Refuge were held. Currently, if a vessel needed dry dock work or inspected by the USCG, the vessel would need to travel to Gregorio D. Perez Marina, Seaplane Ramp, or to the area where the inverted “L” shaped finger area separating the eastern area and the larger western basin where they are removed from the water and inspected. It would be prudent for the Port to identify a boat haul-out and repair facility at the Harbor of Refuge. It is recommended that a user survey be conducted to collect data related to the need of such facility, the frequency of boat inspections and repairs and to understand what features are needed. The user survey should consider the potential elimination of the haul-out ramp at the Gregorio D. Perez Marina should that marina be reconfigured in the future for additional slip spaces.

Although past inspections found that ground surface where dry dock work of vessels were improperly covered to control sediment and spills of containments, the Port has minimized such environmental concerns by ensuring the vessel owner provide a dry dock work plan and inspections are conducted on a daily basis. See Figure 4-15.

Figure 4-15: Harbor of Refuge and Aqua World Marina

Source:

Source: Google Earth and WSP

In 2011 and 2012, Oceaneer Enterprises performed two dive inspections and identified several deficiencies. As a result, the Port is preparing a solicitation to address the deficiencies. Once repairs have been completed, inspections should be performed on regular intervals not to exceed five years. Detailed underwater inspections should also be performed immediately following typhoon events. At a minimum, anchorage blocks and marine growth should be removed from chains and attachments prior to typhoon season.

As observed during the 2021 inspection effort, several boats are being stored in dry dock on the north side of the L-shaped finger. See Photo 42 and Photo 43. At some locations, the ground surface is not properly covered to contain sediment and spills from boats. Improper protection of the ground surface leaves the area vulnerable to sediment runoff or contamination by paint or cleaning chemicals that may be used.

For several years, there have been discussions of adding a boat haul-out and repair facility to the harbor to accommodate inspection and repair of boats. Currently, if an inspection is needed, boats travel to Hagåtña Marina where they are removed from the water and inspected. However, repair of vessels at Hagåtña Marina is not permitted. For these reasons, it may be prudent to install a boat haul-out and repair facility at the harbor. It is recommended that a user survey is conducted to collect data related to the need of such a facility, the frequency of boat inspections and repairs, and to understand what features are needed. The user survey should consider the potential elimination of the haul-out ramp at the Gregorio D. Perez Marina should that marina be reconfigured in the future for additional slip spaces.

Condition Assessment

In general, long-term moorage structures are in **serious/critical** condition. Listing floats, excessive deflection of framing elements, and suspect framing were observed at multiple locations. Moderate to severe corrosion of steel framing members was also observed at several locations.

Photo 42: Harbor of Refuge (Long-Term Moorage Structure)

Photo 43: Harbor of Refuge (Dry Dock Storage)

Maintenance and Operational Improvements

Currently, the PAG is evaluating the installation of additional moorings.

4.2.6.6 Aqua World Marina (East Basin)

Adjacent to the Harbor of Refuge is the Aqua World Marina, an area leased and managed by Aqua World, Inc. Aqua World manages boat slips and landside leases. Sunken vessels are present at this marina resulting from previous typhoons and should be removed to prevent further leaching of chemicals into the water and damage that may occur to passer-by vessels.

Piti Channel is subject to sedimentation from currents and erosion from the shoreline. Depending on the need to maintain small boat passage, consideration should be given to conducting a hydrographic survey and planned dredging and bank protection. See Photo 44.

Photo 44: Aqua World

4.2.6.7 Gregorio D. Perez Marina

Gregorio D. Perez Marina (also known as Hagatna Boat Basin or Hagatna Marina is located in the village of Hagatna and is the marina nearest to Guam's downtown center. The marina basin was originally constructed prior to World War II and consists of two lagoons. Several breakwaters provide protection from offshore waves and swells as well as additional protection for the marina floats within the Southern Basin.

The U.S. Army Corps of Engineers constructed the marina and basin in 1977 under the authority of Section 107 of the Rivers and Harbors Act of 1960. It consisted of an entrance channel 860 feet long, 120 feet wide, 12 to 15 feet deep; a 1.2 acre turning basin 12 feet deep; main access channel 540 feet long, 80 feet wide, 10 feet deep; a revetted mole 1,135 feet long, an east breakwater 200 feet long, a west breakwater 525 feet long; a 250-foot-long wave absorber; 3 circulation channels; and navigation aids. The navigation aids are in place. On-shore, two range towers are in place that identify the channel into the marina. The marina contains three floating docks, two boat launches, breakwaters, bulkhead structures, a rinse down station and a small miscellaneous float to the east.

A fuel refilling facility (not owned by the PAG) is in the east basin and is configured with hose lengths that allow boaters to refill their boats while tied up to a small float. However, the PAG does own the bulkhead. The containment surrounding the fuel pump is incomplete and would be insufficient to contain a spill. A sanitary sewer pump out is located on the concrete structure near the fueling facility and is owned and operated by a private company. A functioning sewer pump out station is needed at this marina. See Figure 4-16.

Figure 4-16: Gregorio D. Perez Marina

Source: Google Earth and WSP

In accordance with Public Law 17-71, PAG has authority over the public harbors, small boat marinas and marine facilities. Language in the Public Law states that the PAG has expertise in the area of managing harbors, ship docking, and implementing harbor safety as evidenced by its success at the Port. It also stated that the PAG is financially able to take on additional responsibilities in the development of marine resources. Since that transfer, the PAG has been providing financial support for the facility.

The floating docks are constructed with timber framing, plastic floats, and composite plastic lumber decking. Each dock is equipped with several finger floats and configured to accommodate approximately 40 permanent slips. The breakwater consists of a combination of rip rap armoring, and a steel sheet pile wall. Although record drawings of the landside bulkhead were not available for review, it is estimated that the landside bulkhead consists of a steel sheet pile wall faced with concrete that extends below the water line.

Two concrete boat ramps serve the West Basin. The southern boat ramp adjacent to Marine Corps Drive is used by recreational boaters with smaller trailerable boats. Because this boat ramp does not contain mooring floats, boats dropped in the water temporarily tie up to leased slips, an adjacent boat, or the concrete bulkhead. There is inadequate amount of trailerable parking area for boaters using the facility. Some boaters park their trailers in unauthorized areas which results in operational issues. The western boat ramp serves larger trailerable boats, as well as large boats that are being pulled out for inspection or maintenance. Similar to the southern float, mooring floats are not provided at the western boat ramp.

The following projects were completed with federal assistance from the Department of the Interior US Fish and Wildlife Service, which provides Sport Fish Restoration funds to the Guam Department of Agriculture. The projects had a cost share 82.5% federal and 17.5% local (PAG).

- Dock A – Replaced with composite decking and marine-treated wood framing (Completed July 2011)
- Dock B – Replaced with composite decking and aluminum framing (Completed November 2012)
- Dock C - Replaced with composite decking and aluminum framing (Completed February 2013)
- Pile Extensions at Docks A & B –20 steel piles were extended by five feet to prevent the walkways from rising above the piles during storms (Completed December 2012)

Condition Assessment

In general, GDP Marina is in **poor** condition. Widespread corrosion of the sheet pile wall at the breakwater is present above the water line. From discussions with PAG staff, it is understood that Phase 3 repairs to replace the severely deteriorated sheet pile wall is being discussed. Erosion of the slope armoring on the north side of the breakwater is present. Failure or partial failure of this structure may impact the ability for vessels to enter/exit the marina. At several locations, floats are listing and present a safety hazard to pedestrians. See Photo 45, Photo 46, and Photo 47.

Photo 45: GDP Marina

Photo 46: GDP Marina (Deteriorated Sheet Pile Wall)


Source: WSP

Photo 47: GDP Marina (Erosion on North Side of Breakwater)

Maintenance and Operational Improvements

Recommended maintenance items are provided below.

- Repair/Replace the severely deteriorated sheet pile wall

4.2.6.8 Agat Small Boat Marina

Agat Small Boat Marina (also known as Agat Small Boat Harbor) is located in the village of Agat on the west coast of Guam near Ga'an Point. The marina and detached breakwater were constructed in 1989 with contributions from the USACE and PAG. Shoreside facilities were completed in 1990. See Figure 4-17.

Figure 4-17: Agat Small Boat Marina

Source: Google Earth and WSP

The site consists of an entrance channel to the southwest (1,200 feet long), a detached breakwater, four floating docks (A, B, C, and D), a boat ramp, and loading pier. Note that Dock B is currently not in use and is not located on site. In total, the marina can accommodate mooring of approximately 150 boats. Upland facilities include a parking area for vehicles and vehicle/boat trailer combinations, an administration office, a restaurant/gift shop, and an office building that houses the Guam Fire Rescue Marine Unit.

The floats at docks A, C, and D appear to be recently replaced and are constructed with composite plastic decking and polyethylene flotation tubs. It is unclear whether framing consists of timber, aluminum, or a composite plastic material. At each float, a series of steel guide piles are used to secure the floats in position. Previous assessments state that guide piles are not tall enough to prevent the docks from floating above the piles and breaking free during a typhoon event. Access to the floats is provided by aluminum gangways topped with composite plastic decking. Potable water and electrical power are present at all floats.

In regard to the detached breakwater, wind-driven wave surges result in strong current flow into the marina near Dock D resulting in non-desired movement of vessels and excessive sediment deposits. It is understood that a study performed by USACE has been performed and discusses the causes and potential solutions to these issues.

Condition Assessment

In general, Agat Marina is in **fair** condition. With exception of minor corrosion of the steel guide piles, damage at docks A, C, and D was not observed. Similarly, the breakwater and slope armoring to the east are in satisfactory to good condition with no noticeable defects. The northern pier at the boat ramp has major to severe damage. At several locations, vertical timber framing is missing and has been replaced with rubber tires suspended from the facing. The boat ramp is in satisfactory condition with only minor cracking observed. At the loading pier, severe damage consisting of cracking, and open- and closed-corrosion spalling are present at multiple locations. Due to the severe nature and extent of damage present, it is understood that this facility closed to pedestrian and vehicular use. A sanitary sewer pump-out is located adjacent to the boat ramp but is non-functional. See Photo 48, Photo 49, and Photo 50.

Source: WSP

Photo 48: Agat Small Boat Marina

Photo 49: Agat Small Boat Marina (Loading Pier)

Photo 50: Agat Small Boat Marina (Boat Ramp North Pier)

Maintenance and Operational Improvements

Recommended maintenance items are provided below.

- Modify the height of the guide piles to accommodate storm surges.
- Remove and replace the sanitary sewer pump-out.
- Provide additional warning signs and measures to prevent vessels that exceed the marina size and weight limit from mooring. To accommodate larger vessels, consideration should be given to replacing Dock A with a heavy-duty concrete float system.
- Evaluate the USACE study regarding the detached breakwater. Meet with stakeholders to discuss the study and determine if modification to the breakwater is needed.

4.3 SECURITY AND RESILIENCY

The Port security staff polices the Port, Agat Small Boat Marina, Gregorio D. Perez Marina, Aqua World, Port Beach, Family Beach, Outhouse Beach, Marianas Yacht Club, and Harbor of Refuge over three 8-hour shifts per day. The existing functional areas within the Port include:

- Oil Tank Farm
- Office and Warehouses
- Container Yard
- Berths
- Other properties
- Family Beach
- Hotel Wharf
- Golf Pier
- Marinas (Gregorio D. Perez, Agat Small Boat Marina, Aqua World, Harbor of Refuge)
- Cruise Ship Facilities

4.3.1 SECURITY CONDITION

Harbor and Terminal Security comprise the security functional divisions at the PAG. Harbor Security uses several long-range cameras to monitor the harbor. Additionally, there are separate Harbor Masters for the PAG and Navy controlled inner Apra Harbor. This Master Plan will focus on the terminal security needs for the PAG.

Existing buildings and perimeter gates have locks where padlocks and keys are changed out periodically. Port Police personnel must be present when any perimeter gate is opened. Existing perimeter gates have locks where padlocks and keys are changed out periodically. The Police must be present when any perimeter gate is opened.

There is no permanently assigned K-9 unit. If one is needed at the Port, a unit can be borrowed from Guam airport or Guam Customs and Quarantine Agency.

Cruise ship calls at the Port have declined since 2019 due to the pandemic with only one scheduled for 2022, although the PAG would like to increase the number of cruise ships that call on the Port in the future. Providing cruise ship security is difficult, labor intensive and slow at Berths F3 to F5. Once the Hotel Wharf reconstruction is completed, the PAG will be able to offer a better facility with more efficient security operations.

4.3.2 PORT FACILITY SECURITY PLAN REQUIREMENTS

The Port Facility Security Plan (PFSP) was updated and submitted and approved by the USCG in 2021. The PFSP is a working document and is subject to change as needed. The annual inspection was completed in March of 2022 and there were no exceptions.

Compliance with the Maritime Transportation Security Act of 2002 (MTSA) regulations satisfies the International Ship and Port Facility Security (ISPS) code for U.S. ports. The PFSP for the PAG meets those requirements. The ISPS code addresses both operational and physical requirements. Ultimately, it will be the PAG’s responsibility to create the processes and procedures to meet the operational and physical requirements of the ISPS Code.

4.3.2.1 Maritime Security Levels

Port security currently follows the Maritime Security (MARSEC) system. Security level 1 is the minimum appropriate protective security measures maintained at all times under normal security conditions.

Security level 2 entails additional specific protective security measures maintained for a period of time as a result of a heightened risk of a security incident. This is the heightened level of security.

Security level 3 entails further specific protective security measures maintained for a limited period of time when a security incident is probable or imminent. This is the exceptional level of security.

4.3.2.2 Port Operations Security Requirements

The PAG must address Port operations including securing cargo handling, unaccompanied baggage, and ship’s stores. The security of the Port must be monitored, access to the Port facility should be limited, and restricted areas within the Port must be designated. The USCG recommends use of Title 33, Code of Federal Regulations, Part 6 as an applicable regulatory reference for the PAG.

Cargo Handling

Secure cargo handling must ensure cargo tampering does not occur and that the correct cargo is accepted and loaded onto vessels.

Methods of securing cargo include checking of seals or other methods to prevent tampering and using scanning/detection equipment, mechanical devices, or dogs.

Monitoring the Security of the Port Facility

Monitoring methods include lighting, security guards (foot, vehicle, and waterborne patrols), automatic intrusion detection devices and surveillance equipment, and audible and/or visual alarms.

Limiting Access to the Port Facility

Methods to limit access to the Port facility might include restricting areas by fencing or other barriers, inspecting vehicles used by those seeking entry to the Port, and verifying the identity of all Port personnel and their vehicles. Valid TWIC cards are required for unescorted access to the facility, provided that person has an appointment or reason to be on the terminal. Individuals who do not have a valid TWIC card must be escorted by a Port employee or tenant who possess a valid TWIC card.

Designating Restricted Areas within the Port Facility

Restricted areas are established and have been identified in the PFSP. Methods to restrict access to areas within the Port include providing barriers and/or fencing to surround restricted areas, access points where access can be controlled by Port Police Officers, and automatic intrusion detection devices and surveillance equipment or systems to detect unauthorized access into or movement within restricted areas.

4.3.2.3 Security Improvements

In order to secure the Port facility and ships, personnel, cargo, cargo transport units and ship's stores, the following security recommendations should be considered as part of the PAG 2023 Master Plan and PFSP.

Fencing and Barriers

The perimeter must be secured, which would entail fencing (at least 10-feet in height) with potentially barbed and/or razor wire on the top of it and barriers built with materials that will provide a useful lifespan in the Port's corrosive environment. The fencing should be designed with a minimum of access points. Any secondary entrance or exit facilities should be locked at all times when not being used and have barriers at the gates. The barriers would be moved when the secondary entrance or exit facilities are required. The primary exit and entrance facility should be appropriately sized to meet the peak traffic demands of trucks and personnel entering and exiting the facility without excessive queuing.

The exterior fencing should have cameras installed near it and sensors installed on it to monitor any activity near the perimeter. These devices should be wired back to a central security monitoring and control facility at the Port. As the Port operates 24-hours a day, there should be security staff on site and within the monitoring and controlled facility at all times.

Within the terminal, nested perimeters should be established to separate restricted areas, military operations, cargo handling areas, cargo storage areas, cruise ship areas, and utility (power and telecommunications) entrances with fencing and/or barriers. Again, this fencing may have barbed and/or razor wire on top. This interior fencing should also have cameras and sensors installed to monitor a breach in security.

There is a turn-around areas immediately after the gate complex and before the vehicle enters the terminal for all three operations should a vehicle need to be detained or turned away. The vehicle entry areas should have cameras with OCR software to be used to verify container numbers, license plates and other markings on vehicles.

Lighting

The entire facility must have lighting, to serve as a deterrent, improve visibility of cameras, and aid security officers. Lighting should be installed around the exterior perimeter, interior perimeters, and within the facility.

Additionally, if it is contemplated that security devices will be installed on lighting poles, the poles must have continuous power. Energy saving devices that only turn the power on to the poles when the light level drops to a level where the lights are activated should not be installed on those light poles. The security devices will need a permanent power source.

Scanning Devices

Scanning devices may be used for ship stores, container seal verification, and radiation monitoring. Within the entrance/exit facilities, stores handling, vehicle/documentation inspection area, and cargo handling and storage areas, scanning devices should be installed to ensure the security of stores and cargo. Even if these devices are not installed initially, it is important to set aside space for these devices and develop the power and communications infrastructure to support operation of these devices. Ultimately, these devices will be wired back to the central security monitoring and control facility.

These devices may include X-ray machines, RFID readers, mobile gamma ray imaging, and fixed radiation portal monitors.

Cameras

Cameras (both fixed and pan-tilt-zoom) should be installed along fence lines, within restricted areas, on and within restricted access buildings. Additionally, cameras should be installed at all entrance and exit facilities. An image of all license plates and transport vehicles and container markings entering and exiting the facility should be recorded and verified. This can be accomplished via cameras aimed at license plates and vehicle marking areas, and OCR software. Cameras will be a combination of visual, thermal and infra-red. All cameras will be wired back to the central security monitoring and control facility.

The PAG is installing Closed Circuit Television (CCTV) cameras throughout the cargo terminal, primarily on high mast light poles. Cameras are also being installed at the Administration Building and Horizon Building. This project was completed in 2022.

Camera height is dependent on how high the containers are stacked. Since the high mast lights in the terminal yards vary between 50 feet, 80 feet and 100 feet, mounting heights for cameras will vary. When pavement is replaced, the Port may choose to create higher density (go from 3-high to 4-high or 5-high) stacking. At that time, high-mast lights may be selectively replaced and camera mounting heights adjusted accordingly. Typically, a camera height over 80' would be required to deal with containers stacked 5 high. But this can also be impacted by aisle width and the number of stacking rows involved. It is recommended that if pavement is replaced and stacking locations and heights are adjusted, that a lighting study be conducted to confirm high-mast lighting requirements and security camera mounting heights.

Sensors

Sensors should be placed along fences, within restricted areas and buildings to detect security breaches. Sensors can detect the change of temperature, light, and heat. Sensors can also detect motion. These sensors would be wired back to the central security monitoring and control facility.

Access Control

Any restricted access to buildings or areas should have access controlled by electromagnetic locks, position switches, card readers (possibly with personal identification numbers and/or biometric input), and cameras. In case of a power failure, the doors with electromagnetic locks should have a mechanical key and access must be limited for those keys. Under this type of system, mechanical keys are the backup procedure. Currently, the mechanical locks are changed every three months at the Port. With mechanical keys as a backup mechanism, it will be easier to institute a security program where it is known who has access keys to selected areas.

The access control system is part of the CCTV project referenced above.

Audible/Visible Alarm System

As part of the alarm system, an audible and/or visual alarm system may be included so that responders on the property would know where the security breach had occurred. The audible system would add loudspeakers and a paging system, and the visible system would add flashing lights to the alarm system. Of course, personnel in the central security monitoring and control facility would know where the security breach had occurred via the electronic alarm system. The audible and visible alarm systems would be wired back to the central monitoring and control facility. Currently there is no port-wide alarm system in place.

Utilities

The site will be served by exterior power (electrical and gas) and communications (telephone, Internet, radio communications) utilities. The utility entrance onto the facility must be secured and, optimally, there would be redundant and diverse feeds for these services. This utility entrance should be one of the restricted access facilities within the Port property.

Within the site, these utilities must be distributed to the central security monitoring and control facility, buildings within the facility and, ultimately, to the electronic security devices.

A duct bank system will distribute power and communications within the Port. The duct bank system may be encased in concrete and the manholes should have locking and tamper-proof covers.

There should be redundant and back-up utility services throughout the Port. For example, there should be back-up/generator power for all necessary devices including some security devices. There should be both wire-line and wireless communications. Data should be distributed through a self-healing network topology.

Central Security Monitoring and Control Facility

The Port central security monitoring and control facility is located at the Port Command Center (PCC). The PCC is typically staffed with five police and two civilians during the day. This serves as a communications link between Port Police, first responders, emergency operations staff, and military security staff.

This is also the place where the cameras are recorded. Decisions will need to be made regarding the compression rate of the video streams and how long to store the video locally. The consequences of full motion recording and length of storage are requirements that will determine the number and size of storage devices. A final decision will need to be made regarding long-term storage of video images off-site.

The control room has space for officers on duty with desks/consoles, monitors appropriate task lighting. Also, the security officers must be able to see alarm notification and easily search stored video images.

It is recognized that the military operations will likely have a separate security monitoring facility. However, the military and terminal facilities should be linked electronically in order to inform each other of existing situations and possibly act as a secondary operations center in case the monitoring facilities goes down.

Staffing

Staffing is required to take these electronic security devices and security measures from MARSEC level 1 to level 2 to level 3. The devices, alone, will not meet the increasing demands of the security levels. Even security level 1 requires staffing and an operational plan. This facility will not operate properly without local security officers.

From the initial interview with the Port Police Chief, it is clear that there is not enough security staff to manage security at the current facility. Under the proposed Master Plan, and with the ever-increasing international security requirements, it will be crucial to fully fund the security program. This includes not only security devices, but also security staff to operate, maintain, and monitor the security devices.

Cyber-Security

The PAG commissioned a more in-depth Cyber Security study in 2022. The study will review previous security assessments (conducted in 2017), analyze cyber security policies within the Cyber Security Annex and Maritime Transportation Security Act (MTSA), assess the security gap, develop a roadmap for implementing recommendations, and perform a risk assessment.

Wired vs. Wireless Communications

For the security devices at this facility, it is recommended that a wired communications network be installed. Wireless networks are less expensive to install, but wired networks provide a greater level of security and dependability. It is more difficult to intercept a signal on a wired network than on a wireless network. Additionally, wireless networks will be installed for Port communication systems, and it may become difficult to eliminate interference between these systems that will need to coordinate their frequency plans.

Most security devices will require power; therefore, extending a wired communications network to them will be of nominal additional cost.

Electronic Manifests

The PAG had developed its own electronic manifest system; however, the PAG does not require its operators, consignees, and shippers to use electronic manifests. The PAG staff enters data, from paper records, from several of its shippers into their electronic system. Some terminal operators at the Port use a graphical system to place and then locate a container. Currently, Shippers submit an electronic data interface to PAG 24-hours prior to the arrival of the vessel. PAG downloads the information into the Terminal Operating System and verify data with the hard copy of vessel plan provided by the Shipping Agent for accuracy.

Going forward, the PAG should work with its shippers, consignees and operators to develop an electronic system that meets the user's needs and find ways to show its customers the value of migrating to an electronic system from a paper system.

Finally, it is recommended that the PAG develop a data infrastructure to support its own electronic operations as well as its shippers, terminal operators and Customs officials. Ultimately, all entities involved in the supply chain will migrate to an electronic manifest system, so it will be crucial for the PAG to have the infrastructure in place to accommodate this change. The infrastructure includes sizing the duct banks adequately for substantial growth, as well as constructing their own data network to grow over time.

Security Operational Plans

The PFSP should include a section covering the security operational plans. First responders should be identified, and their incident management plans should be reviewed or developed. Working with the first responders, the PAG security staff should cooperatively maintain a security operational plan. That plan should identify who should respond to what type of incident and in what manner.

Additionally, there needs to be communications links (clear, redundant, and reliable communications paths) between the responding and responsible agencies, both in terms of person-to-person communications and data communications as addressed in maritime security regulations.

Finally, interoperability must also be addressed in the security operational plan. Interoperability includes policies and protocols, and equipment that work together. In developing an interoperable communications system, the following factors should be considered:

- Training and familiarization with the facility
- Joint table-top and full-scale exercises with all the first responders and appropriate security personnel
- Clear lines of communications and responsibility with agencies and individuals (both primary and secondary)
- Compatible radio communications between agencies
- Development of underwater surveillance protocols with other relevant security agencies

Cruise Ship Operations

Providing security for the cruise ship dockings currently requires a large amount of security planning and staffing. As there is a desire to increase the number of cruise ship dockings, it will be crucial to streamline the security process. There needs to be a process improvement for scanning ship's stores, scanning baggage, and faster movement of passengers and staff on and off the ships. Some of this improvement can be achieved through electronic equipment, ready access to K-9 units, and temporarily dedicated lanes for entry/exit of vehicles serving the cruise ship docking. Much of this improvement can be achieved through operational process improvements.

4.4 ENVIRONMENTAL, HEALTH, AND SAFETY

4.4.1 ENVIORNMENTAL, HEALTH AND SAFETY (EH&S) PROGRAMS

The PAG is engaged in several initiatives to advance their EH&S programs for the safety and well-being of employees and to ensure compliance with local and federal regulations. These programs include the following.

4.4.1.1 EH&S Plan and Manual + Documentation

PAG is developing several OSHA-required written safety programs (e.g., hazard communication, machine guarding, hot work, etc.) as well as an environmental compliance program.

4.4.1.2 Job Hazard Analyses

A Job Hazard Analysis (JHA) is a technique to identify the dangers of specific tasks in order to reduce the risk of injury to workers. PAG is developing JHAs for port activities, ultimately to reduce risk to PAG personnel. PAG developed a master training spreadsheet that identifies several port activities, which will be used to assist with the JHA development. Onsite visit by a safety professional will be required as part of the development of the JHAs.

4.4.1.3 LOTO Procedures

PAG is required by OSHA to have lock-out/tag-out (LOTO) safety procedures in-place to control hazardous energy from moving equipment. These procedures will be reviewed by a safety professional to ensure compliance.

4.4.1.4 EH&S Training

PAG has engaged a safety professional with providing environmental, health, and safety (EHS) training to PAG personnel. This includes several training topics required by OSHA and the EPA based on the port’s activities.

4.4.1.5 SWPPP’s

PAG is developing Stormwater Pollution Prevention Plans (SWPPP) for the cargo terminal and two offsite marinas. A new Multi-Sector General Permit (MSGP) was issued by the EPA during 2021, which required a additional notifications and updates to the SWPPPs.

4.4.1.6 SPCC Plan

PAG prepared an inventory of oil-containing equipment throughout the port that is included in the required Spill Prevention, Control, and Countermeasure (SPCC) Plan. The final draft of the SPCC Plan was prepared in December 2021.

4.4.1.7 RCRA

As a large quantity generator (LQG) of hazardous waste, PAG is required to have a Resource Conservation and Recovery Act (RCRA) Contingency Plan, which outlines how PAG will address emergency situations related to hazardous waste incidents. The Contingency Plan was finalized in early 2023.

4.4.1.8 EPCRA

PAG stores hazardous materials onsite and thus, may be subject to annual reporting under the Emergency Planning and Community Right to Know Act (EPCRA). PAG developed a list of chemicals in December 2021 which are being reviewed. The determination on reporting will be verified during site visits in 2023. If found to exceed reporting thresholds, the Facility Response Plan will be submitted to the applicable agencies.

4.4.2 FEDERAL AND LOCAL PERMIT AND APPROVAL REQUIREMENTS

Projects previously identified in the 2013 Master Plan and the Implementation Plan executed for PAG by MARAD have mostly been completed. These projects are components of Phase I and in particular Phase I-A of the Port Modernization Plan (PMP) as approved by the Guam Legislature and enacted into Public Law. These projects include:

- Container Freight Station Renovation
- Breakbulk Yard Reconfiguration and Expansion
- Warehouse 2 Demolition
- Container Yard Expansion
- Reconfigured and Expanded Gate Complex
- Additional Load Center (LC-5)
- Stormwater System Improvements
- Firewater System Improvements
- Miscellaneous Demolition Projects

These projects were federally funded, are located within 200 feet of the shoreline, and required programmatic review under the National Environmental Policy Act (NEPA). Accordingly, prior to commencing construction, the U.S. Maritime Administration, acting as federal overseer of the NEPA process, completed an Environmental Impact Assessment, consulted with federal and local regulatory agencies, and issued a finding of No Significant Impact. The PAG also completed

Environmental Site Assessments, Phases I and II, and established environmental protection protocols relevant to the planned construction.

Any deferred projects initially included in the proposed action and deemed to be a future continuation of that action (the original full-size PMP program) would be covered by the NEPA documentation already completed. Such projects can be advanced by a sudden increase in the pace or scale of the Military Alignment on Guam. Examples of such projects include:

- Optical Character Recognition Portals and Canopies
- Radiation Portal Monitors
- Further Yard Expansion
- Additional Pavement Replacement with new Hi-Mast Lighting in Existing Terminal Yards

Projects that were not part of the PMP will have their own permitting requirements that address project specific environmental concerns. These projects are funded by a variety of sources including 2018 Bonds, Federal Government Grants and PAG revenues. These projects include:

- Hotel Wharf and Access Road Maintenance and Repair
- New Administration Building (now viewed as an annex or smaller building, deferred several years)
- Waterline Replacement
- EQMR Building Repairs and Upgrades
- Warehouse 1 Repairs and Upgrades
- F1 Fuel Pier Upgrades
- Golf Pier Repairs
- Terminal Operating System (TOS)
- Gate Operating System (GOS)
- Perez Marina Phase III
- Agat Small Boat Marina Loading Dock Structural Repair
- Agat Small Boat Marina Dock B Repairs
- Harbor of Refuge Renovation
- Pre-Disaster Mitigation Hardening of Port Facilities
- Load Center Refurbishment and Hardening
- Maintenance and Sustainment of Prime Power Generators
- Data Warehousing Systems
- LAN Infrastructure Upgrades
- Port Police Security Upgrades

In addition to the projects list above, this Master Plan identifies additional long range Capital Improvement Projects (CIP) that will be implemented over the next several years. These include:

- Acquisition of new STS Gantry Cranes (up to three)
- Replace reefer receptacles (60 each)
- Purchase container yard equipment
- Fuel connectivity pipeline, Pier F1 to Golf Pier
- Pier F1 Repair/Replacement
- Berths F2 through F6 Renovation/Reconstruction
- Solar Photovoltaic (PV) Energy Project
- Demolition/Renovation of fuel tanks at Area A
- Redevelopment of Sea Plane Ramp
- Replacement of existing hi-mast light fixtures with LED

4.4.2.1 List of Anticipated Federal & Local Permits

It is anticipated that the following environmental permits and approvals may be required to implement certain sections of the recommended near-term and long-term development.

Federal Permits and Approvals

- NEPA (completed for Phase I-A of PMP by MARAD)
- USACE Section 10/404 Permit (needed for Pier F1 and Berths F2 through F6). Port would work directly with USACE to obtain this.

Local Permits and Approvals

Some local permits and approvals are needed for ongoing projects, while some will be needed for future individual maintenance and repair or sustainability projects.

- Guam Environmental Protection Agency (GEPA) administered Section 401 Water Quality Certification
- Guam Bureau of Statistics and Plans - Coastal Zone Management Federal Consistency Program
- Guam Development Permit (if dredging seaward of the mean high-water line)
- GEPA Erosion Control Plan Approval/Permit
- GEPA Environmental Protection Plan (EPP) Approval
- GEPA administered National Pollution Discharge Elimination System (NPDES) storm water general permit for construction activities
- GEPA Test Boring Permit (needed for Hotel Wharf and Access Road). Contractor permit.
- GEPA Dewatering Permit (if needed)

Federal Regulations Governing the Recommended Development

Some of the following permits have been completed during the existing NEPA documentation for the PMP components that are underway or will be completed within the next few years. Others will be completed when future projects are defined and budgeted during the 20-year planning horizon.

- Clean Water Act (Sections 401, 402, 404)
- Rivers and Harbors Act (Section 10)
- Coastal Zone Management Act (Section 307)
- Endangered Species Act (Section 7)
- Fish and Wildlife Coordination Act
- Magnuson Stevens Act
- National Historic Preservation Act (Section 106)
- Federal Clean Air Act
- Migratory Bird Act

If contaminated soil, sediment, or groundwater will be encountered during construction of the recommended development, the following federal regulations may be applicable depending on the characterization of the materials:

- Resource Conservation and Recovery Act
- Comprehensive Environmental Response Compensation and Liability Act
- Toxic Substances Control Act

Local Regulations Governing the Recommended Development

Construction of the Recommended Development will require compliance with the following local regulations:

- Guam Water Quality Standards
- Guam Coastal Zone Management Program Policies
- Guam Environmental Protection Act (Public Law 11-191)
- GEPA Soil Erosion and Sedimentation Control Regulations
- Chapter 49, Title 10 of the Guam Code Annotated, Air Pollution Control Act (P.L. 10-74)

4.5 INFORMATION TECHNOLOGY

The PAG's PMP from the 2013 Master Plan program included several key IT initiatives. The following list includes the ongoing IT initiatives from the 2013 plan and new initiatives identified for this 2023 Master Plan's Port Readiness Plan:

- Terminal Operating System (TOS) upgrade to allow for automated invoicing, cargo and container tracking, financial management and maintenance management.
- Implementation of TOS satellite systems to optimize TOS functionality, such as Remote Reefer Monitoring, Vehicle Mounted Terminals, Truck Appointment System, Terminal Control Center and Cargo Planning.
- Implementation of a Gate Operating System (GOS)
- Implementation of a TOS General Cargo module/app
- Implementation of systems to support further digitization in the logistic supply chains in Guam
- Selection and implementation of a Harbor Master Port Management Information System (MIS)
- Building a fully integrated systems landscape by connecting the new financial management system (FMS) with the new TOS.
- Digitization of data flows between the Port and its Stakeholders, leading to the Port Community System (PCS).
- Acquisition of gantry cranes equipped with OCR cameras to automatically read container data, damage detection and installment of weigh sensors in spreaders.
- A new customs facility inclusive of a cargo scanner and a customs cargo management system connected to the TOS.
- Implementation of measures, procedures, infrastructure and refurbishment of buildings to ensure cyber security, making the network robust.
- Installing a closed-circuit television (CCTV) system and voice over internet provider (VOIP) phone system
- Selection and contracting an Information Technology Support Partner (ITS)

These IT improvements will increase capacity to ensure that Guam's only commercial port is developed and operated to adequately accommodate the rapid expansion expected to occur over the next decade.

As the PAG modernizes and readies for the military buildup, the IT improvements will enable the efficient management of new systems, functions, and services that the Port supports. To accomplish this effectively, the PAG will need to migrate its IT Division from its current structure to a new structure that accommodates the future application of new technologies.

Most of the required IT changes are focused on cargo terminal operations, gate operations, and their connections with financial operations. With implementation of these new systems, more information will be tracked and shared across all PAG functions. The changes are expected to result in more efficient information processing and management, along with improved cargo handling services and seamless data flows.

The current structure of the Operations Department was developed based on the modes of operation, vision, culture, tools, support systems, types of equipment and administrative demands that were standard business practices at that time developed. The new Operating and IT systems will require a new structure for the Operations Department and operating procedures will change. The new Customs Inspection Facility will also lead to adaptations of current standard operational procedures (SOP) in Port facilities.

Setting the stage for the future:

An observation of the current state of the PAG's IT capabilities, future operations and IT improvements leads to the following three main areas of concern:

1. IT Infrastructure is outdated
    - Older equipment is risky
    - A new / migrated TOS will require modern infrastructure
2. Cyber Security is inadequate
    - TOS, FMS and IT infrastructure require increased cyber security
3. Current TOS has reached its use life and is out of support in October of 2023

An IT Study is underway to address the core capabilities of the Port's Operations, Finance, and Security systems and operations. To achieve efficiency in these areas of concern, the IT Study scope is comprised of the following efforts:

- IT Infrastructure – Assess and evaluate the Port's infrastructure backbone, network, client access, servers, wireless connections and IP management functions.
- Cyber Security – Identify ways to improve protection of the Port's financial and law enforcement systems, devices, and important data from unlawful access or criminal use and thus guaranteeing confidentiality, integrity, and availability of information.
- Terminal Operating System (TOS) Upgrade – evaluate and define the modules that may or may not be required in the next TOS and provide alternate system solutions, if necessary, to enhance terminal operations and overall interoperability with all PAG stakeholders – Port, Port Users Group Guam (PUGG), and Guam Customs.

The IT Infrastructure study consists of the following activities:

- Analyze current IT environment (hardware, software, use and needs)
- Analyze existing Policies and Standard Operating Procedures (SOPs)
- Define Technical Architecture
- Define Network Architecture
- Define new applications like VOIP and CCTV
- Define robust cyber secure WIFI network(s)

The Cyber Security study elements are sensitive and confidential information:

The TOS upgrade study covers:

The development of a TOS Road Map. The work process includes a workshop to establish a definition of needs, follow-on analysis of options and delivery of a requirements document.

The TOS Requirements document will cover the following activities:

- Vessel Planning
- Yard Management
- Equipment (Container/Chassis) flows/processes
- Gate operations
- Remote reefer monitoring
- Vehicle mounted terminals
- General cargo handling (High level)
- Invoicing/Billing
- Other system interactions (Gate system, Customs, Port Community System)
- Infrastructure (cloud versus on premises)

The requirements document will support a TOS procurement process and include details of the needs PAG has for TOS functionality. The details needed to evaluate the TOS improvements will be identified.

The IT Study report will identify a set of projects, recommendations leading to the realization of a future proof, robust, secure PAG IT Landscape.

An IT policy committee should be established to decide on the projects to be implemented based on priorities, budgets and resources.

Draft plan for the next three to five years

The outcome of the IT Infrastructure and the Cyber Security studies will have impacts on current capital improvement program (CIP) projects. An integrated approach between CIP planning and IT/Cyber planning is needed for:

- Administration building
- Operations building
- EQMR building
- Harbor Master Port Control Tower
- Phone system VOIP
- Port wide CCTV system.
- Port Police

- Customs

The new/upgraded TOS will be the foundation for modernization of cargo handling in the future. The priorities and timelines will depend on availability of budgets and resources. The following list of TOS needs have been identified:

- Billing, tariff simplification, decrease groovy code in the TOS billing module, moving towards paperless electronic invoicing and outfacing cash payments.
- WIFI, robust, cyber proof, 100% coverage, wide bandwidth for future applications
- Remote Reefer Monitoring
- Vehicle Mounted Terminals
- Electronic Data Interchange (EDI), yard optimizer
- Vessel /berth planning
- Cyber security
- Automated Gate (GOS)
- Customs, cargo scanners, OCR
- Harbor master
- Cargo control center
- General cargo handling
- Upgrading finance systems, integration with the TOS
- Next steps in communications, digitization, Port Community System
- Crane OCR

Impact on organization:

- Restructure the IT Division to align with IT and operating improvements
- Restructure the Operation Department to align with IT and operating improvements

To be successful, the IT Division will need outside resources on an as needed basis. The IT partner should be engaged to answer requests for knowhow, experience, and provide hands-on IT help. This Information Technology Support partner (ITS) will be essential for the successful implementation of IT and Operating improvements.

After the projects being recommended in the IT-Study are executed, the CIP projects outlined in Section 7 can be realized.

The sequence of projects to be initiated are driven by priority, budgets, resources, impact, and timelines. The interconnections between these projects and other PAG initiatives need to be identified and aligned

5 MARKET ANALYSIS AND CARGO FORECAST

The relationship between the Guam economy and historical port cargo throughput provides the basis for forecasting future cargo volumes. This chapter's content is a primary variable of the required throughput capacity, equipment needs and capital/operating costs defined in the ensuing chapters. Market Factors includes a looks at the economic trends that affect cargo throughput such as Guam's population and economic growth, as well as a forward look at expected development in the coming years. Then an analysis of historical cargo throughput at the PAG is included and finally forecasted port volumes are provided by cargo type.

5.1 MARKET FACTORS

5.1.1 POPULATION

Following several decades of double-digit growth, Guam's population growth slowed to 2.9% between 2000 and the 2010 according to the U.S. Census Bureau (USCB). The USCB provides population estimates and projections of Guam in partnership with the Government that are made available through the USCB International Data Base (IDB). The population estimates are provided for the years between each decennial census, and generally use existing data collected from various sources. In regard to the 2020 decennial census (years 2010 through 2020), the USCB reported that Guam's population decreased by 3.5% during the decade to a figure slightly below 2000 levels - an unexpected result given that USCB and the United Nations Department of Economic and Social Affairs (UN DESA) had previously estimated moderate growth during the decade. Table 5-1 includes a summary of Guam's population and percent growth.

Table 5-1: Guam's Historical Population

Year	1970	1980	1990	2000	2010	2020
Guam Population	84,996	105,979	133,152	154,805	159,358	153,836
% Growth from Previous Census	26.8%	24.7%	25.6%	16.3%	2.9%	-3.5%

Source: U.S. Census Bureau, 2020

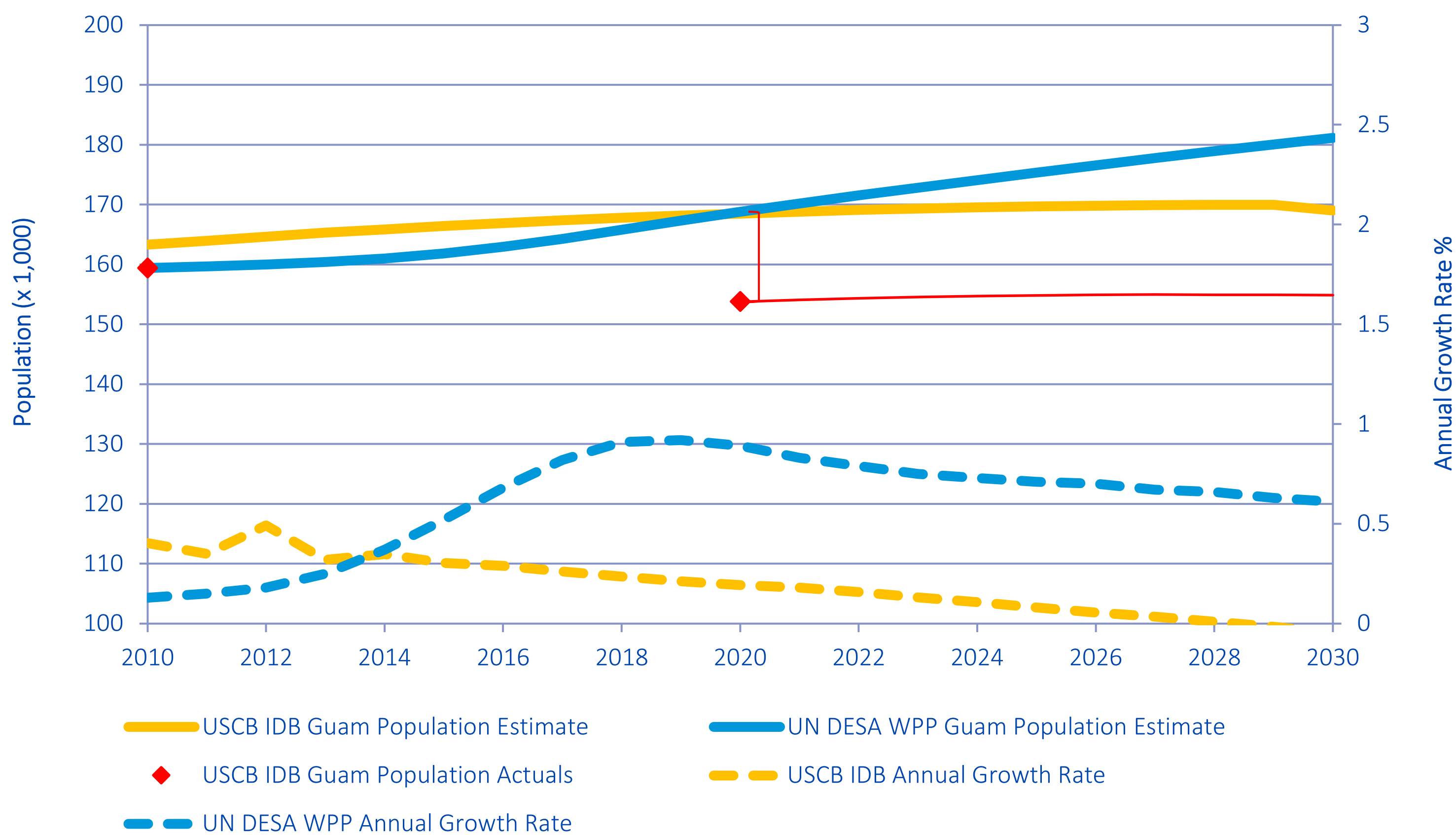
Population projections are provided by the USCB IDB for each year beyond the base census year for a 40-year forecast period. The base population is advanced each year by using projected fertility and survival rates and net international migration. The projections do not take into account the impacts of the ongoing military build-up. According to previous population projections (before the 2020 Census was taken into account) from the USCB IDB, Guam was forecast to continue to gain population at an average compound annual growth rate (CAGR) of

0.06 percent over the next 10 years, reaching a projected population of approximately 170,000 in 2030.

According to the 2019 Revision of *World Population Prospects* (WPP) prepared by the United Nations (UN), Department of Economic and Social Affairs (DESA), Population Division, Guam's projected population was forecast to grow at an average CAGR of 0.65 percent, reaching 181,000 in 2030. To date, DESA has not published an adjustment to this forecast after the 2020 Census.

Figure 5-1 displays Guam's historical estimated population and growth rates for 2010 through 2019 and projected population and CAGR from 2020 to 2030 presented by both the USCB and UN DESA Population Division. The actual population for 2010 and 2020 are shown as well. The actual population for 2020 as per the decennial census was 8.7% lower than the estimate. The growth rates do not reflect the military build-up on Guam. These population growth rates are considered in the computation of the forecast of the Port's cargo growth presented in Section 5.3 of this Report.

Figure 5-1: Guam's Estimated and Projected Population and Growth Rates



Source: U.S. Census Bureau IDB; UN DESA Population Division WPP

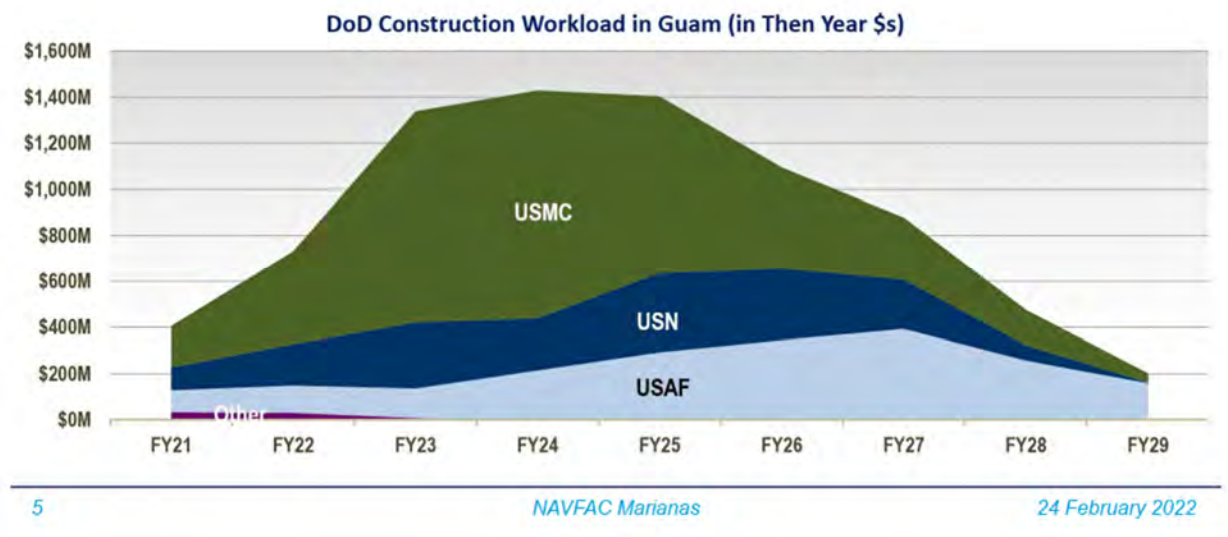
5.1.2 MILITARY PRESENCE AND BUILD-UP

Approximately 30 percent of total current cargo moving through the Port is military related. During the peak of the military build-up, the additional imported military equipment, supplies, and construction related materials are expected to nearly double the Port's military cargo volumes.

The DoD estimates approximately $8.0 billion in spending from FY 2021 through FY 2029 for the Guam military build-up and training facilities on Tinian and Pagan. Over the past eight years, the Federal Government defense spending on Guam has averaged approximately $300 million per year. In FY 2020, the DoD obligated around $530 million for military construction related to the realignment. $402 million were allocated for nine construction related projects in Guam's FY2021 defense spending bill. To date, 13 projects have been completed, 16 are in construction, and 40 are pending. The Marine Corps has reported that up to 134 projects are directly associated with the realignment efforts.

According to the GAO Report, the Marine Corps will increase the number of construction projects each year until FY 2023 when it will peak at 43 active construction projects. As shown in Figure 5-2, the DoD construction program for the Marine Corps build-up in Guam continues through FY 2029. Although COVID-19 threatened the continuity of construction, projects were paused for only two weeks and did not affect the progress of projects overall. However, the estimated construction schedule could be impacted by Federal Government actions, cultural-artifact discovery and preservation, endangered-species protection and by the process for the detection of explosive ordnance on construction worksites.

Figure 5-2: U.S. Marine Corps Build-up Construction Spending Profile, FY 2021-FY 2029



Source: NAVFAC Marianas

5.2 ECONOMY

5.2.1 ECONOMY

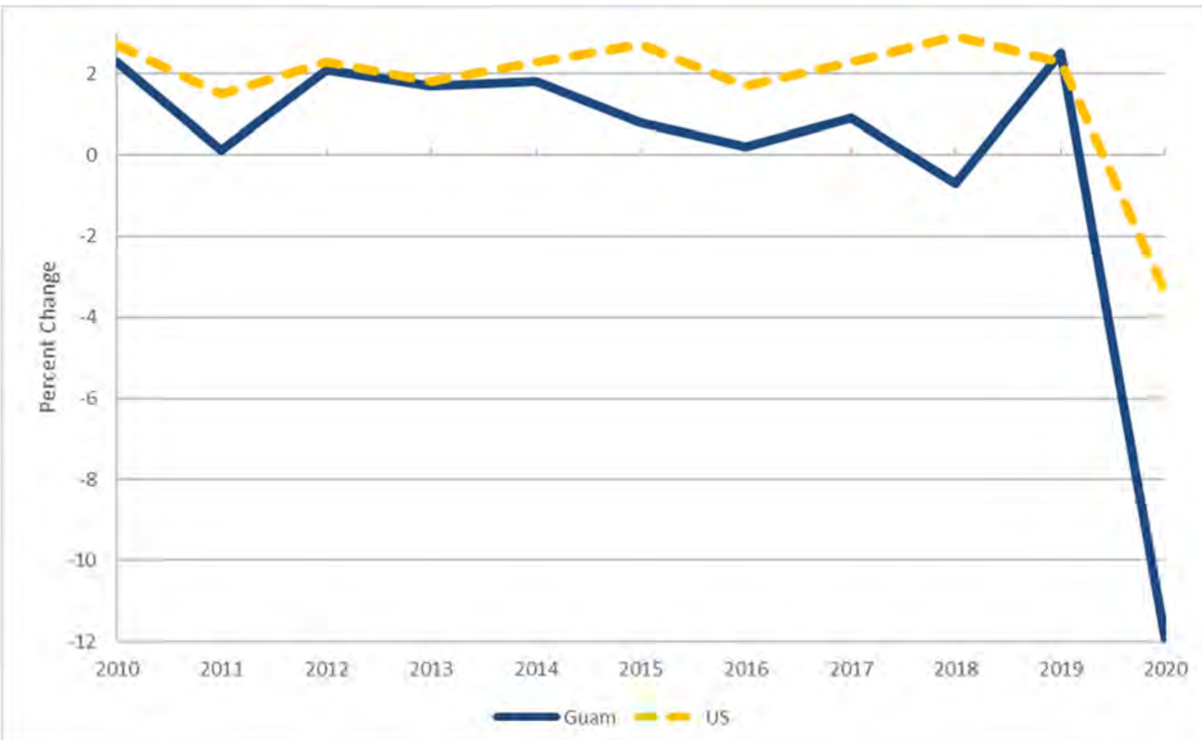
The growth in Guam's economy has been, and is expected to continue to be, driven by a combination of the needs of a growing population and military presence, continued expansion and diversification in the tourism industry, and private and public investment in construction projects for the civilian and defense sectors.

The COVID-19 pandemic resulted in depressed economies around the world. Guam's economy relies heavily on tourism, which was halted for most of 2020 and led to an approximately $1.38 billion loss in revenue. Federal recovery assistance of nearly $1.6 billion helped to offset this through unemployment assistance, Coronavirus Aid, Relief, and the Economic Security Act (CARES Act), and more.

5.2.1.1 Gross Domestic Product (GDP)

Guam's GDP has shown consistent growth in real dollars (adjusted for inflation) since Calendar Year (CY) 2006 based on statistics published by the Bureau of Economic Analysis (BEA). In CY 2019, Guam's GDP was $6.3 billion, which is roughly 0.03 percent of the U.S. mainland GDP of $21 trillion. Figure 5-3 shows that real GDP for Guam increased 2.0 percent in CY 2019 and had shown potential of increasing in CY 2020. Impacted by the COVID-19 pandemic, GDP for CY 2020 experienced an 11.9 percent decrease from the previous year. For comparison, real GDP for the U.S. (excluding the territories) increased 2.3 percent in 2019 and decreased 3.5 percent in CY 2020. A significant impact to Guam's GDP was anticipated given the impact on tourism, income loss by unemployment, and dissipation of consumer and business spending. An estimate provided by a University of Guam study, suggested a GDP decrease ranging from 0.7 to 18.9 percent in comparison to CY 2019 GDP.

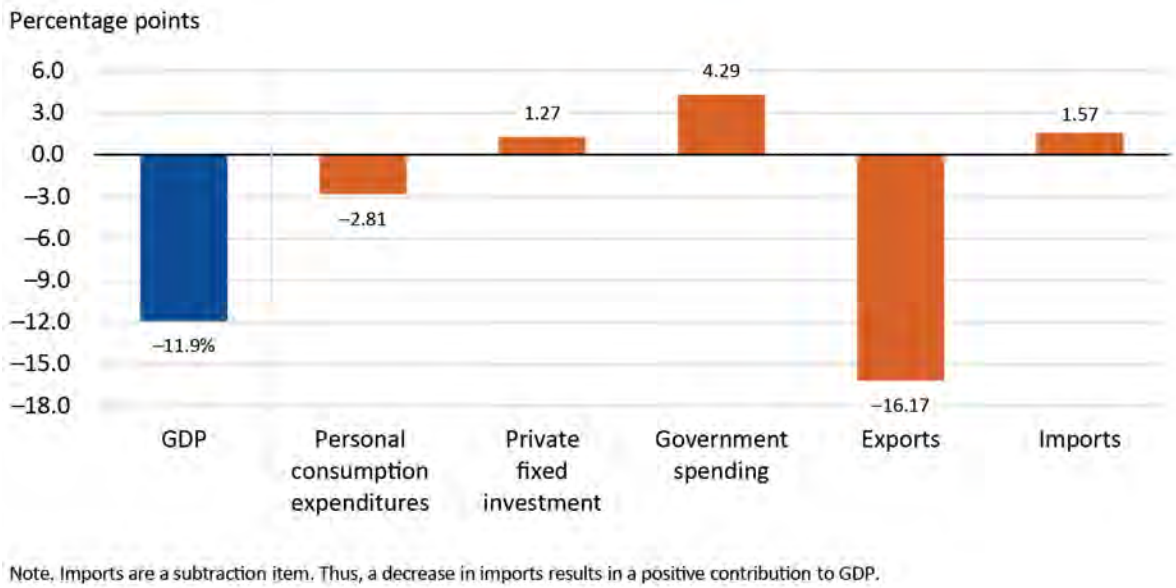
Figure 5-3: Percent Change in Guam and U.S. Real GDP CY 2010-2020



Source: U.S. Bureau of Economic Analysis

The CY 2020 GDP figure consists of approximately $3.5 billion of consumer spending, $3.9 billion of Government spending, and $1.4 billion of private fixed investment, offset by -$3 billion in net exports of goods and services. As shown in Figure 5-4 Guam's economy is highly dependent on government spending when it previously relied on imports. The current supply chain disruptions affecting the world due to labor shortages, COVID-19 restrictions, and increasing inflation have impacted Guam's economy. As of October 2021, several local businesses have noticed improvements in supply chain recovery and have turned to source from local suppliers**.** For further details on Guam's trade imbalance, see Section 5.2.1.5.

Figure 5-4: Contributions to Percent Change in Guam Real GDP for 2019



Source: U.S. Bureau of Economic Analysis

Government spending also increased in CY 2020 on construction, equipment, and employee compensation. Specifically, growth in territorial government was supported by federal grant revenues, including the COVID-19 Relief Fund. For further details on Guam's construction industry, see Section 5.2.1.3.

5.2.1.2 Tourism

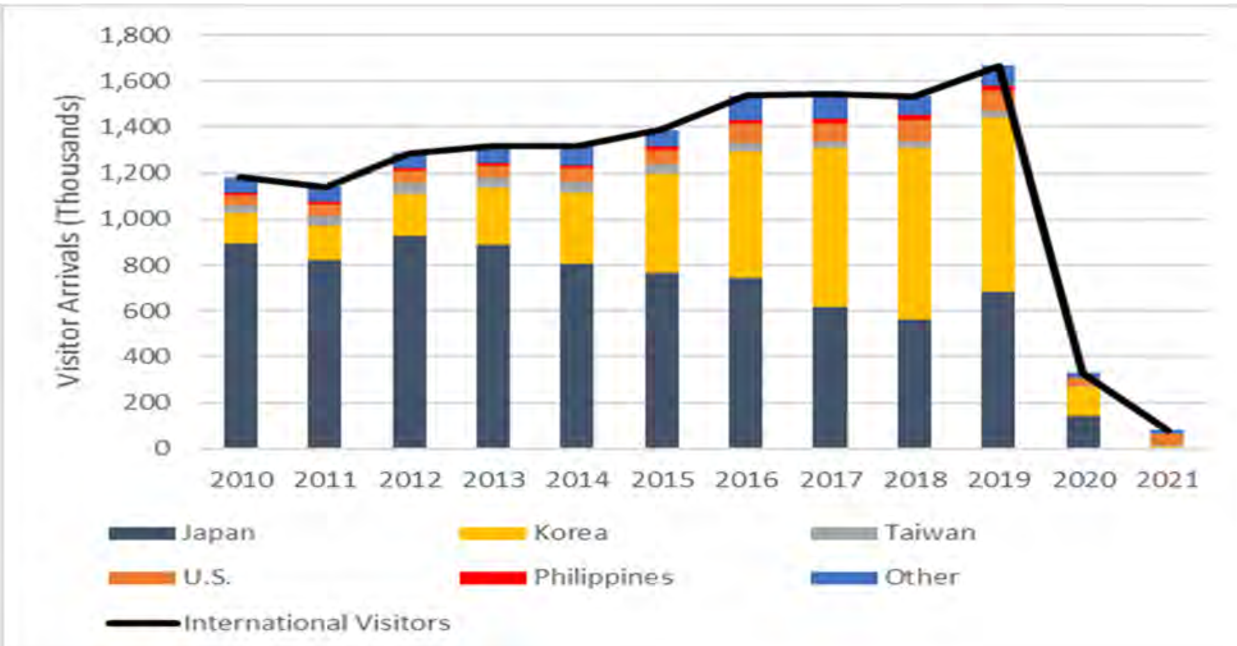
Tourism is the largest contributor to Guam's economy, representing 30 percent of the GDP based on data from the Guam Visitors Bureau (GVB). Guam is a preferred tourist destination for the East Asian market due to its:

- warm climate, tropical beaches, and natural beauty,
- short-haul, economical flights from/to major Asian cities,
- proximity as a U.S. territory,
- water sports such as diving and snorkeling,
- duty-free luxury shopping, and
- distinctive local Chamorro culture and food.

In CY 2019 Guam had approximately 1.67 million visitors —nearly ten times the island's population. As shown in Figure 5-5 visitation increased by more than 5 percent from the previous year, making CY 2019 Guam's best year in tourism to date. The COVID-19 pandemic had a strenuous impact on the tourism industry world-wide. In CY 2020, Guam received around 328,000 visitors, an 80% decrease when compared to CY 2019's record-high figures. For CY 2021 Guam received around 79,000 visitors. Monthly trends show a clear relationship between travel and COVID-19 outbreaks. Travel began to recover in summer 2021 after vaccinations became widely available, with decreases in August and again in September when the Delta and Omicron variants appeared. See Figure 5-6.

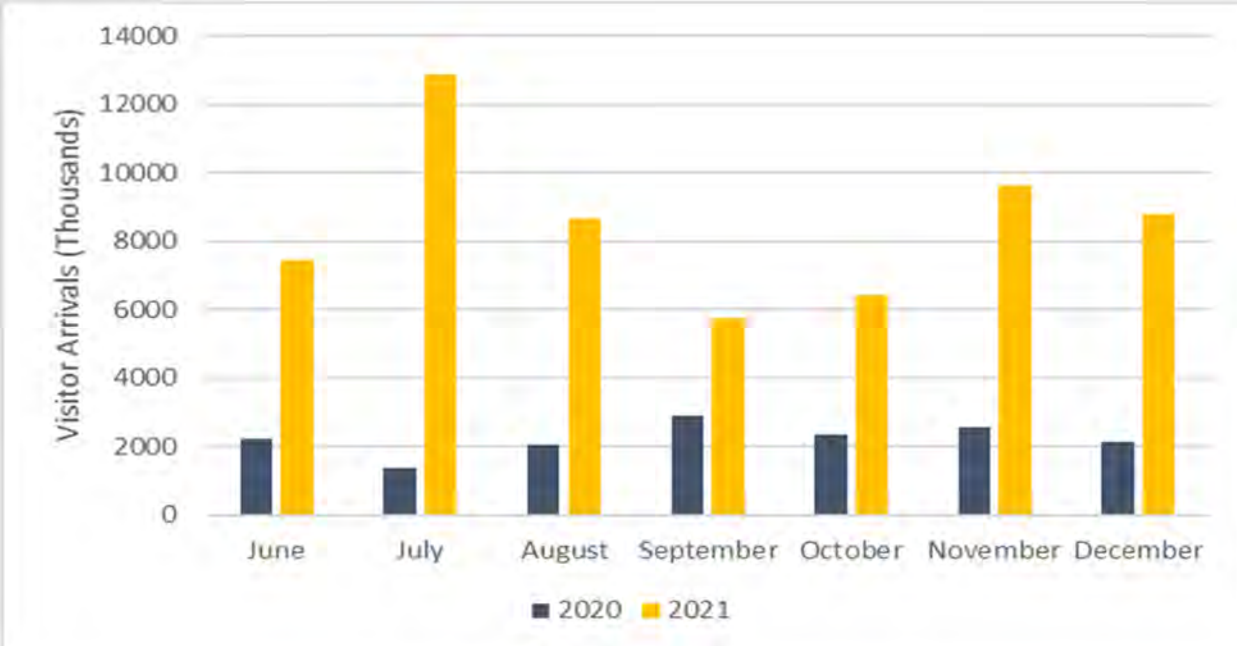
Over the past decade prior to the pandemic, tourism grew by a CAGR of 3.9 percent, and by a CAGR of 4.9 percent from 2014-2019. This section will cover historical data as it pertains to domestic and global trends before the impact of COVID-19 and plans to recover moving forward.

Figure 5-5: Guam Visitors by Origin, CY 2010-2020



Source: WSP analysis. Data provided by the GVB

Figure 5-6: Monthly Guam Visitor Arrivals in 2020 and 2021



Source: WSP analysis. Data provided by the GVB

Historically, Japanese visitors have been Guam's largest market for tourism. However, Japan visitation has decreased from over 925,000 in CY 2012 to 563,000 in 2018 before rebounding to about 684,000 in CY 2019. The decrease in Japanese tourism before COVID-19 has not been unique to Guam, according to JTB Tourism Research and Consulting, which reports a reduction in the total international outbound Japanese market. Total Japan resident visits abroad have declined in the past five years primarily due to an increase in Japanese consumption taxes, which has reduced disposable income, and the continued devaluation of the Japanese yen. As a result, air seat capacity from Japan has decreased in recent years. In January 2018, Delta Air Lines suspended service to Guam due to reduced seat demand out of Japan, network rerouting and the entry of competitive airlines in the Guam market. However, Japan Airlines began offering a second daily flight to Guam from Narita in late March 2018, which may have provided impetus for the 21.6% increase in visitors from Japan in CY 2019.

The decline in Japanese visitors to Guam has been more than offset by increasing diversification in origin of visitors from other locations, including South Korea, the U.S., Taiwan, the Philippines and Hong Kong. South Korean visitation has grown more than 250 percent in the last five years and grew by 25 percent from FY 2016 to FY 2017. The number of South Korean visitors continues to grow, surpassing Japanese visitors as of September 2017, making it the largest tourism market for Guam.

U.S. visitation represented 5 to 6 percent of all visitors to Guam between CY 2016-2019, totaling approximately 91,000 travelers in CY 2019, while Taiwan travelers totaled approximately 28,000. Philippine visitation increased by 8 percent in CY 2019, recording nearly 21,000 visitors.

Arrivals from China totaled approximately 23,000 visitors in CY 2017 but decreased to 16,275 in 2018 and just 11,496 in CY 2019.

While overshadowed by the COVID-19 pandemic, global political events also have a significant impact on international travel to Guam, and are affected by U.S. relations with China, North Korea, and even Russia.

Following the downturn in tourism due to COVID-19, Guam focused post-pandemic tourism recovery efforts to on heavy marketing campaigns and destination development initiatives that build on the improvements at the airport. Airport improvements consisted of a 12,000-foot runway, a new third level corridor for international arrivals completed in 2019, and relocation of baggage screening equipment.

Table 5-2 shows the percent growth of Guam tourism over the past decade and GVB's projected growth for the next three years, based on the most recent forecast available. As of September 2021, with 59,000 visitors Guam had not met the forecasted 82,000 visitors for FY 2021

Table 5-2: Guam's Historical Tourism Growth Rates (Pre-COVID)

CAGR	Percent	Fiscal Years
10-Year Historical CAGR	3.5%	2010-2019
5-Year Historical CAGR	3.7%	2015-2019

Source: WSP analysis, GVB, and Tourism Economics

The tourism growth rates are considered in the computation of the Base Case forecast of the Port's cargo growth presented in Section 7 of this Report.

5.2.1.3 Construction

Total construction activity on Guam has grown from approximately $500 million annually to $900 million in 2019. While construction activity on Guam was originally predicted to keep increasing due to the planned projects by commercial developers, the Government and the DoD, the COVID-19 pandemic led to a decrease in spending. As shown in Table 5-3, a steep decrease of almost 50% exists between 2019 and 2020. However, for FY 2021, the DoD reported $473 million in constructions contracts. This increase demonstrates recovery from 2020 and growth from 2019 numbers.

Table 5-3: Building Permits & Construction Contracts in Thousands, FY 2016-2020

Fiscal Year	2016	2017	2018	2019	2020	5-Year CAGR
Building Permits	$433,358	$423,015	$355,045	$487,316	$305,347	-6.8%
DoD Construction Contracts	$26,463	$167,932	$306,350	$415,878	$153,347	42.1%
Combined	$459,821	$590,947	$661,395	$903,194	$458,694	-0.05%

Source: Guam Economic Outlook for FY 2022, Department of Labor

Current major construction projects in Guam in development or under construction include:

- Guam International Airport Authority (GIAA) opened its new $130 million International Arrivals Corridor in January 2022. The new Corridor adds a third level to the airport terminal and is designed to separate arriving and departing passengers.
- Japanese retail store Don Quijote is planning to open a sizeable retail discount store as Don Don Donki. Construction is underway with a opening planned for 2023.
- Guam's largest power plant, with a construction cost of $560 million, is underway and scheduled for completion in 2024. The 200-megawatt power plant in Dededo is expected to produce 40% of Guam's power needs. GPA awarded the contract to a consortium led by Korea Electric Power Corporation as the engineering, procurement, and construction turnkey operator for the plant. The plant will replace the two Cabras power plants, located in Piti near the Jose D. Leon Guerrero Commercial Port (the "Port"), which were left inoperable by an explosion and fire in August 2015. The new facility will allow the integration of existing solar photovoltaic sources of renewable energy and an additional 120 megawatts from planned solar photovoltaic farms.
- Guam Memorial Hospital will be adding a new medical campus to its facilities. The project is set to cost $1B and will finance $600 million through bond sales. The new campus will include facilities for the Department of Public Health and Social Services.
- The Northern Wastewater Treatment Plant is a $122 million project in development under the Guam Waterworks Authority. Building permits were issued in October 2019.
- The proposed Honhui Guam Resort would be the tallest building in Guam with two towers and 900 rooms and is currently in planning stages. Demolition permits are expected to begin processing in 2023 and overall project completion within 5 years.

Since most of the major construction projects for public agencies are bond or grant funded, a leading indicator of future construction is the availability of funds realized from bonds and other sources. Table 5-4 lists the major public agency projects from FY 2021 (excluding DoD-related projects) for which funding is planned or funding has been obtained.

Table 5-4: List of Public Agencies with Major Construction Planned Projects

Planned Projects – Funds Available	
Guam International Airport Authority	$40,610,000
Guam Solid Waste Authority	$27,610,000
Subtotal	$68,220,000
Planned Projects – Bond/Loan Financing Proposed	
Guam Waterworks Authority	$134,000,000
Department of Education	$100,000,000
Department of Public Works	$70,000,000
University of Guam	$21,000,000
Department of Land Management	$15,750,000
Subtotal	$340,750,000
TOTAL	**$408,970,000**

Source: Guam Economic Outlook for FY 2023, Department of Labor

A leading indicator of DoD construction is appropriations. Appropriations for DoD Military and Civilian Infrastructure are shown in Table 5-5.

Table 5-5: Appropriations in Thousands for DoD Military and DoD Civilian Infrastructure Projects

Fiscal Year	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
DoD Military Construction	$272,268	$248,658	$354,654	$448,500	$470,638	$571,205
DoD Civilian Infrastructure	$20,000	--	--	--	--	--
TOTAL (Combined)	**$292,268**	**$248,658**	**$354,654**	**$448,500**	**$470,638**	**$571,205**

Source: Guam Economic Outlook for FY 2018, Department of Labor; NDAA for 2018

Historically, the H-2B visa program has provided Guam with a large supply of temporary foreign labor to support the limited labor pool in Guam. Guam's previous exemption from the H-2B visa yearly quota ended Dec. 31, 2014 and most H-2B workers' visas to work in Guam expired in 2016 and early 2017. This resulted in a significant decline in construction workers during this period. See Section 5.2.1.4 for additional information.

In October 2016, 11 Guam-based companies and the Guam Contractors Association initiated a class-action lawsuit against U.S. Citizenship and Immigration Services (USCIS) and other federal agencies, alleging that, starting in 2016, USCIS began rejecting their H-2B visa petitions for work during exceptionally busy periods at a rate approaching 99 percent compared to a prior Guam average approval rate of approximately 95 percent through 2015.

In 2016 and 2017, DoD officials and Guam construction contractors faced a construction labor shortage in Guam due to challenges in getting approvals for H-2B visas. According to data from the Guam Department of Labor, USCIS approved approximately 4 percent of H-2B visa applications for Guam between January and September 2016. In 2014 and 2015, the U.S. Citizenship and Immigration Services approved over 98 percent of H-2B visa applications for Guam.

In January 2018, the U.S. District Court of Guam preliminarily enjoined USCIS from relying on the failure to satisfy peak-load or one-time occurrence conditions as grounds for denying H-2B visa petitions and ordered USCIS to reconsider H-2B visa petitions that were previously denied.

The 2018 NDAA allows Guam and CNMI to have up to 4,000 H-2B visa workers each year for military buildup-related construction projects. The Department of the Navy’s workload projections in the July 2015 Final SEIS indicate that more than 3,000 foreign laborers will be needed to supplement the Guam or CNMI workforce during the peak of construction for the military build-up. While the 2018 NDAA addresses the labor shortage for the military build-up, it is unclear if Guam's non-defense H-2B visa shortages will be resolved.

The 2018 NDAA bill also extends Guam’s exemption from the national H-2B visa cap until October 2023. The Guam H-2B worker provision in the 2018 NDAA takes effect April 11, 2018; and the earliest start date for H-2B workers in Guam is May 11, 2018.

In April 2018, the U.S. District Court of Guam certified a class of businesses in Guam, thereby permitting Guam employers who believe they have had unlawful denials of H-2B visa petitions by USCIS to seek temporary relief under the 2018 Preliminary Injunction Order. According to the Guam Department of Labor Alien Labor Processing and Certification Division, between the date of the 2018 Preliminary Injunction Order and April 20, 2018, approximately 1,601 H-2B visa petitions were filed. During this period, no H-2B visa petition was denied by the USCIS.

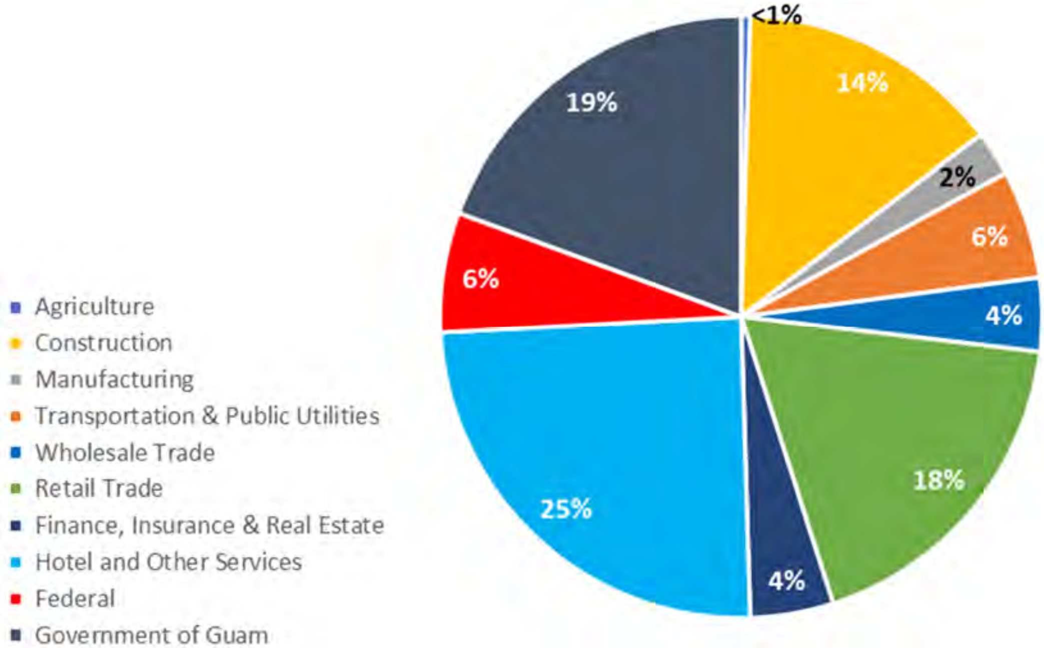
The amount of H-2B visa holders increased from 6,760 in March 2019 to 7,850 in March 2020. The COVID-19 Pandemic impacted construction projects causing a push for the 2021 National Defense Authorization Act passed to extend H-2B visa exemptions for civilian labor projects in Guam.

In 2021, Philippines was redesignated as eligible to participate in the H-2B visa program.

5.2.1.4 Employment

The private sector in Guam supplies approximately 75 percent of the labor force, while the public sector supplies nearly a quarter of all employment in Guam, including the Government accounting for 18 percent of employment (Figure 5-7). Guam's civilian labor force is predominantly retail trade and service-oriented due to the prominence of the tourism industry. The Hotel and Other Services and Retail Trade industries are the largest categories of employers in Guam, representing 25 percent and 18 percent of total jobs, respectively. Construction is also an important sector, accounting for 15 percent of private employment in Guam.

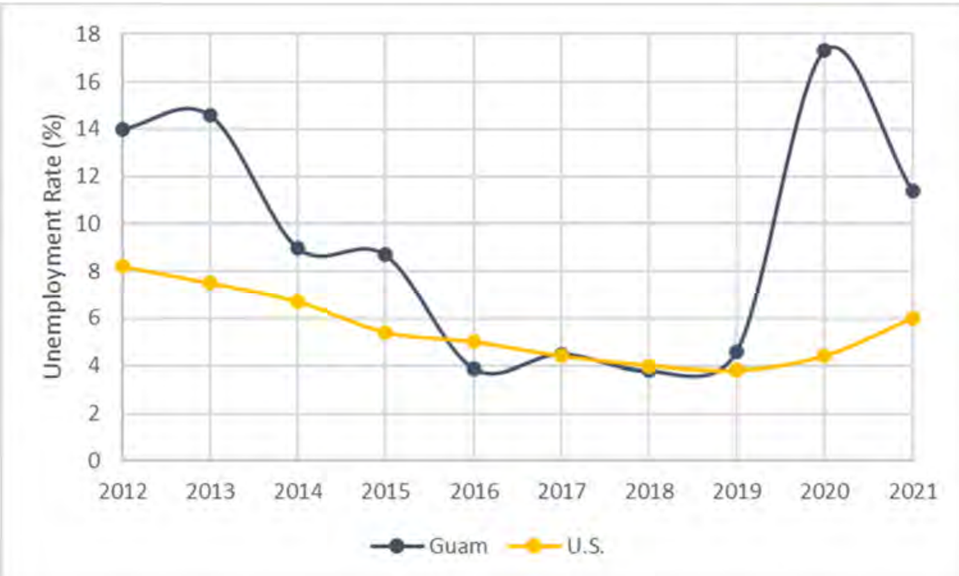
Figure 5-7: Guam Employment Percentage by Sector, 2021



Source: Government Bureau of Labor Statistics, September 2021 (latest)

In 2019, Guam's average unemployment rate of 6.1 percent was higher than the U.S. average unemployment rate of 3.4 percent. Throughout the COVID-19 pandemic, both Guam and the rest of the U.S experienced a significant increase in unemployment peaking at 19.4 percent and 11.2 percent respectively. Since December of 2020, Guam has decreased the rate to the current 11.4 percent. Even without considering COVID-19's impact, Guam's unemployment rate has been historically higher than the unemployment rate of the U.S. as shown in Figure 5-8.

Figure 5-8: Unemployment Rates in Guam and the U.S., 2012 – 2021



Source: The Unemployment Situation on Guam Summary History: 1974 – 2021, U.S. and Guam Bureau of Labor Statistics Department of Labor.

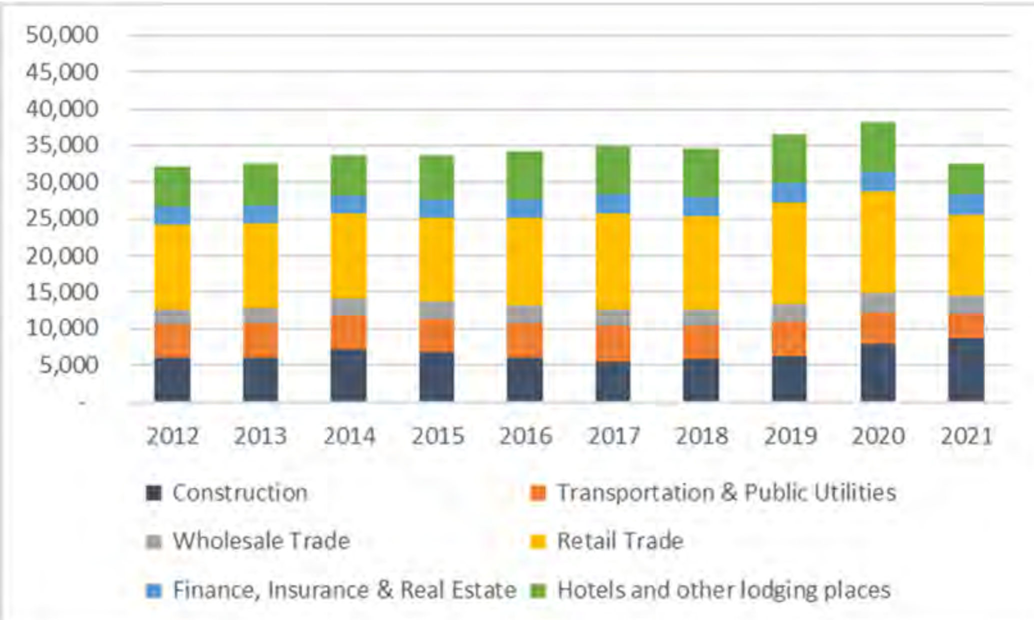
Other than the 12.9-point difference in 2020, the difference between the two metrics peaked in 2011, when Guam had an unemployment rate of 13.3 percent and the U.S. had an unemployment rate of 8.9 percent. Guam's high unemployment rate in 2011 was due in part to the delay in the military build-up after many private companies had prepared for large-scale construction projects, and the Japan earthquake and tsunami in March 2011 that temporarily impacted Guam's tourism industry. In addition, the reconciliation of Guam's demographic statistics from the 2011 release of the 2010 U.S. Census impacted the reporting of unemployment data.

Since 2011, Guam's unemployment rate had been falling rapidly and had, in recent years, come close to matching the U.S. unemployment rate. Guam's declining unemployment rate from 2013 to 2017 is primarily due to an increase in the number of jobs in the tourism and construction industries, as well as a slight decline in the rate of population growth.

Figure 5-9 shows the six largest private sector industries in terms of total number of civilian employees and growth from 2012 to 2021. All industries have seen nominal changes over this period except for the Construction Sector. Employment levels in this sector often fluctuate from year to year based on construction activity. However, the low in 2017 at 5,590 workers, a decrease of 13 percent from the previous year, is notably lower than the average of about 6,410 construction employees over the 10-year period.

As noted in Section 5.2.1.3, the decline in Construction Sector employment is largely attributed to the repatriation of H-2B workers. The number of H-2B workers declined from 1,042 in September 2016 to only 86 in September 2017 due to H-2B restrictions put in place that year. That decline has been greatly reversed given the recent approval of H-2B visa workers for military construction projects sourcing up to 1,470 H-2B workers as of May 2020.

Figure 5-9: Change in Guam Private Sector Employment, 2012-2021



Source: Government Bureau of Labor Statistics, June 2021

5.2.1.5 Trade

Guam has a history of carrying a sizeable trade imbalance, bringing in far more goods than it exports. Guam's Bureau of Statistics and Plans (BSP) does not have import reports post November 2019, however in that month, Guam imported approximately $36 million and exported $2.1 million. This ratio of approximately 15:1 is typical to Guam's annual figures dating back to 2014. On average, approximately 66 percent of imported goods, by value, were moved through the Port with the remaining portion moved by air. By volume, approximately 90 percent of goods move through the Port each year. The preference of Port shipments indicates the high cost of transporting cargo via air.

Much of Guam's trade is influenced by its unique duty-free status, meaning that no tariffs are added to international products. With expectations that the tourism industry will be reactivated in 2022-2023, international visitors to Guam will once again be able to purchase high-end luxury goods such as jewelry, perfumes, cosmetics, electronics, liquor, and cigarettes at lower prices. Of Guam's top import partners, the U.S. accounts for over half of Guam's imports by value, followed by Singapore, Italy, South Korea, France, Japan, and China. While Guam remains heavily dependent on U.S. imports with 53% of imports originating from there as it has in past years, other countries such as Singapore, Italy and France are sources for luxury goods.

Guam's top imports by value include motor vehicles, electrical machinery/equipment, petroleum oils and gases and luxury items such as articles of leather, perfumes, beverages, and watches. Some of these imports, such as motor vehicles and petroleum products, are imported into Guam and then immediately exported. This transshipment cargo is unloaded at an intermediate port such as Guam, and, after temporary storage in the yard, is transferred to another vessel to be transported to the final port of discharge. More than half of Guam's exports are goods transshipped to surrounding Micronesian islands.

Top exports by value include fish, motor vehicles, and duty-free items such as tobacco products, alcoholic beverages and watches. Guam's top export destinations include FSM (e.g., the islands of Yap, Chuuk, Pohnpei and Kosrae), which represents Guam's largest transshipment market and accounts for over one third of Guam's exports by value, as well as Japan, Hong Kong, Palau, Marshall Islands, China and South Korea.

The Port's principal transshipment cargo is shipped in containers, representing approximately 88 percent of total transshipment tonnage in FY 2019 and FY 2020. With COVID-19 negatively impacting every aspect of economies worldwide, it was expected that cargo would be affected too. However, from the tonnage data available from 2019 to 2020, Guam only witnessed a 4% decrease in total breakbulk and containerized cargo.

Transit cargo typically arrives in the Port of Guam from the U.S. or Asia and is then transferred to smaller ports in the CNMI, Palau, FSM and RMI. Transshipment containers (mostly empty) from the Micronesian islands are then typically sent back through the Port of Guam, and outbound to U.S./Asia ports.

The handling of transshipment cargos that are supplemental to those bound for or exported from Guam allows the Port to grow revenues beyond those normally allowed by local economic conditions. Although transshipment cargo does not generate as much revenue (approximately six percent of total annual revenue) as local containers per year, transshipment is a means of achieving a greater return on investment in port infrastructure.

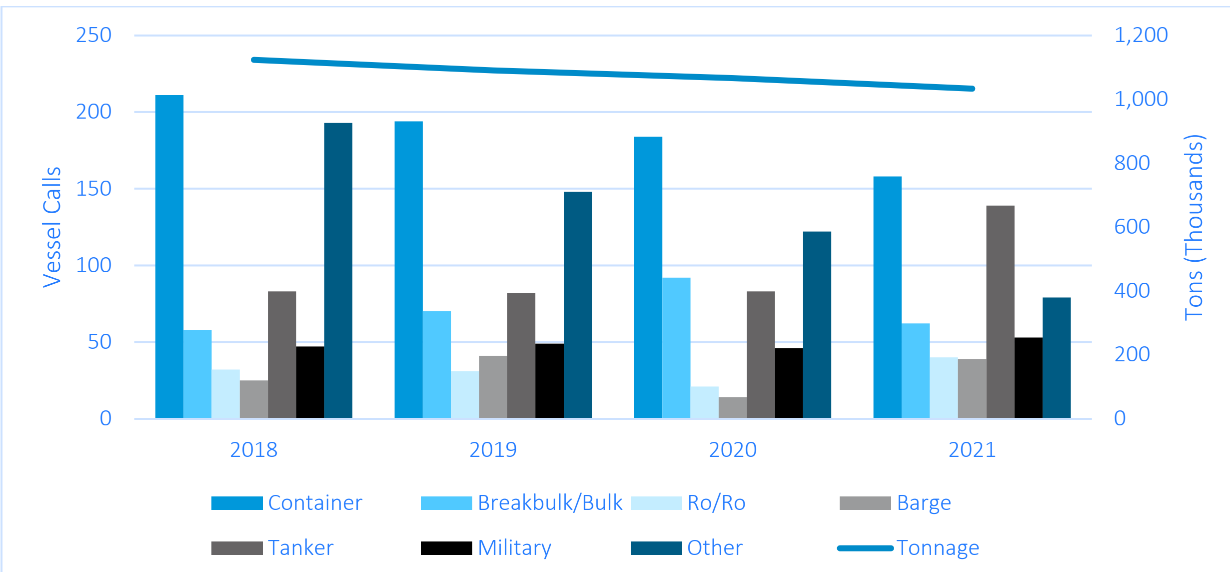
5.3 CARGO TRENDS

The Port handled approximately 1.1 million revenue tons in FY 2021, comprising approximately 975,000 tons in containerized cargo and 109,000 tons in breakbulk cargo. Liquid bulk cargoes do not contribute to the Port's total annual tonnage since the facilities are leased to private companies.

5.3.1 VESSEL TRAFFIC

Approximately 570 vessel calls occurred in FY 2021, carrying approximately one million tons of cargo (excluding automobiles). As shown in Figure 5-10, Container ships are the largest component of vessel calls, though they have been steadily declining from 211 in 2018 to 159 in FY 2021.

Figure 5-10: Historic Annual Vessel Traffic in Apra Harbor & Port Throughput



*2013 annualized projection

Source: WSP Analysis of PAG data

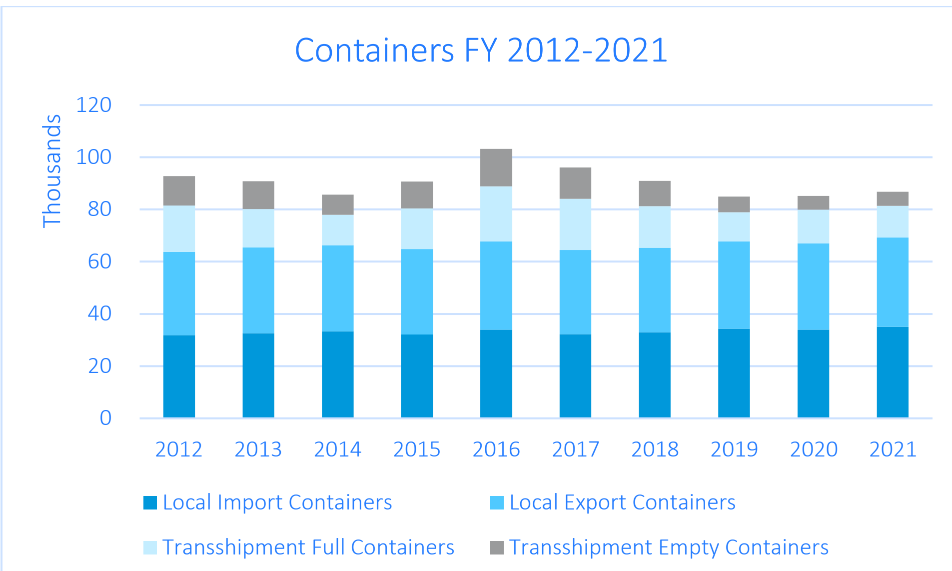
5.3.2 CONTAINERIZED CARGO

On average, approximately 95 percent of the PAG's total cargo tonnage (excluding Ro/Ro) is containerized cargo. The PAG's total revenues in the past five years from containerized cargo has averaged approximately $21.5 million per year (excluding indirect cargo revenue), or approximately 92 percent of the PAG's direct cargo revenues.

As shown in Figure 5-11, container volume at the Port consists of local containers and transshipment. Local container volumes handled by the Port have grown slowly but mostly steady over the past 10 years to 69,253 in FY 2021, a CAGR of 0.91%. Local cargo flows fluctuate based on Guam's population, major civilian and military projects, and the tourism industry. However, they have not varied by more 5% in any year since the financial crisis in 2009, even with the COVID-19 pandemic essentially eliminating tourism in 2021.

Transshipment containers, by contrast, have been volatile due to carrier decisions of where to transship cargo to islands in the region. Transshipped containers decreased from 28,889 in 2021 to 19,445 in 2014 before nearly doubling to 35,288 in 2016 (34% of Port containers) and then decreasing sharply again to just 17,541 in FY 2021 (20% of containers). Due to the transshipment volatility, total containers handled by the Port fell from a high of 103,15 in 2016 to 86,794 in FY 2021.

Figure 5-11: Port of Guam Historical Container Volumes



Source: WSP analysis. Data provided by the PAG

5.3.3 BREAKBULK CARGO

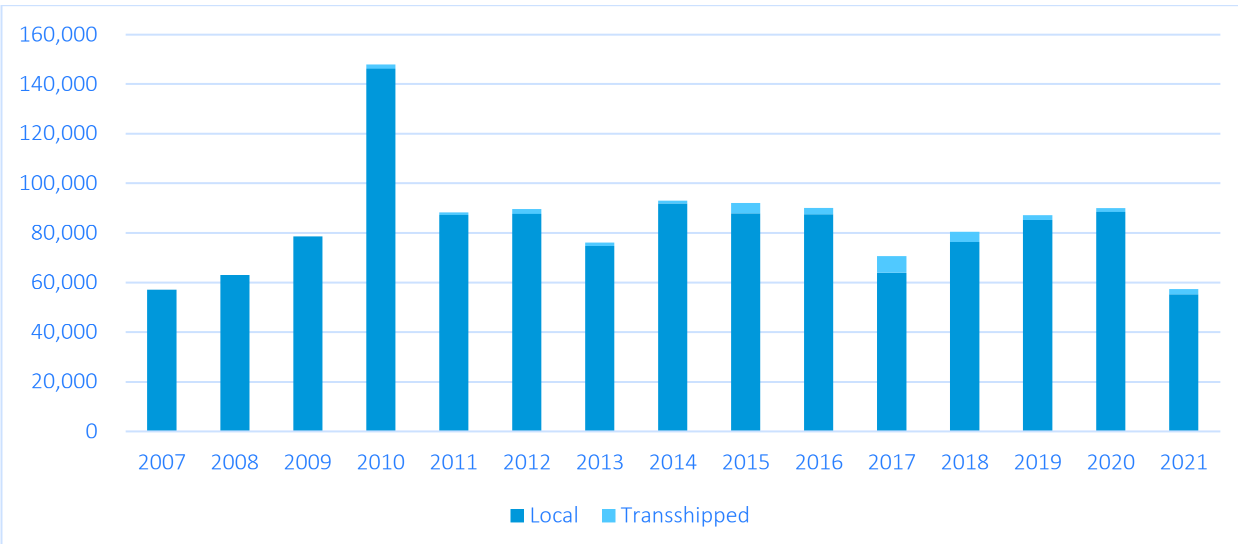
Breakbulk cargo includes a variety of commodities that cannot fit into containers and commodities that are more economically transported as breakbulk. The majority of the Port's breakbulk cargo is Ro/Ro, which refers to cargo that is rolled on/off a vessel, including automobiles, unitized and breakbulk cargo on wheeled equipment. Other breakbulk cargo includes steel plates, cement, rebar and pipes, sacks of aggregate, and asphalt.

Apart from automobiles, most breakbulk cargo inbound to Guam is destined for the construction industry. Outbound breakbulk cargo primarily consists of automobiles, construction materials (moving on transshipment routes) as well as fish, scrap metal, and a variety of other miscellaneous cargos.

On average, approximately 10 percent of the PAG's total cargo tonnage is breakbulk cargo (excluding automobiles). The PAG's total revenues in the past five years from breakbulk cargo has averaged approximately $1.2 million each year, or approximately 2 percent of the PAG's annual revenues.

Historical breakbulk throughput and construction expenditures on Guam are provided in Figure 5-12. Breakbulk cargo volumes have varied year to year but have been approximately 90,000 tons with occasional outlier years such as 2010, 2017-18, and 2021. Like containerized cargo, breakbulk activity at the Port is not capacity constrained.

Figure 5-12: Port of Guam Historical Breakbulk Volumes (excluding automobiles)



Source: WSP analysis. Data provided by the PAG

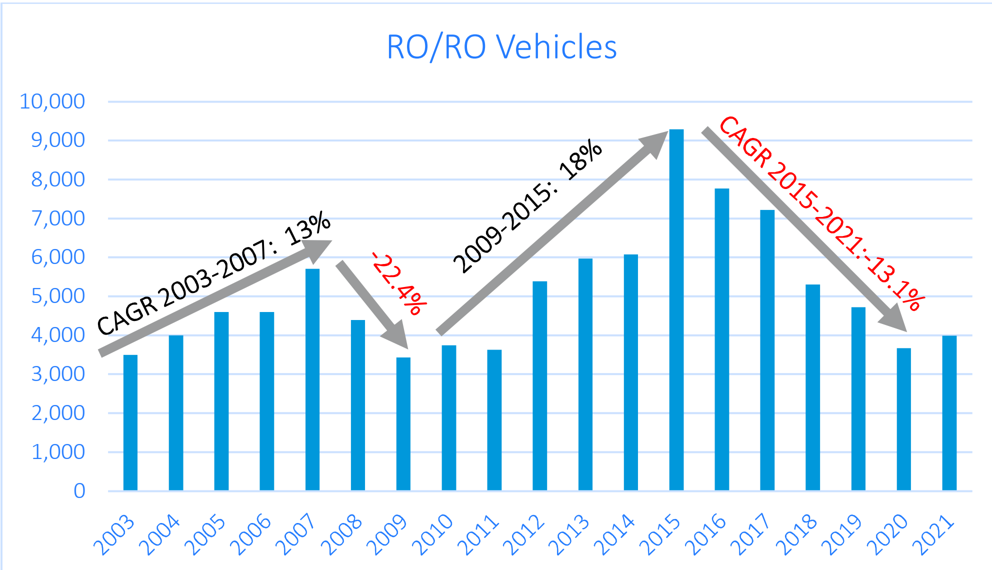
Breakbulk transshipment volumes typically make up less than 5 percent of total breakbulk volumes, with a high of 6,639 tons in 2015 (9.4% of total breakbulk) when overall Port transshipment spiked.

Ro/Ro

Ro/Ro cargo is categorized as a subset of breakbulk cargo in the Authority's statistics, but automobiles are treated independently in this Master Plan. Figure 5-13 shows the total Ro/Ro automobile throughput at the Port from 2003-2021.

Total Ro/Ro units have been cyclical. Units in FY 2020 (3,670) were very similar to 2003 (3,500 autos) and 2009 (3,433). In the interim years there were two peaks in 2007 (5,301 autos) and 2015 (9,291).

Figure 5-13: Port of Guam Historical Ro/Ro Tonnage and Automobiles

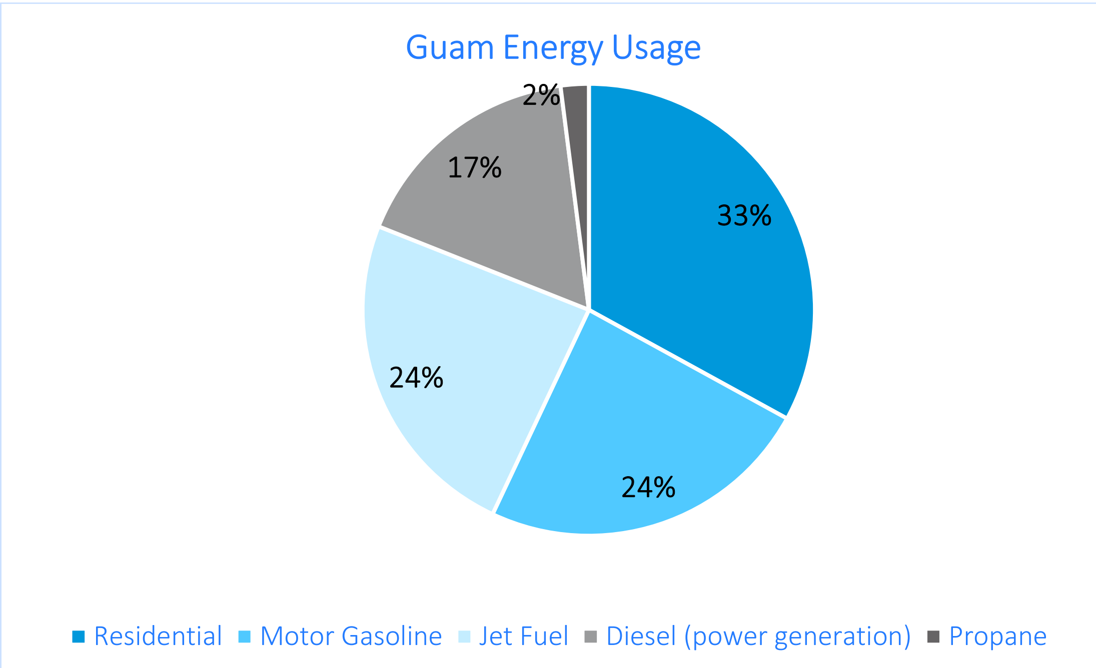


Source: WSP Analysis. Data provided by the PAG

5.3.4 LIQUID BULK

A variety of refined petroleum products (e.g., motor gasoline, aviation gasoline, jet fuel, automotive diesel oil and liquid natural gas) are delivered by ship to the Port for storage in onshore non-production storage and distribution facilities in the Marine Industrial Terminal. Bulk fuels from Mobil Oil and Tristar Agility are delivered to their storage tanks from the adjacent Golf Pier marine transfer facility or from Berth F1 through cross piping in the SPPC facility. The utilization of various fuels on Guam is shown in Figure 5-14. Residential power is the primary use, with 33% of power, followed by auto gas and jet fuel (24% each), diesel (17%) and propane (2%).

Figure 5-14: Guam Energy Use 2020

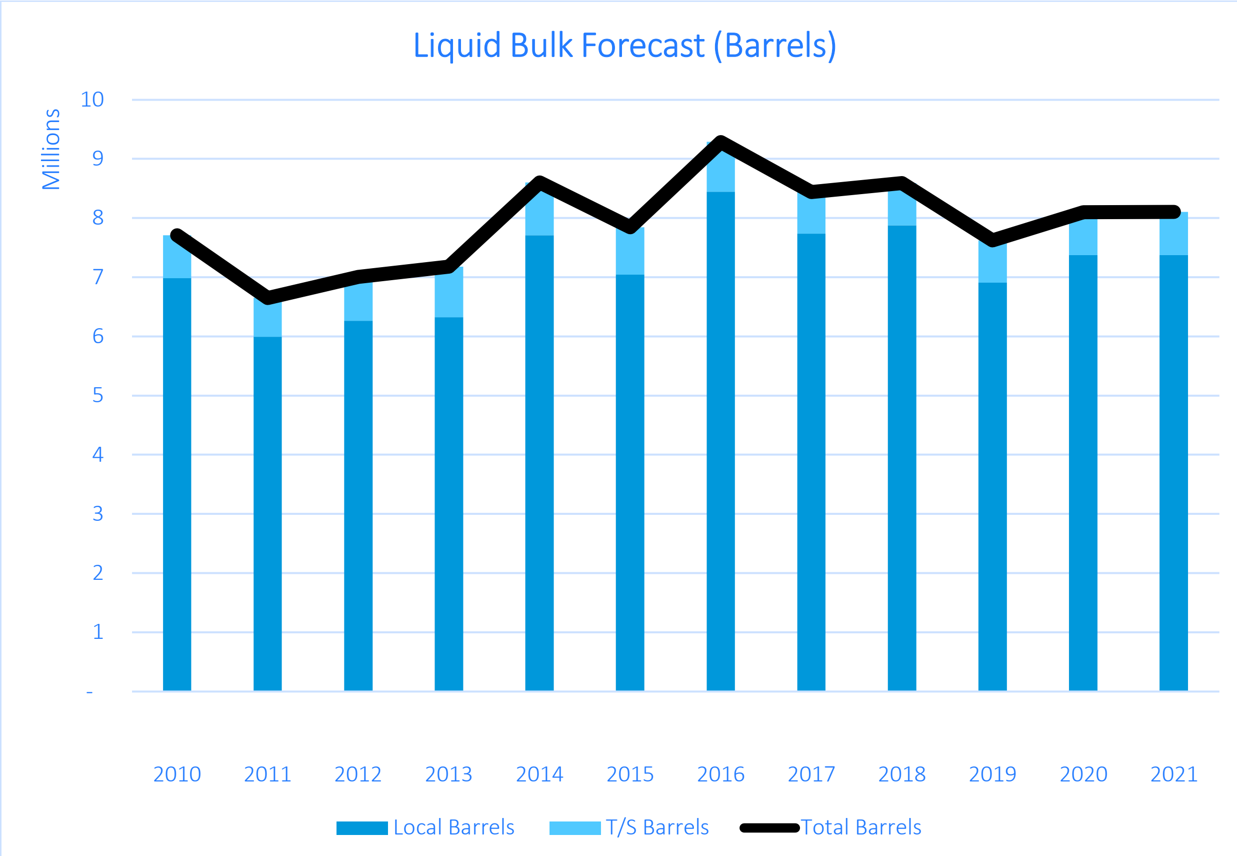


Source: US Energy Administration

Liquid bulk products are distributed by pipeline from their storage tanks to their loading racks, where the products are loaded into tank trucks and distributed to service stations and commercial and government accounts throughout the island. A portion of the bulk fuels are reloaded at the pier to coastal tankers for distribution to Micronesia, Rota and Tinian islands in the CNMI.

Liquid bulk cargo at the Port peaked at 9.3 million barrels in FY 2016 before falling to 7.6 million in 2019. Volumes rebounded slightly to 8.1 million barrels in FY 2020 and 2021. See Figure 5-15.

Figure 5-15: Port of Guam Liquid Bulk Trends



Source: WSP analysis. Data provided by the PAG

Transshipment volumes of liquid bulk products at the Port have been largely steady at about 10% of liquid bulk volume, with the exception of a brief peak of 13.5% in 2013.

5.3.5 CRUISING

Given that this Master Plan Update is primarily focused on cargo operations, a detailed analysis and assessment of cruise activity trends and projections is not included in this report. The review described below was performed for the purpose of assessing the impact of cruise vessel traffic on commercial cargo movements.

The Port's cruise operation shares berth space with other cargo industries at Berth F3. Prior to the COVID-19 pandemic, Guam received nine calls in 2019 with approximately 600 passengers per call. With exception of the Carnival Splendor, vessels typically range in length from 350 to 800 feet and carry between 350 and nearly 2,000 passengers. The Splendor is 950 feet long and has a capacity of 3,000 guests. Vessels typically arrive at 0800 hrs and depart at 1800 hours.

Because the Port does not have a dedicated cruise terminal to berth cruise vessels and process passengers, cruise operations directly impact cargo operations at Berth F3. In the past, cargo operations have been halted during cruise vessel calls due to safety and security considerations.

The water depth at Berth F3 is approximately -30 feet mean lower low water and is adequate to accommodate smaller cruise ships. The Cruise Terminal Location Report provided to the PAG in 2009 recommended that cruise operations be relocated to Hotel Wharf. Berthing cruise vessels at Hotel Wharf avoids conflicts with cargo vessels and allows for larger cruise vessels to call on Port facilities. Once the Hotel Wharf reconstruction is completed, the Port intends to follow that recommendation.

5.3.6 ROUTES AND CARRIERS

To service Guam, ocean carriers deploy cargo ships between the U.S. or Asia markets and Guam to take advantage of lower operating costs and then use smaller feeder vessels for transporting transshipment cargo between Guam and the Micronesia islands. Vessels on these trade routes often carry a combination of containers, breakbulk and roll-on/roll-off (Ro/Ro) cargo to reduce service costs and meet the various market demands of the islands. Roll-on/roll-off cargo consists of automobiles, unitized, and breakbulk cargo on wheeled equipment.

Carriers with service routes between the U.S. mainland and Guam are exempt from certain U.S. cabotage requirements contained in the Merchant Marine Act of 1920 (PL 66-261), also known as the Jones Act. Section 27 of the Jones Act requires that all goods transported by water between U.S. ports be carried on U.S.-flag ships, built in U.S. shipyards, owned by U.S. citizens, and crewed by U.S. citizens and U.S. permanent residents. Table 5-6 provides details on the carriers with service routes calling on the Port. Note that the total number of containers for each foreign carrier does not include intermittent container service during FY 2017.

Table 5-6: Ocean Carriers with Services to Guam

Company Name	Type	Cargo	Containers in FY 2021	% of Total FY 2021	Years serving the Port
Matson, Inc.	Jones Act Carrier (U.S.-built, flagged, owned, and crewed)	Local containers	48,723	56.1%	26 Years
American President Lines (APL)	U.S. Flag Carrier Foreign-built	Local containers	20,968	24.2%	32 Years
Waterman Steamship Corp.	U.S. Flag Carrier Foreign-built	Local Ro/Ro	0	0%	8 Years
Kyowa Shipping Co. (Kyowa)	Foreign Flag Carrier	Transshipment and local containers, breakbulk and Ro/Ro	7,811	9.0%	48 Years
Marianas Express Lines Limited (MELL)	Foreign Flag Carrier	Local containers	9,278	10.7%	25 Years*
Total			86,780	100%	

*MELL did not serve Guam from 2016 to 2018.
Source: PAG

Vessels serving Guam that do not directly proceed to other U.S. destinations are not required to use U.S. built ships (46 U.S.C. 12111), effectively allowing the deployment of foreign-owned, foreign-built U.S. flag vessels in the domestic Guam trade. However, the vessels must be U.S. flagged, meaning that the ships must employ a U.S. crew and are subject to USCG inspection. The foreign ownership of a U.S. flag vessel must be arranged through a special purpose U.S. trust.

The historical exemption from the U.S. build requirement is of limited usefulness to carriers in the domestic Guam trade since the natural westbound trade lane from the West Coast to Guam passes through Hawaii, which is not exempted from the U.S. build requirement. In the past five years, there have been numerous media reports and a small number of legislative proposals requesting a Jones Act exemption for Hawaii and other non-contiguous territories. Although a U.S. territory, CNMI (e.g., Saipan, Tinian, Rota) is exempt from the provisions of the Jones Act due to the international treaty associated with their annexation by the U.S.

Because foreign-flagged vessels are restricted from transferring cargo directly to/from U.S. ports on the mainland and Guam or Hawaii, these vessels must call at a foreign port in between calls to U.S mainland ports and Guam or Hawaii.

5.3.6.1 U.S. Carriers

The U.S. flag carriers serving Guam are Matson, Inc., APL, and Waterman. Matson is the only U.S. carrier that is fully compliant with the Jones Act requirements, i.e., transporting goods using U.S. flag ships, built in U.S. shipyards, owned by U.S. citizens and crewed by U.S. residents. The two other U.S. carriers operate foreign-built, U.S. flagged vessels.

Matson

Matson, Inc., formerly known as Matson Navigation Company, is a containership operator serving Guam, Hawaii and China trades. Matson entered the Guam trade by joining an alliance in 1996 with APL. At the time APL was being sold into foreign ownership and needed Matson to purchase and operate their Jones Act eligible containerships on their U.S. flag services.

Currently, Matson is the primary carrier at the Port, accounting for approximately 56 percent of all cargo in FY 2021. Matson's Guam service currently employs six containerships with capacities ranging from 2,378 Twenty-foot Equivalency Units (TEU) to 3,220 TEU's. These vessels carry cargo from the U.S. West Coast to Honolulu, then to Guam. As shown in Figure 5-16, the vessels continue on to China, where they are loaded with cargo to be shipped to the U.S. mainland and discharged in Long Beach (blue lines). Cargo on a Matson vessel that is destined for the FSM and RMI islands is transshipped via Kyowa's vessels from the Port. Matson also provides a weekly transshipment service between Guam and Rota and Saipan, CNMI.

Figure 5-16: Matson Service Through Guam

Source: Matson

American President Lines

APL provided service to Guam from 1980 until 1996, when it sold the service to Matson. However, APL continued to operate the vessels for 10 more years as part of an alliance with Matson. In 1997, APL was acquired by the Singapore-based Neptune Orient Line Limited (NOL) and became a foreign shipping company. The APL / Matson alliance terminated in 2006 with APL's departure from the Guam trade. APL reentered the Guam trade in 2016 with a biweekly service and at the beginning of 2017 began offering weekly service.

In 2016, French shipping line CMA CGM acquired NOL/APL. APL currently owns and operates (through special U.S. trusts) several foreign-built U.S. flag containerships that allows them to compete for Federal Government preference cargo, especially military preference cargoes, and are eligible for federal Maritime Security Program (MSP) operating subsidies. The Maritime Security Act of 1996 established the MSP, which provides an annual subsidy to sixty 60 U.S. flag ships operating in the foreign trade, i.e., 60 of the 81 ships in the U.S. flag foreign (international) trade fleet (as of 04/01/2017). The MSP is administered by U.S. Maritime Administration. The U.S. government grants the MSP subsidy to the ship owner in exchange for agreeing to make the ship available for military sealift in the event of an overseas contingency.

Currently, APL is the only domestic container carrier with direct service from Asia to Guam. This allows the company to transport "Buy America" construction supplies from Asia for use by commercial and DOD contractors on Guam.

APL carried approximately 24 percent of all cargo coming in and out of the Port in FY 2021. APL's Guam service is comprised of two container ships, the APL Saipan and APL Guam, with capacities of 1,641 TEUs and 1,100 TEUs, respectively. The two container ships run a weekly service that links Guam and Saipan to the U.S. mainland via the carrier's global network in Busan and Yokohama. Cargo from/to Guam joins APL's Eagle Express service (EX1) or the Guam Saipan Express service (GSX) in either Busan or Yokohama. These routes are shown in Figure 5-17.

Figure 5-17: APL Service Through Guam

Source: CMA CGM

Waterman

Waterman Steamship Corp., the principal subsidiary of International Shipholding Corp., is an independent owner and operator of U.S.-flag Ro/Ro vessels. In prior years, Waterman had a scheduled U.S.-flag car/truck carrier vessel service between Guam, Japan, South Korea and U.S. West Coast ports. In 2021, Waterman vessels did not call on the PAG.

5.3.6.2 Foreign Carriers

The foreign-flag carriers serving Guam include Kyowa Shipping Co. (Kyowa) and Marianas Express Lines Limited (MELL). These carriers serve the Guam-Asian market, as well as provide a majority of transshipment services to other non-U.S. territory ports in the region.

Kyowa

Founded in 1974, Kyowa Shipping Co. is a Japan-based regional carrier that provides regular liner shipping service from Japan, Australia, Asia, and Southeast Asia to Guam and Saipan. The company has become one of the top marine transport companies for the islands in the West Pacific Ocean.

Kyowa has a space chartering and connecting carrier agreement with Matson for service between Asia and Guam/Micronesia and with MELL for service to the FSM and RMI islands. Cargo originating from the U.S. mainland and Hawaii is sent to Guam on a weekly Matson vessel. Similarly, cargo from Asian ports on MELL's service rotation are sent to Guam on a weekly basis. Once in Guam, this cargo is transferred to one of Kyowa's multipurpose vessels that carry containers, breakbulk and Ro/Ro cargo and is transshipped to various destination ports throughout Micronesia.

In addition, Kyowa has a space chartering agreement with NYK-Hinode, a Japan-based cargo vessel operator, to deliver approximately 150 personal vehicles per month to Guam.

Cargo from Korea and Japan is also picked up directly by Kyowa vessels as part of its rotation and remains on these vessels until offloaded at its destination port in Micronesia. Figure 5-18 illustrates the service rotation.

Figure 5-18: Kyowa Direct and Transshipment Services Through Guam

Source: MSA

Marianas Express Lines Limited (MELL)

MELL was founded in 1997 and started with two vessels plying the route of Hong Kong, Guam, Saipan, and Taiwan. MELL is currently a container liner operator headquartered in Singapore that carries containers between China, Southeast Asia, Japan, Australia and islands in the Pacific. The company became a subsidiary of Pacific International Lines (Private) Ltd. in March 2015.

MELL provides regular service to Guam, utilizing two vessel rotations and deploying five vessels having an average capacity of 727 TEUs. The rotation for the Micronesia Express Service (MXS) is Hong Kong, Kaohsiung, Guam, Saipan, Yap, and Koror. The rotation for the East Micronesia Services (EMS) is Guam, Chuuk, Pohnpei, Kosrae, Majuro, and Ebeye. Figure 5-19 illustrates MELL's current service rotation.

MELL carried approximately 11 percent of all cargo coming in and out of the Port in FY 2021. The MXS service transfers an average of approximately 290 containers per vessel call in Guam. Cargo on a MELL vessel that is destined for the FSM and RMI islands is transshipped via Kyowa's vessels from the Port.

Figure 5-19: MELL Service Through Guam

Source: MELL

5.3.6.3 Competition

The Port has several competitive advantages over other ports in its region. First, Guam is the largest island in the Marianas archipelago and a strategic U.S. military hub. For this reason, the Port receives the benefits associated with catering to both a larger civilian and military population and has the resources to maintain and expand its facilities. Second, the Port is the only marine facility in the region with the required infrastructure (berth depth, storage yard) and equipment (gantry cranes, container handlers) to service container vessels with a capacity up to 4,000 TEUs.

Where a port has a very large local market, such as Guam, compared with other nearby ports, it is more likely to serve as a carrier's transshipment hub with its larger vessels centered on this "gateway" port. The use of smaller containerships or barges for transshipment routes offers carriers a more cost-effective way of providing faster and more frequent services to multiple smaller ports in the region on short and/or low container volume rotations. The smaller ports have shallow berths without dockside container cranes requiring smaller "geared" ships and barges, those with cranes installed on the vessel, to provide service to these ports.

During FY 2014 and FY 2015, a portion of Guam's transshipment cargo shifted to Saipan in the CNMI and to Majuro in the RMI but returned to Guam in FY 2016. These other island ports are heavily reliant on transshipment cargo because of their relatively small populations. For this reason, these ports competitively price their cargo handling services. However, smaller ports such as these have limited infrastructure (berths and container storage space), cranes and container handling equipment.

Saipan

Saipan is the second-largest island in the Mariana Islands archipelago, after Guam. The island has been a municipality of the U.S. Commonwealth of the Northern Mariana Islands since 1978. Saipan had a population of 48,220 in 2010 and 43,385 in 2020 according to the USCB. However, the USCB estimates the current population as 52,000.

Saipan has experienced an influx of investment because of Chinese developers starting a number of projects on the island. The Port of Saipan has thus experienced investment aimed at expanding and modernizing its facilities. The Port of Saipan is operated by the Commonwealth Ports Authority. The Port of Saipan has 22 acres of container yard and 2,600 linear feet of berthing space. The channel, turning basin, and berthing areas have a depth of 40 feet. The Port of Saipan does not currently have fixed, mobile, or floating cranes.

Majuro

Majuro, a large coral atoll in the eastern chain of the Marshall Islands, is the capital and largest city of the RMI. Majuro had an estimated population of 27,797 in 2011, according to the RMI Census Report.

The Port of Majuro is operated by the Marshall Islands Ports Authority. It also does not have fixed, mobile, or floating cranes. With an approximate container yard area of 6.3 acres and 1,464 linear feet of total berthing space, the Port of Majuro is considerably smaller than the Port of Saipan. The channel, turning basin, and berthing areas have a minimum depth of 50 feet. The Port of Majuro primarily serves small fishing vessels and cargo vessels that deliver a variety of imported food, household items, construction equipment and materials, fuel products, and copra and coconut oil.

5.4 DEMAND FORECAST

Forecasts of expected volumes of containerized, breakbulk and petroleum cargos to be shipped through the Port over the next 20 years are used as the foundation for this Master Plan Update. Forecasting involves benchmarking against historical trends and performing sensitivity analysis looking forward.

The forecasts consist of three largely independent drivers, as depicted in Table 5-7.

1. Organic growth forecasts throughput to support the needs of the population living on Guam and the tourism industry

2. The military buildup will drive temporary increases in throughput, particularly in goods related to construction of new military and civilian infrastructure being developed to accommodate the increased military presence.
3. As the largest economy in the region with the best port facilities, Guam is a logical transshipment location for cargo bound to/from nearby islands. This throughput dependent upon decisions by ocean carriers regarding where to transship cargo or to serve some islands directly.

In addition, a separate forecast was developed for the steady state after the military buildup is complete. Throughput will be greater than the organic forecast as a larger population is served even as the temporary increase in construction ends after the buildup is complete.

Table 5-7: Overview of Cargo Forecasts

<table>
<tr><th>Forecast</th><th>Basis</th><th>Cargoes</th></tr>
<tr><td>1. Organic</td><td>Historical analysis
- Cannot separate effects of local, tourism, military, construction</td><td rowspan="4">1. Containers
2. Bulk
3. Ro-Ro
4. Liquid bulk</td></tr>
<tr><td>2. Transshipment</td><td>Highly variable based on carrier decisions</td></tr>
<tr><td>3. Military Buildup</td><td>- 2008 forecast adjusted for inflation and current NAVFAC projections
- Peak characteristics
- Historical data inconsistent</td></tr>
<tr><td>4. Steady State Post Buildup</td><td>Population and activity increase with larger military presence</td></tr>
<tr><td colspan="3"></td></tr>
<tr><td rowspan="2">Total Throughput:</td><td colspan="2">High: Tourism recovers, strong military peak, 50% transshipment returns</td></tr>
<tr><td colspan="2">Base: 50% increase of military buildup due to offsetting factors, 25% transshipment returns</td></tr>
</table>

Forecast	Basis	Cargoes
Forecasts 1 to 4 combined	Low: Offsetting factors limit growth to historical percentages	

Source: WSP

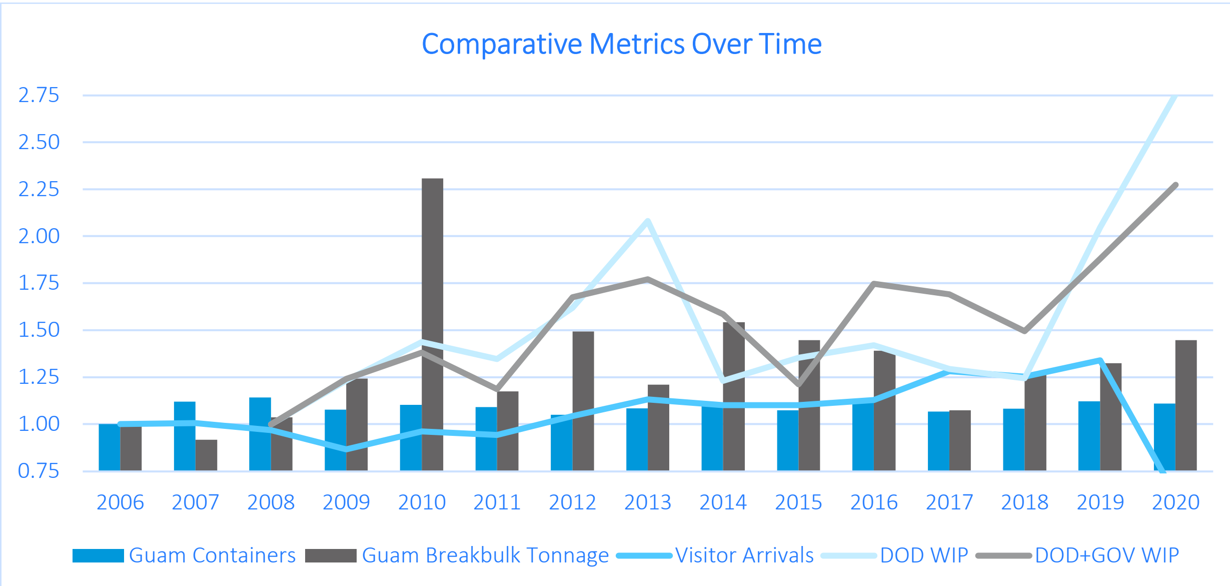
The forecast for this Master Plan is significantly complicated by the COVID-19 pandemic. As depicted in section 5-1, tourism dropped to essentially zero in March 2020 and has yet to start a significant recovery. Furthermore, supply chain issues have affected the availability and price of goods, to unknown effect. Finally, the military buildup is in process, but cannot be separated out from organic growth. These factors combine to limit the feasibility of developing a reliable statistical model to forecast throughput. Therefore, the forecast necessarily relies more upon expert judgment.

5.4.1 HISTORICAL ANALYSIS

WSP examined data from 2006 through 2020 to determine if statistical relationships between economic activity and port throughput could be developed. Key measures included visitor arrivals to Guam, population, tourism, and construction volume for the military and government. No statistically significant relationships were found relating to throughput. However, it is clear from the historical data is that breakbulk is more closely correlated with construction expenditures than containers.

Figure 5-20 below shows how these variables have changed compared to a base year of 2006. Even as visitor arrivals grew steadily from 1.05 million in 2009 to 1.63 million in 2019 and construction spending increased substantially (if less consistently) since 2008, local containers (excluding transshipment) have been essentially flat since, with a low just under 64,000 in 2012 to a high of 67,864 in 2016. Breakbulk tonnage has been more variable during this timeframe rising from 60,831 tons in 2017 to 82,040 in 2020. Moreover, container counts remained steady despite the dramatic falloff in visitors in 2020 due to the Covid-19 pandemic – perhaps due to the military buildup offsetting some reductions in local needs.

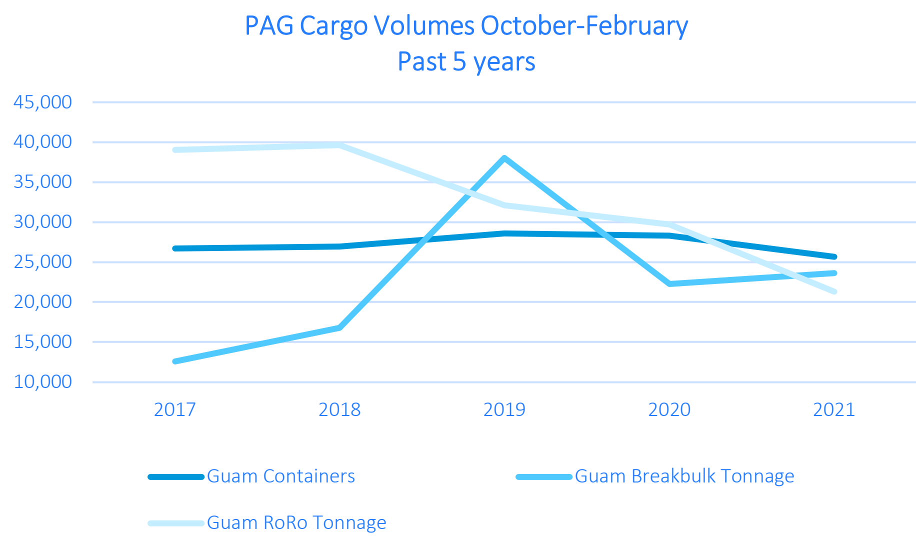
Figure 5-20: Comparative Metrics Over Time



Source: Throughput from PAG, WIP from NAVFAC, Guam Visitors Bureau

Focusing on the most recent five years, the stability of container volumes is even clearer. Despite increased construction as the military buildup began and the near cessation of tourism, local container volumes in winter 2020-21 were essentially identical to 2016-2017 and down only 9% from winter 2019-2020. Looking back further, container volumes for the local Guam market remain steady, shifting no more than 14% over the past 15 years through events such as the financial crisis and record-breaking tourism. See Figure 5-21.

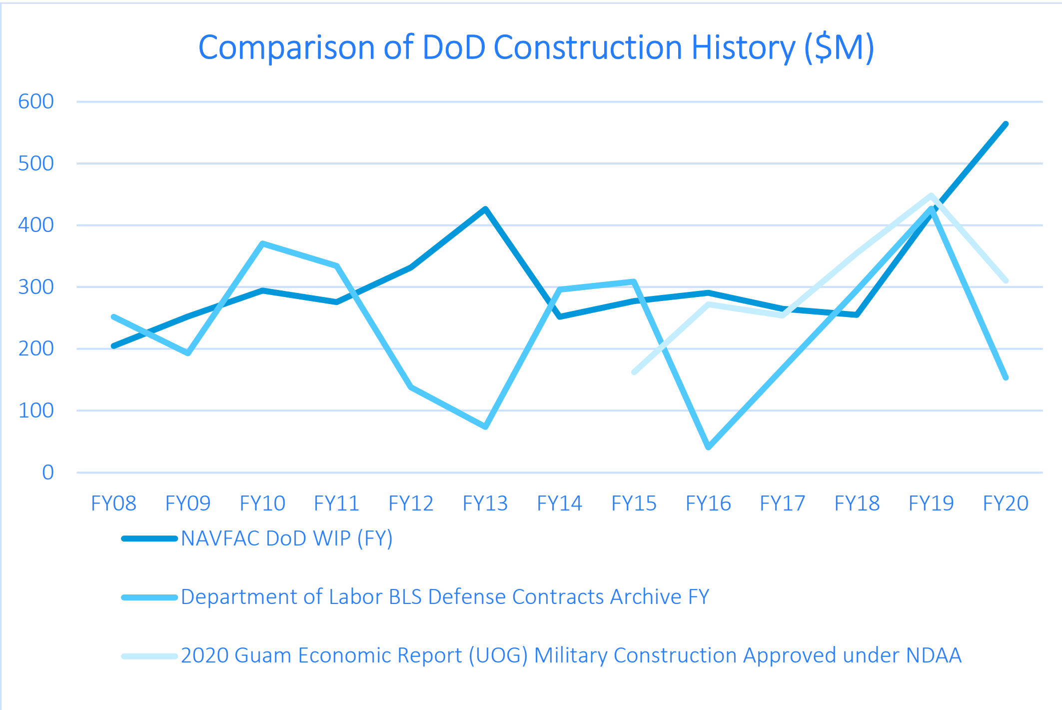
Figure 5-21: PAG Cargo Volumes, October – February, Past 5 Years



Source: WSP Analysis of data provided by PAG

WSP also examined multiple data sources and found inconsistencies in the historical data from difference sources. A key example is military WIP. Figure 5-22 below compares military WIP in the NAVFAC forecast to data from the Guam Bureau of Labor Statistics and the University of Guam (UOG) 2020 Guam Economic Report. Since 2008, NAVFAC reports over $4.1 billion of work in place compared to under $3.05 by the Department of Bureau of Labor Statistics (BLS). Since 2015, NAVFAC reports over $2.07 billion, compared to $1.80 billion for UOG and $1.39 billion for BLS. Most critically, NAVFAC has a substantial increase to $565 million in FY 2020 – the greatest amount in this timeframe by $140 million – while the other two data sources showed steep declines. NAVFAC utilizes the BLS data for civilian WIP, so the metric should be comparable. That it is not raises questions about how to handle the forecast going forward.

Figure 5-22: Comparison of DoD Construction History



Source: WSP Analysis, NAVFAC Marianas, Bureau of Labor and Statistics, and University of Guam

5.4.2 METHODOLOGY

The cargo volumes were forecast based on sustained increases under the Organic Growth Scenario for the anticipated population on Guam and the Micronesian region and supporting three separate scenarios (Organic, Mid Build-up, and Full Build-up) for the proposed military realignment and expansion program on Guam.

5.4.2.1 Military Build-up

As noted previously, the DoD is in the midst of a military build-up on Guam that will add over 7,000 U.S. servicemembers and dependents to the island. The build-up will impact cargo volumes in three ways:

- During the construction period, DoD contractors will import substantial volumes of materials and supplies. These supplies will come in containerized, breakbulk, and liquid bulk handling modes.
- The DoD will bring in additional active-duty personnel and their dependents. This will also increase the flow of household goods, personal vehicles and goods sold at the commissaries and at local businesses. This will primarily impact containerized volumes but will also have an impact on breakbulk and liquid bulk cargos.

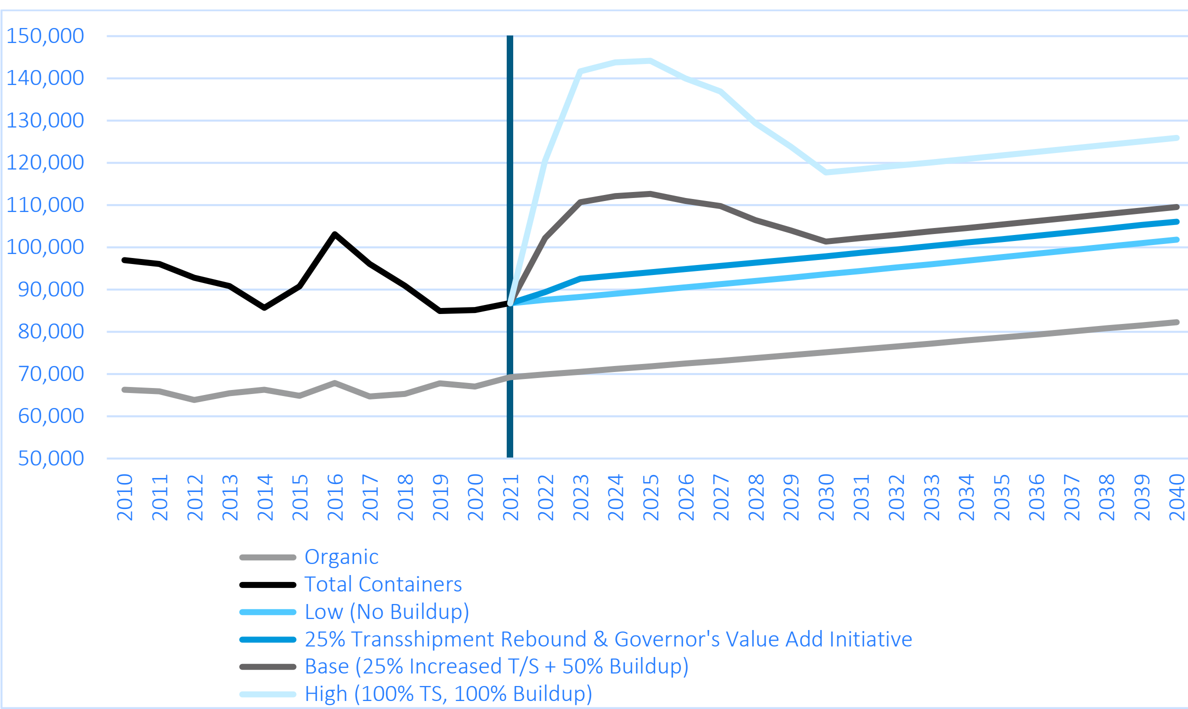
- The build-up will require additional workers from off-island both during and after construction. The US Customs and Immigration Services released guidance in May 2021 that enables Guam and the Northern Mariana Islands (CNMI) to admit foreign construction workers if they are supporting the military realignment under the National Defense Authorization Act (NDAA). A February 8, 2022 guidance further clarified that housing development qualifies for H-2B workers in addition to infrastructure improvements.

5.4.3 CONTAINER CARGO FORECAST

As depicted in Figure 5-23, three scenarios were defined for containers. Organic growth follows the 10-year CAGR of 0.91% growth. A second scenario assumes 25% of transshipment that has left Guam since 2016 returns and the Governor's Value-Add Initiative spurs growth. The Base forecast assumes the military buildup induces half the containers per billion dollars of expenditure assumed in the 2008 Master Plan, while the high scenario assumes the same ratio of container traffic to buildup expenditures from the 2008 Master Plan.

Planning for port throughput is based on the Base scenario, with a peak of 112,688 forecast in 2025. Note this is only about 10% greater than the 103,152 containers the Port handled in 2016 at the height of transshipment.

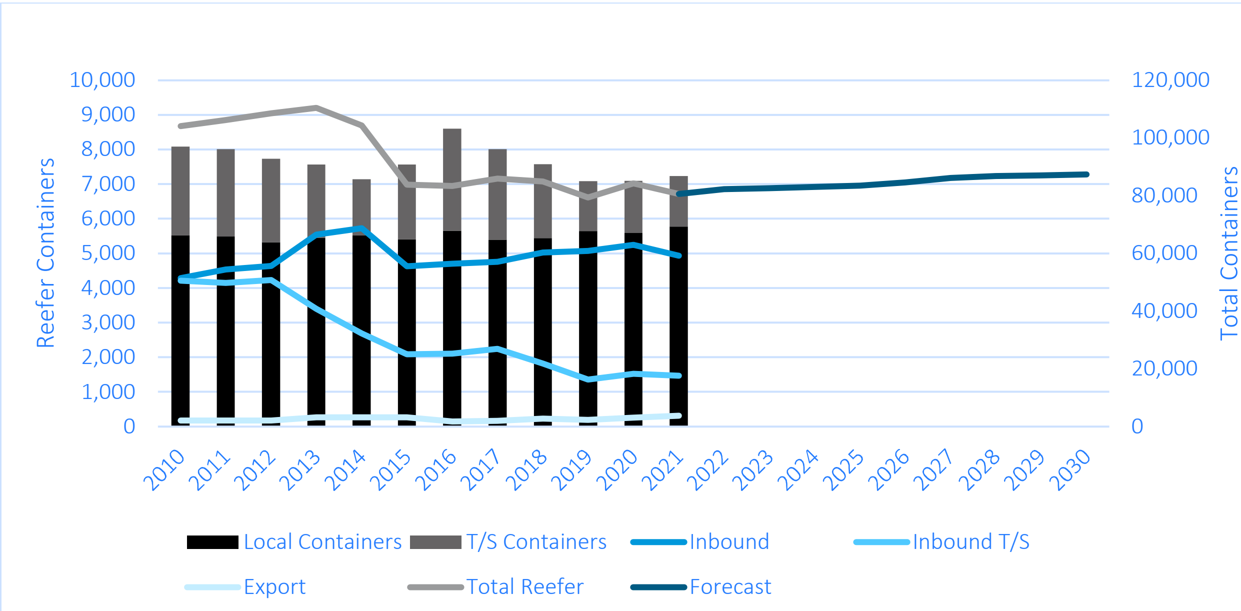
Figure 5-23: Container Forecast – Comparison of Growth Scenarios



Source: WSP analysis

Refrigerated containers, known as reefer, are an important subset of containerized throughput since adequate reefer sockets must be available to accommodate demand. Reefer cargo is primarily linked to organic growth since construction cargo generally does not require refrigeration. Thus, reefer containers are forecast to correlate with population, which has been declining but will receive a boost of new residents as servicemembers arrive. See Figure 5-24.

Figure 5-24: Reefer History and Forecast



Source: WSP analysis of PAG data

5.4.4 BREAKBULK CARGO FORECAST

Unlike other cargo types, breakbulk cargo is highly correlated with construction. The breakbulk forecast was developed by calculating the ratio between total construction expenditures on Guam and breakbulk throughput for the eight years from 2014-2021. This ratio was then applied to expected construction values for the coming eight years 2022-2029. The data is imperfect since military construction is reported as works in place (WIP) – the actual value of construction – while civilian construction is based on permit values that may or may not be implemented.

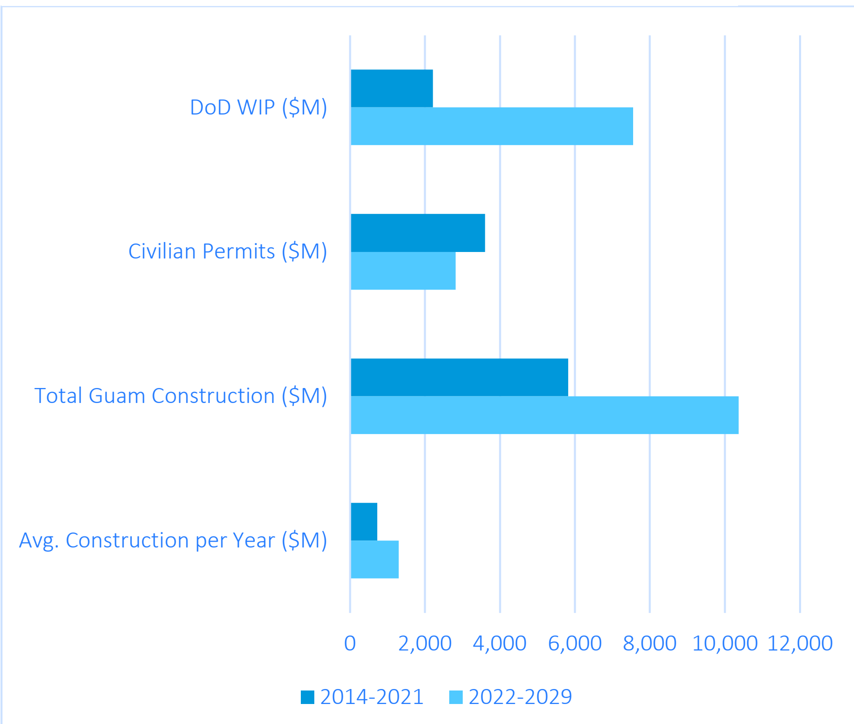
As shown in Figure 5-25 and Figure 5-26 below, construction expenditures (in 2020 dollars) are expected to increase from $727 million per year in 2014-2021 to $1.3 billion per year in 2022-2029. The associated increase in breakbulk tonnage is from an average of 82,576 tons per year to 154,924, a rise of 89% during the buildup years.

Source: WSP Analysis of NAVFAC and Guam Statistical Yearbook data

The analysis assumes that military construction will crowd out some public and private civilian projects by consuming substantial amounts of construction resources on Guam and increasing bid prices. Compared to the historical permit value average, civilian construction is assumed to be 50% in 2022-2025 before rising back to average by 2027.

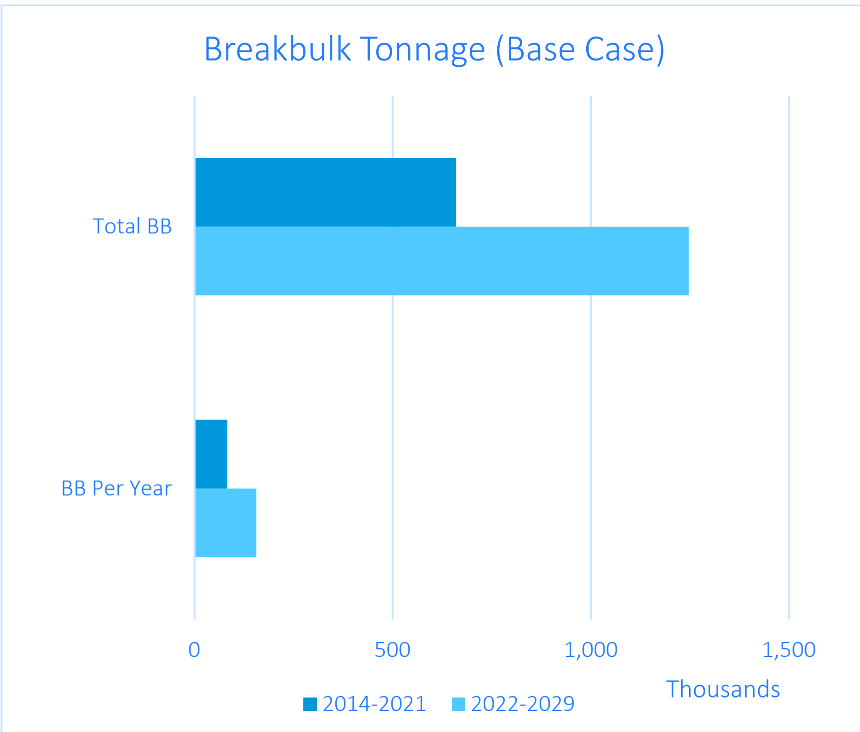
The resulting annual breakbulk forecast is shown in Figure 5-27. The low forecast assumes the smallest ratio between construction on island and breakbulk tonnage during the past 8 years; the base assumes the median ratio, and the high assumes the greatest ratio.

Figure 5-25: Guam Construction History and Forecast



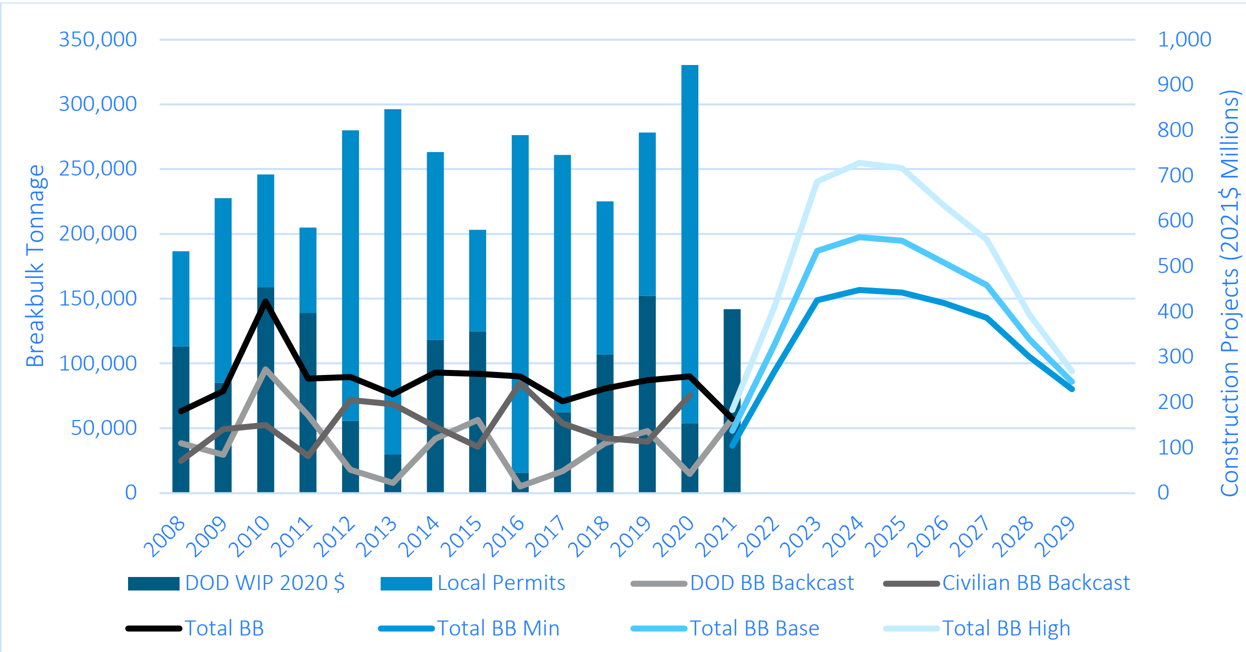
Source: WSP analysis

Figure 5-26: Breakbulk Tonnage History and Forecast



Source: WSP analysis

Figure 5-27: Breakbulk History and Forecast

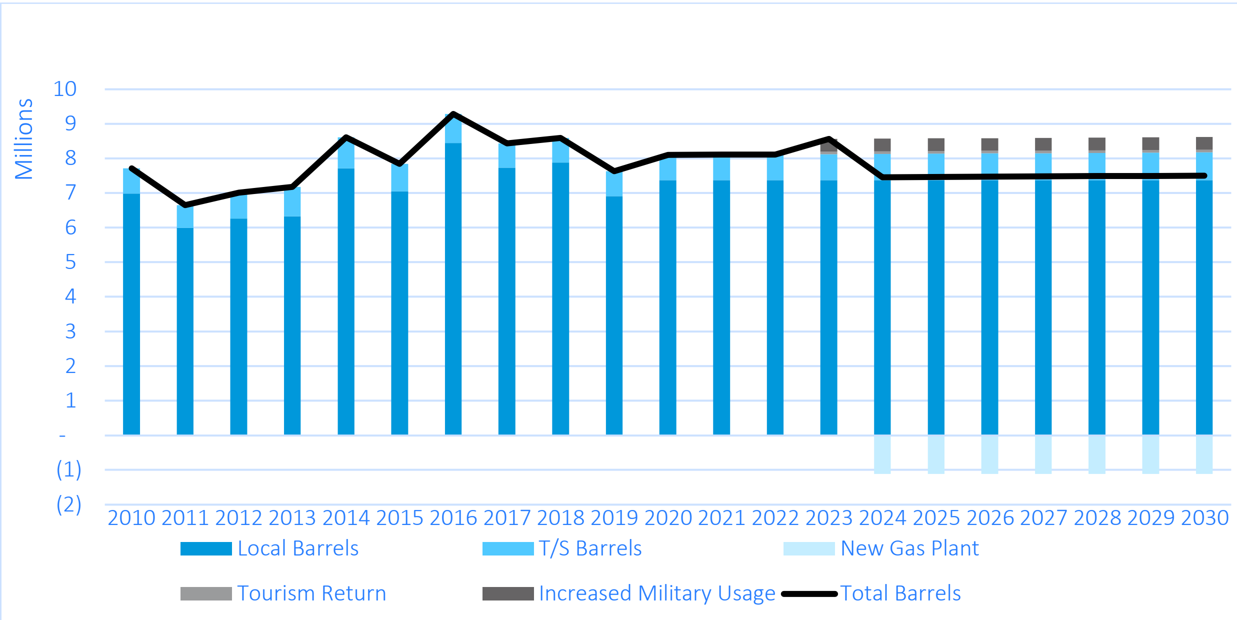


Source: WSP analysis

5.4.5 LIQUID BULK CARGO FORECAST

Many factors affect liquid bulk demand including the population, price of oil, tourism, and efficiency of power plants and automobiles. Guam has undertaken initiatives to reduce the use of fossil fuels, including construction of a new gas plant expected to come online by 2024 and several renewable energy projects. In addition, as with other cargoes, transshipment impacts liquid bulk. Given these offsetting trends, liquid fuel is forecast to be flat at 7.5 million barrels per year through 2030. See Figure 5-28.

Figure 5-28: Liquid Bulk History and Forecast (Barrels)

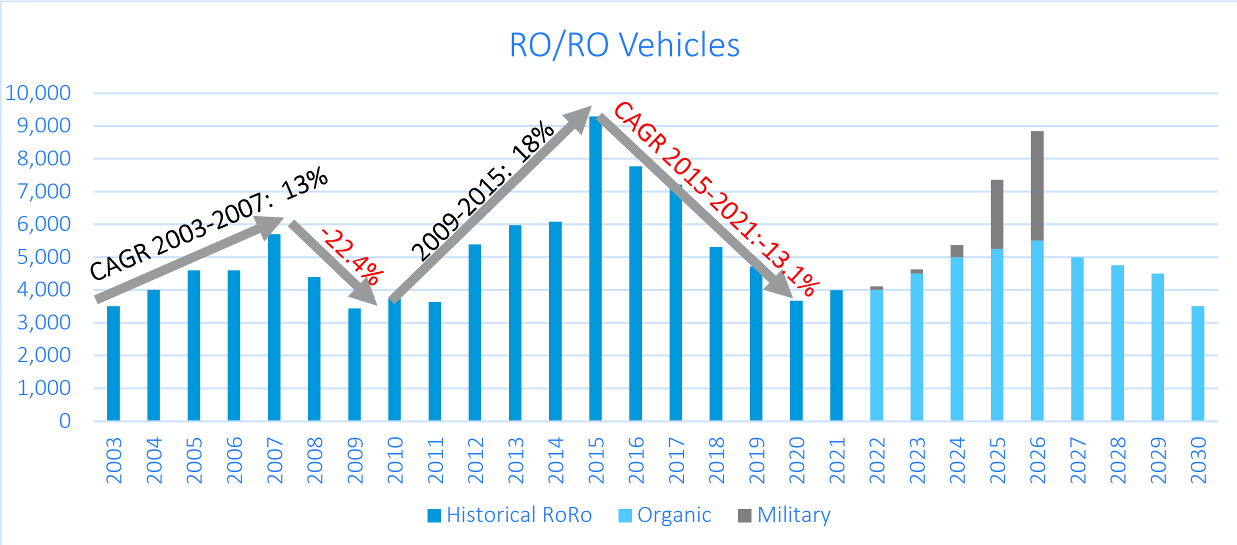


Source: WSP analysis

5.4.6 RO/RO FORECAST

Automobiles are forecast to grow in the coming years. First, FY 2021 saw the first increase in Ro/Ro since the peak in 2015, indicating a potential new increasing cycle after five years of reductions. Automobiles are expected to become more available following supply-chain issues related to COVID-19 and the chip shortage. In addition, the 5,000 servicemembers moving to Guam as part of the military realignment will be either bringing a car with them or buying one locally. Auto throughput is forecast to peak at 8,840 in 2026, still lower than the 2015 spike. See Figure 5-29.

Figure 5-29: Ro/Ro Vehicle Forecast



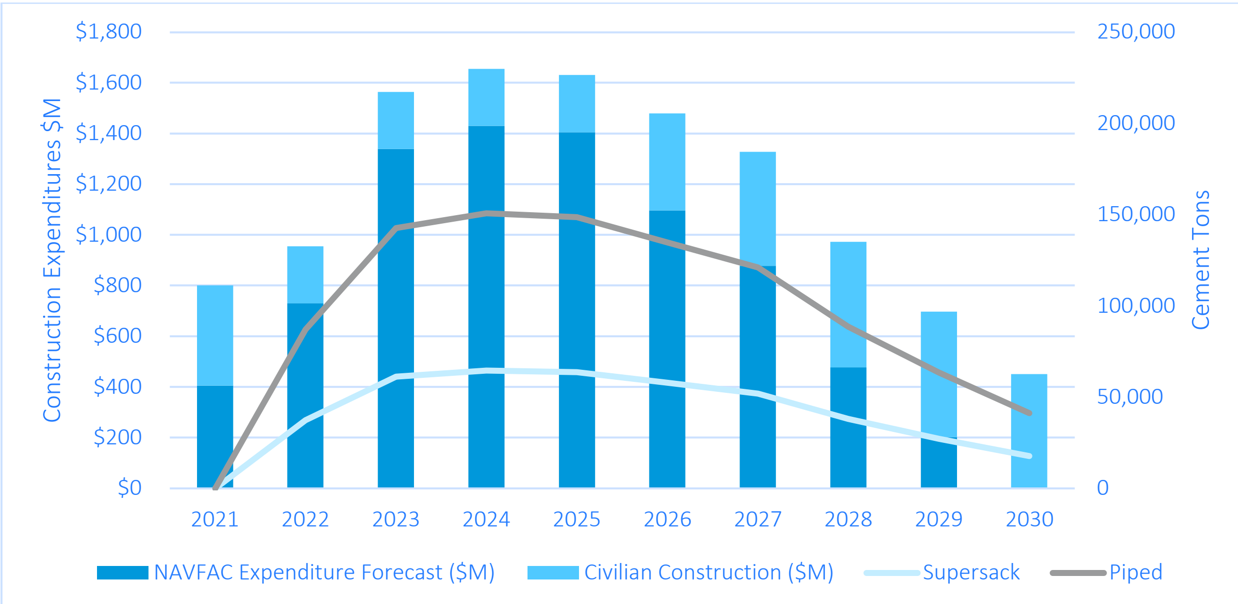
Source: WSP analysis

5.4.7 CEMENT FORECAST

As one of the key inputs for concrete construction, cement imports are expected to rise sharply due to the military buildup. Although no reliable historical numbers exist for comparison, WSP was able to develop a forecast based on data from interviews with key local concrete suppliers.

Cement arrives on Guam in two forms; flowable product that is piped to plants on or near the Port, and in supersacks that arrive as palletized breakbulk. As shown in Figure 5-30, cement is forecast to peak at 205,000 tons in 2024 when military the buildup is at its greatest. It is assumed that 30% of cement arrives in supersacks and 70% via pipe.

Figure 5-30: Cement Forecast



Source: WSP analysis

6 CAPACITY AND DEMAND ANALYSIS

6.1 OPERATIONAL ANALYSIS

Using the forecasted cargo volumes in Section 5, a capacity vs. demand analysis was performed for the PAG commercial cargo terminals. To make this comparison, a capacity analysis was performed using WSP's proprietary Port Rail Intermodal Modeling Environment (PRIME) tool. PRIME consist of two primary components:

- Terminal Layout Tool (TLT)
- Container Terminal Capacity Model (CTCM)

WSP collected operational data for cargo moving in and out of the commercial port. This data consisted of the following information.

- Vessel movement
  - Vessel and voyage name
  - Vessel arrival and departure time
  - Number of lifts (inbound and outbound)
  - Loss time due to breakdowns
  - Cranes deployed
- Container movement
  - Container number and type
  - Category (import/export/transship)
  - Container entry and exit time
  - Container entry and exit mode (vessel, truck)
- Gate movement
  - Container and chassis number
  - Transaction type (receipt, delivery)
  - Temperature (in case of reefer)
  - Transaction time

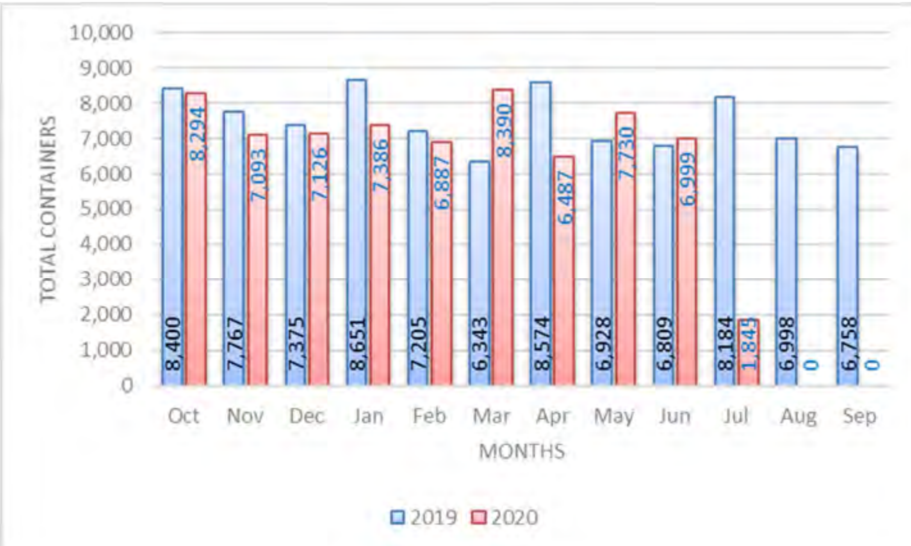
6.1.1 VESSEL MOVEMENT ANALYSIS

We analyzed vessel movement data which showed that PAG handles, on average, about 13,350 TEUs per month or about 7,500 containers per month for FY 2019 and 2020. Figure 6-1 below shows the monthly throughput for FY 2019 and 2020.

Typically, a terminal experiences seasonal variation in throughput based on the level of market demand during certain peak seasons. For example, higher monthly throughput in August-September as stores prepare for holiday inventory. The analysis showed that PAG saw a seasonal peaking of about 1.23 over the average monthly throughput based on FY 2019 and 2020 data.

TEU ratio provides the mixture of 20 feet and 40 feet containers arriving and departing the terminal. A ratio of 1.00 means all containers are 20 feet long, and a ratio of 2.00 means all containers are 40 feet long. PAG's vessel data analysis showed a TEU ratio of 1.78 for FY2019 and 2020.

Figure 6-1: PAG Monthly Container Lifts FY2019-2020



Source: PAG Data and WSP Analysis

The vessel data also included vessel work start and end time, lifts per vessel, and crane deployment for each vessel. Figure 6-3 shows the crane deployment pattern based on vessel lifts per call. The analysis showed the following results.

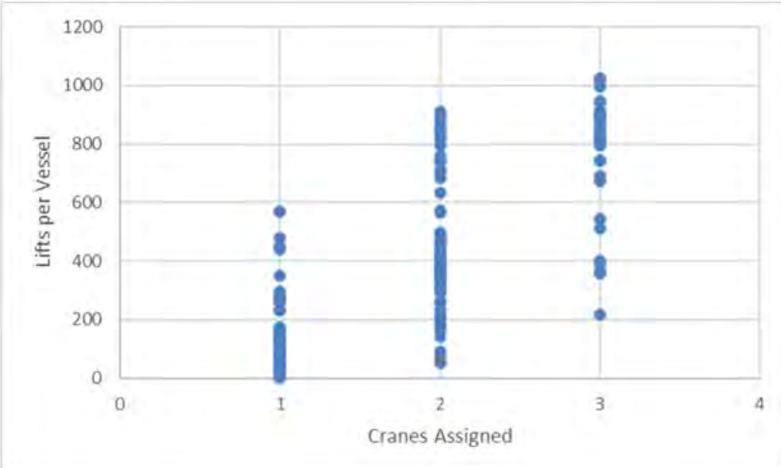
Figure 6-2: Vessel Mix and Turnover

Vessel Size (TEU)	Count	Share	Vessel Turnover
1000	117	55%	15%
2000	61	29%	40%
3000	25	12%	56%
4000	8	4%	41%

Source: WSP and the PAG

- Largest Vessel: Matson Kaiman Hila and Daniel K Inouye – 3,220 TEU
- Average Crane Productivity: 21.3 lifts per hour
- Crane deployment pattern:
  - ~250 vessel lifts: 1 crane
  - ~450 vessel lifts: 2 cranes
  - ~850 vessel lifts: 3 cranes

Figure 6-3: PAG Crane Deployment Pattern by Vessel Lifts



Source: PAG Data and WSP Analysis

WSP also interviewed Matson, Kyowa, MELL and APL to understand their vessel deployment plans and turnover rates during the build-up. Based on those discussions, future vessel mixes and turnover rates were developed. Table 6-1 shows the existing and future vessel mixes and turnover rate.

Table 6-1: Existing and Future Vessel Mix and Turnover

Vessel Capacity	Vessel Mix (% of Calls)		Turnover (% of Vessel Capacity	
	Existing	Build-Up	Existing	Build-up
1,000 TEU	55%	45%	15%	15%
2,000 TEU	29%	25%	40%	50%
3,000 TEU	12%	15%	56%	65%
4,000 TEU	4%	15%	41%	45%

Source: PAG Data and WSP Analysis

6.1.2 CONTAINER MOVEMENT ANALYSIS

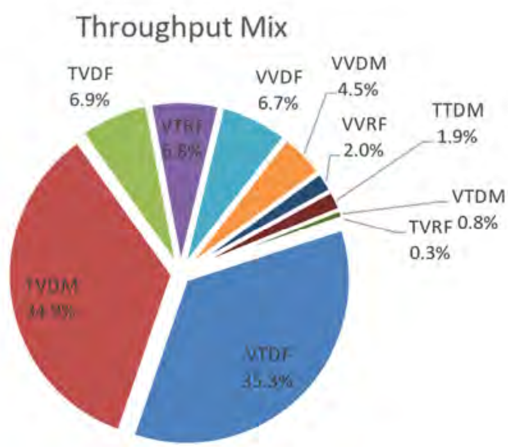
PAG provided a detailed database from their Terminal Operating System (TOS) containing container flow throughput in the commercial port. WSP analyzed container movement data to derive the throughput mix and dwell time distribution.

6.1.2.1 Throughput Mix

The throughput mix for PAG is showing in Figure 6-4. At PAG, import dry full containers accounted for the major share of the throughput mix with 35.3% and export dry empties accounted for second biggest share at about 35%.

Figure 6-4: PAG Throughput Mix

Code	Description	Count	Share
VTDF	Import Dry Full	23,258	35.3%
VTRF	Import Reefer Full	4,453	6.8%
VTDM	Import Dry Empty	526	0.8%
TVDF	Export Dry Full	4,519	6.9%
TVRF	Export Reefer Full	228	0.3%
TVDM	Export Dry Empty	23,006	34.9%
VVDF	T'Ship Dry Full	4,402	6.7%
VVRF	T'Ship Reefer Full	1,313	2.0%
VVDM	T'Ship Dry Empty	2,947	4.5%
TTDM	Depot Dry Empty	1,269	1.9%



Source: PAG Data and WSP Analysis

6.1.2.2 Dwell Time

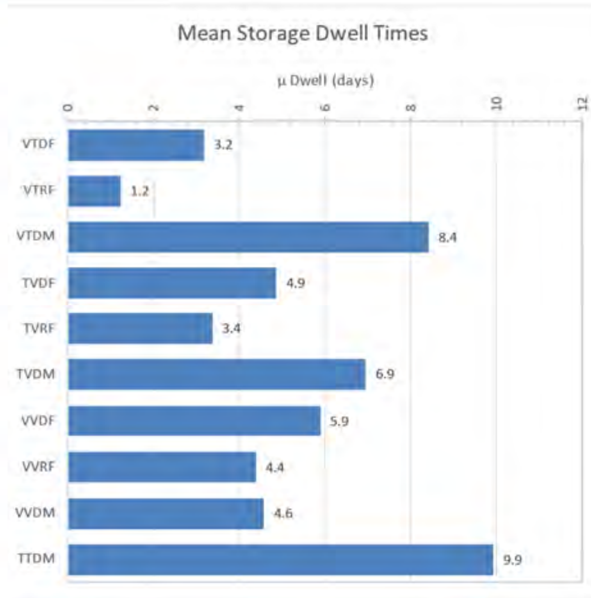
The database provided by PAG included arrival and departure dates and times for every container handled at the commercial port. Dwell times were determined by calculating the difference between these arrival and departure times, rounded to the nearest whole day. Mean and statistical distribution of dwell times were calculated for all major container mixes that impact the operations. The mean container storage dwell time for the majority of container flows are shown in Figure 6-6. Sample dwell distribution for top two container types are shown in Figure 6-5.

Figure 6-5: PAG Sample Dwell Distribution

Source: PAG Data and WSP Analysis

Figure 6-6: PAG Mean Container Storage Dwell Time

Code	Description	Mean Dwell (days)
VTDF	Import Dry Full	3.2
VTRF	Import Reefer Full	1.2
VTDM	Import Dry Empty	8.4
TVDF	Export Dry Full	4.9
TVRF	Export Reefer Full	3.4
TVDM	Export Dry Empty	6.9
VVDF	T'Ship Dry Full	5.9
VVRF	T'Ship Reefer Full	4.4
VVDM	T'Ship Dry Empty	4.6
TTDM	Depot Dry Empty	9.9



Source: PAG Data and WSP Analysis

6.1.3 GATE MOVEMENT ANALYSIS

PAG provided a detailed database from the TOS describing the movement of containers through the gate complex. Peaking factors for peak hourly and daily flows were calculated using the database. Weekly peaking is calculated as the ratio of peak gate volume during a week to mean weekly gate volume over the course of a week. Hourly peaking is calculated as the ratio of peak gate volume during an hour to mean hourly gate volume over the course of a day. Table 6-2 shows the gate flow factors developed from the data provided by PAG.

Table 6-2: PAG Gate Flow Factors

Variable	Unit	Value
Gate Operating Schedule	Shifts/Week	5
Gate Operating Schedule	Hours/Day	10
Gate Weekly Peak	Ratio	1.32

Source: PAG Data and WSP Analysis

Figure 6-7 shows the weekly transaction breakdown for the entire year on the left and hourly transaction breakdown for peak week on the right.

Figure 6-7: PAG Weekly and Hourly Gate Transaction

Source: PAG Data and WSP Analysis

6.2 CARGO TERMINAL CAPACITY

6.2.1 EXISTING OPERATIONS

Container yard operations require specialized equipment used to lift containers to/from the ship and in the storage yard. PAG currently has three ship-to-shore cranes that are used to lift the containers to/from the ship. The containers, once lifted from the ship, are then placed on chassis, which are moved by off-road terminal vehicles called Utility Tractor Rigs (UTRs). Once on the chassis, these containers can either be stored on the chassis in a designated area or they can be removed and then stacked on the ground using a Top Pick (TP). Currently, empty and transshipment containers at the cargo terminal are stacked on the ground (grounded). Refrigerated containers are placed on chassis and are stored near reefer outlets. All other loaded containers are either placed on chassis or are grounded. Figure 6-8 shows the current layout developed in PRIME, of container storage yard at the cargo terminal.

Table 6-3 shows the existing terminal ground slots (TGS) at the port as of 2021.

Table 6-3: PAG Existing Ground Slots

Storage Type	TGS
Full Dry Wheeled Slots	888
Full Top-Pick Grounded Slots	419
Empty Grounded Slots	492
Reefer Wheeled Slots	124

Source: PAG Data and WSP Analysis

Figure 6-8: Existing Terminal Layout

Source: Google Earth and WSP

6.2.2 TERMINAL CAPACITY ANALYSIS

WSP's PRIME tool was used to estimate maximum practical throughput capacity and cargo handling equipment needs as a function of site layout, equipment selection/performance and operating conditions for PAG. Maximum practical capacity is defined as that volume which, if exceeded, would cause a disproportionate increase in unit operating cost and/or decrease in performance, within the context of the terminal's land use, layout, and uncontrollable commercial drivers.

The CTCM is a static linear model that estimates berth-constrained and container yard-constrained throughput capacities. The model first estimates berth-constrained capacity. It then calculates the storage demand associated with the berth-constrained capacity. Storage capacity of the terminal is estimated and compared to the berth constrained storage demand. From this data, the ratio of site storage capacity to berth-driven storage demand is calculated. Finally, the storage-constrained throughput capacity is calculated.

6.2.2.1 Berth Throughout Capacity

The equation shown below is used to estimate the berth-constrained capacity of the marine terminal. The model calculates the maximum number of calls possible by the average container vessel, multiplies by the lifts per call, and annualizes the result.

$$C_B = Berth\ Capacity = \frac{C_W \times L_C \times 52\, wk/yr}{P_S}$$

Where,

C_w = maximum number of calls in a week

L_c = mean lifts per vessel call

P_s = Seasonal peaking factor

6.2.2.2 Storage Yard Throughput Capacity

The equation shown below is used for calculating the yard-constrained capacity of the terminal. The CTCM calculates the storage demand for each flow component, driven by the terminal volume, V. In this case, V is the berth-constrained capacity. The model takes the sum of storage capacities developed in the site plan for the facility, divides by the storage demand, and multiplies it by the driving volume to establish capacity.

$$C_Y = Yard\ Capacity = \frac{\sum_i^N C_i}{\sum_i^N S_i} \times V$$

Where,

i = Flow and Storage Component

V = Terminal annual volume

C_i = Storage Capacity for Flow I from Plan

The port's current throughput capacity was estimated based on the data received from PAG and using the above stated method. Table 6-4 shows the existing berth and yard throughput capacity of the terminal. Yard capacity is the limiting factor, thus, the port has an existing throughput capacity of 126,000 containers per year.

Table 6-4: PAG Existing Throughput Capacity

Throughput Type	TEU/Yr	Container/Yr
Berth Throughput Capacity	341,000	192,000
Yard Throughput Capacity	225,000	126,000

Source: WSP analysis

6.2.2.3 Gate Capacity

A new truck gate complex was constructed in 2015. The gate consists of four lanes with a concrete canopy, and three booths under the canopy. The gate lanes consist of one inbound lane, one reversable lane, one outbound lane, and the fourth lane is a bypass lane. The new gate complex uses the TOS to expedite the truck transaction time.

At current terminal throughput capacity of 126,000 containers per year, the existing gate has sufficient capacity to handle the anticipated flow of trucks. In the future, if a gate operating system (GOS) is implemented, it will further expedite the truck transaction time and increase processing capacity at the gate.

6.2.3 STS CRANES

In December 2016, WSP performed an independent analysis of PAG shipping schedules and STS crane operations. In order to perform the analysis, the ship-call schedules, including average and peak lift-count data and the normal complement of required STS Cranes, for each of the ships were obtained from the two primary shipping lines calling the PAG, Matson and APL. In addition, historical PAG STS Crane operational data were also requested to determine the average ship-lifts per operating hour for the PAG STS Cranes. From this data WSP was able to determine when these ships arrive, depart and the amount of time spent at berth, the average and peak number of hours required for STS Crane (un)loading operations on each ship, and when and/or there is a need for simultaneous multi-berth operations that would require deployment of the maximum number of STS Cranes. The finding of this analysis showed that four STS Cranes at a minimum are required to maintain the necessary level of service at the Port of Guam for a two-berth operation.

While performing the capacity analysis, the PRIME model showed that there is a requirement of minimum of three cranes to support the existing throughput capacity. However, as volume starts to increase during build-up, the port will need an additional fourth STS crane to support the capacity required to meet the forecasted demand.

6.2.4 GENERAL CARGO CAPACITY

A general cargo storage capacity analysis was performed based on the demand forecast described in Section 5. PAG currently handles and is forecasted to handle different types of cargo classified as general cargo including:

- Aggregate
- Asphalt
- Cement Bags
- Pipe
- Bulk Scrap Metal
- Heavy Lift
- Pre-slung
- Roll-on / Roll-off (Ro/Ro)
- Unitized

Storage area requirements for these different types of cargo were calculated using the existing method of storage at the port and other cargo handling facilities outside of PAG. Table 6-5 includes assumptions for storage area requirements as well as cargo type and circulation area assumptions.

Table 6-5: Storage Assumption for General Cargo

Cargo Type	Storage Utilization	Storage Density (CF / ton)	Circulation Area (% of Storage Area)	Storage Type
Aggregate	70%	6	100%	Open
Asphalt	70%	19	30%	Either
Cement Bags	70%	23	35%	Covered
Pipe	65%	54	50%	Open
Bulk Scrap Metal	65%	13	100%	Open
Heavy Lift	65%	160	75%	Open
Preslung	65%	99	50%	Open
Ro/Ro	70%	158	35%	Open
Unitized	70%	31	50%	Either

Source: WSP analysis

A peak two-week period of general cargo volumes was modeled to determine the average daily area requirements anticipated during peak volume years. The following existing operating data for vessel schedules and cargo tonnage were used to prorate the volume of cargo handled on each weekly vessel call during each peak week scenario:

- Ships are serviced 7 days a week
- Gate is open 5 days per week
- A peak week cargo volume factor of 1.5

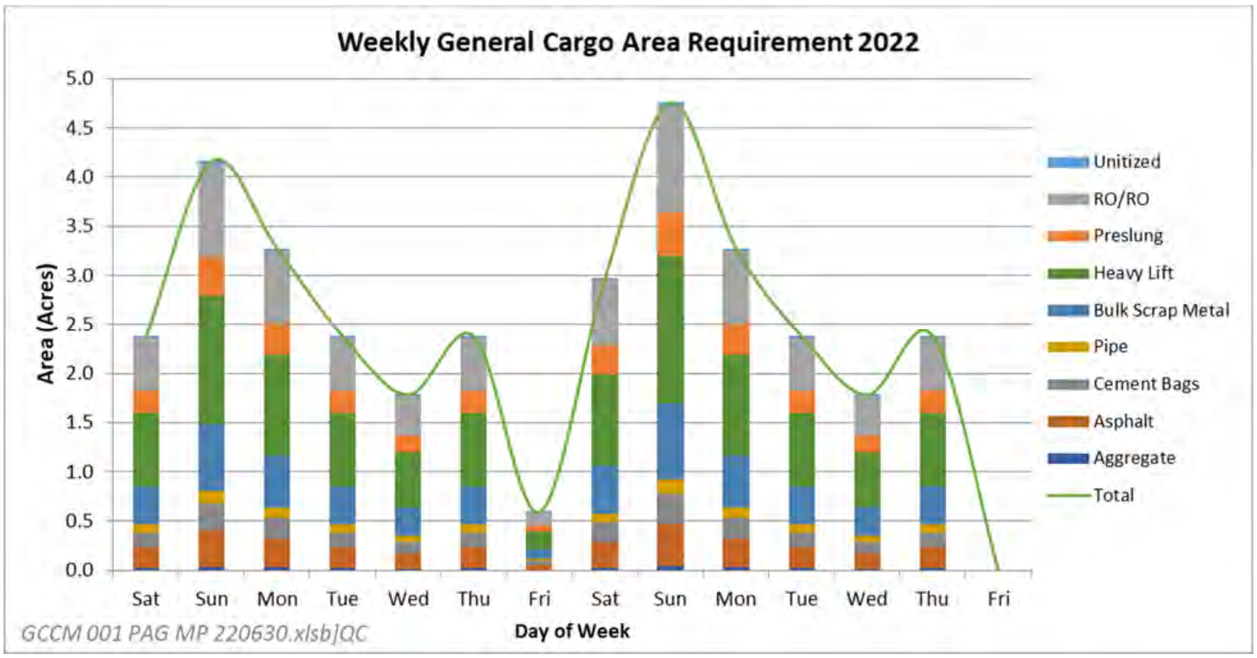
- Some cargo arriving late in the week departs the following week

Based on the cargo demand shown in Section 5, the general cargo ramps up in 2022 and peaks in 2024 before coming down in 2029. Thus, three general cargo area requirement analysis was performed for years 2022, 2024 and 2029.

6.2.4.1 General Cargo 2022

General cargo will start ramping up in 2022 at about 144,000 tons. Approximately 4.8 acres of storage area will be needed during this year. The current general cargo storage area is sufficient to handle this projected demand. Figure 6-9 shows the area requirement for two peak week periods of the year.

Figure 6-9: General Cargo Storage Requirement - 2022

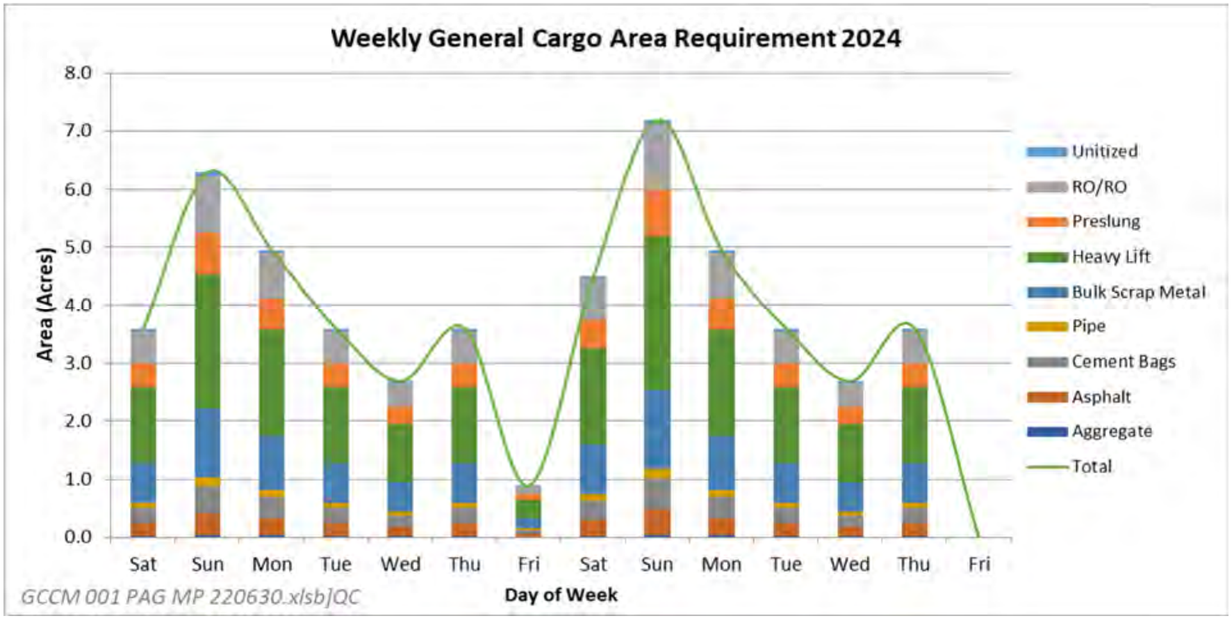


Source: WSP analysis

6.2.4.2 General Cargo 2024

General cargo will peak in 2024 at about 251,000 tons. Approximately 7.2 acres of storage area will be needed during this year. The current general cargo storage area will not be sufficient to handle this projected demand. With reconfiguration of container storage yard, additional general cargo storage area will be made available at the cargo terminal. Figure 6-10 shows the area requirement for two peak week periods of the year.

Figure 6-10: General Cargo Storage Requirement - 2024

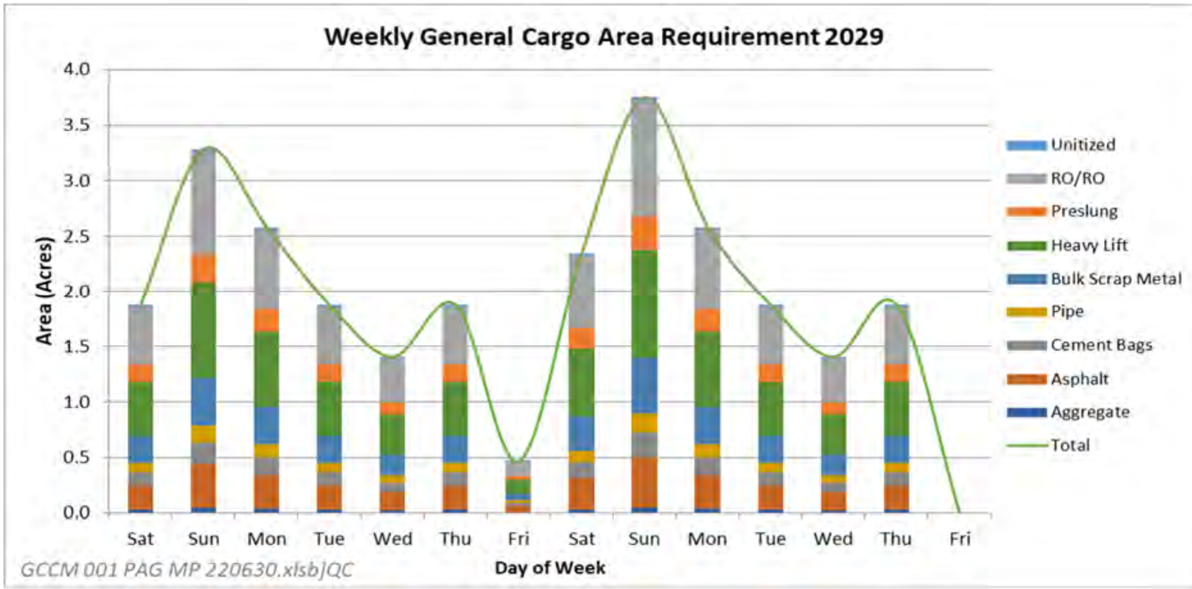


Source: WSP analysis

6.2.4.3 General Cargo 2029

In 2029, general cargo volume will return to pre-buildup numbers at about 94,000 tons. Approximately 3.8 acres of storage area will be needed that year. The current general cargo storage area will be sufficient to handle this projected demand. Moreover, with reduction in area demand for general cargo, additional space will be made available for container storage, if needed. Figure 6-11 shows the post build up area requirement for a two-peak week period of the year.

Figure 6-11: General Cargo Storage Requirement - 2029



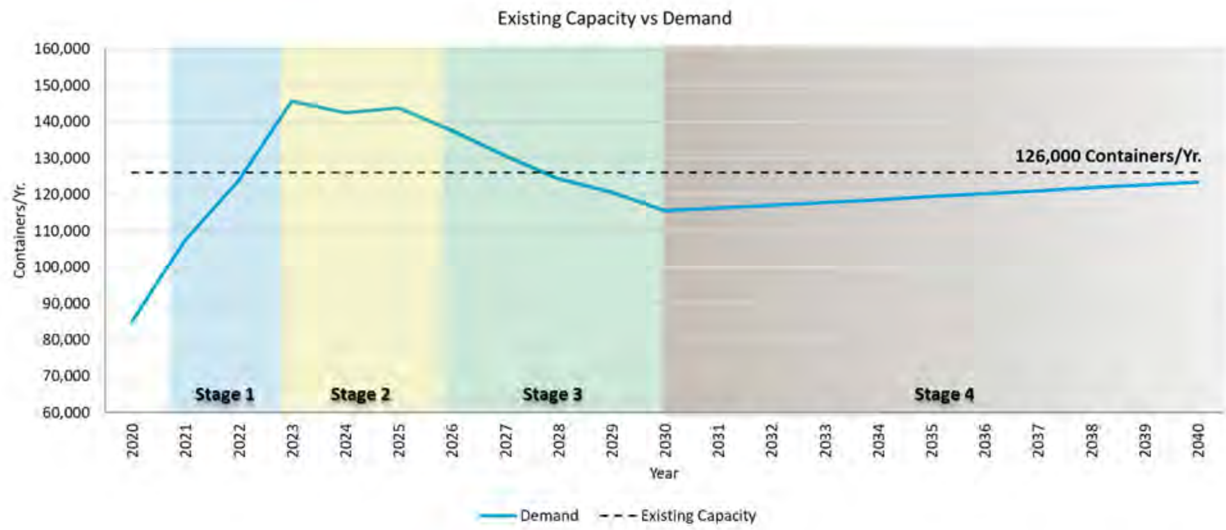
Source: WSP analysis

6.3 CAPACITY VS DEMAND

Section 5 describes various growth scenarios for the container cargo forecast. For this master plan, we considered the high forecast to ascertain adequate storage capacity is available at the cargo terminal. Figure 6-12 shows an Existing Capacity vs Container Demand chart in which the blue line denotes the high growth scenario for container demand and the black dashed line shows the existing PAG container terminal throughput capacity. It can be seen from the figure that demand will exceed capacity around 2023. The container cargo demand stays above 140,000 containers per year untill 2026, before it starts to normalize to organic growth in 2030. Hence, capacity enhancements should be made in four stages.

- Stage 1: Ramp Up (2022 – 2023)
- Stage 2: Build-up (2024-2026)
- Stage 3: Ramp Down (2027 – 2029)
- Stage 4: Organic Growth (2030 – onward)

Figure 6-12: PAG Existing Capacity vs Container Demand



Source: WSP analysis

6.3.1.1 Terminal Capacity Enhancement

WSP developed four layouts to accommodate the three stages of container forecast along with general cargo area demand as discussed in Section 6.2.4.

Stage 1: Ramp Up

In order to handle the demand beyond year 2022, some wheeled slots in the storage yard will need to be converted to grounded slots. These changes will convert 290 wheeled storage slots into 300 grounded storage slots. There will be an additional 80 reefer sockets added to the terminal, which are planned by PAG as part of adding new 480V plugs which can be used by all customers. Currently, PAG has a mixture of 240V and 480V plugs, and only Matson can use the 240V plugs. This ground slot conversion will increase the terminal throughput capacity from 126,000 container per year to 137,000 containers per year. This conversion will also increase the general cargo area from 5.9 acres to 9.8 acres.

Stage 2: Build Up

In order to handle the demand for year 2024 – 2026, additional wheeled slots in the storage yard will need to be converted to grounded slots. The changes to the layout will convert 102 wheeled storage slots into 246 grounded storage slots. This ground slot conversion will increase the terminal throughput capacity from 137,000 container per year to 149,000 containers per year. The general cargo storage area will remain same at 9.8 acres. With this yard configuration, both container and general cargo peak demand will be accommodated. The yard equipment requirement and run times will increase as more containers are grounded.

Stage 3: Ramp Down

After the container and general cargo peak is over, the demand will start to decrease from military build-up levels. However, the demand will still not be at pre-buildup level. In order to minimize operational cost and provide flexibility in operations, some of the grounded slots will be converted back to wheeled. The changes to the layout will convert 276 grounded slots to 184 wheeled storage slots This ground slot conversion will decrease the terminal throughput capacity from 149,000 container per year to 137,000 containers per year. The general cargo storage area will decrease from 9.8 acres to 8.4 acres.

Stage 4: Organic Growth

After the military build-up is complete, the container and general cargo demand will return to its organic growth rate. At this stage, the terminal layout can return to the existing configuration. Changes done to the terminal layout during the military build-up will correct some of the terminal circulation challenges. These improvements will be kept after the buildup to have better truck circulation in the storage yard. The changes to the layout will convert 379 grounded slots to 299 wheeled storage slots. This ground slot conversion will decrease the terminal throughput capacity from 137,000 container per year to 126,000 containers per year. The general cargo storage area will decrease from 8.4 acres to 6.1 acres.

Table 6-6 shows a summary of various stages along with terminal capacity, storage slots and general cargo area availability.

Table 6-6: Terminal Enhancement Stages Summary

Parameters	Existing	Ramp Up	Build-up	Ramp Down	Organic
T'put Capacity (Lifts/Yr.)	126,000	137,000	149,000	137,000	126,000
Slot Availability (TGS)	1,920	2,001	2,114	2,022	1,942
Containers Stacked (%)	46%	70%	78%	65%	46%
General Cargo Area (Acres)	5.9	9.8	9.8	8.4	6.1

Source: WSP analysis

Figure 6-13 to Figure 6-16 shows terminal layouts from Stage 1 – Ramp Up to Stage 4 – Organic Growth respectively.

Figure 6-13: Improved Terminal Layout – Stage 1 Ramp-Up

Source: WSP analysis

Figure 6-14: Improved Terminal Layout – Stage 2 Build-up

Source: WSP analysis

Figure 6-15: Improved Terminal Layout – Stage 3 Ramp Down

Source: WSP analysis

Figure 6-16: Improved Terminal Layout – Stage 4 Organic Growth

Source: WSP analysis

6.4 PHASING SCHEDULE

As the Port proceeds towards handling of military build-up cargo, it will have to accommodate the increase in the cargo demand. This will involve scheduling the storage yard use and terminal changes in a way that the terminal is able to handle the forecasted demand.

With the confirmation that peak year volumes will be accommodated by making storage configuration changes at the port facility, understanding the annual storage area requirements allows for sequencing and verification that these changes don't impact cargo operations negatively. Capacity analysis results were used to determine the storage area requirements for general and container cargos from the current terminal configuration through the military buildup program and back to organic growth.

Error! Reference source not found. shows the storage yard phasing schedule for general and container cargo under the Current Build-up (Mid) Scenario. The table is divided into container and general cargo characteristics. The container cargo columns show the forecasted volume (in containers), terminal ground slots, and percent of grounded container storage required. The general cargo columns show the forecasted volume (in tons), storage area available and percent of storage area used. Notes are provided to describe changes that impact the storage yard sizes or how they are used.

Table 6-7: Storage Yard Phasing Schedule

Year	Container			Breakbulk			Notes
	Volume (Cont.)	TGS	% Ground	Volume (tons)	Area (acres)	% Used	
2021	107,600	1,920	46%	64,000	5.9	56%	Current conditions
2022	123,800	2,001	70%	144,000	9.8	49%	• Convert 299 TGS wheeled to 300 TGS grounded. Add 80 reefer slots. • Add 3.9 acres of general cargo area.
2024	145,700	2,114	78%	255,000	9.8	73%	• Convert 102 TGS wheeled to 215 TGS grounded.
2026	137,700	2,022	65%	222,000	8.4	84%	• Convert 276 TGS grounded to 184 TGS wheeled. • Reduce 1.4 acres of general cargo area.

2030	115,500	1,942	46%	94,000	6.1	62%	• Convert 379 TGS grounded to 299 TGS wheeled. • Reduce 2.3 acres of general cargo area.

Source: WSP Analysis

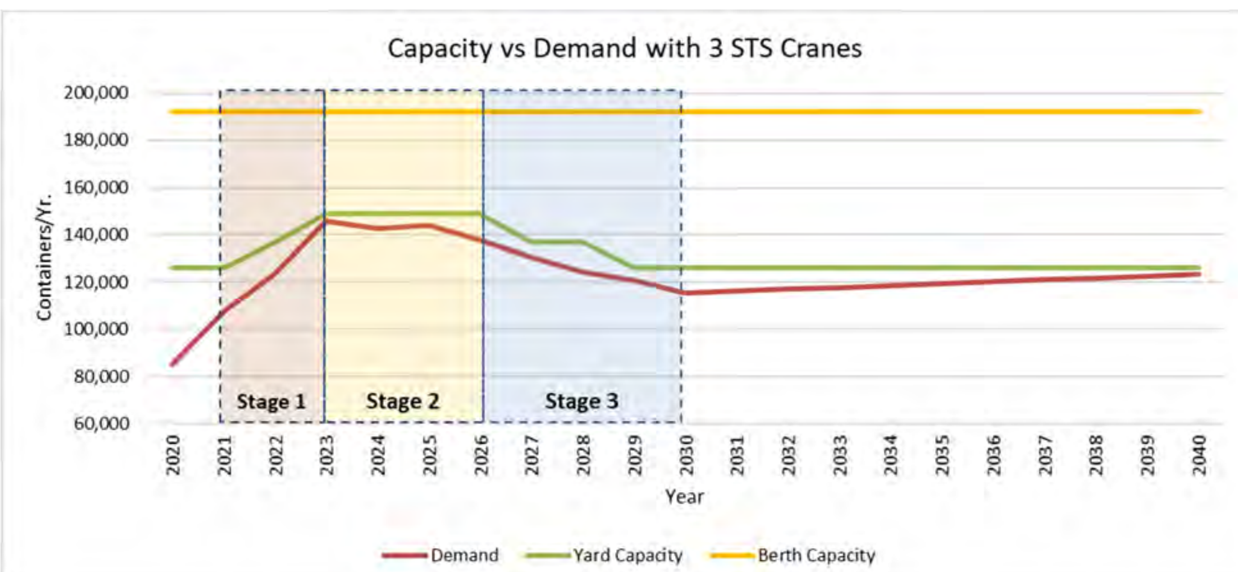
6.5 CRANE SENSITIVITY ANALYSIS

A crane sensitivity analysis was performed to quantify the potential impact on the military build-up schedule in case STS crane(s) are out of service for a significant period. The existing three cranes at PAG are currently capable of handling approximately 192,000 containers per year. This makes the effective capacity for each crane, approximately64,000 lifts per year.

6.5.1 Three STS Cranes in Service

Figure 6-17 shows the capacity vs demand chart with all three STS cranes in operation and assumes they will be replaced as they reach their use life, during the military buildup. In this scenario, there is no impact on military cargo volumes during the build-up as berth throughput capacity is higher than the forecasted military build-up demand throughout the build-up period. Additional capacity after the buildup provides the needed operational readiness for future cargo increases that would be required during an active military operation in the region. The storage throughput capacity can be increased and decreased through implementing equipment/operational changes.

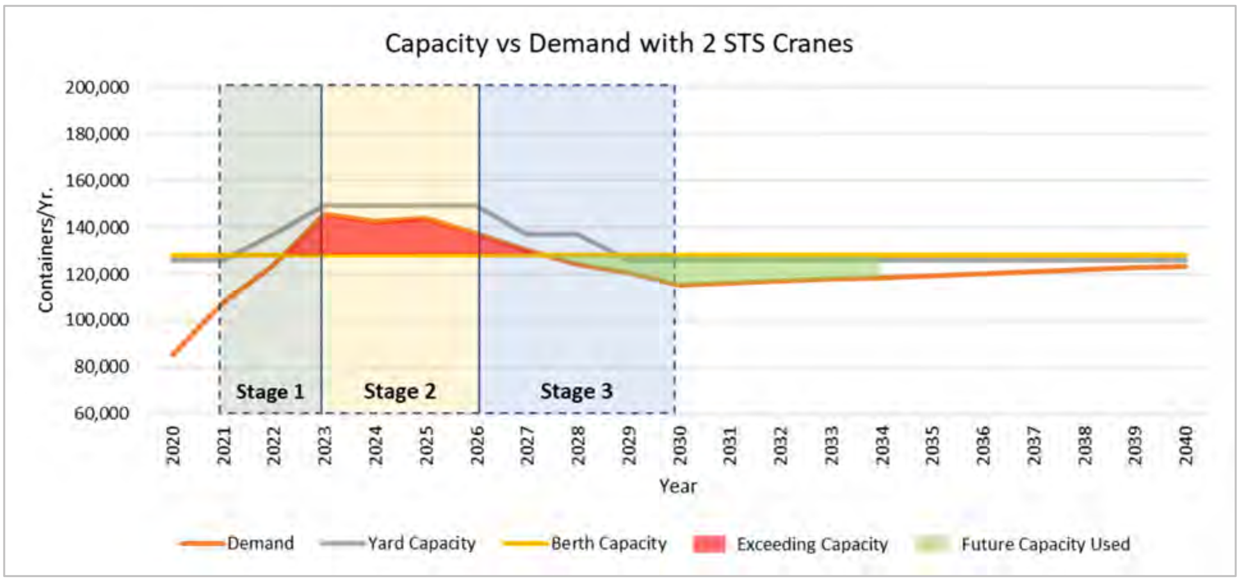
Figure 6-17: Capacity vs Demand - 3 STS Cranes



6.5.2 Two STS Crane in Service

As the cranes reach their useful life, if one STS crane (or any one of the three cranes in sequence) is out of service for a long period of time, the berth throughput capacity would decrease to 128,000 containers per year, which is lower than the cargo forecast with the military build-up peak. Figure 6-18 shows the capacity vs demand chart with two STS cranes in operation. With only two cranes in operation, a deficit of approximately 60,000 annual forecasted containers would be delayed to future years. To recoup this loss in capacity, the military build-up could be delayed up to four years and no additional capacity would be available for future live action operational readiness.

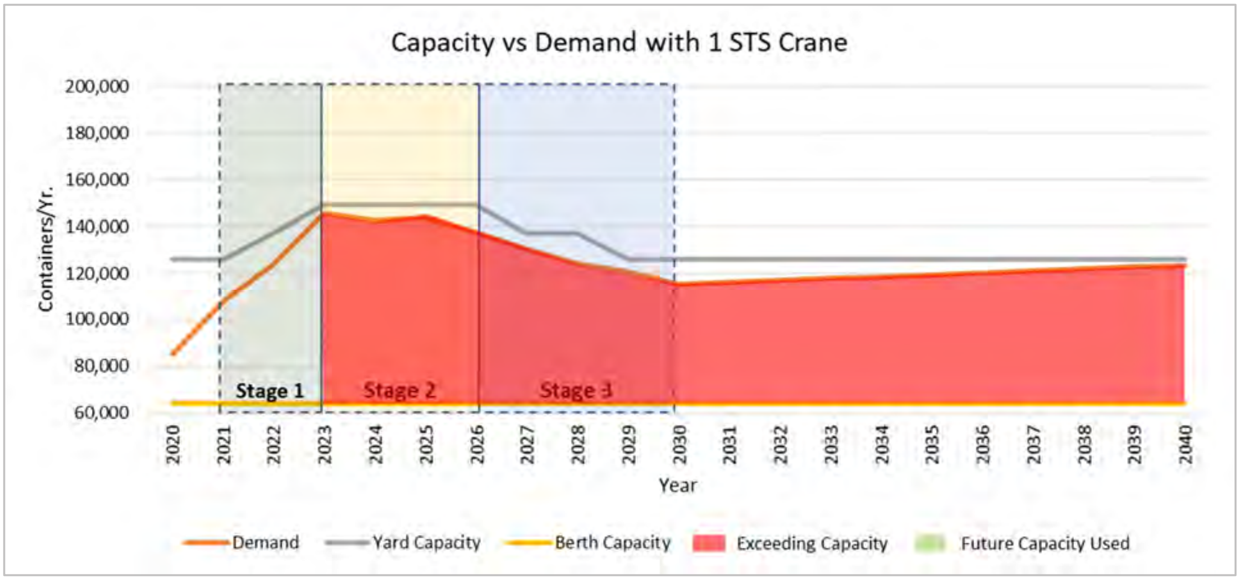
Figure 6-18: Capacity vs Demand - 2 STS Cranes



6.5.3 One STS Crane in Service

As the cranes reach their useful life, if two STS cranes (or any two of the three cranes in sequence) is out of service for a long period of time, the berth throughput capacity would be limited at 64,000 containers per year, which is significantly lower than organic demand for the port. Figure 6-19 shows the capacity vs demand chart with one STS crane in operation. With only one crane in operation, very little of the port or military build-up demand can be met. In this case, the port would not have sufficient crane capacity to handle organic cargo demand.

Figure 6-19: Capacity vs Demand - 1 STS Crane



7 PORT IMPROVEMENT PROGRAM

The combination of five decades of active use with limited reinvestment in aging facilities and infrastructure, and the increased cargo-handling demands associated with future island growth and the on-going military build-up has prompted the need for an improved and sustained capital improvement program.

This section identifies ongoing efforts and new opportunities that should be a factor in defining such a program. It includes a review of ongoing commercial terminal development efforts supported by bond funding and grants. It also reviews the actions that can be controlled by PAG once budgets are right-sized and structure is added to its Maintenance and Repair Programs and CIP investment strategy.

The PAG-controlled portion of this is significant. In order to sustain ongoing operations that are efficient and effective, the Port will need to shore up its financial structure and institute regimented maintenance and repair programs and phased CIP. This is to assure that facilities and equipment are aligned with service needs and achieve expected or extended service lives. It also plans for facility replacement, assuming the asset is still needed, following service life expiration.

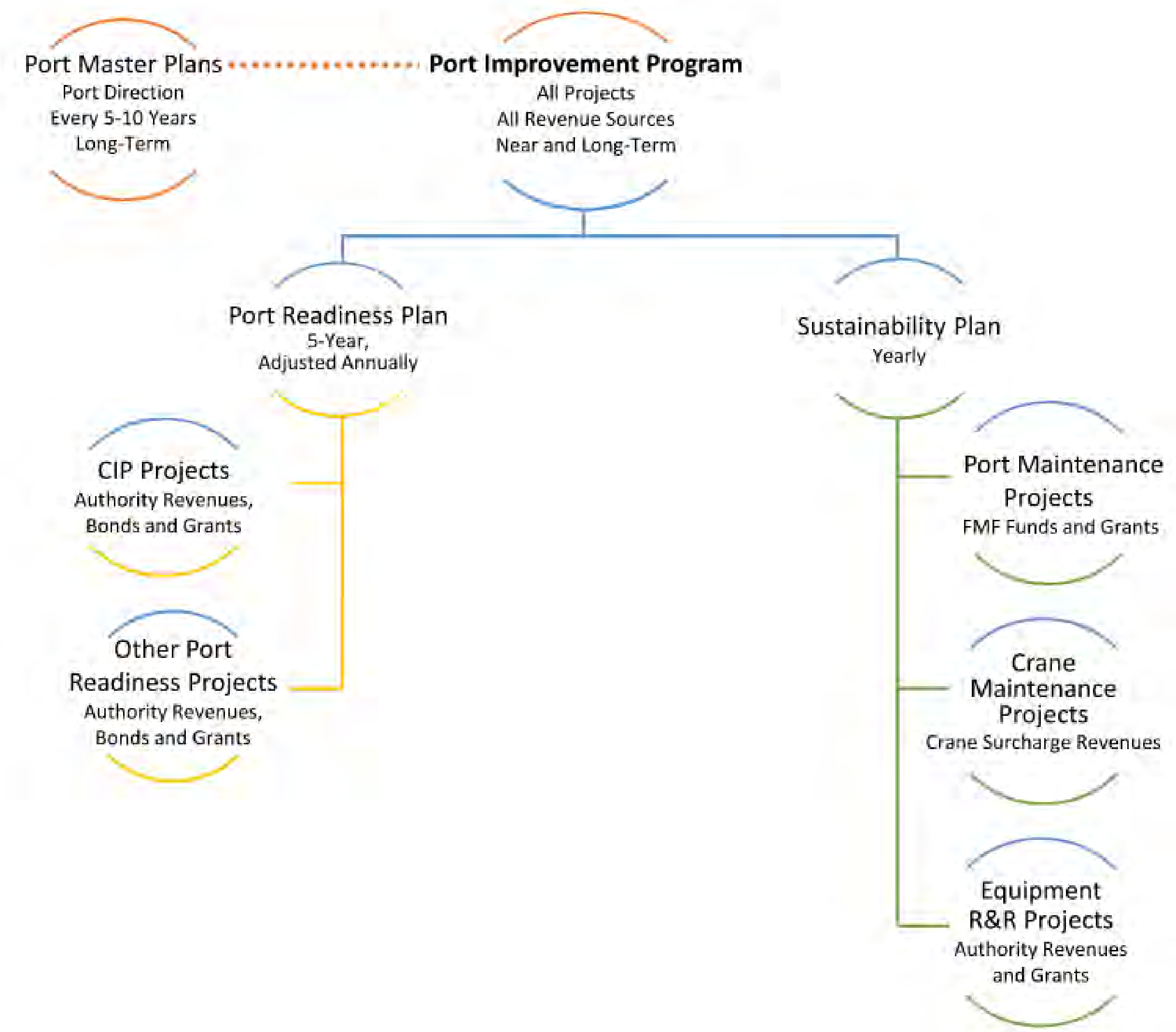
In general, the facilities and equipment needed to sustain operations include the following.

- Wharves and piers
- Buildings
- Terminal equipment (cranes and yard equipment)
- Utility systems (power/lighting [primary and backup], storm, potable water, firemain, sanitary sewer, fuel)
- Pavements and structures (access and traffic, ground storage, chassis storage, tank storage, containment and wash-down areas)
- Security fencing and gates
- Entrance and exist gate facilities

For the purposes of making recommendations for development of PAG facilities and strengthening its operating capacity within the 10-year planning horizon, it is important to differentiate between recommendations driven by sustained Port operations, capital improvements, and replacement of aging facilities that have exceeded their service lives.

Consequently, the Port Improvement Program is divided into two categories: The Port Readiness Plan (PRP) and the Sustainability Plan. The Port Readiness Plan is subdivided into Capital Improvement Projects and Other Port Readiness Projects. See Figure 7-1 for a flowchart showing the relationship between the Port Readiness Plan, CIP, and Sustainability Projects.

Figure 7-1: Port Improvement Program and Associated Plans



Source: PAG and WSP Analysis

7.1 PORT READINESS PLAN

The PRP is focused on hardening port infrastructure to ensure resiliency, reliability, and supply chain sustainability for all Port users, the DOD mission on Guam, and the local community. The PAG is continuing to define and quantify the PRP Readiness elements while pursuing additional funding and financing sources.

7.1.1 CAPITAL IMPROVEMENT PROJECTS

Capital improvement projects refer to projects in which capital expenditures are used to fund the construction or implementation of new or replacement assets such as buildings, piers, light poles, digital operating systems, etc. CIP's may be funded from a variety of sources such as grants, bonds, and PAG revenues.

Note that several CIP's need further definition of the scope and source of funding. These projects can only be executed when revenue generated by grants, bonds, or the tariff structure are available. For a list of the current CIP projects, see Table 7-1.

Table 7-1: Capital Improvement Projects

ID NO.	PROJECT TITLE/DESCRIPTION	FUNDING AUTHORITY	SCHEDULE									
			2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	Installation of Canopy Fronting Building Maintenance Bay	Port		CPLT								
2	Devanning Concrete Ramp	Port		CPLT								
3	LC3 Genset + Tank + AST + Slab Extension	PSGP/Port		CPLT								
4	Agat Small Boat Marina Design Build Bathroom and Showers			50%	50%							
5	Golf Pier Replacement	Bonds/ Grants							100%			
6	Enterprise One Financial Management System	Bonds			100%							
7	Replacement of (3) Metal Gate Booths	Port		100%								
8	STS Crane Demolition Project	Port		50%	25%	25%						

ID NO.	PROJECT TITLE/DESCRIPTION	FUNDING AUTHORITY	SCHEDULE									
			2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
9	Waterline Replacement	Bonds		10%	50%	40%						
10	Welding Shop – Phases 1 and 2	OIA/Port			50%	50%						
11	Radar Intrusion and Vessel Tracking System	PSGP/Port			100%							
12	Rehabilitation of Hotel Wharf and Access Road	Bonds/ MARAD/ Port					40%	60%				
13	Lighting: Replace all Fluorescent Lights in All Buildings with LED Lights	Port			50%	50%						
14	Gate Operating System	Grants/Port			100%							
15	Inbound/Outbound OCR Portals	Grants/Port			40%	60%						
16	Northside Catwalk for the Agat Small Boat Marina Boat Ramp	Grants/Port			50%	50%						
17	OWS at Berth F2	Port				50%	50%					
18	PUGG Secured Digital Framework	Grants/Port				50%	50%					

ID NO.	PROJECT TITLE/DESCRIPTION	FUNDING AUTHORITY	SCHEDULE									
			2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
19	Various IT Projects (WiFi, RRM, VMT)	Grants/Port				50%	50%					
20	Various Yard Equipment	Grants/Port				20%	20%	20%	20%	20%		
21	Installation of Pavilion and New Restrooms at Port Beach	Port					50%	50%				
22	Gregorio D. Perez Marina Renovation and Rehabilitation	Grants/Port					20%	20%	20%	20%	20%	
23	Agat Small Boat Marina Renovation and Rehabilitation	Grants/Port					20%	20%	20%	20%	20%	
24	WH-1 Building Repair/Upgrade	Bonds			20%	80%						

Total Estimated Cost = $191,554,000

Source: The PAG

Figure 7-2: Capital Improvement Project Locations

Source: Google Earth and WSP

7.1.2 PORT READINESS PROJECTS

A list of Port Readiness Projects and their respective priorities is provided in Table 7-2 and shown graphically in Figure 7-3.

Table 7-2: Port Readiness Projects

ID NO.	PROJECT TITLE/DESCRIPTION	FUNDING AUTHORITY	SCHEDULE									
			2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
1	Purchase Container Handling Equipment	Grants/Port		20%	20%	20%	20%	20%				
2	TOS Upgrade	Grants/Port		50%	25%	25%						
3	Fuel Connectivity Pipeline (F1 to Golf Pier)	Grants/Port		50%	50%							
4	Two New STS Gantry Cranes	Grants/ Loans/Port			50%	50%						
5	One New STS Gantry Crane	Grants/ Loans/Port						50%	50%			
6	Wharf SLE Berths F2-F6	Grants/Port		50%	25%	25%						
7	Cyber Security Initiative	Grants/Port			50%	50%						
8	F4 to F6 Ground Improvements	Grants/Port			50%	25%	25%					
9	Redevelopment of Area A	Grants/Port			20%	40%	40%					

ID NO.	PROJECT TITLE/DESCRIPTION	FUNDING AUTHORITY	SCHEDULE									
			2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
10	Berth F2 Wharf Renovation/Reconstruction	Grants/Port						25%	50%	50%		
11	Dredging (Hotel Wharf, Fuel Piers, etc)	Grants/Port								100%		
12	Solar Energy Project	Grants/Port			25%	50%	25%					
13	Berth F3/F4/F6 Wharf Renovation/Reconstruction	Grants/Port						10%	10%	30%	25%	25%
14	Admin Bldg Annex	Port/Loans					20%	30%	30%	20%		
15	Container Yard Repavement Projects	Grants/Port				20%	60%	20%				
16	Building Demolition	Grants/Port										

Total Estimated Cost = $489,000,000 (excludes Item #16)

Source: The PAG

Figure 7-3: Port Readiness Project Locations

Source: Google Earth and WSP

7.1.3 SUSTAINABILITY PROJECTS

Sustainability projects refer to projects that consist of the maintenance and upkeep of assets. In general, sustainability projects are mostly separate from CIP projects. However, once capital improvement projects are completed, they are subjected to sustainability investments to keep them operational throughout their intended service life. In some cases, sustainability projects are well-defined and scheduled because deficiencies have been identified, monitored, and risen to a level of priority where there is consensus in funding them among other competing interests. In other cases, projects are "To Be Scheduled" meaning that scheduling, packaging and pricing depend on the pace of deterioration, the need to develop a plan for phased implementation to preserve continuity of operations, prioritization among competing demands, and the need to be aligned with funds availability which is about to improve. These issues typically need to be evaluated for all projects, but in the instance of To Be Scheduled projects, the issues have not yet been addressed because other pressing priorities in a scarce economic environment have kept these needs on the back shelf to the point where they can no longer be ignored. See **Error! Reference source not found. Error! Reference source not found.** for a list of current PAG sustainability projects and Figure 7-4 for a map showing their locations.

Table 7-3: Sustainability Projects

ID NO.	PROJECT TITLE/DESCRIPTION	FUNDING AUTHORITY	SCHEDULE									
			2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
1	Repair All Concrete Spalling at CFS Building			CPLT								
2	OAE Services											
3	Annual Maintenance of Mobil Pipeline and Golf Pier Maintenance	Port										
4	EQMR Building Repair/Upgrade	Bonds			50%	50%						
5	Golf Pier Concrete Slab Repair & 3 Motorized Valves	Grants/Port										
6	Gregorio D. Perez Marina Clean Existing OWS and Retrofit Check Valves											
7	Harbor Master Misc Roof Related Items	Port		CPLT								
8	Installation of 2 Gates at Dock A and Dock B. Dry Dock Repair at Perez Marina	Port		CPLT								

ID NO.	PROJECT TITLE/DESCRIPTION	FUNDING AUTHORITY	SCHEDULE									
			2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
9	Replacement of 125 Reefer Outlet Receptacles	Port										
10	Service the ICCP System at Berth F5											
11	Supply and Install Fendering System at F3-F6	HMGP/Port			90%	10%						
12	Agat Small Boat Marina Dock B Replacement	DOI/USFW/ DAWR/USDA			40%	60%						
13	Broken Grating Drainage Replacement	Port										
14	Electrical Work for 61 Reefer Outlets	Port			20%	80%						
15	Harbor of Refuge Renovations and Repair Phase 2-5	Grants/Port			60%	40%						
16	Storm Drain Channel Repairs	Port										
17	WH-1 Hardening	HMGP/Port			90%	10%						
18	Harbor of Refuge Pump Out and Docking System	Grants/Port					50%	50%				

Total Estimated Cost = $11,800,000 (excludes Item #2)

Figure 7-4: PAG Sustainability Projects

Source: Google Earth and WSP

7.1.4 FUTURE PROJECTS

Future projects represent various capital improvement or sustainability/maintenance type projects that have been identified and have not yet been incorporated into the CIP, PRP, or Sustainability lists provided in the sections above. The list of future projects is provided below.

- ADA Projects
- CFS Building Painting
- Concrete Striping and Numberings
- Concrete Tire Stopper Project
- Construction of Hard Top Canopy for Fleet Maintenance
- Construction of Hard Top Canopy at the Inbound Truck Lane
- Construction of Hard Top Canopy at the Maintenance Shop
- Construction of Hard Top Canopy for the Top Loader Maintenance
- Deep Draft Wharf Feasibility Study
- Demolition of Fuel Tanks
- Development of Seaplane Ramp
- Development of Berth F7
- EQMR Office Space Renovations and Additions
- EQMR Repair and Upgrade (Reduced Scope of Work)
- F3 to F6 Bulkhead Repair
- Fencing Installation Around all Docks as Agat Small Boat Marina
- Firewater Backflow Preventer at CFS Building
- Golf Pier Demo and Reconstruction

- Improve Storm Drainage Along Reefer Receptacles
- Install A/V Annunciator/Warning Beacons on 10' Tall Poles (2 each)
- Install Chain Link Fence at Operations
- Installation of Light Poles/Fixtures at Reefer Outlet Area
- Installation of New Dock at Harbor of Refuge
- LC1 Metering Cabinet
- LC2 and LC3 Switch Gear Replacement
- Light Post Bollard Restoration Project
- Miscellaneous Harbor Master Repair Projects
- Miscellaneous Maintenance at Operations Building
- Miscellaneous Projects
- Pavement Repair
- Gregorio D. Perez Marina Dock A Repair
- Port Police Century by the Admin Building
- Renovation of Two Restrooms at Operations Building
- Replace all Metal Hallide and any High-Pressure Sodium
- Repairs at 2^{nd} Floor Roof Surrounding Harbor Master Office
- Replace Typhoon Shutter at Gatehouse, Admin Building
- Retrofit 11 Existing Outfall Pipes Handling
- Revetment Project Completion

- Structural Safety Measures for Buildings EQMR, WH-1, and the Welding Shop Against Falling Concrete
- Synchronizing Load Centers
- Utilization of Quarry for Recycling and Composting
- Waste Water Injection Pump Station and Storage Facility Project
- WH-1 Repairs and Upgrade (Reduced Scope of Work)

8 FINANCIAL ANALYSIS

8.1 INTRODUCTION

In the role of consulting engineer for the Authority, WSP developed a feasibility assessment based on proposed capital investments. **WSP is not a Registered Municipal Advisor, and, as such, is not registered with the Securities and Exchange Commission**. Accordingly, the financial terms and the details of anticipated debt issuances were provided to WSP by GEDA and the Authority. WSP assembled and analyzed these parameters to develop the financial forecasts provided in this Report and requisite cash flow pro-forma estimates were based upon information provided to WSP.

8.2 PORT FINANCIAL OVERVIEW

8.2.1 POPULATION

The PAG's total FY 21 operating revenue was $55 million, a modest increase compared to FY 2020 and on par with income pre-COVID in FY2019. The PAG's operating revenues are presented in Table 8-1.

Table 8-1: PAG Operating Revenues 2017-2021

Operating Revenue Category	FY 2017 ($000s)	FY 2018 ($000s)	FY 2019 ($000s)	FY 2020 ($000s)	FY 2021 ($000s)
Cargo throughput charges (1)	$30,715	$33,496	$34,357	$33,820	$34,777
Equipment and space rental (2)	$8,769	$9,015	$8,833	$9,192	$8,559
Crane surcharges	$6,092	$5,958	$5,875	$5,811	$5,984
Wharfage charges	$4,986	$5,435	$5,771	$5,639	$5,800
Other operating income (3)	$332	$264	$256	$224	$134
Total Operating Revenues	**$50,894**	**$54,168**	**$55,092**	**$54,686**	**$55,254**
Change from Prior Year	*-2.5%*	*6.4%*	*1.7%*	*-0.7%*	*1.0%*

(1) Facility Maintenance Fee (FMF) revenues are included in cargo throughput charges and totaled $1.5 million in FY 2017. Historical FMF revenue ranged from $1.4 million in FY 2013 to $1.75 million in FY 2016

(2) Includes Marina revenues

(3) Other operating income includes Special Services, Harbor of Refuge, and Other Operating Income

Source: WSP analysis of PAG data

Fees related to cargo vessels and the movement of freight represent the majority of the PAG's operating revenue. These charges include port entry fees, vessel dockage, cargo handling, fuel surcharge, and security fees. Equipment and space rental revenues include facility usage charges for the Marine Industrial Terminal, Gregorio D. Perez Marina, Agat Small Boat Marina, and Harbor of Refuge, as well as demurrage charges on cargo stored on the terminal. Crane surcharges are fees assessed for the use of the PAG's STS gantry cranes. Wharfage charges are fees assessed moving cargo across the wharfs, berths, or piers. Other operating income includes cruise passenger charges, bunkering fees, and fees for administrative and other special services. In addition to these operating revenues, the Authority receives funds from various grants from the Federal Government.

These fees include two special funds that provide revenue from cargo operations. Implemented in 2010, the facility maintenance fee (FMF) is a separate charge to provide funding for the maintenance, replacement, and repair of the PAG's cargo facilities. The crane surcharge was implemented in December 2012 after approval by the PUC. Crane surcharge revenue is dedicated to cover the costs of the operation and maintenance (O&M) of the existing gantry cranes, the purchase of future cranes, as well as any debt service for cranes.

8.2.2 EXPENSES

The PAG's operating expenses include the cost of operating and maintaining Port facilities and equipment, providing cargo services to shippers, and managing and administering the Port's business. Cash operating expenditures (excluding depreciation and other non-cash items) in FY 2021 were approximately $52 million. A breakdown of the PAG's cash operating expenses, with the labor and employee benefit allocated amongst the categories, is provided in Table 8-2.

Table 8-2: PAG Operating Expenses 2017-2021

Operating Expenses	FY 2017 ($000's)	FY 2018 ($000's)	FY 2019 ($000's)	FY 2020 ($000's)	FY 2021 ($000's)
Management and Administrative (4)	$10,822	$10,433	$11,866	$14,591	$14,877
Stevedoring services	$3,993	$3,629	$3,792	$4,392	$4,297
Terminal Services	$2,809	$2,539	$2,894	$3,351	$3,336
Equipment maintenance	$5,640	$6,087	$6,076	$6,391	$6,432
Transportation services	$5,550	$4,923	$5,153	$6,007	$6,023
Facility maintenance (5)	$1,987	$1,945	$1,962	$2,116	$2,142
General Expenses, Utilities, Insurance	$7,695	$8,213	$6,885	$6,977	$7,946
Retiree Healthcare Benefits	$7,551	$6,765	$2,960	$5,505	$6,954
Total Operating Expenses	**$46,047**	**$44,534**	**$41,588**	**$49,330**	**$52,007**
Change from Prior Year	*17.5%*	*-3.3%*	*-6.6%*	*18.6%*	*5.4%*

(4) Includes Management and Administration, General Expenses, Insurance, and Utilities

(5) Facility Maintenance costs are fully covered by the FMF revenues, which are included in revenue table under Cargo Throughput Charges. FMF funds are spent on designated projects approved by the PAG board, and may not be undertaken in the year the FMF fees were collected or may take multiple years to complete. Thus, FMF revenue and Facility Maintenance expenditures will not necessarily match in any given year

Source: WSP analysis of PAG data

Management and administrative expenses include the following.

- Salaries/wages
- Insurance benefits
- Retirement benefits
- Other benefits
- Other personnel costs
- Communications
- Leases/rentals
- Utilities
- General insurance
- Damage/shortage/write-down/supplies
- Advertising
- Agency and management fees
- Crane performance management contract
- Professional services
- Contractual services
- Earthquake expenses
- Typhoon expenses

The Authority employs approximately 385 staff. In FY 2021 this consisted of 146 in Management and Administration, 55 for equipment maintenance, 65 for transportation services, 50 for stevedoring services, 29 for facility maintenance, and 40 for terminal service.

8.3 SOURCES OF FUNDING

PAG construction projects are funded by a mix of grants, loans, special funds, and PAG revenues. Each of these sources is described in the following sections.

8.3.1 GRANTS

Grants are one of the three primary sources of funding for the PAG's Capital Investment Projects. The Authority has secured or seeking about $73 million in federal grants to fund Capital Improvement Projects from FY 22 to FY 30. This includes at least 12 different grant programs run by the USDOT, US Department of Defense, the Department of Homeland Security, the Department of Commerce, and Department of Agriculture.

8.3.2 2018 BOND ISSUANCE PROCEEDS

The PAG issued $71.445 million in 2018 Series port revenue bonds to finance a portion of the PAG's capital improvement program, fund a debt service reserve and redeem existing bank loans. The bonds are fully amortizing, have a debt service reserve funded at maximum annual debt service, and a final maturity of July 1, 2048. Maximum annual debt service is around $6.5 million and average annual debt service is around $4.1 million over the life of the debt.

Approximately $41.5 million of the Bonds' $71.45 million proceeds are to be allocated to Capital Improvement Projects between FY 22 and FY 30.

8.3.3 FACILITY MAINTENANCE FUND (FMF)

Implemented in 2010, the FMF is a separate charge to provide funding for the maintenance, replacement, and repair of the PAG's cargo facilities. The PAG assesses an FMF of $34.66 per loaded container or $1.88 per revenue ton for breakbulk. The PAG allocates 100 percent of annual FMF revenues for certain Sustainability Plan projects within the Cargo Terminal each year. However, the expenditure of the allocated funds for each project can occur over several years. Thus, some of these funds are programmed for prior year projects and may not be available for the FY 22-30 CIP. The PAG received approximately $1.8 million in FMF revenues in FY 2021. At the end of FY 2021, $4.3 million was held in FMF fund.

8.3.4 CRANE REPLACEMENT FUND

The crane surcharge was implemented in December 2012 after approval by the PUC. Crane surcharge revenue is dedicated to cover the costs of the operation and maintenance (O&M) of the existing gantry cranes, the purchase of future cranes, as well as any debt service for cranes. The PAG must deposit 9.5 percent of surcharge revenues for the first 44,400 loaded containers and the first 42,010 tons of breakbulk, equal to $547,205 if the baseline volumes are met, into the Crane Reserve Account. At the end of FY 2021, $4.9 million had accrued into the fund. Since these funds are not pledged revenue to service the 2018 bond issuance, Crane Replacement funds could potentially be utilized for a future debt issuance to pay for new gantry cranes.

8.3.5 LOCAL FUNDING

The PAG may fund capital projects with revenue from its operations if funds remain after operating costs and debt service are paid. As of the end of FY21, the PAG reported $10.3 million in unrestricted funds. Excluding depreciation, the PAG generated an operating surplus of approximately $3 million FY 2021. The PAG may petition the Public Utilities Commission (PUC) for tariff increases to provide additional funds for capital projects. Subject to the additional bonds test for the 2018 issuance, the PAG could also opt to finance capital improvements through a future debt issuance.

8.4 PORT IMPROVEMENT PLAN SUMMARY

The Port Improvement Plan (PIP) provided in Section 7 of this master plan details the projects and timing of improvements in the coming years. Each project is assigned a priority from 1 (most important) to 4 (lowest importance). For this summary, any costs not covered by grants or the 2018 bond funds fall to PAG/to be determined (TBD). It is expected that future grants and loans may cover portions of these local costs. See Table 8-3.

Table 8-3: Capital Plan 2022 – 2032 ($000,000s)

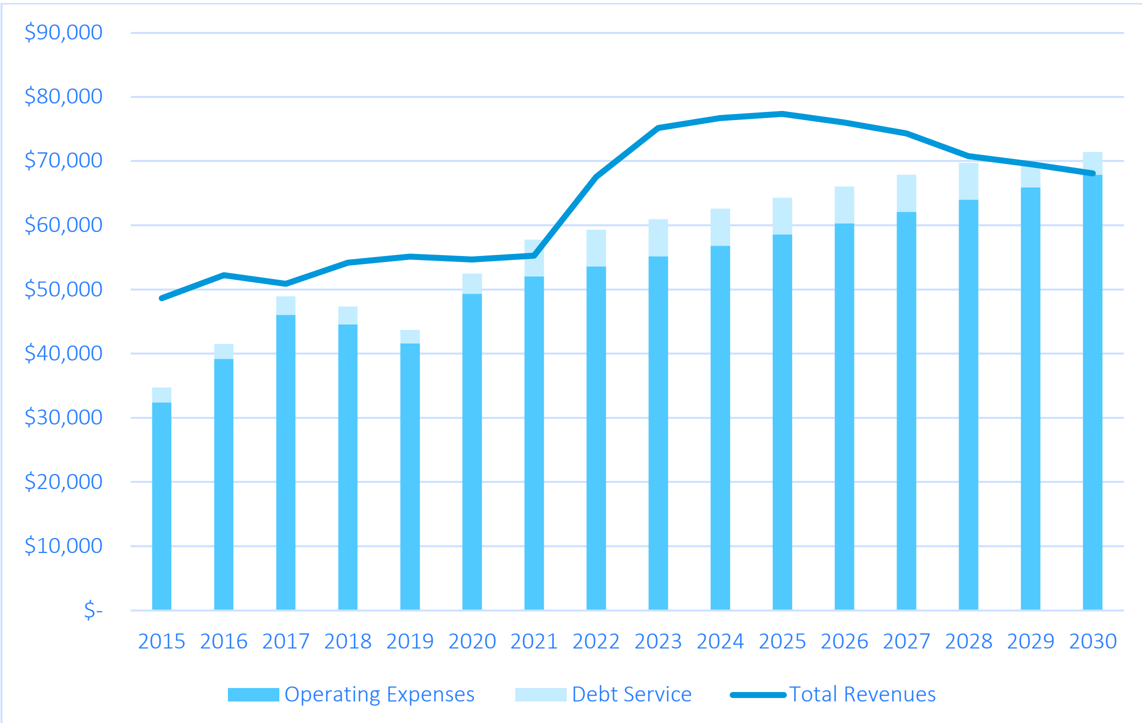
PIP ITEM	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29	FY30	FY31	FY32	TOTAL
CIP	$2.6	$7.3	$35.2	$49.9	$9.8	$69.4	$9.4	$8.0	$0.0	$0.0	$0.0	**$191.6**
PRP	$0.0	$0.0	$23.5	$56.3	$64.8	$44.5	$40.0	$45.5	$184.5	$15.0	$15.0	**$489.1**
SUST	$2.4	$4.6	$4.1	$0.4	$0.4	$0.0	$0.0	$0.0	$0.0	$0.0	$0.0	**$11.9**
TOTAL	**$5.0**	**$11.9**	**$62.8**	**$74.6**	**$79.0**	**$53.0**	**$48.5**	**$53.5**	**$184.5**	**$15**	**$15**	

Source: WSP analysis of PAG data

8.5 PROJECTED CASH FLOWS

Figure 8-1 below depicts historical and projected revenues, operating expenditures, and debt service. The revenue projection assumes the Base Case throughput forecast, with the military buildup growing cargo throughput substantially in 2022-2024 before tapering. Operating expenses are assumed to grow 3% per year. No tariff increase is included in this projection.

Figure 8-1: Historical and Projected Revenues and Expenditures ($000s)



Source: WSP analysis of PAG data

9 ECONOMIC IMPACT

9.1 INTRODUCTION

The Port is clearly a major driver of economic activity for Guam. The island cannot sustain its economy without the ability to import goods through the Port, given that air freight is the only civilian alternative, more costly, and has far less capacity. Thus, it could be argued that nearly the entire economy of Guam depends on keeping the Port in a state of good repair. However, this is not a useful construct for evaluating the economic impact of the Master Plan CIP because the Port will continue to make the necessary investments to enable operations in any case.

9.2 IMPACT OF THE MASTER PLAN ON GUAM'S ECONOMY

The primary economic impact of the Master Plan program is to the construction industry. The master plan analysis identified that Port capacity is adequate to accommodate foreseeable throughput, even with substantial near-term increase due to the military buildup. Therefore, the master plan projects largely focus on ensuring the Port is in a state of good repair for the long term. In other words, the master plan projects will not increase port throughput, though certain projects, notably Hotel Wharf reconstruction will facilitate both improved efficiency and the ability to handle military deployments. Because of this, the economic impact focuses on job creation and activity generated by capital expenditures.

9.2.1 PRIMARY IMPACTS

Primary Economic impacts include direct, indirect, and induced impacts. Direct impacts reflect the new spending, hiring, and production by engineering and construction companies to complete the program.

9.2.2 SECONDARY IMPACTS

Secondary economic impacts include indirect and induced impacts as money is spent on local supplies and by wage-earners in the local economy.

- Spending on capital improvement projects will create economic activity in the construction sector and related sectors. For example, contractors working at the Port require building suppliers, equipment, fuel to operate machinery, personal protective equipment, and other resources. The businesses supplying these related resources therefore enjoy increased sales due to the Port construction program. These businesses, in turn, require inputs from other companies to create their products. This is known as indirect economic impact.

- Construction and related businesses employees earn wages and spend earnings in all areas of the economy such as housing, food, goods, and services. In this manner, a dollar spent on construction will create downstream effects, known as induced economic impacts. Together, the direct, indirect, and induced impacts comprise the total economic impact.

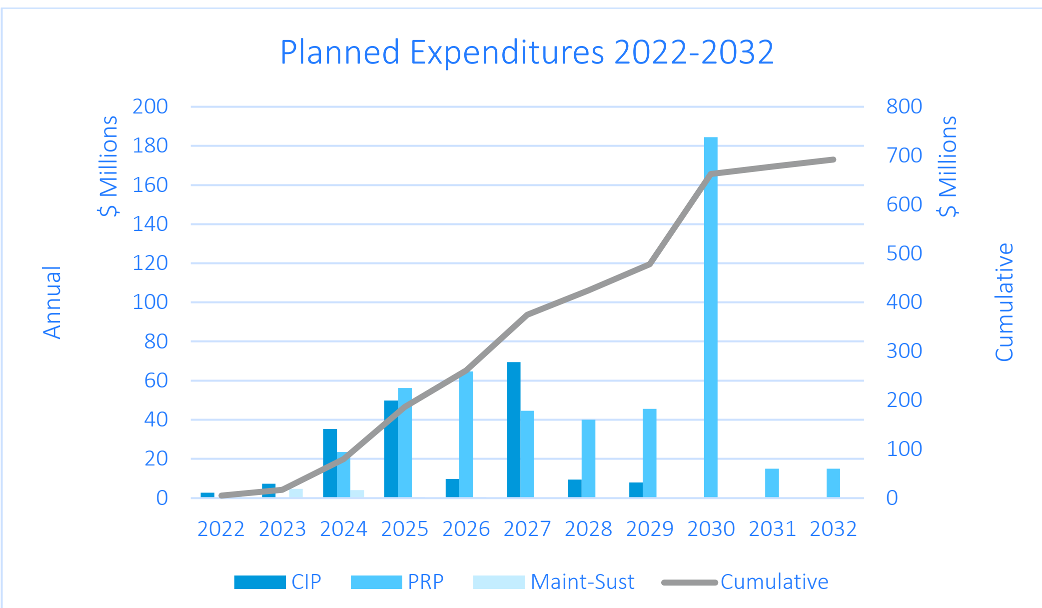
9.3 PORT CAPITAL PLAN

The Port Capital Plan consists of three elements:

1. Capital Improvement Plan projects include rehabilitation of Hotel Wharf and its access road, replacement of Golf Pier and Pier F1, rehabilitation of Gregorio D. Perez Marina and Agat Small Boat Marina, and other projects.
2. Port Readiness Program projects such as wharf renovation/reconstruction, dredging Hotel Wharf and Fuel Piers, and procuring new gantry cranes, etc.
3. Maintenance/Sustainability projects to keep assets in a state of good repair.

The following figure summarizes the plan for each element from 2022 through 2032. A total of $692 million in project cost is planned, with the majority (71%) spent on PRP projects. More than 25% of the construction program ($184.5M) is slated for 2030.

Figure 9-1: Port Planned Expenditures 2022 – 2023 (2022 $'s)



Source: WSP analysis of PAG data

9.4 METHODOLOGY

Economic impact assessments typically utilize an input-output modeling framework that estimates the indirect and induced effect of spending in one sector of the economy (e.g., construction) on other sectors (e.g., construction equipment and supplies, fuel to operate machinery, etc.). However, this multiplier effect of construction on Guam is muted compared to other economies. Nearly all of the materials and supplies needed for construction are imported to Guam. Thus, there is limited indirect impact on local suppliers since the downstream benefits of construction mostly flow off island.

The military commissioned analyses of the economic impact of its buildup on Guam, notably the 2012 Draft Environmental Impact Statement (DEIS) and 2014 Socioeconomic Impact Assessment Study: Guam and CNMI Military Relocation prepared by NAVFAC (SIAS Study). IMPLAN multipliers were utilized to estimate secondary economic impacts. IMPLAN is a widely-utilized software product that calculates these effects. Prior studies have often relied on Hawaii as a proxy for Guam for input-output multipliers. However, a University of Guam analysis determined that multipliers are likely overstated since the Guam economy is far smaller and has less domestic production.

The SIAS analyzed the impact of the military buildup as then planned for all sectors of the Guam economy, including construction. Key metrics from the SIAS study are utilized for the current analysis, including the relationship between expenditures on construction and job creation, the mix of Guam residents and foreign workers that will fill those jobs, and the multipliers for secondary and induced impacts from construction.

These ratios were adjusted to the current analysis by accounting for inflation and applying the metrics to the construction program recommended in the capital plan to calculate the jobs supported by port construction.

A key component of economic impact is not just the jobs created, but the wages earned from those jobs. Higher wage jobs create more wealth that may be spent in the local economy. Clearly there will be a broad mix of jobs related to the Port capital program as the projects will utilize planners, engineers, construction managers, construction workers, skilled tradespeople, and unskilled labor. The Bureau of Labor Statistics reports an average construction industry wage of $17.07 per hour ($35.460 per year) for Guam in 2019.

This SIAS study estimated 75 civilian full-time equivalent workers plus 4 supervisors per $10 million of project cost based on the 2012 Draft Environmental Impact Statement (DEIS) developed for the military buildup (DEIS Volume 9 Appendix F, Table 4.3-1). Adjusting for inflation, the equivalent 2022 value is $10 million of construction supports 53.3% jobs. Per the Guam Consumer Price Index (Guam Bureau of Statistics and Plans, 2022 Fourth Quarter), the 2022 consumer price index was 149.9; 28.9% greater than the 2012 value of 116.3%.

There are three broad categories of projects that have differing effects on labor – and thus, economic impact. Construction is labor intensive – a rule of thumb is that approximately 33% of costs are spent on labor. Equipment has a much lower labor component. Equipment such as yard tractors, is delivered ready-to-use and does not increase employment on Guam. Other equipment such as cranes, require on-site assembly. All equipment requires maintenance and repairs which creates jobs and economic activity. Finally, expenditures on IT and financial systems are primarily for software and create almost no employment beyond limited hardware installation or user training. The analysis assumes equipment generates 1/5 the number of jobs as construction, and IT/Finance 1/10th.

The government of Guam will also enjoy fiscal impacts from port construction due to sales, income, and business taxes levied on elements of the project.

9.5 GUAM WORKFORCE

Due to the limited local labor force on Guam, a significant portion of construction work is comprised of foreigner workers. The 2014 SIAS study estimated that, on average, 70% of construction workers will be foreigners on H2B visas. These workers are less likely to spend money earned in wages locally for numerous reasons, such as frequently being housed in dormitory-style accommodations, and typically not having family members come to Guam during their employment (NAVFAC interviews for SIAS found just 0.2 to 0.35 dependents per foreign worker).

The SIAS and DEIS assumed the following percentages for local expenditures.

- 19% of construction contracts purchased from local suppliers
- 20% of H2B worker incomes spent locally (assuming housing provided by employer)
- 45% of local workers' incomes spent locally
- 47% of construction supervisors' incomes spent locally

Although military buildup construction is smaller than contemplated when the DEIS was written, over $9 billion is still forecast to be expended. The construction labor force, therefore, can be expected to be fully employed on either military or civilian projects. The marginal increase in local work due to the Port construction program is thus limited, though the increased demand would be expected to drive construction wages upward.

9.6 RESULTS

Applying this methodology to the Port Capital Plan, an estimated 3,435 full-time equivalent (i.e. 2,080 hours) direct jobs are projected to be supported by Port capital expenditures from 2022-2032. The average number of jobs is 423 during this period, with a peak of 1,405 in 2030. Changes in the timing of construction would adjust the annual figures. See Table 9-1.

Table 9-1: Port CIP and Labor Statistics

Capital Program Element	Total	% of Total	Jobs per $10M	Direct Jobs
Construction	593,682,917	85.7%	56.2	3,335
Equipment	80,125,000	11.6%	11.2	90
IT/Finance	18,545,000	2.7%	5.6	10
Total	692,352,917	100%		3,435

Source: WSP analysis of PAG data

Using the average construction salary as a benchmark equates to approximately $122 million in wages during the capital program.

The NAVFAC economic analysis construction multiplier in the SIAS analysis (which considers the large percentage of wages paid to H2B workers) averages 36% for construction labor over the term of analysis. Implementing this multiplier results in an additional 1,222 indirect/induced jobs for a total of 4,657. See Table 9-2.

Table 9-2: Projected Direct and Indirect Jobs Through 2032

Total Jobs	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	Total
Direct Jobs	28	52	296	464	301	611	213	265	1,036	84	84	3,435
Indirect/ Induced Jobs	10	19	105	165	107	217	76	94	369	30	30	1,222
Total Jobs	39	71	402	629	408	828	289	359	1,405	114	114	4,657

Source: WSP analysis of PAG data

Induced jobs are spread throughout the economy. Assuming the average wage for Guam of $19.10/hour results in an additional $48 million in indirect/induced wages for a total of $170 million.

Fiscal Impacts:

Government of Guam revenues related to the construction program will include personal income taxes on the wages of the workers, gross receipts tax (GRT), and corporate income tax. Assuming a similar ratio of expenditures to GRT and corporate taxes, the estimate cashflow to the Government is $25.2 million total from 2022-2032, equal to an average of $2.3 million per year.

APPENDIX A – MASTER PLAN SCOPE OF WORK

PORT AUTHORITY OF GUAM MODERNIZATION PROGRAM
JOSE D. LEON GUERRERO COMMERCIAL PORT
PORT AUTHORITY OF GUAM (PAG)

OWNERS AGENT/ENGINEER CONSULTANT AGREEMENT

2020 PAG Master Plan

TASK ORDER NO. 10
(FY020-002WSP)

SCOPE OF WORK
(EXHIBIT A)

Introduction

The intent of this *2020 PAG Master Plan* is to clearly articulate the Port's near-term and long-term approach to modernization while PAG becomes more self-sufficient, achieves fiscally sustainable operations, and promotes increased awareness and consensus on its approach among all affected stakeholders.

Our approach to updating the plan will involve four elements of validation, review and coordination:

1. Analyze and update, as appropriate, the assumptions and criteria that underlie the previous PAG Master Plan Update 2013 Report
2. Validate and integrate key elements of the following reports that were developed since the Master Plan Update 2013 Report was released:
    a) Master Plan Approval Documents
    b) Cargo Forecast Updates
    c) Terminal Development and Operations Plans
    d) Terminal Operating System and Gate Operating System Reports
    e) The 2016 PUC Tariff Report
    f) The 2018 Consulting Engineer's Report in support of the CIP Revenue Bond issuance
3. Expand the scope of the Master Plan to include an implementation strategy based on potential expanded facility requirements, updated cargo and revenue projections, planned staffing adjustments, planned tariff adjustments, and a coordinated funding approach involving combination of bonds, grants and self-financing.

4. Validate and incorporate decisions and outcomes of various initiatives and policy changes that have occurred over the past seven years that include, but are not limited to, the following:

    - The current revised Military Buildup Program and schedule
        - The Military Buildup has been delayed and resized
        - The NAVFAC Pacific Guam Program Management Office will be providing better updated information on the program
        - Cargo related projections will now have a better basis
        - Cargo-related revenue projections will be updated based on the above
    - The Port responded to the PUC in 2016 by issuing a new 5-Year Tariff which will now be reviewed and updated as appropriate for the next 5-year period
    - A simplified tariff structure is being developed to facilitate more efficient electronic Terminal Operating System (TOS) data interfacing and invoicing with stakeholders
    - TOS improvements are being incorporated to improve operational efficiencies, data accuracy, and facilitate electronic data sharing
    - A new Performance Maintenance Contractor (PMC) contract is being issued to improve equipment maintenance
    - A new Information Technology Consulting Firm (ITCF) contract is being issued to augment port TOS/IT development and improve terminal operations and improve security
    - The Port is developing a more structured Maintenance Program for Facilities and Equipment
    - The Port is planning on procuring two new STS container cranes to replace older equipment and increase operating efficiencies
    - The MARAD funded H-wharf upgrade program is commencing with the facilities coming online by 2022
    - The CIP Bond supported projects are moving ahead and will become part of the Port's infrastructure over the next three years
    - Guam Customs is developing a new inspection facility adjacent to the terminal gate which will be integrated with the cargo operations

This Master Plan is intended to provide a comprehensive review of the Port's current condition, identify the elements of continuous improvement and sustainability, and articulate an implementation strategy that remains coordinated with the anticipated forces of change within the foreseeable planning horizon.

The following technical approach is envisioned in order to achieve the goals described above.

Task 10.3.1: Project Kickoff & Data Collection
The WSP Planning Team will initiate this task by conducting a series of project kick-off sessions in Guam over a one-week period. It is anticipated that a Port Authority of Guam (PAG) Strategic Planning Group (SPG) will be created before the project kickoff week begins. This group will be the primary interface between the WSP Planning Team and the PAG.

Blair Garcia, James Reed, Shannon McLeod, Louis Wolinetz, Hardik Gajjar and Rob van Eijndhoven will begin the kickoff week by meeting with the SPG for a review of the previous port master plan update, current modernization and capital improvement plans and other relevant activities that are currently underway or contemplated for the future. This series of week-long meetings will serve to amplify the basic components for the project and provide better defined information useful for both PAG management and WSP's planning activities. Inventory and facility review efforts for other project tasks will begin during this week as well. Stakeholder participation in the master planning process will begin this same week through meetings with stakeholder organizations identified by both WSP and the SPG. Formal meeting schedules will be coordinated by the SPG with a proposed agenda provided by WSP.

Utilizing existing PAG site and facility drawings, equipment inventories, and reports developed since the last Master Plan update, WSP will assemble existing facility and equipment inventories and review the current uses of landside and waterside properties, pertinent facilities and applicable operating equipment as well as adjacent related complementary properties. Not only will these inventories serve as an essential foundation for the master planning effort, they can be useful tools for PAG as a stand-alone and upgradable worksheet.

In addition to the review of current land and water uses that will support Task 10.3.3, WSP will review relevant information provided by the SPG and PAG management and other relevant documents to further augment the master planning process. As the information is collected and the inventory is developed, a data log will be created and maintained throughout the execution of the Task Order. Periodic updates of the data log will be provided to the SPG. Relevant Task Order information (background documents, collected data, deliverables, transmittals) will be warehoused on the WSP ProjectSolve site for ease of access by both WSP and the SPG.

Task 10.3.2: PAG Overview
Once the initial data collection and project kickoff phase is completed, the master planning efforts will focus on the following:

- Summarize goals and objectives for the MP Update
- Discuss the current PAG governance and reporting structure to the Public Utilities Commission (PUC)

- Describe the current port employment description to include
  - PAG organization, responsibility and staffing
  - PMC, ITCF and other third-party support services
- Summarize funding issues/opportunities/strategies
  - Tariffs
  - Leases
  - Debt Ceiling
  - Reserve Covenants
  - Grants
    1. Department of Defense (DOD) PIEP Funds
    2. Security Grants
    3. Other Grants
  - Loans and Debt Service
    1. Crane Loan(s)
    2. Equipment Loans
    3. Revenue Bonds
  - Autonomous Agency Contributions
  - Development Opportunities
  - Cargo and Revenue History
  - Management and other Special Reserve Accounts
  - Facility Maintenance Fees

Task 10.3.3: Review Current Operations

The purpose of this task is to review and summarize current facilities and operations within the Port. The review will consider current operations, utilization and adequacy of the following PAG assets:

- Landside access (roads)
- Waterside access (channels/berths)
- Current cargo-related infrastructure inventory
  - buildings
  - wharves
  - utilities
  - structures
- Current equipment and systems inventory
- Navigation aids and vessels
- Owned, occupied and leased land

A comprehensive summary of the above list of attributes will be developed to set the foundation for the infrastructure and equipment planning that will occur in later tasks. The current operating structure/procedures and pending lease agreements will be included as part of this conditions review and summary.

Task 10.3.4: Stakeholder Outreach

During Task 10.3.1, an initial series of stakeholder outreach meetings will be conducted to inform key port stakeholders about this master planning effort and to begin collecting their perspective and input as it relates to the future development and modernization of the port. The SPG will arrange and coordinate all stakeholder meetings. Prior to these meetings, informative materials will be produced by WSP and agreed to by the SPG prior to presenting them to the stakeholders. The following groups are anticipated to be included in the initial outreach meetings:

- Port Board of Directors (BOD),
- Port Management and Staff
- Legislative Oversight Chair
- Port Users Group Guam (PUGG)
- Guam Customs
- Others as directed by the PAG and SPG

Other groups or combinations of these groups may meet together or separately. Follow-up discussions with stakeholders as required during the planning tasks will be conducted through the direction of the SPG. It is anticipated that an initial stakeholder outreach effort will be conducted during the project kickoff (as described above) and another after the completion of Task 10.3.6 and a final outreach once the draft report is completed. This third outreach effort would include all of the initial groups listed above as well as the following groups:

- PUC
- Office of the Governor
- Guam Legislature
- NAVFAC Pacific Guam Program Management Office
- Others as directed by the PAG and SPG

If required, additional outreach efforts may be supported by WSP's on-island staff, but this effort is not included in this technical approach.

Task 10.3.5: Market Analysis & Cargo Forecast

The intent of this effort is to assess the current and projected cargo opportunities/requirements based on Guam's market drivers including the most current projections for the US Military Buildup in Guam and the CNMI. The latest forecast models developed in support of the last 5-year Tariff Analysis and the CIP Bond Program will be updated based upon a review of recent market drivers and validation of the previous cargo forecasts.

SPG, PAG Commercial, and PUGG engagement will be needed to identify commercial cargo opportunities and current/projected tenant requirements. This will include confirmation of compatible facility and land uses inside and outside the commercial port and its impact on services (demand, investment) and revenue (leases, fees) requirements. The magnitude and timing of the military buildup in Guam and the CNMI has changed over the past decade. Working in concert with the NAVFAC Pacific Guam Program Management Office, WSP will review and update the past cargo forecasts that have been developed and confirm the range of possible demand scenarios that may occur.

To develop the current market demand forecast scenarios, the planning team will initiate discussions with the NAVFAC Pacific Guam Program Management Office to obtain the latest buildup planning projections. The planning team will then evaluate the impact of the updated military buildup plans and adjust the previous container and bulk cargo forecast to represent several market scenarios as follows:

- Low: organic growth with a slow military buildup
- Mid: organic growth with a moderate pace military buildup
- High: organic growth with an accelerated military buildup

Once the forecasts for container and bulk cargoes are updated, they will then be compared to the existing and future throughput capacity estimates developed in Task 10.3.6.

Task 10.3.6: Capacity & Needs Analysis

Using the throughput capacity models developed for the 2013 Master Plan Update, capacity estimations for each of the cargo demand scenarios will be performed. This effort will include, but is not limited to:

- Reviewing all operating and equipment assumptions to verify that they are currently being used or change them to emulate current operations.
- Meet with PAG Management and review any planned actions resulting from previous PUC directives.
- Review STS Crane replacement and procurement calendars and funding scenarios

To verify the updated operating variables in the model, vessel, storage yard and gate operations will be analyzed to verify or update key model inputs (productivity rates, cargo mix, storage densities, etc.). Once the model inputs are validated or updated, capacity analyses will be performed for each of the demand scenarios to identify the optimum market driven scheduling required to implement elements of the modernization and capital improvement programs. This modeling effort will begin with identifying the throughput capacity estimations for each end year demand scenario and then work backward to determine the appropriate phased improvement schedule driven by market need. This will be accomplished by comparing the three demand scenarios (yearly) against capacity estimates to size infrastructure, equipment and operations to meet the defined annual needs over a 20-year timeframe.

Task 10.3.7: Modernization Program & Scenario Requirements

The port modernization and capital improvement program requirements and the land use master plan will then be combined to develop an end-state (20 year) infrastructure and land use plan for each of the demand scenarios. These plans will include a review of ongoing commercial terminal development efforts while also identifying potential non-commercial terminal development opportunities and requirements. The plans will also include the following considerations:

- Review implications of improved Guam Customs facilities and procedures
- Review implications of improved PAG/PUGG communication processes
- Review implications of STS crane fleet upgrades
- Review implications of improved STS and yard equipment maintenance practices
- Review implications of future PMC support agreements
- Review implications of expanded/improved facilities (H-wharf, EQMR, Administration Building, Golf Pier, F1 Improvements, and Fuel Connectivity between Golf Pier and F1)
- Review implications of new/expanded facility opportunities (container yard, LNG facilities, expanded tank farms, etc.)
- Integration of relevant stakeholder input on scenario analysis, related development requirements, scenario gaps and flexible implementation approach

Once the three full build scenario plans are developed, a CIP development phasing program for accommodating market demand gaps for near-term (0-5 years) and long-term (6-20 years) will be developed. This will include phased development land use plans; a program schedule and estimated development costs estimates for each phase. Elements of modernization and sustainability related to the commercial cargo terminal will be included in the phased plans. The estimated development costs will be created as an order of magnitude conceptual annual Capital Expenditures (CapEx) budget including infrastructure, equipment procurement, systems and equipment for a series of phased improvements for each demand scenario. Close coordination and discussion with the SPG will be required during the development of the market driven phased development programs. Program phasing will be coordinated between market demand scenarios to incorporate elements of flexibility to react if further changes in the military buildup occur.

For each market scenario driven phased program, annual variable Operating Expenditures (OpEx) will be estimated using the throughput capacity model defined in Task 10.3.6. The model will be calibrated to emulate the current operations and will then be used to estimate the labor, energy (fuel and electricity) and consumables required for handling cargo through the port and maintaining the infrastructure/equipment under each of the demand scenarios.

Task 10.3.8: Financial Analysis

Identifying the revenue available for funding future growth and ensuring that resources are available to maintain existing assets is essential for the long-term financial sustainability and operational viability of the Port. This task will provide future revenue projections at the Port and develop related funding strategies to maximize the financial resources available for operations and future CIP improvements.

This task will begin by working with the financial controller to review the revenue and expense history at the Port for the prior five years and evaluate noticeable trends or anomalies that when combined with updated buildup information and other new initiatives can establish baseline data for future projections.

The next step will involve forecasting future revenue based on Commercial, SPG, and PUGG input on non-cargo revenues and potential military input related to the cargo forecast associated with the timing and magnitude of the military buildup (identified in Task 10.3.5). Any changes or refinements to the last 5-Year Tariff Projection and 20 Year Financial Plan will also be incorporated. Likewise, adjustments to the 20-Year CIP and future operating and maintenance (O&M) costs, considering year of execution and escalation will be reviewed and updated.

Once the historical trends, new opportunities, and cargo forecasts have been confirmed, projecting future cash flow from operations and leases can begin. For the cargo-related portion, the financial analysis will project cargo revenues based on the three market scenarios previously defined in Task 10.3.5:

The revenue projections will incorporate cargo volumes/schedules, non-cargo leases, potential outside investments and grants, and PUC petition for tariff adjustments. Revenues from non-cargo operations and lease revenue will be analyzed and projected based on likely growth and future rate increases. All revenues will be summarized to attain gross revenues. The next step will involve taking gross revenues to net revenues. Net revenue and net revenue available for financing (net revenue less reserves and other encumbrances) will be calculated by deducting OpEx, CapEx identified in Task 10.3.7 along with any other expenses identified as part of our research (e.g. Autonomous Agency Contributions, Reserve Accounts, other encumbrances) and existing debt service or other obligations from gross revenues. A net present value calculation will be applied to mitigate the risk of inflation or other impacts on future revenues and to help accurately assess bonding capacity.

Inherent in each scenario that is developed will be unique revenues and costs associated with the selected operational modes and funding strategies, including the benefits of changes to staffing and equipment.

WSP will incorporate the data on port operational and financial projections into the financial model, developed in Microsoft Excel, created to support the 2018 bond issuance.

The key objective of this task will be to identify the amount of bonding capacity that the net revenue can accommodate taking into consideration the debt ceiling, loan covenants, reserve covenants, and other relevant loans, bonds and grants. This task will also identify and evaluate alternative funding strategies to maximize the potential bonding capacity. Further, WSP will calculate the increase in tariffs that would be necessary to fully fund the proposed capital improvements.

Note that WSP is not a broker-dealer registered with the Securities and Exchange Commission, and, as such, cannot make recommendations regarding borrowing to PAG. WSP can project bonding capacity based on standard, 30-year level debt service bond issuances with key assumptions provided by the PAG, GEDA, or the PAG's financial advisor.

A full description of the architecture of the financial model and its operation, along with any changes that have been designed since the previous submittal (for PUC purposes) of model-generated materials will be included. An outline of the contextual assumptions that surround the inputs and outputs of the model will be identified as part of this task.

The financial analysis task will have the following subtasks:

Subtask 10.3.8.1 – Methodology and Approach
This subtask will include supporting documentation such as an Implementation Plan Approach, Financial Feasibility Analysis Approach, and Economic Impact Assessment Approach

Subtask 10.3.8.2 – Implementation Plan
This subtask will evaluate the timing and magnitude of necessary improvements and sustainability requirements.

The Task 10.3.7 effort will continue into and be performed in parallel with this Task 10.3.8 financial analysis because an iterative analysis process will be required to balance the market driven phased programs for each scenario against their estimated annual financial performance. This analysis will help identify the optimum timing of infrastructure improvements and major equipment/supply acquisitions so that excess capacity is not wasted, and insufficient capacity does not cause a loss of potential revenue or escalate operating costs.

Task 10.3.9: Economic Impact Assessment
This task will provide an assessment of the economic impact that CIP investments, increasing tariffs, and growing cargo volumes will have on Guam. The economic assessment will have the following subtasks:

Subtask10.3.9.1 –Identify economic data sources, trends, forecasts, and models (e.g., customized input output models) relevant to Guam economic conditions. From this research effort, selected consumption and business expenditure trend patterns will be investigated for use in determining economic impacts.

Subtask 10.3.9.2 – Review Tariff Study assumptions. Evaluate potential impacts of tariff increases on island prices, cost of living, business costs. Relationships between port tariffs and product prices/cost of living and producer price indices (holding other economic and demographic factors constant) will be investigated to determine if correlations can be identified. This information will help to assess whether, and to what extent, on-island product prices may be affected by tariffs or other transport cost factors, holding other factors constant. To the extent possible (data availability permitting), estimates of the impacts on specific products will be considered. No formal statistical/econometric modeling is proposed.

Subtask 10.3.9.3 – Evaluate the economic impacts of different cargo volumes and CIP investment scenarios. Based on the previous tasks, and other internal sources, assumptions will be made regarding the potential increase in commodity prices, other business and government costs, and changes to economic activity that might occur with and without Port CIP investments and efficiency gains in response to the military expansion. Avoided adverse economic impacts attributable to the modernization will be identified and evaluated and serve to offset the negative impacts from higher port tariffs. Scenarios will include variable levels of buildup and the corresponding increases and reductions in the private sector local economy. Qualitative assessments will be made, supplemented by supporting data, but no formal economic modeling is proposed.

Subtask 10.3.9.4 – Economic Analysis Section of the Report. A summary outlining the methodology, assumptions, and findings from the first three subtasks will be provided as a Section in the Master Plan.

Task 10.3.10: Project/Program Planning & Analysis

Several special studies and areas for analysis will be required as part of the master planning process. The following is a listing of identified studies and/or analyses to be performed:

Subtask 10.3.10.1 – Guam Customs Inspection Facility Feasibility Study

The PAG has provided US Customs with a 4-acre parcel of land adjacent to the main terminal gate to be developed as a local office and cargo inspection facility. WSP will work with Customs to ascertain and validate their design requirements and confirm that the resulting planned facilities will integrate with the planned traffic circulation flows to/from the terminal. WSP will participate in stakeholder meetings with Customs, the PUGG, SPG and PAG to facilitate the clarification of the Customs facility design criteria. WSP will develop and analyze two to three layouts which will be discussed with the stakeholders to reach consensus on an acceptable facility plan for incorporation into the master plan. The physical interface with the terminal will be developed along with CapEx and OpEx cost estimates for incorporation into the master plan.

Subtask 10.3.10.2 – Cargo Terminal

This subtask will focus on the physical "Opportunities and Constraints" resulting from the current configuration, and planed reconfiguration, of the terminal facilities and properties and how the modernization program will influence terminal operations. Current and planned facility and building functional usages will be investigated and analyzed, such as the impacts of the new Administration Building Annex concept and the upgraded EQMR Building. Facility repurposing, demolition and/or expansion options will be explored to improve overall terminal traffic patterns, functionality and operating efficiencies. Elements of this study may include, but not limited to, the following:

- Addition of the Guam Customs facilities
- Wharf facility upgrades to accommodate new STS crane interfacing infrastructure
- Gate Operational System (GOS) implementation
- Improved reefer monitoring
- Reconfigured container storage
- Expanded liquid bulk storage
- Expanded H-wharf operations
- LNG facility alternatives
- Expanded staff parking

Subtask 10.3.10.3 – Agat and Hagatna Marinas
Condition surveys of the two marinas will be performed and the results presented to the SPG for consideration. Stakeholder (tenants, boat slip lease holders, etc.) input regarding their wants and needs will be solicited and categorized for consideration by the SPG. After SPG review and comment, WSP will develop a set of recommendations covering fixes, enhancements and/or improvements for consideration by the PAG. The recommendations will be presented in a summary presentation supported by estimates of any CapEx costs and related revenue generating capacity of any future developments. The results of this effort will be incorporated appropriately into the master plan.

Subtask 10.3.10.4 – Harbor of Refuge
WSP will first meet with the SPG to assess how the Harbor of Refuge is currently being used to service the port and the people of Guam. The existing lease holds will be reviewed and interviews with tenants and other stakeholders will be used to assess areas requiring improvement and/or expansion. A basic condition assessment of the harbor’s facilities and infrastructure will be performed. Recommendations for improvements and/or alternative land usages will be made for incorporation into the master plan update. These recommendations will be supported by estimates of CapEx and OpEx costs and related revenue generating capacity of any future developments to be incorporated into the modernization plan.

Subtask 10.3.10.5 – Proposed LNG Facility
Third-party stakeholders have indicated an interest in constructing LNG terminal facilities within the Port of Guam. WSP, in concert with the SPG, will meet with the stakeholders to ascertain their requirements and review the alternative sites that have been proposed. A brief feasibility study will be performed to look at the “positives” and “negatives” associate with each of the proposed sites. It is assumed that this development would be funded by the stakeholders and that their facilities would be

constructed on port leased properties. An economic evaluation will be performed to determine the appropriate financial terms for the property lease and a tariff structure for the import/export of product across the wharf and associated distribution pipelines. The results of this analysis will be summarized in a report to be presented to the PAG for consideration. LNG facilities incorporation into the master plan update will be indicated as an optional alternative for consideration.

Subtask 10.3.10.6 – Area A Feasibility
Area A is the former Mobil Oil site that had been used primarily as a liquid bulk tank farm. A feasibility study will be performed to develop potential alternative uses for the site. Potential stakeholder interest for use of the property will be solicited locally on Guam for alternative development scenarios. Feedback from interested stakeholders will be used as one source for any alternative development. Other alternatives will be developed by WSP based on our experience with port development scenarios from around the globe. Alternatives will need to include considerations for CapEx costs associated with demolition of remaining infrastructure and the environmental permitting and remediation requirements, depending upon the degree of ground contamination identified for the site. Recommendations for alternative land usages for this site will be included in a summary report and incorporated into the master plan update. These recommendations will be supported by estimates of CapEx and OpEx costs and related revenue generating capacity for any future development to be incorporated into the modernization plan.

Subtask 10.3.10.7 – Solar Panel Initiative Feasibility Study
The PAG is interested in the feasibility of installing a photovoltaic panel system on the rooftops of several Port buildings. The primary goal of this initiative is to create an economic model that could predict the feasibility of installing a photovoltaic system and potential tax benefits. A secondary goal is to achieve non-economic factors such as green stewardship and carbon footprint reduction.

The feasibility study includes two primary tasks as outlined below:

A. Solar Site and Energy Analysis:

   The first phase of this Solar Panel Feasibility Study is an analysis of the Port of Guam site and facilities to determine the suitability, size, location, and productivity of potential solar photovoltaic (PV) installations. The primary tasks include:

   - Identify optimal roof location for solar array, including evaluation of annual solar access due to shading, azimuth, and tilt angle.
   - Develop energy production estimates for on-site PV generation.
   - Optimize PV array (location, area, capacity, tilt angle, orientation, prevention of shading from local obstructions) to meet total site energy goals.

- Provide criteria and recommendations for PV module equipment and assess mounting options for rooftop or site PV array installations.

Deliverables for the Site and Energy Analysis will be a written report summarizing findings and including system size and production data as well as site markups.

B. Economic Incentives and Stakeholder Implications:

After the initial Site and Energy Analysis is completed, the energy and system capacity data will be used to study the financial case for deployment and any potential stakeholder implications and incentive opportunities. Primary tasks include:

- Producing an energy cost study to determine expected operational savings relative to the capital expenses from system installation.
- Evaluating the financial case and structure of a solar PV system as an investment vehicle.
- Determining any available incentive programs or alternative delivery options for improving financial case.
- Evaluating social or other non-economic factors that may impact the decision to pursue installation of a solar PV system.

Deliverables include a written report outlining the findings of the economic study and making final recommendations around implementation.

Subtask 10.3.10.8 - PUGG Initiative for System Integration
The PUGG has defined the need for improved data and information sharing/reporting between the stakeholders involved in the cargo supply chain at the Port of Guam. These stakeholders primarily include the shippers, Guam Customs and the PAG. WSP will work with a third-party consultant to provide digital implementation services to help facilitate improved electronic communication in this regard. WSP has already been engaged by the PAG to provide TOS and IT systems improvements that deal with the basic systems that serve as the communications backbone associated with the cargo supply chain at the port (e.g. NAVIS).

WSP, in concert with RVE Management (RVE) and the SPG, will meet with the stakeholders to further ascertain the detailed requirements that the PUGG is looking to have implemented at the port. These requirements will be evaluated in light of the current TOS/IT approach, systems, hardware and software being implemented at the port and the scope of WSP/RVE’s current services. A set of recommendations will then be made as to how best to integrate the PUGG requirements and their proposed consultant into the current TOS/IT planning and systems design process. Upon SPG and PAG approval, WSP/RVE will then work in concert with the PUGG to develop a coherent plan to integrate their requirements into the data and information reporting architecture of the TOS/IT systems now being implemented.

Task 10.3.11: Final Recommendations

The recommended phased development program scenario will be identified by comparing the performance of each and consider sustainable organic requirements, modernization objectives, and the most likely military buildup impacts needing to be accommodated.

The proposed schedule and financial strategy for implementing the recommended program elements will be both stable and flexible to adapt to changing circumstances over time.

Any briefings needed to update key stakeholders and approval processes (Legislature, PUC, PUGG) will be accomplished at Port direction and at a time and budget to be determined.

Deliverables

1. Data Collection Summary: A working Excel log that summarizes the data collected and being used for this study. This log will be available on ProjectSolve and shared with the SPG on a regular basis throughout the project.
2. Draft Findings Presentation (through Task 10.3.6): An interim presentation of key findings through Task 10.3.6 will be provided. While on island presenting these draft findings, additional required stakeholder meetings will occur and Tasks 10.3.7 and 10.3.8 will begin.
3. A summary of the results of economic analyses performed under Task 10.3.9
4. Results of the various studies and analyses performed under Task 10.3.10 will be coordinated and presented as they are performed. Findings and recommendations will be first provided as draft presentations, for stakeholders, in a series of meeting and/or conference calls for discussion, refinements, reviews and ultimately consensus. Final recommendations and/or findings will be vetted by the SPG and published in the final master plan report.
5. Draft Findings (through Task 10.3.11) Presentation: Prior to finalizing the draft report, a presentation of all analysis findings will be performed via webinar.
6. Draft Master Plan Report: Submitted to the SPG for review and comment.
7. Final Master Plan Report: Submitted upon considering SPG, PUC and other key stakeholder's review comments.
8. Post-release Briefings: TBD

Consultant's Cost Computations (Cost Estimate)

See Exhibit B

Progress Reporting:

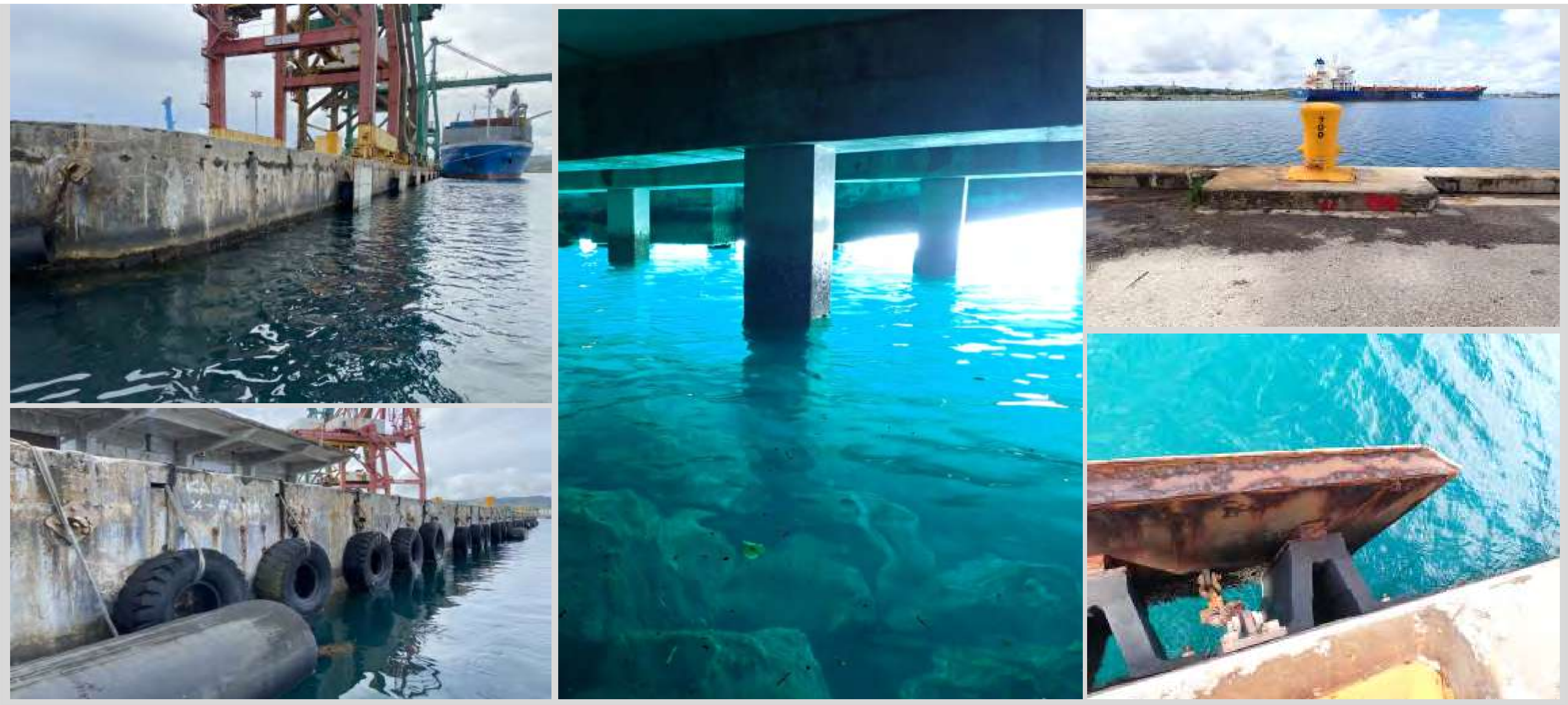
Progress of deliverables will be updated monthly. Reporting shall adhere to the protocols established in CONSULTANT AGREEMENT.

List of Attachments and Exhibits:

Exhibit B Consultants Cost Computation

APPENDIX B – BERTHS F2-F6 CONDITION ASSESSMENT REPORT

Final Submittal



Port Authority of Guam
Facility Condition Assessment Report
Berths F2, F3, F4, F5, and F6

For the
Port Authority of Guam
Piti, Guam

13369I

April 2022

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Facility Condition Assessment Report – Final

Port Authority of Guam
BERTHS F2, F3, F4, F5, AND F6

Submitted to

Port Authority of Guam
Piti, Guam

20 April 2022

Submitted by

WSP USA
33301 Ninth Avenue South, Suite 300
Federal Way, Washington 98003-2600

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FINAL
FACILITY CONDITION ASSESSMENT REPORT
PORT AUTHORITY OF GUAM – BERTHS F2, F3, F4, F5, AND F6

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EXECUTIVE SUMMARY

This report presents the current overall condition assessment rating of Berths F2, F3, F4, F5, and F6, provides a summary of observations and findings from the condition assessment effort, and provides concept-level repair recommendations and a construction cost estimate for elements that were found to be deficient for their intended use. The facility condition assessment comprised above-deck and below-deck/above-water inspection of marine elements at Berths F2 through F6.

Berth F2

Overall, the berth is in **poor** condition. The concrete facing has delaminated and spalled from the steel sheet pile wall at several locations. At the inner tidal zone, severe corrosion is present at the sheet pile wall. Previous inspection reports identify holes in the sheet pile wall at multiple locations. Open-corrosion spalling of the longitudinal concrete pile cap is present at multiple locations along the length of the berth. In general, Berth F2 lacks a dedicated fender system. Moderate to major corrosion is present at the mooring hardware.

Berth F3

Overall, the berth is in **poor** condition. Previous inspection reports identify holes in the sheet pile wall at multiple locations. Open-corrosion spalling along the concrete bullrail is present at multiple locations. Cracking of the concrete facing is present at multiple locations. The fender system is non-uniform and consists of a combination of tires, floating pneumatic fenders, and cylindrical fenders. Moderate to major corrosion is present at the mooring hardware.

Berth F4

Overall, the berth is in **fair** condition. Previous inspection reports identify a previously repaired section of sheet pile wall where erosion is present. Moderate to major corrosion is present at the mooring hardware and fender panels. Several of the rubber fender elements are severely torn.

Berth F5

Overall, the berth is in **satisfactory** condition. Concrete piles and pile caps are in good condition. Moderate to major corrosion is present at the mooring hardware and fender panels. Moderate to major corrosion is present at the upland sheet pile wall. Several of the rubber fender elements are severely torn.

Berth F6

Overall, the berth is in **satisfactory** condition. Minor cracking of the concrete facing was observed at several locations. Rubber fender elements are torn and split at isolated locations.

The total cost estimate for repairs to Berths F2 through F6 is shown below and is based on repairs being performed during fiscal year 2023. This estimate is intended to provide a rough order of magnitude and include labor, materials, equipment, mobilization, construction contingency, contractor overhead and profit, management, engineering design, permitting, construction management, design services during construction, and gross revenue tax. This estimate also includes adjustments for inflation, higher-than-normal fuel costs, labor shortages, and the surplus of construction projects in Guam which are estimated to impact construction projects.

- Berths F2 through F6 $3,564,000

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FACILITY CONDITION ASSESSMENT REPORT – FINAL
PORT AUTHORITY OF GUAM, PITI, GUAM

1.0 INTRODUCTION

As part of Task Order No. FY020-003WSP dated 4 September 2020, the Port Authority of Guam (PAG) authorized Subtask 3, Wharf Service Life Extension. As part of this subtask, WSP performed a facility condition assessment of Berths F2, F3, F4, F5, and F6. The purpose of the condition assessment effort was to observe the current condition of structural elements and to verify the extent and magnitude of damage reported in previous inspection reports and other baseline documents.

This facility condition assessment report (FCAR) assigns an overall condition assessment rating to each marine facility in accordance with Table 2-14 of ASCE's 2015 Manuals and Reports on Engineering Practice No. 130, *"Waterfront Facilities Inspection and Assessment"(MOP 130)*. This FCAR also provides a summary of field observations, concept-level repair recommendations, and repair cost estimates for assets found to be deficient for their intended use. Photographs of typical conditions and observed damage are provided in Appendix A.

1.1 FACILITY DESCRIPTION

The Port of Guam (Port) is located on the western side of the island of Guam and encompasses over 1,000 acres of land. Strategically located along major Pacific shipping and air routes, the Port serves as an important transportation hub for the Commonwealth of the Northern Marianas, the Micronesian islands, and markets to the east and west. Maritime facilities at the Port consist of the following facilities. Note that this FCAR is limited to evaluation of Berths F2 through F6. See Figure 1.

- Pier F1 (Apra Harbor)
- Berths F2 through F6 (Apra Harbor)
- Hotel Wharf (Apra Harbor)
- Golf Pier (Apra Harbor)
- Family Beach (Apra Harbor)
- Pier Dog (Apra Harbor)
- Harbor of Refuge
- Agat Marina
- Perez Marina (Boat Basin)

Figure 1 – Berths F2 through F6

1.2 BERTHS F2 THROUGH F6

Berths F2, F3, F4, F5, and F6 are located on the western side of Apra Harbor in the Port's industrial district. It is estimated that some structures have been in service since the 1940's and have undergone multiple repair/rehabilitation cycles. Berth F2 is approximately 676 feet long and serves as a ship repair facility and mooring wharf for tugs, barges, and crew boats. Berth F3 is a general-use wharf starting at the northeast corner of Berth F2 and extending 750 feet to the southeast. Berths F4, F5, and F6 are approximately 1,954 feet long and support loading and unloading of shipping containers via three ship-to-shore cranes.

Berths F2, F3, F4, and F6 are bulkhead-type structures consisting of steel sheet pile walls faced with concrete that extends several feet below the mean lower-low water (MLLW) level. The berth face at F2 is defined by a reinforced concrete pile cap located at the top of the bulkhead wall. The berth face at F3 through F6 consists of a concrete bullrail with integrated cleats and mooring bollards. A wearing surface consisting of asphalt concrete pavement is present on the upland portion of these facilities. Berth F5 is a pile-supported wharf and consists of a concrete slab spanning between concrete pile caps and supported by concrete piles. In addition, steel sheet pile bulkheads are present on the landside and waterside faces of F5; the waterside bulkhead being a toe wall.

The fender system at F2 consists of irregularly spaced rubber tires and floating pneumatic fenders. See Photo 1. At F3, the fender system is comprised of regularly spaced rubber tires and cylindrical fenders suspected from the bullrail. See Photo 2. At F4, F5, and F6, the fender system consists of regularly spaced fender panels backed by rubber arch fenders. See Photo 3, Photo 4, and Photo 5.

Photo 1 – Berth F2

Photo 2 – Berth F3

Photo 3 – Berth F4

Photo 4 – Berth F5

Photo 5 – Berth F6

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2.0 FACILITY CONDITION ASSESSMENT

2.1 CONDITION ASSESSMENT APPROACH

WSP performed a baseline condition assessment of above-deck and below-deck/above-water assets at the Port of Guam. Above-deck and below-deck/above-water assessments were performed in accordance with the American Society of Civil Engineers (ASCE) Manuals and Reports on Engineering Practice No. 130, *"Waterfront Facilities Inspection and Assessment" (ASCE 130).*

2.2 FACILITY CONDITION ASSESSMENT METHODOLOGY

Condition assessment of elements included both visual observation and limited hands-on assessment. In accordance with ASCE 130, elements were assigned an element-level damage rating, with damages defined as minor, moderate, major, or severe. These damage ratings are defined in Chapter 2 of ASCE 130 and have been standardized to provide a qualitative and consistent description of an elements level of damage. Abbreviated element level damage rating tables from ASCE 130 are provided in Appendix C for reference.

Following completion of the field work, element-level damage ratings in combination with visual observations were used to assign facility condition assessment ratings of each maritime facility. In accordance with Table 2-14 of ASCE MOP 130, a summary of the facility condition assessment ratings is provided below.

Table 1 – Facility Condition Assessment Ratings

Rating	Description
Good	No visible damage or only minor damage noted. Structural elements may show very minor deterioration, but no overstressing observed. No repairs are required.
Satisfactory	Limited minor to moderate defects or deterioration observed but no overstressing observed. No repairs are required.
Fair	All primary structural elements are sound but minor to moderate defects or deterioration observed. Localized areas of moderate to advanced deterioration may be present but do not significantly reduce the load-bearing capacity of the structure. Repairs are recommended, but the priority of the recommended repairs is low.
Poor	Advanced deterioration or overstressing observed on widespread portions of the structure but does not significantly reduce the load-bearing capacity of the structure. Repairs may need to be carried out with moderate urgency.
Serious	Advanced deterioration, overstressing, or breakage may have significantly affected the load-bearing capacity of the primary structural components. Local failures are possible, and loading restrictions may be necessary. Repairs may need to be carried out on a high-priority basis with urgency.
Critical	Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural components. Failures that are more widespread are possible or likely to occur, and load restrictions should be implemented as necessary. Repairs may need to be carried out on a very high-priority basis with strong urgency.

2.2.1 Above-Deck Assessment

The above-deck assessment evaluated the general condition of the bullrail, mooring hardware, and overlay. The assessment was performed by walking along the berth face and visually observing the condition of the elements. At limited locations, hammer sounding was performed at the concrete bullrail to identify locations where the concrete has delaminated from the substrate.

2.2.2 Below-Deck Assessment

A limited below-deck assessment was performed at Berth F5 between Stations 20+50 and 22+50. The assessment was performed by walking along the rat slab adjacent to the landside bulkhead. Concrete elements were visually assessed for damage such as cracks, mechanical damage, and corrosion spalls. Steel elements were visually assessed for corrosion damage such as pitting, flaking, and loss of cross-sectional thickness.

3.0 CONDITION ASSESSMENT FINDINGS

Findings from the condition assessment effort and ratings for above-deck and below-deck/above-water assets are described in the following sections. Ratings have been assigned based on field observations and by element-level damage ratings for individual elements.

3.1 BERTH F2

The limited waterside assessment and above-deck assessment of Berth F2 were performed on August 6th and 9th 2021, respectively.

3.1.1 Sheet Pile Bulkhead

The sheet pile bulkhead is in **poor** condition. At isolated locations, the concrete facing has delaminated from the steel sheet pile wall. Moderate to major cracks are widespread and were observed through the berth. On the northeast end of the berth, the concrete facing has spalled at multiple locations and exposed the severely corroded steel sheet pile bulkhead. Previous inspection reports identify multiple locations where voids and holes are present at the steel sheet pile bulkhead.

3.1.2 Pile Cap

The concrete pile cap is in **poor** condition. Open corrosion spalling is present at multiple locations along the berth face where the bulkhead and pavement meet. Similarly, mechanical spalling was observed at multiple locations.

3.1.3 Mooring Hardware

The mooring hardware is in **fair** condition. Pitting and corrosion were observed at all bollards.

3.1.4 Fender System

The fender system is in **serious** condition. At isolated locations, floating pneumatic fenders are present and exhibit moderate to severe damage consisting of tearing, loss of rubber, cracking, and weathering. Tires, hung from bollards or eye bolts are present at some locations. In general, the berth lacks a dedicated fender system.

3.1.5 Pavement

The asphalt and concrete paving are in **poor/fair** condition. Cracking and nonuniform wearing surfaces were observed at multiple locations.

3.1.6 Slope Protection

The slope protection southwest of Berth F2 is in **satisfactory** condition. The rip rap armoring was stable and did not show signs of erosion.

3.2 BERTH F3

The limited waterside assessment and above-deck assessment of Berth F3 were performed on August 6th and 7th 2021, respectively.

3.2.1 Sheet Pile Bulkhead

The sheet pile bulkhead is in **poor** condition. Moderate to major cracks are widespread and were observed at multiple locations. Previous inspection reports identify multiple locations where voids and holes are present and where the sheet piling has separated.

3.2.2 Bullrail

The bullrail is in **fair** condition. At isolated locations, closed corrosion spalling was observed within the top two feet of the waterside bullrail. Similarly, cracking, closed-corrosion, and open-corrosion spalling were observed at multiple bollard locations.

3.2.3 Mooring Hardware

The mooring hardware is in **satisfactory** condition. Minor to moderate corrosion was observed at multiple locations.

3.2.4 Fender System

The fender system is in **poor** condition. The fender system is not uniform and consists of a combination of tires, floating pneumatic fenders, and cylindrical rubber fenders. Fender elements are supported by multiple means such as nylon toe straps, steel cables, and chains.

3.2.5 Pavement

The asphalt paving is in **satisfactory** condition.

3.3 BERTH F4

The limited waterside assessment and above-deck assessment of Berth F4 were performed on August 6th and 7th 2021, respectively.

3.3.1 Sheet Pile Bulkhead

The sheet pile bulkhead is in **fair** condition. Minor to moderate cracks are widespread and were observed through the berth. At one location, previous inspection reports identify a section of sheet pile wall that is missing and covered with a steel plate. Erosion of backfill material was observed at the bottom of the plate.

3.3.2 Bullrail

The bullrail is in **fair** condition. Mechanical spalls were observed at isolated locations.

3.3.3 Mooring Hardware

The mooring hardware is in **satisfactory** condition. Minor to moderate corrosion were observed at multiple locations.

3.3.4 Fender System

The fender system in is **poor** condition. Severe tearing of the rubber fenders was observed at multiple locations. Tension chains are missing at several locations. At several locations, weight chains are slack and not fully supporting the weight of the fender panels. Moderate to major corrosion is present at all fender panels.

3.3.5 Pavement

The pavement is in **satisfactory** condition. Minor depressions and cracks were observed at isolated locations.

3.3.6 Crane Rail

The crane rail is in **satisfactory** condition. However, a depression measuring 1/2 inches deep was observed on the waterside crane rail near Station 12+44.

3.4 BERTH F5

The limited waterside assessment and above-deck assessment of Berth F5 were performed on August 6th and 7th 2021, respectively. The limited above-water/below-deck assessment was performed on August 9th 2021.

3.4.1 Sheet Pile Bulkhead

The steel sheet pile bulkheads are in **fair** condition. Moderate corrosion is present within the top 3 feet of the sheet pile wall that borders Berth F6. Moderate corrosion is present at the landside sheet pile wall, located directly in front of the landside pile row.

3.4.2 Concrete Bulkhead

The concrete bulkhead is in **good** condition. Damage was not observed.

3.4.3 Concrete Piles

The concrete piles are in **good** condition. Fiberglass pile wraps were observed at multiple locations and are in good condition.

3.4.4 Steel Piles

Steel piles are in **satisfactory** condition. Corrosion staining at the inner tidal zone was observed at multiple piles.

3.4.5 Pile Caps

The concrete pile caps are in **satisfactory** condition. Closed corrosion spalling was observed at two locations. Previous inspection reports identify a closed-corrosion spall at the transverse pile cap at Bent 21 pile row C.

3.4.6 Deck Soffit

The concrete deck soffit is in **good** condition. Damage was not observed.

3.4.7 Bullrail

The bullrail is in **satisfactory** condition. Closed corrosion spalling and minor cracking were observed at several locations adjacent to mooring hardware.

3.4.8 Mooring Hardware

The mooring hardware is in **fair/satisfactory** condition. Moderate to major corrosion such as pitting and scaling were observed at multiple locations.

3.4.9 Fender System

The fender system is in **serious** condition. Torn and sheared rubber arch fenders were observed at multiple locations. Shear chains and tension chains are missing throughout.

Moderate to major corrosion is present at all fender panels. At one location, tires are hung from the bullrail where the fender system is missing.

3.4.10 Pavement

The asphalt pavement in in **satisfactory** condition. Minor cracks in the pavement are present at multiple locations. Near station 16+50 at the landside crane rail, the concrete topping on either side of the crane rail is severely damaged.

3.4.11 Crane Rail

The crane rail is in **satisfactory** condition. Damage was not observed.

3.5 BERTH F6

The limited waterside assessment and above-deck assessment of Berth F6 were performed on August 6^{th} and 7^{th} 2021, respectively.

3.5.1 Sheet Pile Bulkhead

The sheet pile bulkhead is in **fair** condition. Minor to moderate cracks are widespread and were observed through the berth.

3.5.2 Bullrail

The concrete bullrail is in **satisfactory** condition. Minor cracks and closed corrosion spalling were observed at multiple locations.

3.5.3 Mooring Hardware

The mooring hardware is in **satisfactory** condition. Minor to moderate corrosion was observed at multiple locations.

3.5.4 Fender System

The fender system is in **fair** condition. Torn and sheared rubber arch fenders were observed at isolated locations. Shear chains and tension chains are missing throughout. Moderate corrosion is present at all fender panels.

3.5.5 Pavement

The asphalt pavement in in **satisfactory** condition. Minor cracks in the pavement are present at multiple locations.

3.5.6 Crane Rail

The crane rail is in **satisfactory** condition. Damage was not observed.

4.0 OVERALL FACILITY CONDITION ASSESSMENT RATING

The current overall facility condition assessment ratings for marine assets at Berths F2 through F6 are provided in the following tables. Assessment ratings were assigned based on visual observations and element level damage ratings; see Appendix D. The overall rating was determined by considering the following.

- Total number of observed damages
- Severity of observed damages
- Distribution of observed damages
- Sensitivity of affected elements
- Location of damages
- Serviceability

Table 2 – Berth F2 Condition Assessment Ratings

Asset Identification	Condition Assessment Rating
Sheet Pile Bulkhead	Poor
Pile Cap	Poor
Mooring Hardware	Fair
Fender System	Serious
Pavement	Poor
Slope Protection	Satisfactory
Berth F2 Overall Condition Assessment Rating	
Overall Facility Condition Assessment Rating	**Poor**

Table 3 – Berth F3 Condition Assessment Ratings

Asset Identification	Condition Assessment Rating
Sheet Pile Bulkhead	Poor
Bullrail	Fair
Mooring Hardware	Satisfactory
Fender System	Poor
Pavement	Satisfactory
Berth F3 Overall Condition Assessment Rating	
Overall Facility Condition Assessment Rating	**Poor**

Table 4 – Berth F4 Condition Assessment Ratings

Asset Identification	Condition Assessment Rating
Sheet Pile Bulkhead	Fair
Bullrail	Fair
Mooring Hardware	Satisfactory
Fender System	Poor
Pavement	Satisfactory
Crane Rail	Satisfactory
Berth F4 Overall Condition Assessment Rating	
Overall Facility Condition Assessment Rating	**Fair**

Table 5 – Berth F5 Condition Assessment Ratings

Asset Identification	Condition Assessment Rating
Steel Sheet Pile Bulkhead	Fair
Concrete Bulkhead	Good
Concrete Piles	Satisfactory
Steel Piles	Satisfactory
Pile Caps	Satisfactory
Bullrail	Satisfactory
Mooring Hardware	Fair
Fender System	Serious
Pavement	Satisfactory
Crane Rail	Satisfactory
Berth F5 Overall Condition Assessment Rating	
Overall Facility Condition Assessment Rating	**Satisfactory**

Table 6 – Berth F6 Condition Assessment Ratings

Asset Identification	Condition Assessment Rating
Sheet Pile Bulkhead	Fair
Bullrail	Satisfactory
Mooring Hardware	Satisfactory
Fender System	Fair
Pavement	Satisfactory
Crane Rail	Satisfactory
Berth F6 Overall Condition Assessment Rating	
Overall Facility Condition Assessment Rating	**Satisfactory**

Table 7 – Facility Condition Assessment Rating Summaries

Asset Identification	Condition Assessment Rating
Berth F2	Poor
Berth F3	Poor
Berth F4	Fair
Berth F5	Satisfactory
Berth F6	Satisfactory

5.0 RECOMMENDATIONS

Repair recommendations for structural marine assets are provided below. Recommendations are based on element level damage ratings for individual elements and the effect that the damaged elements have on the overall use of the structure. For this report, elements assigned a damage rating of major or severe represent elements with advanced deterioration and/or damage. It is recommended that these elements are repaired as soon as possible to avoid further damage which may impact the use of the facility. It is also recommended that mooring hardware and fender panels having moderate damage are repaired as these elements are critical for the continued berthing and mooring of vessels.

Berth F2

- Repair Holes in the Sheet Pile Wall: This repair consists of installing steel patches over existing holes and displacing water by pumping cementitious grout into the voids. Due to the age of the structure and severity of damage observed, this repair procedure should be considered a temporary means to extend the life of the sheet pile wall.
- Repair the void in the sheet pile wall at Station 6+76. Remove the existing rip rap and install a sheet pile wall that extends approximately 40 feet to the north. Install grout or concrete at the corner, backfill, and replace the rip rap.
- Mooring Hardware Rehabilitation: Perform coating repairs at the mooring hardware. Remove dirt, oil, debris and existing paint/coating systems and apply a high-performance coating system.
- Overlay Repairs: Remove and replace the asphalt and concrete overlay at areas with significant damage and non-uniform surfaces.
- Concrete Pile Cap and Facing: Repair of the pile cap and removal of damaged/delaminated portions of the concrete facing may result in further damage to concrete at surrounding areas. For this reason and because the berth lacks a dedicated fender system, it is recommended that an in-depth study of Berth F2 be performed. The study should include fender system alternatives and discuss the feasibility of replacing the sheet pile bulkhead or performing a large-scale repair program.

Berth F3

- Repair Holes in the Sheet Pile Wall: This repair consists of installing steel patches over existing holes and displacing water by pumping cementitious grout into the voids. Due to the age of the structure and severity of damage observed, this repair procedure should be considered a temporary means to extend the life of the sheet pile wall.
- Concrete Bullrail Repairs: At locations where closed- and open-corrosion spalls are present, sawcut and remove concrete. Where steel reinforcement is exposed, remove corrosion from reinforcement, add supplemental reinforcement as necessary, and remove/replace damage concrete to restore the original thickness.

- Mooring Hardware Rehabilitation: Perform coating repairs at the mooring hardware. Remove dirt, oil, debris and existing paint/coating systems and apply a high-performance coating system.

Berth F4

- Repair Holes in the Sheet Pile Wall: This repair consists of installing steel patches over existing holes and displacing water by pumping cementitious grout into the voids. Due to the age of the structure and severity of damage observed, this repair procedure should be considered a temporary means to extend the life of the sheet pile wall.

- Concrete Bullrail Repairs: At locations where closed- and open-corrosion spalls are present, sawcut and remove concrete. Where steel reinforcement is exposed, remove corrosion from reinforcement, add supplemental reinforcement as necessary, and remove/replace damage concrete to restore the original thickness.

- Mooring Hardware Rehabilitation: Remove dirt, oil, debris and existing paint/coating systems and apply a high-performance coating system.
- Fender Panel Rehabilitation: Remove fender panels and discard existing chains and shackles. Similarly, remove and discard rubber fender elements with major or severe damage. Remove and salvage UHMW-PE rub strips, clean fender panels and apply a high-performance coating system. Reinstall rub strips, supply new chains shackles, and fenders and reinstall fender panels.
- Crane Rail: Continue monitoring the vertical misalignment of the crane rail at Station 12+44.

Berth F5

- Concrete Pile Cap Repair: Sawcut and remove damaged section of concrete. Where steel reinforcement is exposed, remove corrosion from reinforcement, add supplemental reinforcement as necessary, and remove/replace damaged concrete to restore the original thickness.

- Concrete Bullrail Repairs: At locations where closed- and open-corrosion spalls are present, sawcut and remove concrete. Where steel reinforcement is exposed, remove corrosion from reinforcement, add supplemental reinforcement as necessary, and remove/replace damaged concrete to restore the original thickness.

- Mooring Hardware Rehabilitation: Remove dirt, oil, debris and existing paint/coating systems and apply a high-performance coating system.
- Fender Panel Rehabilitation: Remove fender panels and discard existing chains and shackles. Similarly, remove and discard rubber fender elements with major or severe damage. Remove and salvage UHMW-PE rub strips, clean fender panels and apply a high-performance coating system. Reinstall rub strips, supply new chains shackles, and fenders and reinstall fender panels.
- Overlay Repairs: Remove and replace the damage concrete adjacent to the landside crane rail near Station 16+50. Where steel reinforcement is exposed, remove

corrosion from reinforcement, add supplemental reinforcement as necessary, and remove/replace damaged concrete to restore the original thickness.

Berth F6

- Repair Holes in the Sheet Pile Wall: This repair consists of installing steel patches over existing holes and displacing water by pumping cementitious grout into the voids. Due to the age of the structure and severity of damage observed, this repair procedure should be considered a temporary means to extend the life of the sheet pile wall.

- Concrete Bullrail Repairs: At locations where closed- and open-corrosion spalls are present, sawcut and remove concrete. Where steel reinforcement is exposed, remove corrosion from reinforcement, add supplemental reinforcement as necessary, and remove/replace damaged concrete to restore the original thickness.

- Mooring Hardware Rehabilitation: Remove dirt, oil, debris and existing paint/coating systems and apply a high-performance coating system.
- Fender Panel Rehabilitation: Remove fender panels and discard existing chains and shackles. Similarly, remove and discard rubber fender elements with major or severe damage. Remove and salvage UHMW-PE rub strips, clean fender panels and apply a high-performance coating system. Reinstall rub strips, supply new chains shackles, and fenders and reinstall fender panels.

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6.0 REPAIR COSTS

The total cost estimate for repairs to Berths F2 through F6 is shown below and is based on repairs being performed during fiscal year 2023. This estimate is intended to provide a rough order of magnitude and includes labor, materials, equipment, mobilization, construction contingency, contractor overhead and profit, management, engineering design, permitting, construction management, design services during construction, and gross revenue tax. This estimate also includes adjustments for inflation, higher-than-normal fuel costs, labor shortages, and the surplus of construction projects in Guam which are estimated to impact construction projects. For a detailed breakdown of recommended repairs and associated costs at each berth, see Appendix C.

- Berths F2 through F6 $3,564,000

APPENDIX A

PHOTOGRAPHS

Photo 1 – Berth F2 Typical Berth Face

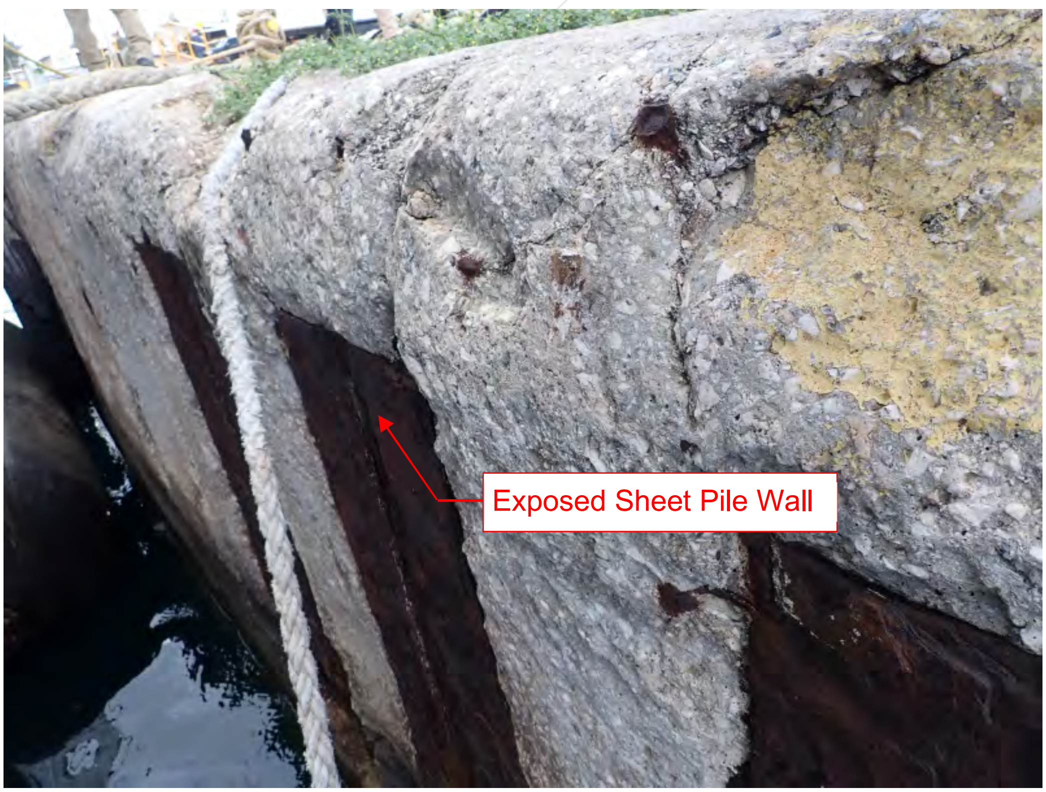

Photo 2 – Berth F2 Exposed Sheet Pile Wall

Photo 3 – Berth F2 Typical Concrete Pile Cap

Photo 4 – Berth F2 Typical Floating Pneumatic Fender

Photo 5 – Berth F3 Typical Berth Face

Photo 6 – Berth F3 Typical Closed-Corrosion Spalling

Photo 7 – Berth F3 Typical Corrosion at Mooring Hardware

Photo 8 – Berth F4 Typical Berth Face

Photo 9 – Berth F4 Typical Corrosion at Mooring Hardware

Photo 10 – Berth F4 Concrete Spall at Bullrail/Cavel

Photo 11 – Berth F4 Depression at Crane Rail

Photo 12 – Berth F4 Typical Fender Panel

Photo 13 – Berth F5 Typical Berth Face

Photo 14 – Berth F5 Typical Corrosion at Mooring Hardware

Photo 15 – Typical Fender Panel

Photo 16 – Berth F5 Damage at Asphalt Overlay

Photo 17 – Berth F5 Typical Damaged Fender Elements

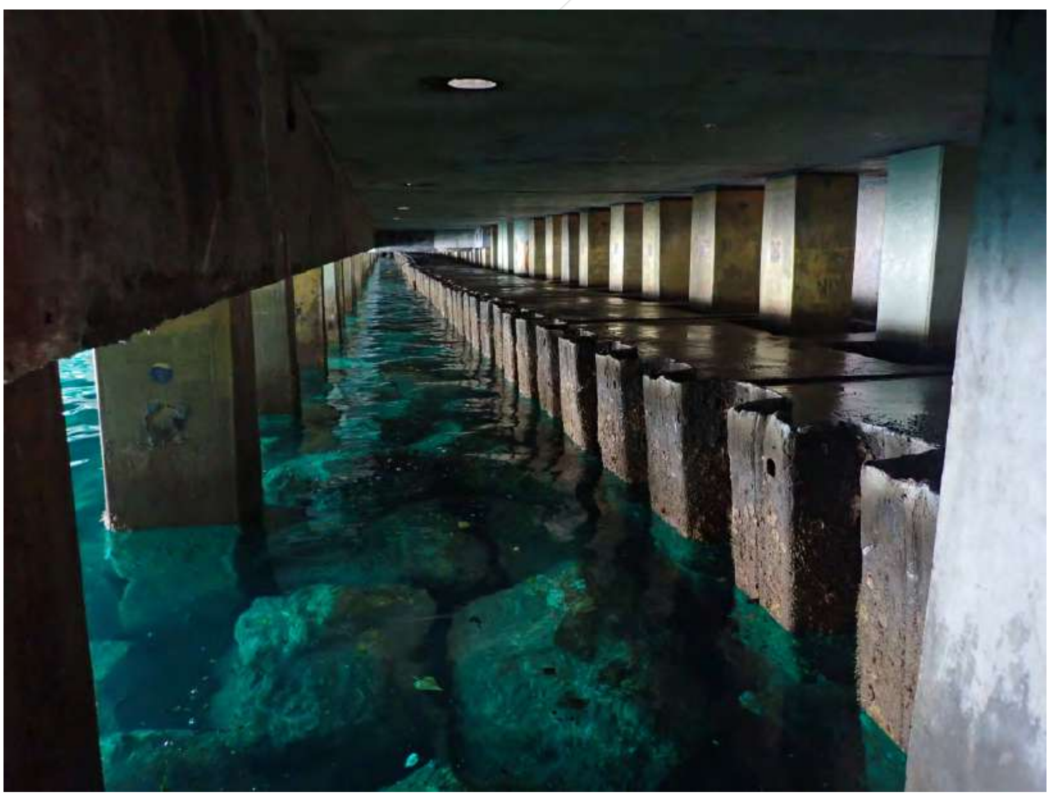

Photo 18 – Typical Landside Sheet Pile Wall

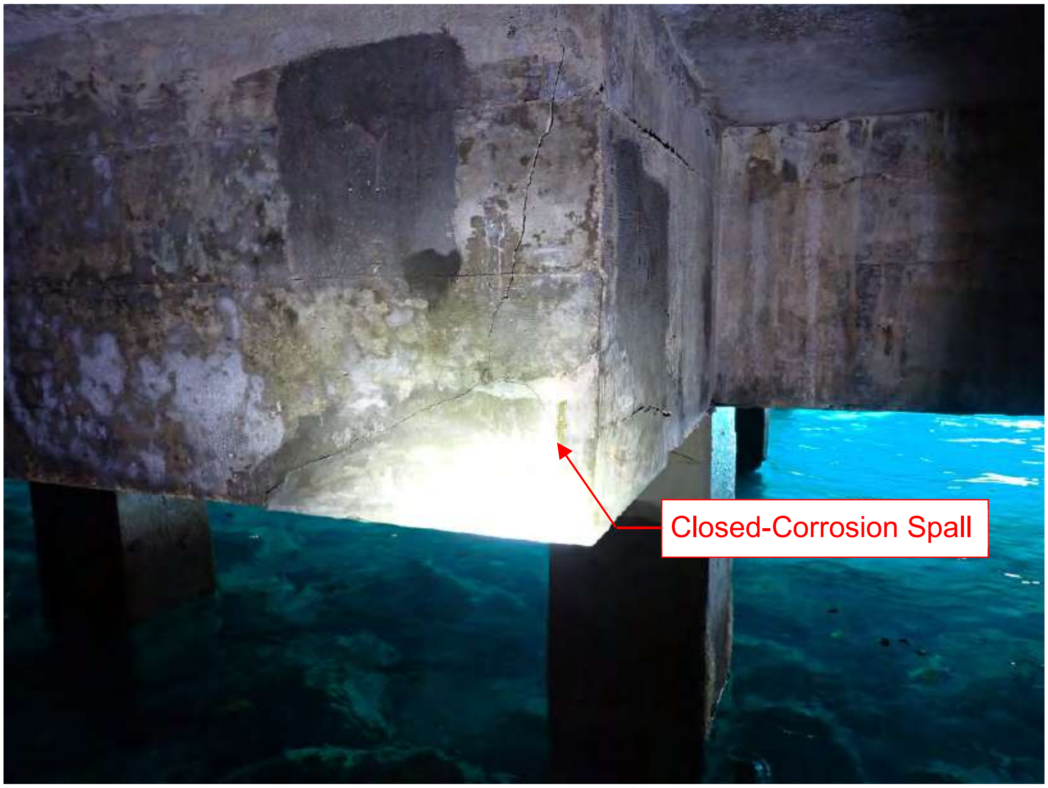

Photo 19 – Berth F5 Closed Corrosion Spall at Pile Cap

Photo 20 – Berth F6 Typical Berth Face

Photo 21 – Berth F6 Typical Corrosion at Mooring Hardware

Photo 22 – Typical Fender Panel

Photo 23 – Berth F6 Open-Corrosion Spall at Bullrail

APPENDIX B

ELEMENT LEVEL DAMAGE RATING SYSTEM

Table 2-5. Damage Ratings for Steel Elements*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI	Not Inspected	Not inspected, inaccessible, or passed by[b]	
ND	No Defects	• Protective coating or wrap intact • Light surface rust • No apparent loss of material	
MN	Minor	• Protective coating or wrap damaged and loss of thickness up to 15% of nominal at any location • Less than 50% of perimeter or circumference affected by corrosion at any elevation or cross section • Loss of thickness up to 15% of nominal at any location	Minor damage not appropriate if • Changes in straight line configuration or local buckling • Corrosion loss exceeding fabrication tolerances (at any location).
MD	Moderate	• Protective coating or wrap damaged and loss of thickness 15 to 30% of nominal at any location • More than 50% of perimeter or circumference affected by corrosion at any elevation or cross section • Loss of thickness 15 to 30% of nominal at any location	Moderate damage not appropriate if • Changes in straight line configuration or local buckling • Loss of thickness exceeding 30% of nominal at any location
MJ	Major	• Protective coating or wrap damaged and loss of nominal thickness 30 to 50% at any location • Partial loss of flange edges or visible reduction of wall thickness on pipe piles • Loss of nominal thickness 30 to 50% at any location	Major damage not appropriate if • Changes in straight line configuration or local buckling • Perforations or loss of wall thickness exceeding 50% of nominal
SV	Severe	• Protective coating or wrap damaged and loss of wall thickness exceeding 50% of nominal at any location • Structural bends or buckling, breakage, and displacement at supports, loose, or lost connections • Loss of wall thickness exceeding 50% of nominal at any location	

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.
a = Any defect listed is sufficient to identify relevant damage grade.
b = If not inspected due to inaccessibility or passed by, note as such.

Table 2-6. Damage Ratings for Reinforced Concrete Elements*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI	Not Inspected	Not inspected, inaccessible, or passed by[b]	
ND	No Defects	Good original hard surface, hard material, sound	
MN	Minor	• Mechanical or impact spalls up to 1 in. deep • Occasional corrosion stains or small pop-out corrosion spalls • General cracks up to 1/16 in. wide	Minor damage not appropriate if • Structural damage • Corrosion cracks • Chemical deterioration[c]
MD	Moderate	• Structural cracks up to 1/16 in. wide • Corrosion cracks up to 1/4 in. wide • Chemical deterioration: random cracks up to 1/16 in. wide; "Soft" concrete and/or rounding of corners up to 1 in. deep • Mechanical abrasion or impact spalls greater than 1 in. deep	Moderate damage not appropriate if • Structural breakage and/or spalls • Exposed reinforcement • Loss of cross section due to chemical deterioration beyond rounding of corner edges
MJ	Major	• Structural cracks 1/16 in. to 1/4 in. wide and partial breakage (through section cracking with structural spalls) • Corrosion cracks wider than 1/4 in. and open or closed corrosion spalls (excluding pop-outs) • Multiple cracks and disintegration of surface layer due to chemical deterioration • Mechanical abrasion or impact spalls exposing the reinforcing	Major damage not appropriate if • Loss of cross section exceeding 30% due to any cause
SV	Severe	• Structural cracks wider than 1/4in. wide or complete breakage • Complete loss of concrete cover due to corrosion of reinforcing steel with more than 30% of diameter loss for any main reinforcing bar • Loss of bearing and displacement at connections • Loss of concrete cover (exposed steel) due to chemical deterioration • Loss of more than 30% of cross section due to any cause	

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.
a = Any defect listed is sufficient to identify relevant damage grade.
b = If not inspected due to inaccessibility or passed by, note as such.
c = Chemical deterioration: sulfate attack, alkali-silica reaction, alkali-aggregate reaction, alkali-carbonate reaction ettringite distress, or other chemical/concrete deterioration.

Table 2-8. Damage Ratings for Mooring Hardware*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI	Not Inspected	Not inspected, inaccessible, or passed by[b]	
ND	No Defects	• Material sound, surfaces smooth without indications of corrosion, surface coating in good condition, connections sound • Bolt countersinks grouted or sealed	No Defects Rating not appropriate if • Surface coatings worn or damaged • Visible corrosion on fasteners
MN	Minor	• Fitting has surface corrosion over 10 to 25% of its area. • Minor wear marks or pitting on surface of fittings are less than 1/8-in. deep • Fasteners have minor corrosion with no significant loss of section.	Minor damage not appropriate if • Deep pits, gouges, or wear on fitting surfaces • Any noticeable loss of section on fasteners threads, if visible
MD	Moderate	• Fitting has moderate surface corrosion with loose scale over less than 50% of its area • Significant surface wear marks or pitting on fitting are up to 1/4-in. deep • Fasteners have corrosion with less than 25% loss of section	Moderate damage not appropriate if • Loose scale on fasteners • Inability to remove fasteners due to heavy corrosion, if accessible
MJ	Major	• Fitting has surface corrosion with loose scale over 50% or more of its surface area and/or less than 25% section loss • Significant surface wear marks or pitting on fitting 1/4-in. deep or greater • Fasteners have corrosion with loose scale or loss of section greater than 25%	Major damage not appropriate if • Displaced, damaged, or broken fitting components • Loose or missing fasteners
SV	Severe	• Fitting has heavy surface corrosion and loose scale with greater than 25% loss of section at critical areas of the fitting • Structural displacement, deformation, or rotation of the fitting are present; fitting components are broken, cracked, or delaminated • Loose, broken, or missing fasteners	

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.
a = Any defect listed is sufficient to identify relevant damage grade.
b = If not inspected due to inaccessibility or passed by, note as such.

Table 2-9. Damage Ratings for Mooring Foundations*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI	Not Inspected	Not inspected, inaccessible, or passed by[b]	
ND	No Defects	• Good original hard surface, hard material, sound	No Defects Rating not appropriate if • Weathering on timber, steel, or composite fenders • Hairline cracks in concrete elements
MN	Minor	• Timber Foundations: Weathered timber; evidence of fungal decay; minor checks, splits, and gouges up to 1/4-in. wide • Steel Foundations: Weathering of steel coating, light surface corrosion • Concrete Foundations: No significant section loss to load-bearing areas, hairline cracking of the concrete due to corrosion of the mooring hardware • Composites: Weathered surfaces	Minor damage not appropriate if • Load-bearing areas around mooring hardware not sound • Displacement, loss of bearing, or connections • Fungal decay, insect infestation within or adjacent to the bearing area on timber elements • Corrosion loss exceeding fabrication tolerances (at any location) • Structural damage or corrosion cracking or concrete elements
MD	Moderate	• Timber cracked and checked up to 1/2-in. wide; weathered surfaces; fungal decay under or adjacent to the mooring hardware, with loss of section (max 1 in.) • Corrosion of steel with less than 10 to 25% section loss at any location • Noticeable cracking of concrete, larger than hairline but with no loss of interlock	Moderate damage not appropriate if • Displacements, loss of bearing, or connections • Changes in straight-line configuration or local buckling • Loss of thickness exceeding 30% of nominal at any location for steel elements • Structural breakage, spalls, or corrosion cracks in concrete elements • Chemical deterioration[c] or "softening" of concrete elements
MJ	Major	• Timber cracked and checked greater than 1/2-in. wide; weathered; fungal decay present (max 3 in. depth); up to 25% loss of bearing • Steel corrosion with 25 to 50% section loss at any location • Noticeable cracking of concrete, resulting in loss of interlock • Composite elements cracked or split	Major damage not appropriate if • Breakage or displacement of any element • Exposed steel strands in prestressed concrete elements • Perforations or loss of section exceeding 50% on steel elements

Table 2-9. Damage Ratings for Mooring Foundations (Continued)*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
SV	Severe	• Displacement/yielding of any support members • Loss of full bearing of fitting under hardware • Fungal decay of timber members (greater than 3 in. depth) • Significant corrosion of steel members with greater than 50% section loss at any location • Cracking or spalling of concrete based under hardware • Composite broken or damaged	

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.
a = Any defect listed is sufficient to identify relevant damage grade.
b = If not inspected due to inaccessibility or passed by, note as such.
c = Chemical deterioration: Sulfate attack, alkali-silica reaction, alkali-aggregtate reaction, alkali-carbonate reaction ettringite distress, or other chemical/concrete deterioration.

Table 2-11. Damage Ratings for Pneumatic, Foam-Filled, and Hydropneumatic Fenders*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI	Not Inspected	Not inspected, inaccessible, or passed by[b]	
ND	No Defects	• Good original surfaces • Components sound • All hardware intact and operable	No Defects Rating not appropriate if • Components are weathered, worn, or torn
MN	Minor	• Wear on the fender unit with no visible belting • Hardware intact with visible surface corrosion, but less than 10% section loss • Swivel operable but binding	
MD	Moderate	• Wear on the fender, belting visible to a maximum depth of 1 inch • Hardware intact with 10 to 25% section loss • Swivel heavily corroded and or bound	Moderate damage not appropriate if • Fender unit permanently set or deformed
MJ	Major	• Wear on the fender, belting visible to a maximum depth of 2 inches • Permanent deformation of unit • Hardware loose or heavily corroded with between 25 and 50% section loss • Swivel heavily corroded and or bound, or with 25 to 50% section loss • Air pressure inflation and valves do not appear operable	Major damage not appropriate if • Components missing or broken
SV	Severe	• Considerable wear on the fender, belting visible to a depth greater than 2 inches • Punctures, tears, or holes in fender; foam exposed • Hardware heavily corroded with greater than 50% section loss or missing or broken • Swivel heavily corroded and or bound, or with greater than 50% section loss or broken • Air pressure inflation and valves are broken or damaged[c]	

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.
a = Any defect listed is sufficient to identify relevant damage grade.
b = If not inspected due to inaccessibility or passed by, note as such.
c = For pneumatic and hydropneumatic fenders, an assessment of the air pressure and inflation/pressurization system should be confirmed.

Table 2-12. Damage Ratings for Rubber Fender Elements*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI	Not Inspected	Not inspected, inaccessible, or passed by[b]	
ND	No Defects	• Good original surface, sound • Connections intact and tight	No Defects Rating not appropriate if • Noticeable abrasion or wear of rubber surfaces
MN	Minor	• Small gouges or surface defects present less than 10% of nominal depth • Connection intact, tight with light corrosion (less than 10% section loss at any location)	Minor damage not appropriate if • Surface cracking or degradation of rubber components
MD	Moderate	• Gouges, wear, or tears less than 25% of nominal depth • Rubber damaged at the connectors or connection plates • Connections loose, a bolt missing, or corrosion with 10 to 25% section loss at any location	Moderate damage not appropriate if • Permanent deformation or misalignment of rubber elements
MJ	Major	• Cracks, gouges, or tears between 25 and 50% of nominal depth • Rubber torn at the connectors or connection plates • Connections loose, two bolts missing, or corrosion with 25 to 50% section loss at any location	Major damage not appropriate if • Rubber element is split or torn through
SV	Severe	• Cracks, gouges, or tears greater than 50% of nominal depth • Rubber torn through at the connectors or connection plates • Connections with loose or missing bolts, or corrosion with greater than 50% section loss at any location	

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.
a = Any defect listed is sufficient to identify relevant damage grade.
b = If not inspected due to inaccessibility or passed by, note as such.

Table 2-13. Damage Ratings for Fender Panels*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI	Not Inspected	Not inspected, inaccessible, or passed by[b]	
ND	No Defects	• Good original surfaces • All connections intact • Backing panel sound	No Defects Rating not appropriate if • Coatings damaged • Visible surface corrosion
MN	Minor	• Small cracks or gouges (less than 10% of nominal) • 90% of panel connections intact • Backing frame with surface corrosion with no significant loss of section • Support chains intact with light surface corrosion	Minor Rating not appropriate if • Panels displaced or misaligned • Any loose or missing hardware
MD	Moderate	• Cracks or gouges (less than 25% of nominal) • 75% of panel connections intact • Panels displaced from the backing panel • Backing frame corroded • Support chains intact, with less than 25% section loss	Moderate Rating not appropriate if • Panels displaced or misaligned • Any loose or missing hardware
MJ	Major	• Cracks or gouges (less than 50% of nominal) • 50% of the panel connections intact or multiple panels displaced from the backing panel • Backing frame corroded with loose scale, but panel substantially in place • Support chains heavily corroded with more than 25% section loss	Major Rating not appropriate if • Panel/frame system sagging, misaligned, or with limited bearing
SV	Severe	• Cracks or gouges (greater than 50% of nominal) • Less than 50% of the panel connections intact or multiple panels displaced from the backing panel • Backing frame heavily corroded with loose scale • Sagging/displacement of panel/frame system • Support chains heavily corroded with loose scale and/or missing or broken	

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.
a = Any defect listed is sufficient to identify relevant damage grade.
b = If not inspected due to inaccessibility or passed by, note as such.

Table 2-14. Condition Assessment Ratings

Rating		Description
6	Good	No visible damage or only minor damage noted. Structural elements may show very minor deterioration, but no overstressing observed. No repairs are required.
5	Satisfactory	Limited minor to moderate defects or deterioration observed but no overstressing observed. No repairs are required.
4	Fair	All primary structural elements are sound but minor to moderate defects or deterioration observed. Localized areas of moderate to advanced deterioration may be present but do not significantly reduce the load-bearing capacity of the structure. Repairs are recommended, but the priority of the recommended repairs is low.
3	Poor	Advanced deterioration or overstressing observed on widespread portions of the structure but does not significantly reduce the load-bearing capacity of the structure. Repairs may need to be carried out with moderate urgency.
2	Serious	Advanced deterioration, overstressing, or breakage may have significantly affected the load-bearing capacity of the primary structural components. Local failures are possible and loading restrictions may be necessary. Repairs may need to be carried out on a high-priority basis with urgency.
1	Critical	Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur, and load restrictions should be implemented as necessary. Repairs may need to be carried out on a very high-priority basis with strong urgency.

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.

APPENDIX C

COST ESTIMATE

PROJECT: Port of Guam Repairs Wharf Service Life Extension	WSP PROJECT NO. 13369I	PAGE: 1 OF 1
OPERATION: Berths F2 - F6	ESTIMATOR: MAD	DATE: 20-Apr-22

ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
1	Mobilization/Demobilization (15%)	LS	1	$258,867	$258,867
2	F2 - Repair Holes in Sheet Pile Wall (See Note 1)	EA	40	$16,150	$646,000
3	F2 - Repair Void at STA 6+76	LS	1	$176,782	$176,782
4	F2 - Recoat Mooring Hardware	EA	20	$1,400	$28,000
5	F2 - Pavement Repair (demo and replace)	SF	13,500	$12	$162,000
6	F3 - Repair Holes in Sheet Pile Wall (See Note 1)	EA	5	$16,150	$80,750
7	F3 - Repair Concrete Bullrail	LF	100	$925	$92,500
8	F3 - Recoat Mooring Hardware	EA	9	$1,400	$12,600
9	F4 - Repair Holes in Sheet Pile Wall (See Note 1)	EA	2	$16,150	$32,300
10	F4 - Recoat Mooring Hardware	EA	14	$1,400	$19,600
11	F4 - Repair Concrete Bullrail	LF	20	$925	$18,500
12	F4 - Rehab Fender Panel	EA	18	$11,150	$200,700
13	F5 - Repair of Concrete Pile Cap	LS	1	$20,000	$20,000
14	F5 - Recoat Mooring Hardware	EA	15	$1,400	$21,000
15	F5 - Repair Concrete Bullrail	LF	10	$925	$9,250
16	F5 - Rehab Fender Panel	EA	11	$11,150	$122,650
17	F5 - Repair Pavement	SF	200	$12	$2,400
18	F6 - Repair Holes in Sheet Pile Wall (See Note 1)	EA	5	$16,150	$80,750
19	F6 - Recoat Mooring Hardware	EA	6	$1,400	$8,400
20	F6 - Repair Concrete Bullrail	LF	10	$925	$9,250
21	F6 - Rehab Fender Panel	EA	9	$11,150	$100,350
	SUB TOTAL				**$2,102,650**
22	Contingency (30%)				$630,795
23	Indirect Costs (-)				
24	Management and Administrative (5%)				$105,132
25	Design (10%)				$210,265
26	Permitting (5%)				$105,132
27	Construction Management (10%)				$210,265
28	Design Services During Construction (3%)				$63,079
	SUB TOTAL				**$3,427,319**
	Gross Receipts Tax (4%)				$137,093
	TOTAL PRICE (rounded up to nearest $1,000)				**$3,564,000**

Notes:
1. Estimate based on repairs completed in FY 2023
2. Quantity of holes in sheet pile walls to be repaired based on inspection reports and factored up by 50%
3. Cost for rubber fender replacement not included as these items are currently out for bid at Berths F4 - F6
4. It is recommended that a special purpose inspection be performed to define the limits of repair.
The special purpose inspection is not included in the cost estimate

APPENDIX C – PIER F1 CONDITION ASSESSMENT REPORT

Final Submittal

Port Authority of Guam

Facility Condition Assessment Report

Pier F1

For the
Port Authority of Guam
Piti, Guam

13369I

April 2022

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Facility Condition Assessment Report – Final

Port Authority of Guam
PIER F1

Submitted to

Port Authority of Guam
Piti, Guam

20 April 2022

Submitted by

WSP USA
33301 Ninth Avenue South, Suite 300
Federal Way, Washington 98003-2600

13369I

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FINAL
FACILITY CONDITION ASSESSMENT REPORT
PORT AUTHORITY OF GUAM – PIER F1

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EXECUTIVE SUMMARY

This report presents the current overall condition assessment rating of Pier F1, provides a summary of observations and findings from the condition assessment effort, and provides concept level repair recommendations and a construction cost estimate for elements that were found to be deficient for their intended use. The facility condition assessment comprised above-deck and below-deck/above-water inspection of marine elements at Pier F1.

Pier F1

Overall, the pier is in **serious** condition. Several elements have severe damage consisting of spalled concrete, open corrosion spalls, bent piles, sheared piles, split piles, and non-functional fender systems. At multiple locations, failed pile repairs were observed at the pile to pile cap interfaces. Open- and close-corrosion spalls were also observed at the main pier and trestle.

The total cost estimate for repairs to Pier F1 is shown below and is based on repairs being performed during fiscal year 2023. This estimate is intended to provide a rough order of magnitude and includes labor, materials, equipment, mobilization, construction contingency, contractor overhead and profit, management, engineering design, permitting, construction management, design services during construction, and gross receipts tax. This estimate also includes adjustments for inflation, higher-than-normal fuel costs, labor shortages, and the surplus of construction projects in Guam which are estimated to impact construction projects.

Pier F1 Repairs $32,152,000

1.0 INTRODUCTION

As part of Task Order No. FY020-003WSP dated 4 September 2020, the Port Authority of Guam (PAG) authorized Subtask 3, Wharf Service Life Extension. As part of this subtask, WSP performed a facility condition assessment of Pier F1. The purpose of the condition assessment effort was to observe the current condition of structural elements and to verify the extent and magnitude of damage reported in previous inspection reports and other baseline documents.

This facility condition assessment report (FCAR) assigns an overall condition assessment rating to Pier F1 in accordance with Table 2-14 of ASCE's 2015 Manuals and Reports on Engineering Practice No. 130, *"Waterfront Facilities Inspection and Assessment"(MOP 130)*. This FCAR also provides a summary of field observations, concept-level repair recommendations, and a repair cost estimate for elements found to be deficient for their intended use.

1.1 FACILITY DESCRIPTION

The Port of Guam (Port) is located on the western side of the island of Guam and encompasses over 1,000 acres of land. Strategically located along major Pacific shipping and air routes, the Port serves as an important transportation hub for the Commonwealth of the Northern Marianas, the Micronesian islands, and markets to the east and west. Maritime facilities at the Port consist of the following facilities. Note that this FCAR is limited to evaluation of Pier F1. Figure 1.

- Pier F1 (Apra Harbor)
- Berths F2 through F6 (Apra Harbor)
- Hotel Wharf (Apra Harbor)
- Golf Pier (Apra Harbor)
- Family Beach (Apra Harbor)
- Pier Dog (Apra Harbor)
- Harbor of Refuge
- Agat Marina
- Perez Marina (Boat Basin)

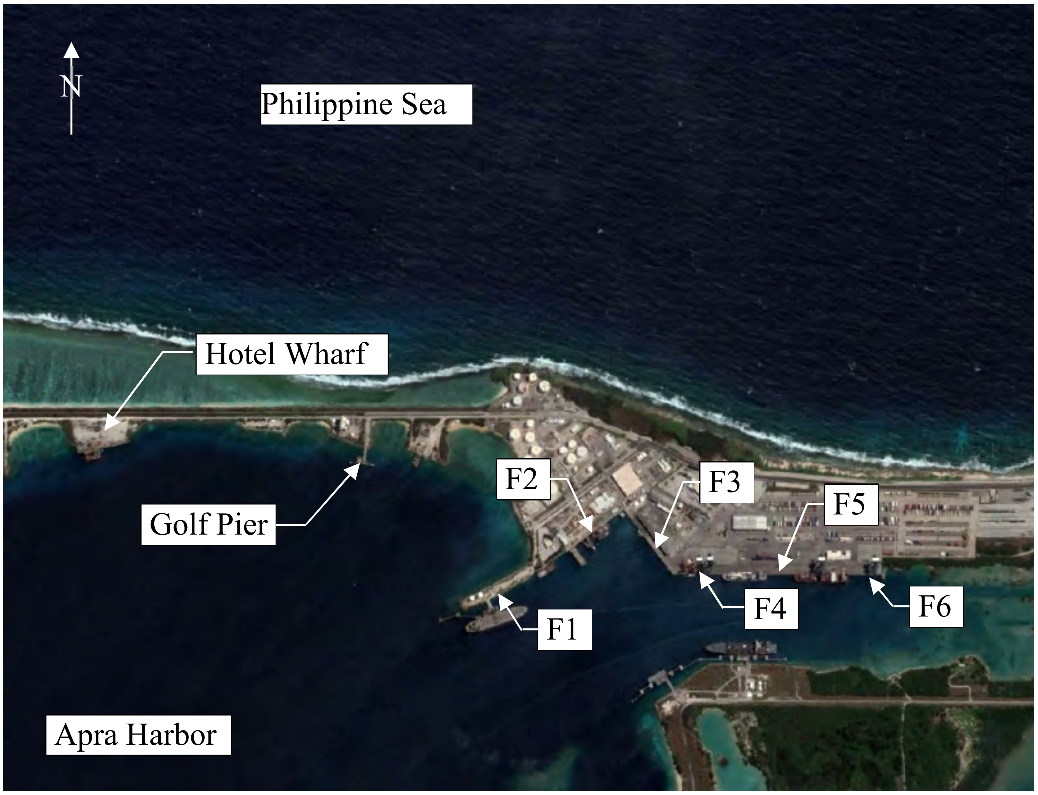

Figure 1 – Apra Harbor

1.2 PIER F1

Pier F1 is comprised of a main pier, approach trestle, and mooring and breasting dolphins. The main pier is approximately 135 feet long by 45 feet wide and is constructed with a cast-in-place concrete deck spanning between concrete pile caps supported by steel pipe piles. A trestle of similar construction is present north of the main pier and provides direct access to the pier. Mooring Dolphins A and B are located northwest of the main pier and consist of concrete pile caps supported by steel piles. Breasting Dolphins C, D, G, and H are located on the southwest and northeast sides of the main pier and are of similar construction to the mooring dolphins. Access to the mooring dolphins is provided by pile-supported walkways that extend from the southwest breasting dolphin. Note that a pile-supported walkway is also present east of the main pier and provides an alternative means of access to the northeast breasting dolphin. See Figure 2.

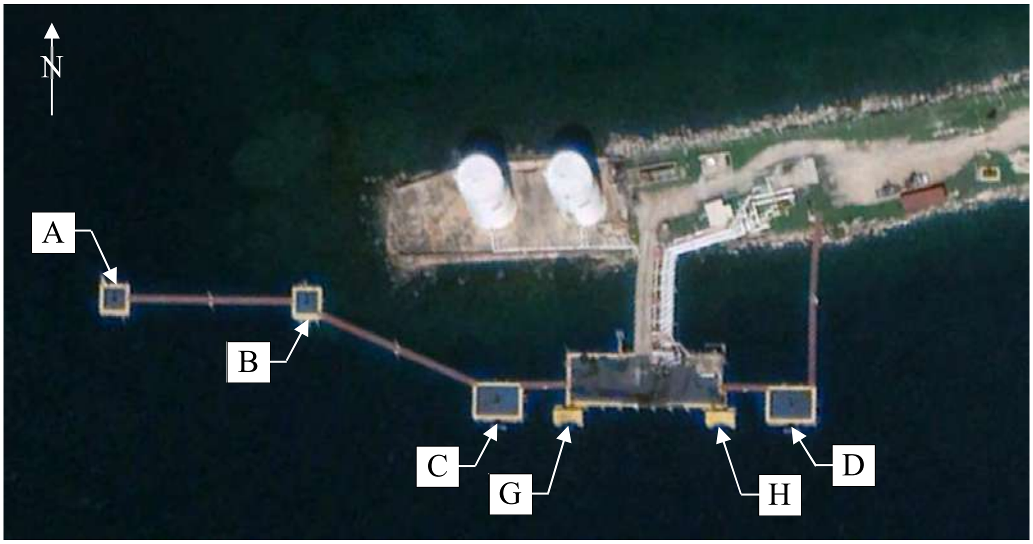

Figure 2 – Pier F1 Overview

2.0 FACILITY CONDITION ASSESSMENT

2.1 CONDITION ASSESSMENT APPROACH

WSP performed a baseline condition assessment of above-deck, and below-deck/above-water elements at the Port of Guam. Above-deck and below-deck/above-water assessments were performed in accordance with the American Society of Civil Engineers (ASCE) Manuals and Reports on Engineering Practice No. 130, *"Waterfront Facilities Inspection and Assessment" (ASCE MOP 130)*

2.2 FACILITY CONDITION ASSESSMENT METHODOLOGY

Condition assessment of elements included both visual observation and limited hands-on assessment. In accordance with ASCE MOP 130, elements were assigned an element-level damage rating, with damages defined as minor, moderate, major, or severe. These damage ratings are defined in Chapter 2 of ASCE MOP 130 and have been standardized to provide a qualitative and consistent description of an elements level of damage. Photographs showing typical conditions and damage are provided in Appendix A. Abbreviated element level damage rating tables from ASCE 130 are provided in Appendix B for reference.

Following completion of the field work, element-level damage ratings in combination with visual observations were used to assign facility condition assessment ratings of each maritime facility. In accordance with Table 2-14 of ASCE MOP 130, a summary of the facility condition assessment ratings is provided below.

Table 1 – Facility Condition Assessment Ratings

Rating	Description
Good	No visible damage or only minor damage noted. Structural elements may show very minor deterioration, but no overstressing observed. No repairs are required.
Satisfactory	Limited minor to moderate defects or deterioration observed but no overstressing observed. No repairs are required.
Fair	All primary structural elements are sound but minor to moderate defects or deterioration observed. Localized areas of moderate to advanced deterioration may be present but do not significantly reduce the load-bearing capacity of the structure. Repairs are recommended, but the priority of the recommended repairs is low.
Poor	Advanced deterioration or overstressing observed on widespread portions of the structure but does not significantly reduce the load-bearing capacity of the structure. Repairs may need to be carried out with moderate urgency.
Serious	Advanced deterioration, overstressing, or breakage may have significantly affected the load-bearing capacity of the primary structural components. Local failures are possible, and loading restrictions may be necessary. Repairs may need to be carried out on a high-priority basis with urgency.
Critical	Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural components. Failures that are more widespread are possible or likely to occur, and load restrictions should be implemented as necessary. Repairs may need to be carried out on a very high-priority basis with strong urgency.

2.2.1 Above-Deck Assessment

The above-deck assessment evaluated the general condition of the mooring hardware, slope protection, and asphalt overlay. The assessment was performed by walking along the deck surface and shoreline and visually observing the condition of the elements.

2.2.2 Below-Deck Assessment

The below-deck assessment evaluated the general condition of deck soffits, pile caps, stringers, abutments, dolphin soffits, and exposed portions of the steel piles. Concrete elements were visually assessed for damage such as cracks, mechanical damage, and corrosion spalls. Steel elements were visually assessed for corrosion damage such as pitting, flaking, and loss of cross-sectional thickness. The below-deck assessment was performed using a 25-foot Port Police boat and by walking along the exposed portion of the shoreline. However, direct access to below-deck elements was limited due to the size and height of the Police boat. Similarly, maneuverability of the Police boat was also affected by tidal currents and wind speeds. In most cases, visual observations were performed from a distance of 10 to 20 feet. For this reason, the below-deck assessment is considered to be cursory in nature.

3.0 CONDITION ASSESSMENT FINDINGS

Findings from the condition assessment effort and ratings for above-deck and below-deck/above-water elements are described in the following sections. Ratings have been assigned based on field observations and element-level damage ratings for individual elements.

3.1 PIER F1

The limited waterside assessment and above-deck assessment of Pier F1 were performed on August 6th 2021.

3.1.1 Main Pier

3.1.1.1 Piles

The steel piles and associated pile wraps are in **satisfactory** condition. Minor corrosion was observed at isolated locations.

3.1.1.2 Pile Caps and Stringers

The concrete pile caps and stringers are in **poor** condition. Open corrosion spalling with exposed reinforcement was observed at several locations. At the northeast corner of the pier, a severe crack is present along the soffit of the waterside pile cap.

3.1.1.3 Deck

The concrete deck is in **poor** condition. Open corrosion spalling with exposed reinforcement was observed at two locations.

3.1.2 Approach Trestle

3.1.2.1 Piles

The steel piles and associated pile wraps are in **satisfactory** condition. Minor corrosion was observed at isolated locations.

3.1.2.2 Pile Caps

The concrete deck is in **satisfactory** condition. Minor cracks were observed at multiple locations.

3.1.2.3 Appurtenances

The appurtenances are in **satisfactory** condition. Minor corrosion was observed at walkways, light pole supports, and pipe supports.

3.1.3 Mooring Dolphin A

3.1.3.1 Piles

The steel piles and associated pile wraps are in **serious** condition. Moderate corrosion was observed at multiple locations. Torn and missing pile wraps were observed at several locations. At one location, a batter pile is missing. A previous inspection report states that one pile has shifted from its original location. Major to severe corrosion is present at steel collars; located at the pile to pile cap interface.

3.1.3.2 Concrete Dolphin

The concrete dolphin is in **fair** condition. Minor closed corrosion spalling was observed along the east and south sides of the dolphin. Steel plates partially embedded into the top surface were observed at multiple locations.

3.1.3.3 Mooring Hardware

The mooring bollard (quick-release hook) is in **fair** condition. Moderate corrosion is present at the hooks and anchor bolts.

3.1.3.4 Walkway

The walkway between Mooring Dolphin A and B is in **satisfactory** condition. Minor weathering of the paint was observed at multiple locations. Similarly, weathering of the timber deck boards was observed along the full length of the walkway.

3.1.3.5 Intermediate Walkway Support

The intermediate walkway support between Mooring Dolphin A and B is in **fair** condition. Moderate corrosion was observed on all faces of the steel H-pile support piles.

3.1.3.6 Appurtenances

The appurtenances are in **satisfactory** condition. Within the inner-tidal zone, moderate corrosion is present on the ladder framing. Guardrail is not present on the north, west, and east sides of the dolphin.

3.1.4 Mooring Dolphin B

3.1.4.1 Piles

The steel piles and associated pile wraps are in **fair** condition. Moderate corrosion was observed at multiple locations. Torn pile wraps were observed at several locations. Moderate corrosion is present at steel collars; located at the pile to pile cap interface. Note that information related to damage below the water line was not available for review.

3.1.4.2 Concrete Dolphin

The concrete dolphin is in **fair** condition. Moderate closed corrosion spalling and corrosion cracks were observed along the south, and west sides of the dolphin.

3.1.4.3 Mooring Hardware

The mooring bollard (quick-release hook) is in **fair** condition. Major corrosion is present at the hooks and anchor bolts.

3.1.4.4 Walkway

The walkway between Mooring Dolphin B and Breasting Dolphin C is in **satisfactory** condition. Minor weathering of the paint was observed at multiple locations. Similarly, weathering of the timber deck boards was observed along the full length of the walkway.

3.1.4.5 Intermediate Walkway Support

The intermediate walkway support between Mooring Dolphin B and Breasting Dolphin C is in **fair** condition. Moderate corrosion was observed on all faces of the steel H-pile support piles.

3.1.4.6 Appurtenances

The appurtenances are in **satisfactory** condition. Minor corrosion was observed on the light pole base. Guardrail is not present on the north, west, and east sides of the dolphin.

3.1.5 Breasting Dolphin C

3.1.5.1 Piles

The steel piles and associated pile wraps are in **critical** condition. At six locations, batter piles have been sheared at the pile to pile cap interface and a gap of 2 to 2-1/2 inches is present at one location. Moderate to major corrosion of the steel piles is present at multiple piles; evidenced by corrosion staining on the pile jackets. Torn pile wraps were observed at several locations. Moderate to major corrosion is present at steel collars; located at the pile to pile cap interface.

3.1.5.2 Concrete Dolphin

The concrete dolphin is in **fair** condition. Moderate closed corrosion spalling were observed along the south, and west sides of the dolphin.

3.1.5.3 Mooring Hardware

The mooring bollard (quick-release hook) is in **poor** condition. Major corrosion is present at the hook and anchor bolts.

3.1.5.4 Fender System

The fender system is in **poor** condition. Two sections of UHMW-PE are missing from the fender panel face. Severe corrosion is present at the steel fender panel framing. The rubber cell fender has minor weathering. Weight chains and shear chains are not present.

3.1.5.5 Walkway

The walkway between Mooring Dolphin C and the Main Pier is in **satisfactory** condition. Minor weathering of the paint was observed at multiple locations. Similarly, weathering of the timber deck boards was observed along the full length of the walkway.

3.1.6 Breasting Dolphin G

3.1.6.1 Piles

The steel piles and associated pile wraps are in **poor** condition. Moderate to major corrosion of the steel piles is present at multiple piles; evidenced by corrosion staining on the pile jackets. Torn pile wraps were observed at several locations. Torn pile wraps were observed at several locations. Moderate corrosion is present at steel collars; located at the pile to pile cap interface.

3.1.6.2 Concrete Dolphin

The concrete dolphin is in **poor** condition. Severe open corrosion spalling and large sections of steel reinforcement are visible on the dolphin soffit. Mechanical spalling is present at the east and west corners of the dolphin surface.

3.1.6.3 Fender System

The fender system is in **fair** condition. Minor to moderate gouges are present at the UHMW-PE panel. Moderate corrosion is present at several locations of the steel fender panel and support assembly. Minor tearing of the rubber leg fenders was observed at multiple locations.

3.1.6.4 Walkway

The walkway between Breasting Dolphin G and the Main Pier is in **good** condition. Damage was not observed.

3.1.7 Breasting Dolphin H

3.1.7.1 Piles

The steel piles and associated pile wraps are in **poor** condition. Major to severe corrosion of the steel piles is present at multiple piles; evidenced by corrosion staining on the pile jackets. Torn and split pile wraps were observed at several locations. At one location, previous underwater inspections reports state that one of the piles appears to be permanently bent below the waterline.

3.1.7.2 Concrete Dolphin

The concrete dolphin is in **poor/serious** condition. Open- and close-corrosion spalls were observed at multiple locations on the soffit and sides of the dolphin. Spalling and delamination of cementitious material (likely from previous repairs) was observed at multiple locations.

3.1.7.3 Fender System

The fender system is non-functional and in **critical** condition. At present, a large-diameter tire is suspended from the dolphin face.

3.1.7.4 Walkway

The walkway between Breasting Dolphin H and the Main Pier is in **good** condition. Damage was not observed.

3.1.8 Breasting Dolphin D

3.1.8.1 Piles

The steel piles and associated pile wraps are in **poor** condition. Moderate to major corrosion of the steel piles is present at multiple piles; evidenced by corrosion staining on the pile jackets. Torn and split pile wraps were observed at several locations. At one location, previous underwater inspection reports state that one of the piles is split below the waterline.

3.1.8.2 Concrete Dolphin

The concrete dolphin is in **fair** condition. Moderate closed corrosion spalling were observed along the south, east, and west sides of the dolphin.

The walkway between Breasting Dolphin D and the Main Pier is in satisfactory condition. Minor corrosion was observed at select locations.

3.1.8.3 Mooring Hardware

The mooring bollard (quick-release hook) is in **poor** condition. Major corrosion is present at the hook and anchor bolts.

3.1.8.4 Fender System

The fender system is in **poor** condition. One section of UHMW-PE facing is missing from the fender panel face. Severe corrosion is present at the steel fender panel framing. The rubber cell fender has minor weathering. Weight chains and shear chains are not present.

3.1.8.5 Walkways

The walkway between Breasting Dolphin D and the shoreline is in **satisfactory** condition. Minor corrosion was observed at select locations.

3.1.8.6 Intermediate Walkway Support

The intermediate walkway support between Mooring Dolphin D and the shoreline is in **fair** condition. Moderate corrosion was observed on all faces of the steel H-pile support piles.

3.1.9 Slope Protection

The slope protection is in **fair** condition. From conversations with Port staff and on-site observations, it is understood that the peninsula area west of the trestle was constructed on reclaimed land and is founded on sunken barges. Along the south shoreline west of the trestle, approximately 200 feet of rip rap is missing. At this location, portions of corroded steel barges are visible. Along the north side of the peninsula, a void is present beneath the concrete slab-on-grade which has settled.

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4.0 OVERALL FACILITY CONDITION ASSESSMENT RATING

The current overall facility condition assessment ratings for marine components at Pier F1 are summarized in Table 2. Assessment ratings were assigned based on visual observations and element level damage ratings; see Appendix B. The overall rating was determined by considering the following.

- Total number of observed damages
- Severity of observed damages
- Distribution of observed damages
- Sensitivity of affected elements
- Location of damages
- Serviceability

Table 2 – Pier F1 Condition Assessment Ratings

Component Identification	Condition Assessment Rating
Main Pier	Poor
Trestle	Satisfactory
Mooring Dolphin A	Serious
Mooring Dolphin B	Fair
Breasting Dolphin C	Serious
Breasting Dolphin G	Poor
Breasting Dolphin H	Critical
Breasting Dolphin D	Poor
Slope Protection	Fair
Pier F1 Overall Condition Assessment Rating	
Overall Facility Condition Assessment Rating	**Serious**

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5.0 RECOMMENDATIONS

Repair recommendations for structural marine components are provided below. Recommendations are based on element level damage ratings for individual elements and the effect that the damaged elements have on the overall use of the Pier. Typically, components rated as poor, serious, or critical are comprised of multiple elements having major or severe damage. For these types of structures, it is recommended that elements are repaired or replaced to avoid temporary load restrictions and to help prevent further damage which may impact the daily use of the facility.

At Pier F1, it is estimated that some components have been in service since the 1940's and are well beyond their design service life; evidenced by corrosion, spalling, breakage, and multiple repair phases. For this reason, it is recommended that deficient structural elements are repaired and/or deficient components are replaced as described below.

- Replace Mooring Dolphins A and B

- Replace Breasting Dolphins C, D, G, and H

- At the Main Pier and Approach Trestle, sawcut and remove damaged sections of concrete. Where steel reinforcement is exposed, remove corrosion from reinforcement, add supplemental reinforcement as necessary, and remove/replace damaged concrete to restore the original thickness. Prior to performing repairs, a special purpose inspection should be performed to collect detailed damage information and to outline the extent of repairs that are needed.

- Regarding the peninsula area west of the trestle, it is our understanding that the two storage tanks are no longer in use. For this reason, it is recommended that a study is performed to understand the intended use of the peninsula and whether short-term or long-term repairs are best suited for this area. The design fee to perform this study is not included in the repair cost estimate.

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6.0 REPAIR COSTS

The total cost estimate for repairs to Pier F1 is shown below and is based on repairs being performed during fiscal year 2023. This estimate is intended to provide a rough order of magnitude and includes labor, materials, equipment, mobilization, construction contingency, contractor overhead and profit, management, engineering design, permitting, construction management, design services during construction, and gross receipts tax. This estimate also includes adjustments for inflation, higher-than-normal fuel costs, labor shortages, and the surplus of construction projects in Guam which are estimated to impact construction projects. For a detailed breakdown of recommended repairs and associated costs, see Appendix C.

Pier F1 Repairs $32,152,000

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APPENDIX A

PHOTOGRAPHS

Photo 1 – Main Pier

Photo 2 – Open Corrosion Spalling

Photo 3 – Crack at Waterside Pile Cap

Photo 4 - Trestle

Photo 5 – Peninsula West of Trestle

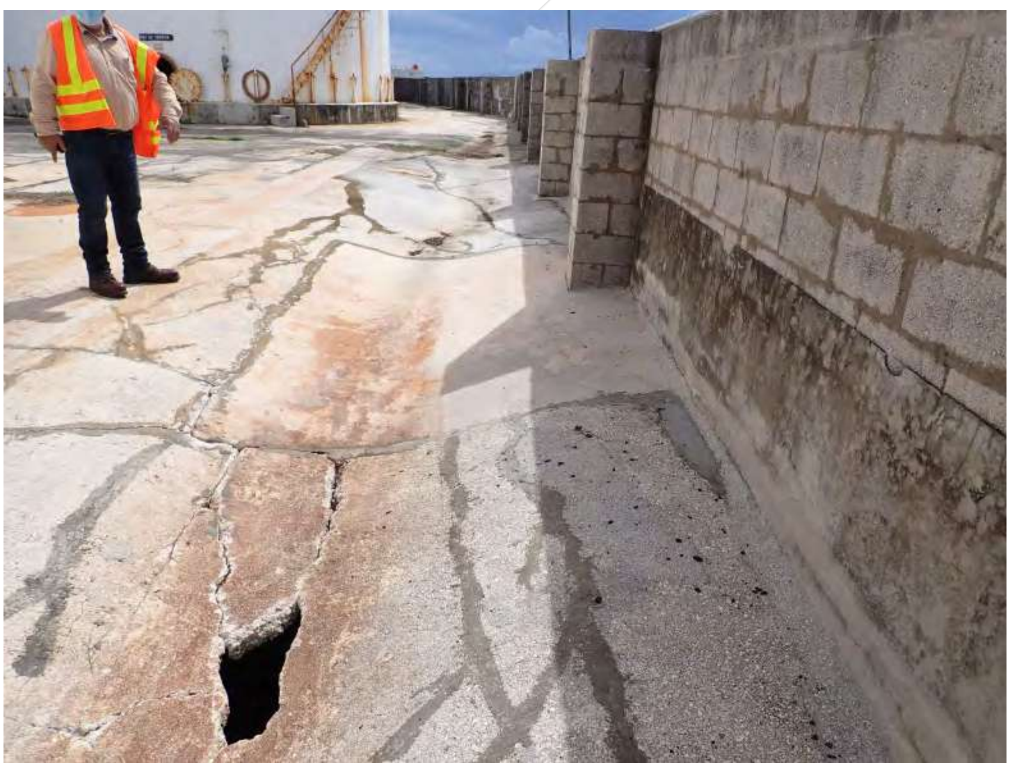

Photo 6 – Void and Settlement at North Side of Peninsula

Photo 7 – Mooring Dolphin A

Photo 8 – Mooring Dolphin A

Photo 9 – Mooring Dolphin B

Photo 10 – Mooring Dolphin B

Photo 11 – Breasting Dolphin C

Photo 12 – Breasting Dolphin C

Photo 13 – Breasting Dolphin G

Photo 14 – Breasting Dolphin G

Photo 15 – Breasting Dolphin H

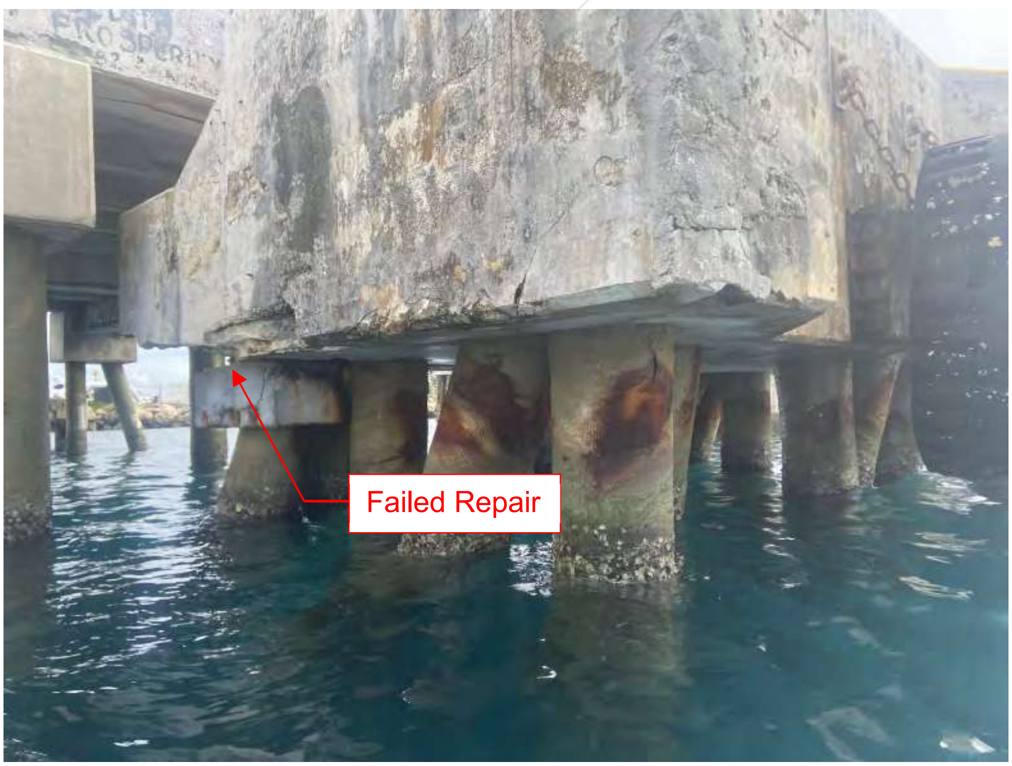

Photo 16 – Breasting Dolphin H

Photo 17 – Breasting Dolphin D

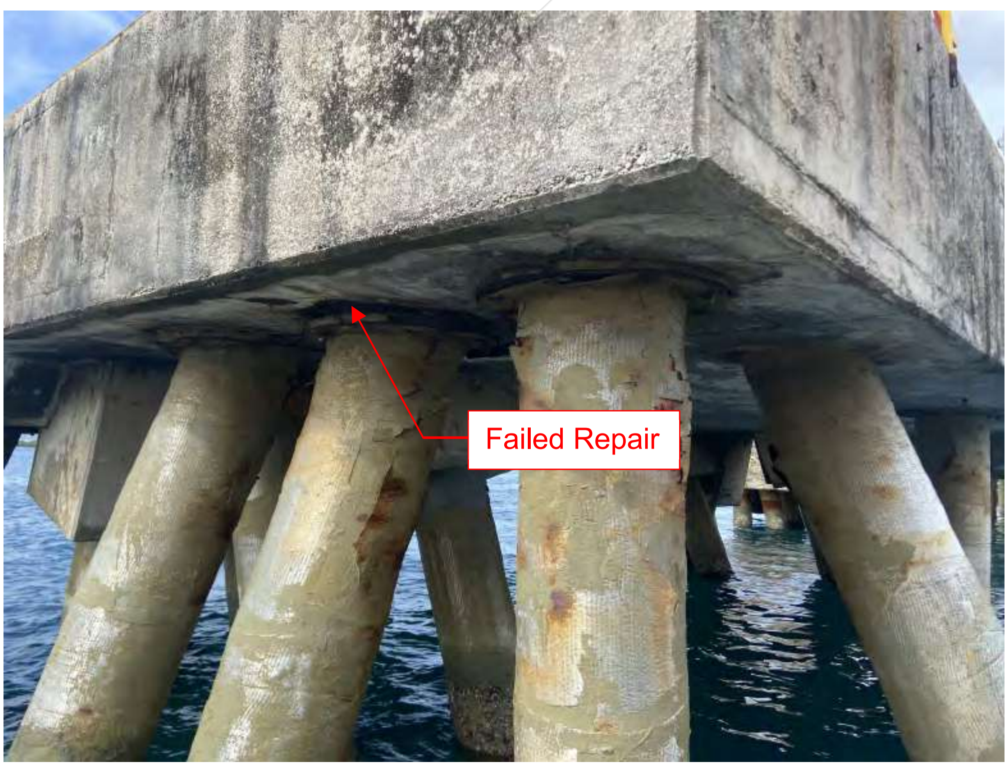

Photo 18 – Breasting Dolphin D

APPENDIX B

ELEMENT LEVEL DAMAGE RATING SYSTEM

Table 2-5. Damage Ratings for Steel Elements*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI	Not Inspected	Not inspected, inaccessible, or passed by[b]	
ND	No Defects	• Protective coating or wrap intact • Light surface rust • No apparent loss of material	
MN	Minor	• Protective coating or wrap damaged and loss of thickness up to 15% of nominal at any location • Less than 50% of perimeter or circumference affected by corrosion at any elevation or cross section • Loss of thickness up to 15% of nominal at any location	Minor damage not appropriate if • Changes in straight line configuration or local buckling • Corrosion loss exceeding fabrication tolerances (at any location).
MD	Moderate	• Protective coating or wrap damaged and loss of thickness 15 to 30% of nominal at any location • More than 50% of perimeter or circumference affected by corrosion at any elevation or cross section • Loss of thickness 15 to 30% of nominal at any location	Moderate damage not appropriate if • Changes in straight line configuration or local buckling • Loss of thickness exceeding 30% of nominal at any location
MJ	Major	• Protective coating or wrap damaged and loss of nominal thickness 30 to 50% at any location • Partial loss of flange edges or visible reduction of wall thickness on pipe piles • Loss of nominal thickness 30 to 50% at any location	Major damage not appropriate if • Changes in straight line configuration or local buckling • Perforations or loss of wall thickness exceeding 50% of nominal
SV	Severe	• Protective coating or wrap damaged and loss of wall thickness exceeding 50% of nominal at any location • Structural bends or buckling, breakage, and displacement at supports, loose, or lost connections • Loss of wall thickness exceeding 50% of nominal at any location	

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.
a = Any defect listed is sufficient to identify relevant damage grade.
b = If not inspected due to inaccessibility or passed by, note as such.

Table 2-6. Damage Ratings for Reinforced Concrete Elements*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI	Not Inspected	Not inspected, inaccessible, or passed by[b]	
ND	No Defects	Good original hard surface, hard material, sound	
MN	Minor	• Mechanical or impact spalls up to 1 in. deep • Occasional corrosion stains or small pop-out corrosion spalls • General cracks up to 1/16 in. wide	Minor damage not appropriate if • Structural damage • Corrosion cracks • Chemical deterioration[c]
MD	Moderate	• Structural cracks up to 1/16 in. wide • Corrosion cracks up to 1/4 in. wide • Chemical deterioration: random cracks up to 1/16 in. wide; “Soft” concrete and/or rounding of corners up to 1 in. deep • Mechanical abrasion or impact spalls greater than 1 in. deep	Moderate damage not appropriate if • Structural breakage and/or spalls • Exposed reinforcement • Loss of cross section due to chemical deterioration beyond rounding of corner edges
MJ	Major	• Structural cracks 1/16 in. to 1/4 in. wide and partial breakage (through section cracking with structural spalls) • Corrosion cracks wider than 1/4 in. and open or closed corrosion spalls (excluding pop-outs) • Multiple cracks and disintegration of surface layer due to chemical deterioration • Mechanical abrasion or impact spalls exposing the reinforcing	Major damage not appropriate if • Loss of cross section exceeding 30% due to any cause
SV	Severe	• Structural cracks wider than 1/4in. wide or complete breakage • Complete loss of concrete cover due to corrosion of reinforcing steel with more than 30% of diameter loss for any main reinforcing bar • Loss of bearing and displacement at connections • Loss of concrete cover (exposed steel) due to chemical deterioration • Loss of more than 30% of cross section due to any cause	

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.
a = Any defect listed is sufficient to identify relevant damage grade.
b = If not inspected due to inaccessibility or passed by, note as such.
c = Chemical deterioration: sulfate attack, alkali-silica reaction, alkali-aggregate reaction, alkali-carbonate reaction ettringite distress, or other chemical/concrete deterioration.

Table 2-8. Damage Ratings for Mooring Hardware*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI	Not Inspected	Not inspected, inaccessible, or passed by[b]	
ND	No Defects	• Material sound, surfaces smooth without indications of corrosion, surface coating in good condition, connections sound • Bolt countersinks grouted or sealed	No Defects Rating not appropriate if • Surface coatings worn or damaged • Visible corrosion on fasteners
MN	Minor	• Fitting has surface corrosion over 10 to 25% of its area. • Minor wear marks or pitting on surface of fittings are less than 1/8-in. deep • Fasteners have minor corrosion with no significant loss of section.	Minor damage not appropriate if • Deep pits, gouges, or wear on fitting surfaces • Any noticeable loss of section on fasteners threads, if visible
MD	Moderate	• Fitting has moderate surface corrosion with loose scale over less than 50% of its area • Significant surface wear marks or pitting on fitting are up to 1/4-in. deep • Fasteners have corrosion with less than 25% loss of section	Moderate damage not appropriate if • Loose scale on fasteners • Inability to remove fasteners due to heavy corrosion, if accessible
MJ	Major	• Fitting has surface corrosion with loose scale over 50% or more of its surface area and/or less than 25% section loss • Significant surface wear marks or pitting on fitting 1/4-in. deep or greater • Fasteners have corrosion with loose scale or loss of section greater than 25%	Major damage not appropriate if • Displaced, damaged, or broken fitting components • Loose or missing fasteners
SV	Severe	• Fitting has heavy surface corrosion and loose scale with greater than 25% loss of section at critical areas of the fitting • Structural displacement, deformation, or rotation of the fitting are present; fitting components are broken, cracked, or delaminated • Loose, broken, or missing fasteners	

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.
a = Any defect listed is sufficient to identify relevant damage grade.
b = If not inspected due to inaccessibility or passed by, note as such.

Table 2-9. Damage Ratings for Mooring Foundations*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI	Not Inspected	Not inspected, inaccessible, or passed by[b]	
ND	No Defects	• Good original hard surface, hard material, sound	No Defects Rating not appropriate if • Weathering on timber, steel, or composite fenders • Hairline cracks in concrete elements
MN	Minor	• Timber Foundations: Weathered timber; evidence of fungal decay; minor checks, splits, and gouges up to 1/4-in. wide • Steel Foundations: Weathering of steel coating, light surface corrosion • Concrete Foundations: No significant section loss to load-bearing areas, hairline cracking of the concrete due to corrosion of the mooring hardware • Composites: Weathered surfaces	Minor damage not appropriate if • Load-bearing areas around mooring hardware not sound • Displacement, loss of bearing, or connections • Fungal decay, insect infestation within or adjacent to the bearing area on timber elements • Corrosion loss exceeding fabrication tolerances (at any location) • Structural damage or corrosion cracking or concrete elements
MD	Moderate	• Timber cracked and checked up to 1/2-in. wide; weathered surfaces; fungal decay under or adjacent to the mooring hardware, with loss of section (max 1 in.) • Corrosion of steel with less than 10 to 25% section loss at any location • Noticeable cracking of concrete, larger than hairline but with no loss of interlock	Moderate damage not appropriate if • Displacements, loss of bearing, or connections • Changes in straight-line configuration or local buckling • Loss of thickness exceeding 30% of nominal at any location for steel elements • Structural breakage, spalls, or corrosion cracks in concrete elements • Chemical deterioration[c] or "softening" of concrete elements
MJ	Major	• Timber cracked and checked greater than 1/2-in. wide; weathered; fungal decay present (max 3 in. depth); up to 25% loss of bearing • Steel corrosion with 25 to 50% section loss at any location • Noticeable cracking of concrete, resulting in loss of interlock • Composite elements cracked or split	Major damage not appropriate if • Breakage or displacement of any element • Exposed steel strands in prestressed concrete elements • Perforations or loss of section exceeding 50% on steel elements

Table 2-9. Damage Ratings for Mooring Foundations (Continued)*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
SV	Severe	• Displacement/yielding of any support members • Loss of full bearing of fitting under hardware • Fungal decay of timber members (greater than 3 in. depth) • Significant corrosion of steel members with greater than 50% section loss at any location • Cracking or spalling of concrete based under hardware • Composite broken or damaged	

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.
a = Any defect listed is sufficient to identify relevant damage grade.
b = If not inspected due to inaccessibility or passed by, note as such.
c = Chemical deterioration: Sulfate attack, alkali-silica reaction, alkali-aggregtate reaction, alkali-carbonate reaction ettringite distress, or other chemical/concrete deterioration.

Table 2-11. Damage Ratings for Pneumatic, Foam-Filled, and Hydropneumatic Fenders*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI	Not Inspected	Not inspected, inaccessible, or passed by[b]	
ND	No Defects	• Good original surfaces • Components sound • All hardware intact and operable	No Defects Rating not appropriate if • Components are weathered, worn, or torn
MN	Minor	• Wear on the fender unit with no visible belting • Hardware intact with visible surface corrosion, but less than 10% section loss • Swivel operable but binding	
MD	Moderate	• Wear on the fender, belting visible to a maximum depth of 1 inch • Hardware intact with 10 to 25% section loss • Swivel heavily corroded and or bound	Moderate damage not appropriate if • Fender unit permanently set or deformed
MJ	Major	• Wear on the fender, belting visible to a maximum depth of 2 inches • Permanent deformation of unit • Hardware loose or heavily corroded with between 25 and 50% section loss • Swivel heavily corroded and or bound, or with 25 to 50% section loss • Air pressure inflation and valves do not appear operable	Major damage not appropriate if • Components missing or broken
SV	Severe	• Considerable wear on the fender, belting visible to a depth greater than 2 inches • Punctures, tears, or holes in fender; foam exposed • Hardware heavily corroded with greater than 50% section loss or missing or broken • Swivel heavily corroded and or bound, or with greater than 50% section loss or broken • Air pressure inflation and valves are broken or damaged[c]	

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.
a = Any defect listed is sufficient to identify relevant damage grade.
b = If not inspected due to inaccessibility or passed by, note as such.
c = For pneumatic and hydropneumatic fenders, an assessment of the air pressure and inflation/pressurization system should be confirmed.

Table 2-12. Damage Ratings for Rubber Fender Elements*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI	Not Inspected	Not inspected, inaccessible, or passed by[b]	
ND	No Defects	• Good original surface, sound • Connections intact and tight	No Defects Rating not appropriate if • Noticeable abrasion or wear of rubber surfaces
MN	Minor	• Small gouges or surface defects present less than 10% of nominal depth • Connection intact, tight with light corrosion (less than 10% section loss at any location)	Minor damage not appropriate if • Surface cracking or degradation of rubber components
MD	Moderate	• Gouges, wear, or tears less than 25% of nominal depth • Rubber damaged at the connectors or connection plates • Connections loose, a bolt missing, or corrosion with 10 to 25% section loss at any location	Moderate damage not appropriate if • Permanent deformation or misalignment of rubber elements
MJ	Major	• Cracks, gouges, or tears between 25 and 50% of nominal depth • Rubber torn at the connectors or connection plates • Connections loose, two bolts missing, or corrosion with 25 to 50% section loss at any location	Major damage not appropriate if • Rubber element is split or torn through
SV	Severe	• Cracks, gouges, or tears greater than 50% of nominal depth • Rubber torn through at the connectors or connection plates • Connections with loose or missing bolts, or corrosion with greater than 50% section loss at any location	

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.
a = Any defect listed is sufficient to identify relevant damage grade.
b = If not inspected due to inaccessibility or passed by, note as such.

Table 2-13. Damage Ratings for Fender Panels*

Damage Rating		Existing Damage[a]	Exclusions [Defects Requiring Elevation to the Next Higher Damage Rating(s)]
NI	Not Inspected	Not inspected, inaccessible, or passed by[b]	
ND	No Defects	• Good original surfaces • All connections intact • Backing panel sound	No Defects Rating not appropriate if • Coatings damaged • Visible surface corrosion
MN	Minor	• Small cracks or gouges (less than 10% of nominal) • 90% of panel connections intact • Backing frame with surface corrosion with no significant loss of section • Support chains intact with light surface corrosion	Minor Rating not appropriate if • Panels displaced or misaligned • Any loose or missing hardware
MD	Moderate	• Cracks or gouges (less than 25% of nominal) • 75% of panel connections intact • Panels displaced from the backing panel • Backing frame corroded • Support chains intact, with less than 25% section loss	Moderate Rating not appropriate if • Panels displaced or misaligned • Any loose or missing hardware
MJ	Major	• Cracks or gouges (less than 50% of nominal) • 50% of the panel connections intact or multiple panels displaced from the backing panel • Backing frame corroded with loose scale, but panel substantially in place • Support chains heavily corroded with more than 25% section loss	Major Rating not appropriate if • Panel/frame system sagging, misaligned, or with limited bearing
SV	Severe	• Cracks or gouges (greater than 50% of nominal) • Less than 50% of the panel connections intact or multiple panels displaced from the backing panel • Backing frame heavily corroded with loose scale • Sagging/displacement of panel/frame system • Support chains heavily corroded with loose scale and/or missing or broken	

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.
a = Any defect listed is sufficient to identify relevant damage grade.
b = If not inspected due to inaccessibility or passed by, note as such.

Table 2-14. Condition Assessment Ratings

Rating		Description
6	Good	No visible damage or only minor damage noted. Structural elements may show very minor deterioration, but no overstressing observed. No repairs are required.
5	Satisfactory	Limited minor to moderate defects or deterioration observed but no overstressing observed. No repairs are required.
4	Fair	All primary structural elements are sound but minor to moderate defects or deterioration observed. Localized areas of moderate to advanced deterioration may be present but do not significantly reduce the load-bearing capacity of the structure. Repairs are recommended, but the priority of the recommended repairs is low.
3	Poor	Advanced deterioration or overstressing observed on widespread portions of the structure but does not significantly reduce the load-bearing capacity of the structure. Repairs may need to be carried out with moderate urgency.
2	Serious	Advanced deterioration, overstressing, or breakage may have significantly affected the load-bearing capacity of the primary structural components. Local failures are possible and loading restrictions may be necessary. Repairs may need to be carried out on a high-priority basis with urgency.
1	Critical	Very advanced deterioration, overstressing, or breakage has resulted in localized failure(s) of primary structural components. More widespread failures are possible or likely to occur, and load restrictions should be implemented as necessary. Repairs may need to be carried out on a very high-priority basis with strong urgency.

*Taken from ASCE Waterfront Facilities Inspection and Assessment Manual No. 130, 2015.

APPENDIX C

REPAIR COST ESTIMATE

PROJECT: Port of Guam Repairs Wharf Service Life Extension			WSP PROJECT NO. 13369I		PAGE: 1 OF 1
OPERATION: Pier F1			ESTIMATOR: MAD		DATE: 20-Apr-22
ITEM NO.	DESCRIPTION	UNIT	QUANTITY	UNIT COST	TOTAL COST
1	Mobilization/Demobilization (15%)	LS	1	$2,108,700	$2,108,700
2	Material Shipment	LS	1	$2,800,000	$2,800,000
3	Demo Existing Mooring Dolphin A	LS	1	$141,000	$141,000
4	Install Replacement Mooring Dolphin A	LS	1	$1,654,000	$1,654,000
5	Demo Existing Mooring Dolphin B	LS	1	$187,000	$187,000
6	Install Replacement Mooring Dolphin B	LS	1	$1,654,000	$1,654,000
7	Demo Existing Breasting Dolphin C	LS	1	$245,000	$245,000
8	Install Replacement Mooring Dolphin C	LS	1	$2,242,000	$2,242,000
9	Demo Existing Breasting Dolphin D	LS	1	$245,000	$245,000
10	Install Replacement Mooring Dolphin D	LS	1	$2,242,000	$2,242,000
11	Demo Existing Breasting Dolphin G	LS	1	$116,000	$116,000
12	Install Replacement Mooring Dolphin G	LS	1	$1,424,000	$1,424,000
13	Demo Existing Breasting Dolphin H	LS	1	$116,000	$116,000
14	Install Replacement Mooring Dolphin H	LS	1	$1,424,000	$1,424,000
15	Furnish and Install Intermediate Walkway Supports	EA	3	$312,000	$936,000
16	Furnish and Install Gangways	LF	580	$550	$319,000
17	Main Pier - Repair Open Corrosion Spalling	LS	1	$543,000	$543,000
18	Trestle - Repair Open Corrosion Spalling	LS	1	$130,000	$130,000
19	Geotechnical Borings	EA	4	$110,000	$440,000
	SUB TOTAL				**$18,966,700**
20	Contingency (30%)				$5,690,010
21	Indirect Costs (-)				
22	Management and Administrative (5%)				$948,335
23	Design (10%)				$1,896,670
24	Permitting (5%)				$948,335
25	Construction Management (10%)				$1,896,670
26	Design Services During Construction (3%)				$569,001
	SUB TOTAL				**$30,915,721**
	Gross Receipts Tax (4%)				$1,236,629
	TOTAL PRICE (rounded up to nearest $1,000)				**$32,152,000**

Notes:
1. Estimate is based on repairs being completedin FY 2023
2. Project is Buy America
3. Contractor mobilizes from Hawaii
4. Piles, misc steel, fenders, etc are sourced from the Pacific Northwest
5. Concrete is supplied locally