East Hagatna
Emergency Shoreline Protection

Draft Integrated Feasibility Report and Environmental Assessment

US Army Corps
of Engineers ®
Honolulu District

July 2023

Draft Integrated Feasibility Report and Environmental Assessment
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Hagatna, Guam

Prepared By:
U.S. Army Corps of Engineers
Honolulu District

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EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (USACE), Honolulu District, has prepared a Draft Integrated Feasibility Report and Environmental Assessment (IFR/EA) for the East Hagatna Emergency Shoreline Protection Feasibility Study. The study area is located in East Hagatna along South Marine Corps Drive in the U.S. Territory of Guam, for which the Government of Guam, represented by the Guam Department of Public Works, is the non-Federal sponsor (NFS). This IFR/EA, evaluates and discloses impacts that would result from the implementation of potential emergency shoreline protection measures in the study area. In accordance with federal law, regulation, and USACE policy, this IFR/EA identifies coastal erosion hazards and analyzes a series of potential alternatives, including the "No Action" alternative, to address coastal erosion risks in the proposed study area.

The study is authorized under Section 14 of the Flood Control Act of 1946, as amended (33 United States Code [USC] 701r), for Emergency Shoreline Protection under the USACE Continuing Authorities Program (CAP). This report documents the plan formulation process to select a Tentatively Selected Plan (TSP), along with environmental, engineering, and cost analyses of the TSP, which will allow additional design and construction to proceed following approval of this report.

Generally, plan formulation and evaluation for CAP Section 14 studies will focus on the least cost alternative that provides emergency shoreline protection to public infrastructure. The least cost alternative plan is justified if the cost of the proposed alternative is less than the costs necessary to relocate the threatened facilities (Engineer Pamphlet [EP] 1105-2-58).

Within the study area, approximately 2,100 feet (ft) of South Marine Corps Drive is at imminent risk of failure due to storm surge and wave attack. An existing seawall constructed between the shoreline and the main thoroughfare in the study area is threatened by shoreline erosion and is experiencing severe undercutting, leaving South Marine Corps Drive vulnerable to increased future damage. The plan formulation process identified several structural and non-structural emergency shoreline protection management measures to potentially address coastal erosion risk in the study area. An initial array of up to 6 alternatives underwent early rounds of qualitative and semi-quantitative screening. Additional evaluation, comparison, and optimization of alternatives assisted in identifying and evaluating the final array of four action alternatives (Alternative 1 – No Action Alternative, Alternative 2 – Revetment, Alternative 3 – Precast Concrete Seawall, Alternative 4 – Concrete Rubble Masonry Seawall).

Based on formulation and evaluation of potential alternatives, the TSP is Alternative 2: Revetment. This alternative consists of replacing approximately 2,100 linear ft of existing, compromised seawall with a rock revetment. The top crest elevation needed for the design to meet the USACE 50-year design requirement for sea level change (SLC) and be adaptable to 100-year SLC under the intermediate scenario is 9ft above Mean Sea Level (MSL), approximately 1 ft higher than the existing seawall. The revetment will be approximately 22 ft wide, constructed parallel to the shoreline and extending seaward.

The TSP is the least cost, environmentally acceptable alternative that is less than the cost of facility relocation ($65 million). At the Fiscal Year (FY) 2023 discount rate of 2.5% the fully funded project cost estimate for the TSP is approximately $11.7 million.

Due to the limited nature of construction disturbance, the activities of the TSP i.e., Proposed Action, are not expected to cause any long-term adverse environmental effects in the immediate study area. Environmental commitments and best management practices (BMPs) would be implemented, where appropriate, to ensure that potential construction-related impacts are avoided and minimized to a less than significant level (see Section 6.9 Environmental Commitments). No compensatory mitigation is required. Further examination of impacts from the proposed design will be part of Preconstruction Engineering and Design.

The NFS expressed support for Alternative 2 as the TSP at the June 22, 2022 TSP milestone meeting. Government of Guam support for the TSP was coordinated with the Governor of Guam. To solicit stakeholder input on this study, this draft IFR/EA will be released to the public and federal, territory and local agencies for a 30-day public review period beginning in July 2023. A virtual public meeting is planned for August 2023 to present the TSP and allow the public to respond and ask questions during the review period. Public and agency comments on the draft report will be incorporated into the final report. The final report is scheduled to be complete in Summer 2024.

LIST OF ACRONYMS AND ABBREVIATIONS

AEP	Annual Exceedance Probability
APE	Area of Potential Effects
BEA	Bureau of Economic Analysis
BMP(s)	Best Management Practices
CAP	Continuing Authorities Program
CDP	census-designated place
CE	Common Era
CEJST	Climate and Economic Justice Screening Tool
CEQ	Council on Environmental Quality
CERCLA Act	Comprehensive Environmental Response, Compensation, and Liability
CFR	Code of Federal Regulations
CSRM	Cost and Schedule Risk Analysis
CWA	Clean Water Act
CZMA	Coastal Zone Management Act
D&I	Design & Implementation phase
DPW	Department of Public Works
EC(s)	Environmental Commitments
EFH	Essential Fish Habitat
EFHA	EFH Areas Protected from Fishing
EJ	Environmental Justice
EJSCREEN	Environmental Justice Screening and Mapping Tool
EO	Executive Order
EOP	Environmental Operating Principles
EP	Engineer Pamphlet
ER	Engineer Regulation
ESA	Endangered Species Act
ESI	Environmental Sensitivity Index
FCSA	Federal Cost Sharing Agreement
FID	Federal Interest Determination

FONSI	Finding of No Significant Impact
FWCA	Fish and Wildlife Coordination Act
FWOP	Future Without Project
FY	fiscal year
GDAWR	Guam Division of Aquatic and Wildlife Resources
GDP	Gross Domestic Product
GEPA	Guam Environmental Protection Agency
HAPC	Habitat Areas of Particular Concern
HTRW	Hazardous, Toxic, and Radioactive Wastes
IFR/EA	Integrated Feasibility Report and Environmental Assessment
IUCN	International Union for Conservation of Nature
LERRD	lands, easements, rights-of-way, relocations, and disposals
MOA	Memorandum of Agreement
MSL	Mean Sea Level
NED	national economic development
NEPA	National Environmental Policy Act
NFS	Non-Federal Sponsor
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NNBF	Natural and nature-based features
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NPDES	National Pollutants Discharge Elimination System
NRCS	Natural Resources Conservation Service
OMRR&R	operations, maintenance, repair, replacement, and rehabilitation
P&G	Principles and Guidelines
PDT	Project Delivery Team
PED	preconstruction, engineering, and design
RSLC	relative sea level change
SHPO	State Historic Preservation Officer
SLC	sea level change

SLR	sea level rise
SWPPP	Stormwater Pollution Prevention Plan
TSP	Tentatively Selected Plan
U.S.	United States
USACE	United States Army Corps of Engineers
USC	United States Code
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
UXO	Unexploded Ordnance
WRDA	Water Resources Development Act

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1 INTRODUCTION

This chapter provides information on the United States Army Corps of Engineers (USACE) planning process, study purpose, need and scope, study authority, study area, previous studies that contributed to this feasibility study, problems and opportunities and objectives and constraints considered in formulating study alternatives.

1.1 USACE Planning Process

The USACE uses an iterative six-step planning process, as outlined in Engineer Regulation (ER) 1105-2-100, *"Planning Guidance Notebook",* which includes the following steps (USACE 2000):

- Identification of water and related land resources problems and opportunities (relevant to the planning setting) associated with the federal objective and specific state and local concerns
- Inventory, forecast, and analysis of water and related land resource conditions within the planning area relevant to the identified problems and opportunities
- Formulation of alternative plans
- Evaluation of the effects of the alternative plans
- Comparison of alternative plans
- Selection of a TSP based upon the comparison of alternative plans

This Integrated Feasibility Report and Environmental Assessment (IFR/EA) will mirror the process noted above, beginning with defining the problems and opportunities and culminating in the selection and description of a Tentatively Selected Plan. This IFR/EA discusses and discloses environmental effects, beneficial or adverse, that may result from proposed project in compliance with the National Environmental Policy Act (NEPA) of 1969 (42 United States Code (USC) § 4321 et seq.); the Council on Environmental Quality (CEQ) (regulations published in 40 Code of Federal Regulations (CFR) Part 1500 et seq.; and USACE procedures for implementing NEPA published in 33 CFR Part 230. This IFR/EA also documents project compliance with other applicable Federal environmental laws, regulations, and requirements.

ER 1105-2-100, "*Planning Guidance Notebook*" defines the contents of feasibility reports authorized under the Continuing Authorities Program (USACE 2000). This document and its appendices present the information required by regulation as an IFR/EA.

1.2 Study Purpose, Need and Scope

The purpose of this feasibility study is to evaluate the threat to critical infrastructure posed by coastal erosion and to identify potential emergency shoreline protection solutions to critical infrastructure in East Hagatna. This study is needed because the East Hagatna shoreline is subject to frequent storm wave attacks and big wave events. Coastal erosion due to these factors puts South Marine Corps Drive, a major highway in the capitol city of Hagatna, Guam, at risk of imminent damage and failure.

The study scope includes the development and evaluation of a series of potential alternative plans focused on emergency shoreline protection for a critical stretch of South Marine Corps Drive in East Hagatna, Guam. Alternatives were developed in consideration of study area problems and opportunities as well as objectives and constraints and evaluated against the Council on Environmental Quality's 2013 Principles and Requirements (P&R) four evaluation criteria: completeness, effectiveness, efficiency, and acceptability (CEQ 2013). The evaluation of alternative plans that address shoreline protection needs assisted in identifying the least cost, environmentally acceptable plan.

1.3 Study Authority

This feasibility study is being conducted under the authority of Section 14 of the Flood Control Act of 1946 (Section 14) (Public Law [P.L.] 79-525), as amended (33 U.S.C. 701r). Section 14 authorizes USACE to partner with a non-Federal sponsor to study, design, and construct emergency streambank and shoreline protection for public facilities in imminent danger of failing due to bank failure caused by natural erosion and not by inadequate drainage, by the facility itself, or by operation of the facility. The full text of Section 14 is as follows:

> "*The Secretary of the Army is authorized to allot from any appropriations heretofore or hereafter made for flood control, not to exceed $25,000,000 per year, for the construction, repair, restoration, and modification of emergency streambank and shoreline protection works to prevent damage to highways, bridge approaches, lighthouses (including those lighthouses with historical value), and public works, churches, hospitals, schools, and other nonprofit public services, when in the opinion of the Chief of Engineers such work is advisable: Provided, that not more than $10,000,000 shall be allotted for this purpose at any single locality from the appropriations for any one fiscal year, and if such amount is not sufficient to cover the costs included in the Federal cost share for a project, as determined by the Secretary, the non-Federal interest shall be responsible for any such costs that exceed such amount.*"

Engineering Pamphlet (EP) 1105-2-58 limits emergency shoreline protection projects authorized under Section 14 to essential public facilities and facilities owned by non-profit organizations that have been properly maintained and are in imminent threat of damage or failure by natural erosion processes of streambanks and shorelines. Eligible facilities include highways, highway bridge approaches, lighthouses, public works, churches, public and private non-profit hospitals, schools, and other public or non-profit facilities offering public services open to all on equal terms. South Marine Corps Drive is an essential public facility that has been properly maintained and that is in imminent threat of damage by natural shoreline erosion, eligible for consideration of protection under Section 14.

Section 14 studies have a federal participation limit of $10,000,000. In the Feasibility phase, the first $100,000 is 100% federally funded and the balance is cost shared 50% Federal to 50% non-Federal. In the Design & Implementation (D&I) phase, the cost share is 65% Federal to 35% non-Federal. Additionally, Section 1156 of the Water Resources Development Act (WRDA) of 1986 (33 U.S.C. 2310), as amended, provides

a non-Federal cost share waiver applied to both the Feasibility and Design and Implementation phases for studies located within any U.S. Territory, such as Guam.

In August 2021 a Feasibility Cost Sharing Agreement (FCSA) was executed between USACE and the Government of Guam; at the time, the Section 1156 waiver was $530,000. In November 2022, the Section 1156 waiver increased to $665,000 and will continue increasing annually based on current inflation rates. The cost share waiver deducts from the non-Federal share and adds to the Federal share. The non-Federal sponsor for this project is the Government of Guam, represented by the Department of Public Works (DPW). Additional information on projected cost share requirements can be found in Section 6.7 Cost Sharing.

1.4 Location and Description of the Study Area

Guam is located in the North Pacific Ocean between the Commonwealth of the Northern Mariana Islands (to the north) and the Federated States of Micronesia (to the south), as shown in the inset map of Figure 1. Guam is a U.S. territory and is represented by a delegate in the U.S. Congress. The Guam delegate at the time of this report is Mr. James Moylan (Republican). Located 3,950 miles west of Hawaii, Guam is the westernmost point in the U.S.

The study area is centrally located on the west central Guam coast along Hagatna Bay in the capital city of Hagatna[1], the government and commercial trade center of Guam since the beginning of Spain's occupation over 450 years ago. 2020 U.S. Census Bureau data indicates that there are approximately 154,000 residents of Guam, of which, 943 reside in Hagatna.

[1] The capital village of Hagåtña was named Agana prior to 1998. For the purposes of this report, diacritical marks were removed from “Hagatna”. Both names (Hagatna and Agana) may be used interchangeably within this document.

Figure 1: Guam location map with study area

The East Hagatna Emergency Shoreline Protection study area encompasses a 2,100 foot (ft) long stretch of Trinchera Beach along Hagatna Bay, which runs parallel to South Marine Corps Drive (also referred to as Highway 1). In some places, less than 20 ft of shoreline separates the road from the beach. The project extent is bounded on the western end by a strip mall parking lot that has an access ramp through the seawall down to the beach, and centers on the Veteran's Sunset Beach Park. Upland of the eastern extent of the project area is the Antonio B. Won Pat International Airport.

The study area includes 2,100 linear ft of existing seawall situated parallel to and between the Hagatna Bay shoreline and South Marine Corps Drive (Figure 2). The

project footprint may extend as far as 20 ft seaward from the existing seawall, 30 ft inland of the existing seawall, and 5 ft down into the limestone subgrade. The existing seawall height ranges from approximately 7.5 to 8.9 ft above MSL and is composed of large volcanic rocks cemented together. As-built designs for the existing seawall, likely built after a 1993 USACE feasibility study for the project area, were not provided to the study team.

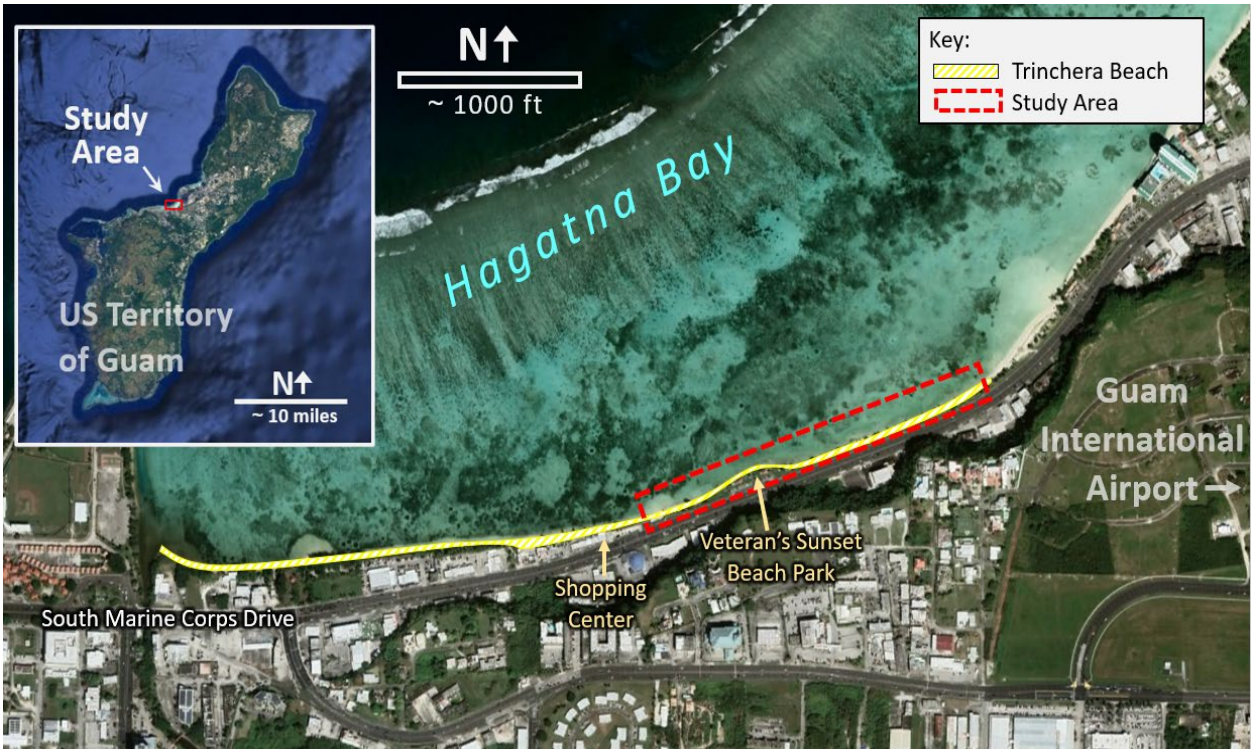

Figure 2: Approximate extent of study area along Hagatna Bay.

1.5 Previous Studies

A history of USACE studies in and around the study area is included below. Prior to 1998 the capital village of Hagatna was called Agana. In 1998, the Guam Legislature changed the name from the English "Agana" back to the original Chamorro form "Hagatna". Studies prior to 1998 will refer to Agana and other English spellings of place names.

- **Guam Comprehensive Study, USACE, Pacific Ocean Division (POD), 1979**. This study identified the water resource problems and needs for the Territory of Guam and was the parent study for the Agana Bayfront feasibility study (USACE 1988). The Stage 1 report included problem identification, planning objectives, potential management and nonstructural measures, and potentially significant impact for regional harbors, water supply, flood plain management, and shore protection and beach restoration. (USACE 1979).
- **Shoreline Investigation, USACE, POD, 1981.** This study described existing shoreline features, structures, and conditions and showed the boundaries of storm surge and storm wave flooding at Agana Bay (USACE 1981).

- **Flood Insurance Study, Territory of Guam, USACE, POD, September 1983.** The study was completed by USACE for the Federal Emergency Management Agency (FEMA) under the authorities of the National Flood Insurance Act of 1968 and the Flood Disaster Protection Act of 1973. The flood insurance study investigated the existence and severity of flood hazards on the island of Guam. The study also developed flood risk data for various areas of the community that have been used to establish actuarial flood insurance rates and assist the community in their efforts to promote sound floodplain management. A section of the report covered the problems of coastal flooding and documented several accounts of damages by wind-generated waves. (USACE 1983)
- **Guam Comprehensive Study - Agana Bay Typhoon and Storm-Surge Protection Study (Technical Documentation), USACE, POD, January 1984.** This was the first report to attempt identification of the problems and needs related to coastal flooding in the Agana Bay area. Due to the lack of data, the documentation did not include typhoon stage-frequency analyses. (USACE 1984)
- **Typhoon Stage-Frequency Analysis for Agana Bay, Guam (Draft Technical Report), USACE, Coastal Engineering Research Center, Waterways Experiment Station, July 1987**. The purpose of the study was to determine the frequency of flood levels along the shoreline of Agana Bay that are caused by the combined effects of astronomical tides and typhoon-induced water levels (USACE 1987).
- **Agana Bayfront Storm Surge Protection Study, Territory of Guam (Draft Feasibility Report and Environmental Impact Statement), USACE, Honolulu Engineer District, April 1989**. This report identified the coastal flooding problems and needs of the low-lying areas of Agana Bay. Various measures were considered to reduce coastal flood damages caused by storm surge. Environmental consequences of the measures were investigated (USACE 1989).
- **East Agana, Territory Guam, Shore Protection Study, Reconnaissance Report, USACE, Honolulu Engineer District, April 1990.** The reconnaissance level report is the predecessor to the 1993 feasibility phase investigation. It identified the coastal flooding problem in East Agana and identified a potential solution to the problem. (USACE 1990)
- **Draft East Agana, Territory of Guam, Detailed Project Report and Environmental Assessment, USACE, Honolulu Engineer District, July 1993 (terminated at Sponsor's request)**. The report identified a federal interest in shore protection measures along two reaches of the East Agana shoreline (USACE 1993). This project was terminated at the request of the non-Federal sponsor. After the termination of this study, a concrete masonry rubble seawall was constructed in the stretches identified in the 1993 report.
- **East Hagatna Section 103 Federal Interest Determination Report, USACE, Honolulu District, 2015.** USACE prepared a Federal Interest Determination (FID) report under the CAP Section 103 program for coastal flood risk management. The Section 103 program has a federal per-project expenditure limit of $10,000,000. The FID evaluated the design and implementation of shore protection measures along approximately 2.1 miles of eroding shoreline at East Hagatna Bay to protect upland development and property from wave action and

coastal storm inundation. Due to the imminent threat of storm damage and immediate need for erosion protection, this study was converted to a CAP Section 14 for emergency shoreline protection (USACE 2015).

1.6 Problems and Opportunities

This section summarizes the first step of the six-step planning process: Identification of water and related land resources problems and opportunities (relevant to the planning setting) associated with the federal objective and specific state and local concerns.

1.6.1 Overview of Coastal Erosion Challenges

Guam is in an area of the Pacific Ocean that has a high risk for tropical storms and typhoons, and the low-lying coastline of East Hagatna is subject to frequent storm wave attack. Large storm events and associated high waves and storm surge have caused significant erosion, undermining the existing seawall. The existing seawall is not anchored into the limestone foundation and instead, sits atop the ground surface, leaving it vulnerable to wave attack. Continual undermining of the seawall has put South Marine Corps Drive and public utilities in the immediate vicinity of the study area at imminent risk of damage. Future sea level rise will continue to exacerbate this condition and accelerate the rate of erosion and damage.

South Marine Corps Drive is a major arterial roadway that extends approximately 22 miles from Andersen Air Force Base in Yigo on the northeastern corner of the island down to Naval Base Guam in Santa Rita in the central western area of the island. Both military bases play a vital role in regional and national security. Closure of South Marine Corps Drive or significant traffic delays would result in impacts to the U.S. Military's ability to prepare for and respond to a crisis in the region.

Additionally, South Marine Corps Drive connects numerous island villages on the west side of the island including the capital city of Hagatna. Guam Department of Public Works traffic counts indicate an average of 51,234 vehicles pass through the section of road at risk daily. Damage to the road and public utilities beneath it would delay the southern villages' access to essential services such as hospitals and emergency responders, thereby resulting in health and safety risks, as well as a significant disruption to Guam's economy.

1.6.2 Problems

The following problem statements are based on information gathered during scoping and supported by information documented in past reports:

- Big wave events and storm surge are eroding the shoreline along South Marine Corps Drive.
- An existing seawall is on the verge of collapse due to erosion and undermining, leaving South Marine Corps Drive and public utilities along the roadway exposed to damage from wave attack and storm surge.
- Critical damage to or closure of South Marine Corps Drive threatens strategic readiness in Guam, the local economy, and the provision of public and emergency services to the people of Guam.

The most critical problem in the study area is the imminent failure of an existing seawall that would leave South Marine Corps Drive subject to heavy damage from storm surge and wave attack. Figures 3 to 5, captured by USACE Project Delivery Team (PDT) members on a site visit in January 2022, show the existing condition of approximately 2,100 linear ft of Trinchera Beach in the study area. The greatest damage to the existing seawall is along Veteran's Sunset Beach Park, where some sections of wall are undercut by up to 2 ft of seawater. This undercutting is already causing the seawall to crack and undermine the structural integrity of the seawall. Figure 3 shows the rocks and concrete skirt eroding out of the seawall on the eastern edge of Veteran's Sunset Beach Park. The western access staircase is in danger of collapsing into the ocean. Erosion has also dislodged some of the larger rocks from the seawall, especially on the eastern end of Veteran's Sunset Beach Park (USACE 2022a).

Figure 3: Existing seawall on eastern edge of Veteran's Sunset Beach Park, facing southwest (USACE 2022a). The beach has eroded below the rocks and concrete skirt, causing the seawall to crack, and undermining its structural integrity.

Figure 4: Existing seawall at Trinchera Beach Park, facing northeast (USACE 2022a)

Figure 5: Close up view facing south of the undercut Hagatna Bay seawall (USACE 2022a)

If the existing seawall fails, South Marine Corps Drive and associated public utilities will be subject to more frequent and severe storm damage as the shoreline in the study area continues to erode. This will be exacerbated by long-term sea level rise. Heavy damage to the South Marine Corps Drive may necessitate road closure or relocation. This would result in economic loss and the potential for decreased public and emergency service provision for people who depend on the road. Without federal intervention, it is assumed that the Government of Guam will bear the full burden of protecting South Marine Corps Drive. They will be fiscally impacted by this responsibility and will likely need to repair or replace failing sections of wall in a piecemeal approach.

1.6.3 Opportunities

Opportunities to attain desirable future outcomes incidental to implementing a solution to the identified problems include:

- Increase community resiliency to coastal storms and erosion.
- Maintain the provision of public and emergency services along South Marine Corps Drive.
- Proactively plan for future sea level change along Guam's shorelines.
- Maintain public access to the Hagatna Bay for recreation and tourism.

1.7 Objectives and Constraints

This section further builds upon the first step of the planning process by identifying planning objectives and constraints. These will be the basis for formulation of alternative plans outlined in Chapter 3.

1.7.1 Federal Objective

The Federal objective, as stated in the P&G, is to contribute to national economic development (NED) consistent with protecting the Nation's environment, pursuant to national environmental statutes, applicable executive orders, and other Federal planning requirements.

1.7.2 Planning Objective

The planning objective for the study is to identify a solution that protects South Marine Corps Drive from failure due to erosion over the 50-year period of analysis.

Under Section 14 of the Continuing Authorities Program (CAP), the least cost alternative plan is justified if the total cost of the proposed alternative is less than the cost to relocate South Marine Corps Drive.

1.7.3 Planning Constraints

The high cost of implementation in remote territories such as Guam is a study constraint. There are two main contributing factors to this constraint:

First, Section 1156 of WRDA 1986 provides a territorial cost-sharing waiver under the Feasibility and Design & Implementation phases of CAP studies. When this feasibility study was initiated in 2021, the Section 1156 waiver was $511,000. The Design and Implementation waiver is set at the FY 2023 level of $665,000. While the intent of the territorial waivers is to reduce costs for tribal and territorial non-Federal sponsors, under a Section 14 authority with a limited federal expenditure of $10 million, the territorial design and implementation waiver does not reduce the non-federal sponsor's final cost share and hinders the study's ability to qualify under a CAP Section 14 authority. The study team would need to find an implementable solution at a much lower cost than that of a non-territory, which will be difficult in a remote location such as Guam.

Secondly, given the recent period of high inflation and the high costs associated with mobilizing equipment and personnel to remote territories such as Guam, there may be a limited number of alternatives that qualify within the range of coastal erosion management measures and alternatives that may be considered and selected under this authority.

In addition to high cost constraints, the location and configuration of the existing seawall places a spatial constraint on the formulation of potential solutions. Subsequently, any improvements to the portion of damaged seawall resulting from this study cannot further exacerbate or induce damages to other portions of the seawall.

1.7.4 Planning Considerations

In consideration of existing local planning statutes, the study must demonstrate consistency with the Conservation of Natural Resource element in the Guam Comprehensive Development Plan (GBSP 1979) and the Guam Territorial Seashore Protection Act of 1974 (PL 12-108, Chapter V-A), including the following provisions from Executive Order 78-23:

> Shore Area Development: Only those uses shall be located within the Seashore Reserve which: (1) enhance, are compatible with or do not generally detract from the surrounding coastal area's aesthetic and environmental quality and beach accessibility; or (2) can demonstrate dependence on such a location and the lack of feasible alternative sites.
>
> Visual Quality: Preservation and enhancement of, and respect for the island's scenic resources shall be encouraged through increased enforcement of and compliance with sign, litter, zoning, subdivision, building and related land-use laws; visually objectionable uses shall be located to the maximum extent practicable, so as not to degrade significantly views from scenic overlooks, highways, and trails.

and Government Code Section 13450 of the Territory Beach Areas Act:

> The indiscriminate building of structures on the ocean shores of Guam should be discouraged.

2 EXISTING AND FUTURE WITHOUT PROJECT (FWOP) CONDITIONS

Section 2 documents the second step in the six-step planning process: Inventory, forecast, and analysis of water and related land resource conditions within the planning area relevant to the identified problems and opportunities. For the purposes of this integrated report the Existing Conditions section constitutes the Affected Environment section for NEPA purposes.

The spatial scope of analysis focuses on the immediate and surrounding environment of the study area. The temporal scope of the study is a period of 50 years, beginning in 2026 and ending in 2076.

For each resource, the existing conditions within the study area are described with a summary of historic conditions where applicable. A forecast of the “Future Without Project (FWOP)” conditions of the “No Action” Alternative is also provided in Section 4 for each respective resource category. No resource categories were screened from analysis. However, the level of detail in the description of each resource corresponds to the magnitude of the potential direct, indirect, or cumulative impacts on each resource and focuses only on resources that would be potentially affected by the alternatives and have the most material bearing on the decision-making process.

FWOP Conditions and Climate Change

Climate change and climate variability must be included as part of any discussion of the forecasted FWOP. An understanding of these future conditions under a climate change scenario can inform the decision process related to the FWOP, plan formulation, evaluation of the performance of alternative plans, and other decisions related to project planning, engineering, operation, and maintenance.

ER 1100-2-8162 (USACE 2019) provides guidance for incorporating climate change information in the feasibility analysis process in accordance with the USACE overarching climate change adaptation policy. This policy requires consideration of climate change in all current and future studies to reduce vulnerabilities and enhance the resilience of water resources infrastructure.

A qualitative climate change assessment was conducted for this study to assess the potential vulnerability of the study area to climate change in the context of shoreline protection and coastal flood risk management alternatives. This assessment included a literature review to determine broad trends and projected trends in climate that could affect the pertinent hydrologic parameters (i.e., temperature and precipitation) in the project area.

2.1 Physical Environment

This section summarizes the physical environment within the study area. Additional details are provided in Appendix 1 Engineering, and Appendix 3 Environmental.

2.1.1 Climate

The Guam climate is tropical, with warm and humid conditions throughout the year. The surrounding ocean has a year-round temperature of 81°F and is largely responsible for the island's climate. There are two distinct seasons, defined by variations in wind and

rainfall. A dry season extends from January through May, and a wet season from July through November. December and June are transitional months. Annual rainfall averages are typically above 80 inches. Easterly trade winds occur throughout the year but are dominant during the dry season. From July to October the winds become variable, and the occurrence of typhoons increases. Annual temperatures are stable and fall within 86-90 °F during the day and 75-77 °F at night (USACE 1993).

East Hagatna is on the west, or leeward side of the island; however, the coast faces north and is exposed to the prevailing tradewinds, which blow from the east or northeast. The study area is protected from these trades by the land mass. The trades are strongest and most constant during January through April when wind speeds of 15 to 25 miles per hour are very common. During July to November, there is often a breakdown of the trades and westerly-moving storm systems which bring heavy showers. Guam is also affected by typhoons that bring torrential rains, violent winds, and storm waves (USACE 1990, 1993, 2015, 2021).

Guam lies near a known breeding ground for tropical depressions, tropical storms, and typhoons. Typhoons (or hurricanes as they are called east of the International Date Line) are defined as tropical cyclonic storms with winds exceeding 65 knots (74 mph). During the period of 1946 to 1991, Guam was directly affected by 20 typhoons. On an annual average, two to three of these storms pass within 200 miles of Guam. Guam's location greatly increases its chances of being affected by severe storm (USACE 1990, 1993, 2015, 2021).

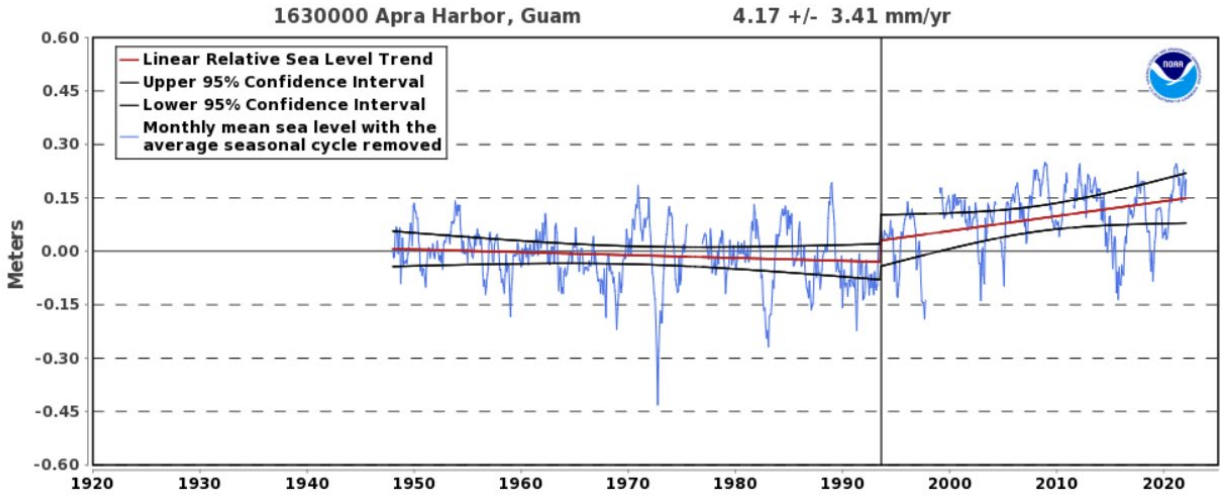

Figure 6: Relative sea level trend at Apra Harbor, Guam. Data accessed at Sea Level Trends - NOAA Tides & Currents on 10 June, 2022. The relative sea level trend is 4.17 millimeters/year with a 95% confidence interval of +/- 3.41 mm/yr based on monthly mean sea level data from 1993 to 2021 which is equivalent to a change of 1.37 feet in 100 years.

The island of Guam is exposed to two distinct wave types: waves generated by the prevailing local winds; and sea and swell from local and distant storms and typhoons. Deepwater wave statistics for the study are contained in the "Summary of Synoptic Meteorological Observations" prepared by the U.S. Naval Weather Service Command. This data shows that the preponderance of waves affecting Guam are easterly tradewind generated waves. However, the study area is well protected from tradewind

generated waves by the island itself and is primarily affected by waves from the south clockwise to the north. The study area is also affected by long period swells generated by distant tropical storms and typhoons which can have a significant effect on the study area. The USACE's Wave Information Study (WIS) developed 30 years (1981– 2011) of wave hindcast data for the study area. The WIS hindcast database will be used as the source of wave data for the feasibility phase of this study.

Since the shoreline in the study area is receding landward, the threat of storm damage will become more extreme and frequent over time. South Marine Corps Drive and utilities within the project study area will sustain significant damage from damaging waves due to long-term sea level rise and elevated sea levels during storm events.

Within the 50-year study period (2026 to 2076) tropical storms are expected to increase in severity but decrease slightly in frequency, while sea level will increase and combined these conditions will increase the frequency of high water events and coastal erosion (East West Center 2020).

2.1.2 Air Quality

The United States Environmental Protection Agency (USEPA) has established National Ambient Air Quality Standards for criteria pollutants including carbon monoxide, nitrogen dioxide, sulfur dioxide, particulate matter, ozone, and lead. Guam's air quality is generally considered good. Piti, Piti-Cabras, and Tanguisson in Guam are non-attainment areas for sulfur dioxide (USEPA 2023). The rest of Guam, including the study area, is in attainment of air quality standards. The study area is located well outside the buffer zones of these non-attainment areas.

2.1.3 Geology

The low-lying East Hagatna shoreline is bounded to the south by a 100-ft-high limestone cliff (the tree line to the south-southeast of the existing seawall in Figure 2), which is the southwest corner of the northern limestone plateau geomorphic province of Guam (Tracey et al. 1964). A strip of small commercial establishments is located between South Marine Corps Drive and the cliff (USACE 1993; Siegrist and Reagan 2008).

The study area is in the floodplain of Hagatna Bay (FEMA 2007). The shoreline is low and flat with a maximum elevation of 7.5 to 8.9 ft above MSL (NOAA NGS 2020). Trinchera Beach extends along approximately 3,400 ft of the East Hagatna shoreline. The beach is narrow, 10 to 20 feet wide, and is almost awash at high tide. The backshore area consists of a narrow and poorly developed coastal plain varying in width from 50 ft to about 1/2 mile (USACE 1993). In Veteran's Sunset Beach Park there is no beach. Toward the eastern extent of the project (towards Tamuning), the beach is approximately 15 ft wide. The beach material is fine calcareous sand with extensive coral, gravel, and rubble. Portions of the shoreline are covered almost exclusively with gravel, rocks, rubble, and small limestone boulders (Figures 3 to 5).

Seaward from the shoreline is a well-developed reef flat which ranges in width from 1/8 mile at the west end (at Pigo) of Hagatna Bay to 1/2 mile at the east-northeast end (at Tamuning) (see Figure 6). The reef flat is bisected at about midpoint by the man-made

peninsula of Paseo de Susana Park and the adjacent channel for the Agana Small Boat Harbor. The reef consists of living coral and algae along the reef margin (seaward) and moderately dense skeletal coral formations, beach rock, and unconsolidated coral sediments along the shoreline (Tracey et al. 1964). Small sand and alluvial deltas formed in the vicinities of storm drains and the inner reef flat has a covering of fine sand and silt (USACE 1993).

The shoreline along the study area is characterized by poorly sorted sand, with a high % coverage by coral rubble, gravel, rubble, and small limestone boulders. The narrow strip of beach has a slope of about 10% and is awash at high tide (USACE 1990). Soils within the terrestrial study area are of the urban land – ustorthents complex (NRCS 2021).

Within the 50-year study period (2026 to 2076) more frequent and severe tropical storms in combination with relative sea level rise are expected to exacerbate shoreline erosion.

2.1.4 Hydrology

Hydrology within the study area is discussed relative to Hagatna Bay. There are no other surface waters within the study area. Hagatna Bay water depth ranges from 0 to 3 ft with the tides along the shoreline of the study area. Tides on Guam are semi-diurnal with a mean range of 1.62 ft and a diurnal range of 2.35 ft based on the 1983-2001 epoch (NOAA 2022a). Hagatna Bay is exposed to waves generated by local prevailing winds driving waves and sea and swell from local and distant storms and typhoons.

Projected sea level rise within the 50-year study period (2026 to 2076) will be approximately 1.28 ft (Figure 8 Appendix A-1 Engineering). The design water level, based on short-term, storm-driven water level changes superimposed on the astronomical tides (Figure 9 Appendix A-1 Engineering) is approximately 1.4 ft (0.42 m) relative to MHHW or 2.3 ft (0.71 m) relative to MSL.

2.1.5 Water Resources and Quality

33 CFR 328.3(a) defines “waters of the United States” as it applies to the USACE regulatory jurisdiction pursuant to Section 404 of the Clean Water Act (CWA). Hagatna Bay is a reach of the Pacific Ocean, a navigable water used for interstate and foreign commerce subject to the ebb and flow of the tide and accordingly is a water of the U.S. The landward limit of CWA jurisdiction extends to the High Tide Line at and fronting the existing seawall (see 33 CFR 328.3(c)(4)). There are no tributaries, adjacent wetlands, or other jurisdictional waters of the U.S. within the study area.

Guam water quality standards designate the waters of Hagatna Bay as M- 2, which requires preserving a balanced, indigenous population of marine organisms, especially shellfish and corals, and intended uses including water sports, aesthetic enjoyment, and mariculture. East Hagatna Bay water quality is reported as good for 2020 (USEPA 2023). Previous USACE studies identified 30 storm drain outfalls throughout the Bay which discharge solids, nitrate-nitrogen, and coliform bacteria exceeding water quality standards (USACE 1993). The Agana River, west of the study area (Figure 7), is impaired for aquatic life, fish and shellfish consumption, and swimming and boating due

to bacteria and other microbes, low oxygen, and PCBs. A storm drain east of the study area is impaired for aquatic life, swimming and boating due to bacteria and other Microbes, low oxygen, murky water, nitrogen and/or phosphorus, and salts (USEPA 2023).

Figure 7: Water Quality Conditions for East Hagatna Bay and its tributaries as displayed in the How's My Waterway Mapper (USEPA 2023). East Hagatna Bay is reported to have good water quality, while Agana River and a storm drain, both outside the study area (red dotted box), are impaired.

2.1.6 Hazardous, Toxic and Radioactive Waste (HTRW)

Per ER 1165-2-132 (USACE 1992), HTRW includes any material listed as a "hazardous substance" under the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. 9601 et seq (CERCLA), including Unexploded Ordinance (UXO).

> "Construction of Civil Works projects in HTRW-contaminated areas should be avoided where practicable. This can be accomplished by early identification of potential problems in reconnaissance, feasibility, and PED phases before any land acquisition begins. Costs of environmental investigations to identify any existence of HTRW and studies required for formulation of the NED plan, recognizing the existence and extent of any HTRW, and studies required to evaluate alternatives to avoid HTRW will be cost shared the same as cost sharing for the phase the project is in (i.e., feasibility, PED, or construction).

> Where HTRW contaminated areas or impacts cannot be avoided, response actions must be acceptable to EPA and applicable state regulatory agencies."

While (UXO are a risk of any ground disturbance beneath or outside the current wall base given the World War II combat history of the island of Guam, based on a review of USEPA's EnviroAtlas, and How's My Watershed, USACE understands that there are no known sources that would have contributed HTRW in the study area (USEPA 2023a, 2023b). Additionally, the USACE is not proposing an activity that would introduce or otherwise become a source of HTRW in the study area.

2.1.7 Noise

Much of the City of Hagatna is a developed urban community. Commercial, institutional and government operations are centralized to within its limits. Vehicular traffic associated with Route 1 South Marine Corps Drive, Route 4 and airline traffic associated with the A.B. Won Pat Guam International Airport and vessel operations at the marina result in significant daytime ambient noise levels (Gourley et al. 2014).

2.2 Natural Environment

The natural environment of the study area encompasses 0.96 acres of intertidal habitat, 2100 ft of shoreline, and 1.45 acres of terrestrial habitat in Trinchera and Veteran's Sunset Beach Parks (Figure 2). Baseline natural environment condition is based on observations made by the PDT during a site visit on January 10-12, 2022 (USACE 2022a), National Oceanic and Atmospheric Administration's (NOAA) 2005 Environmental Sensitivity Index (NOAA 2005), and the Surveys performed in 1992 by the United States Fish and Wildlife Service (USFWS) for a 1993 Environmental Assessment Shoreline Protection Feasibility Study (USFWS 1992) which was not implemented, as well as resource specific literature as detailed below. Figure 8 illustrates NOAA's 2005 Environmental Sensitivity Index (ESI) of natural and cultural resources in Hagatna Bay.

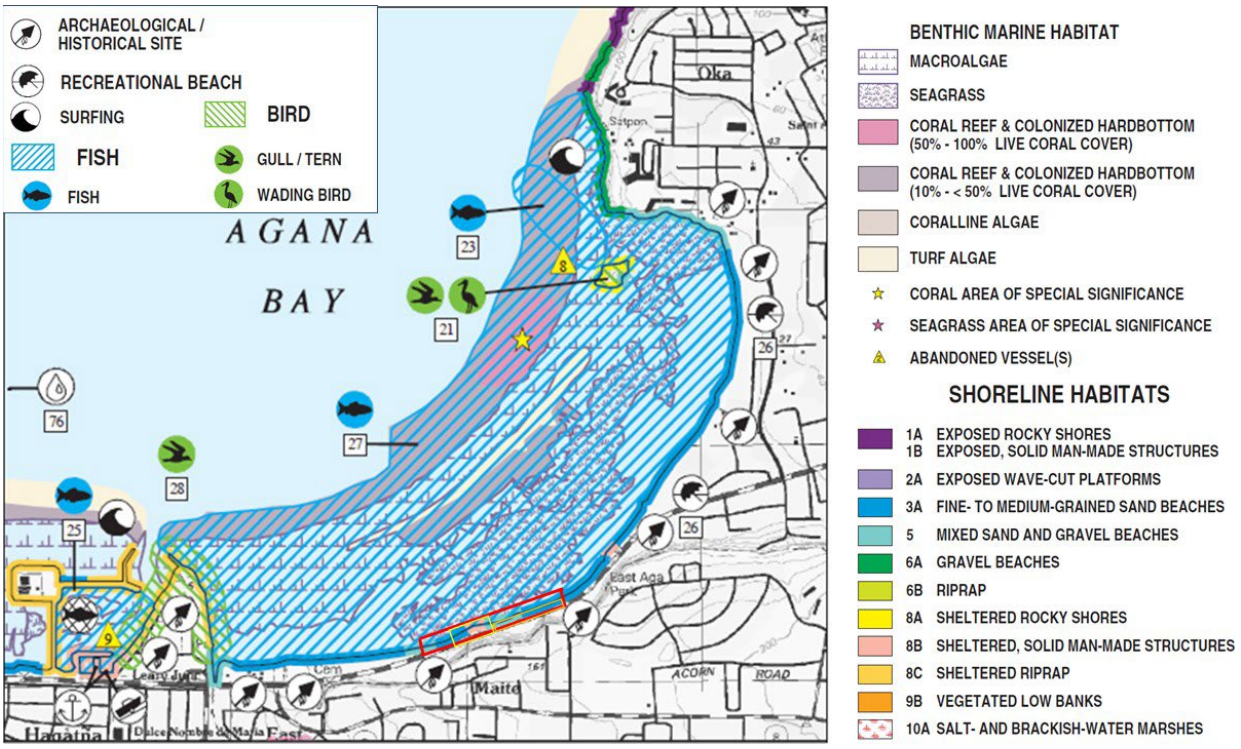

Figure 8: NOAA's 2005 Environmental Sensitivity Index Map 12 with the study area in red, Veteran's Sunset Beach Park in yellow, and Trinchera Beach in orange.

2.2.1 Terrestrial Habitats and Species

Terrestrial wildlife habitat in the study area is limited to the sparse, urbanized habitat of Trinchera Beach Park and Veteran's Sunset Beach Park (Figure 4). This area includes limited land varying from 10 to 60 ft wide between the seawall and South Marine Corps Drive, and a narrow discontinuous sandy beach on the ocean side of the seawall, described in more detail in Section 2.1.3.

2.2.1.1 Terrestrial Vegetation

Vegetation within the beach parks consist of an actively maintained lawn planted with indigenous coconut palm (*Cocos nucifera*) and ironwood (*Casuaria equisetifolia*) trees and the introduced ornamentals plumeria (*Plumeria* sp.) and fish poison tree (*Barringtonia asiatica*). Clumps of indigenous beach morning glory (*Ipomoea pescaprae*) grow along the seaward base of the seawall in some locations. A small number of coconut palm and ironwood trees are also rooted on the beach at the base of the seawall. No invasive plants were observed by the PDT (USACE 2022a). Vegetation within the study area commonly occurs in beach areas throughout Guam.

Replacement of any trees removed will be required mitigation under Guam law (5 GCA Government Operations Guam Code Annotated CH. 63 Fish, Game, Forestry & Conservation § 63302). Unlicensed Tree-Cutting on Public Lands; Prohibited). Tree removal also requires a license (5 GCA § 63302).

2.2.1.2 Terrestrial Birds

While shorebirds are reported in Hagatna Bay (See Section 2.2.2.3, below), only urban birds have been reported in Trinchera Park. The PDT did not note any birds in the park during their visit (USACE 2022a). Migratory birds were recorded by Guam Division of Aquatic and Wildlife Resources (GDAWR) passing through between late August and early May along the East Hagatna Bay coast (Quitugua 2022). Migratory bird surveys and incidental sightings for migratory birds (Table 1), and Sali (Micronesian starlings) (Table 2) were provided by Guam Department of Agriculture for the East Hagatna area. The Sali surveys are located along transects near East Hagatna but not within the study area. The most active nesting pairs are located at Paseo and Sirena Park, near the Hagatna boat basin and well outside the study area, but it is still possible for the Sali to forage in the East Hagatna area (Duenas 2022).

Table 1: Migratory Bird Survey Results. Source: GDAWR 2022.

Common Name	Species	2019	2020	2021	2022
Eurasian Tree Sparrow	*Passer montanus*	21	No surveys due to covid restrictions		0
Philippine Turtle Dove	*Streptopelia dusumieri*	4			0

Table 2: Sali (Micronesian Starling) Survey Results. Source: GDAWR 2022.

Location	2019	2020	2021	2022
Padre Palomo Park Transect	0	No surveys due to covid restrictions	0	0
Paseo/ Sirena Park Transect	2 (Nesting)		7 (Nesting)	4 (Nesting)
Incidental Sightings	0	1, flying from beach towards mountain side	1, flying from beach towards mountain side	0

According to the International Union for Conservation of Nature (IUCN), both the Eurasian Tree Sparrow and the Sali are categorized on the IUCN Animal Threat Category List as Least Concern i.e., widespread and abundantly occurring. The Philippine Collared Dove is categorized by the IUCN as Vulnerable, facing a high risk of extinction in the wild (IUCN 2014).

2.2.1.3 Terrestrial Mammals

No large terrestrial animals were recorded during the 1992 USFWS surveys or 2022 PDT site visit. Skinks, geckos, and rats were the dominant terrestrial vertebrates at the site (USFWS 1992). The PDT did not observe any mammals during their visit in January 2022 (USACE 2022a). GDAWR has reported Mariana fruit bat (*Pteropus mariannus mariannus*) passing through the area in early morning (dawn) most likely returning to a roost, and at dusk leaving a roost. The roosts are most likely north of East Hagatna along the limestone cliff (Flores 2022). For this specific site on East Hagatna, GDAWR has seen fruit bats on the breadfruit trees along the cliff wall, roosting and foraging during breadfruit season between 2010 and 2013. There are some bread fruit trees along the cliff side, so there may be fruit bats in the area during breadfruit season from

February to October (Quitugua 2022). The Mariana fruit bat is listed as Threatened under the Endangered Species Act (ESA, See Section 2.2.3, below).

2.2.2 Marine Habitats and Species

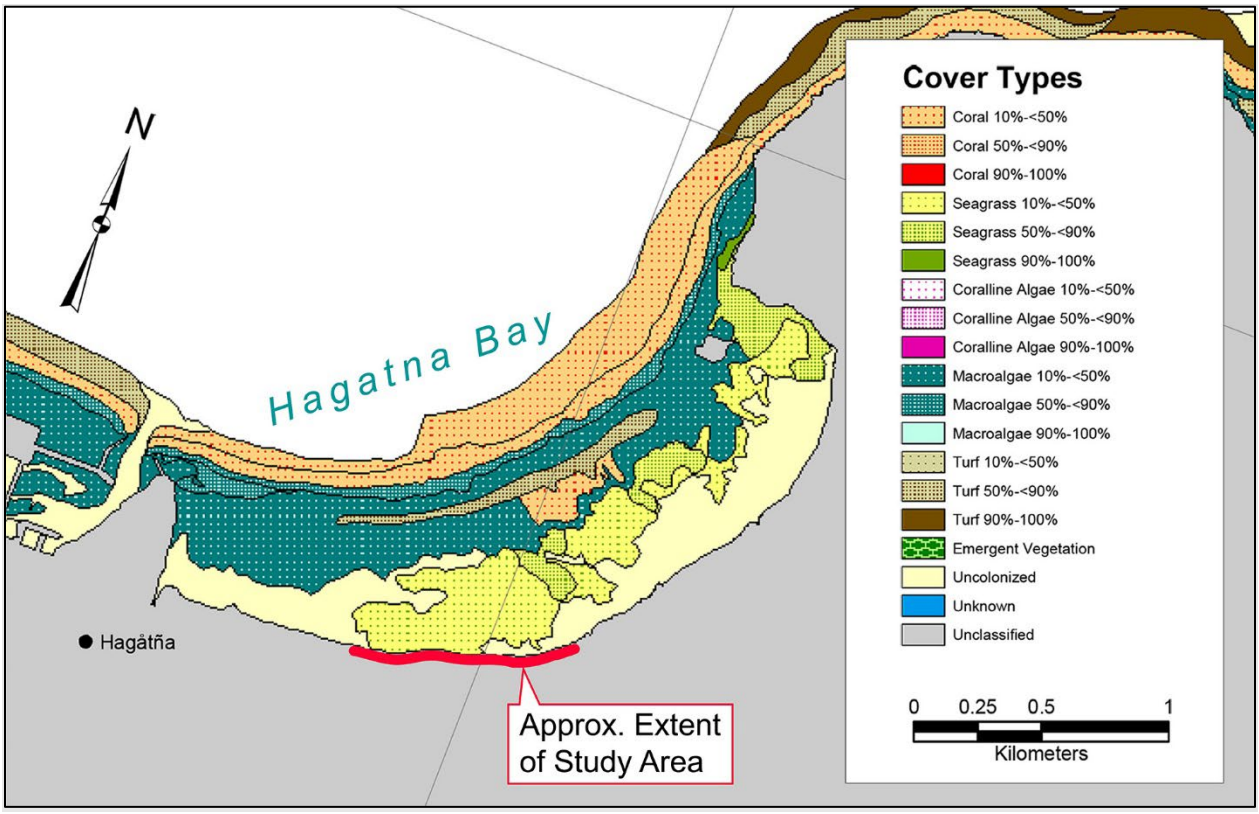

Figure 9: Benthic habitat cover types within Hagatna Bay (adapted from NOAA 2005)

As described in Section 2.2, the habitat that would be directly impacted by the proposed project is a narrow, highly variable intertidal strand of sand, coral rubble, gravel, and rock (as seen in Figures 3-5), supporting no obvious aquatic communities. Previous surveys of the Hagatna Bay benthic environments (NOAA 2005, USFWS 1992) found the benthic habitat within several hundred meters of shore consists of uncolonized sand, or sand sparsely colonized by seagrasses (Figure 8). The nearest areas of coral were found well offshore (Figure 8).

NMFS surveyed the study area along the sea wall and at 25m and 50m from the shoreline in November 2022 (NMFS 2023, Attachment 1h of Appendix 3). The intertidal region extended 20 feet from the existing seawall and was predominantly sand with less than 30% cover of aggregate cobble and rubble. The intertidal and submerged substrates were dominated by sand with scattered patches of seagrass and algae noted in the 25 and 50 m distant areas. Coral colonization was scattered and limited, with 12 individual colonies recorded in the 50 m distant area. Species that are listed as management units (Magnuson-Stevens Fishery Conservation and Management Act, MSA 16 U.S Code § 1801 et seq.) or as threatened or endangered (United States Endangered Species Act, ESA 16 U.S Code § 1531 et seq.) were not observed.

2.2.2.1 Marine Vegetation

NOAA (2005) benthic habitat maps depict areas of sand sparsely colonized by sea grasses scattered amongst the bare sand within several hundred meters of the shoreline (Figure 8). The PDT (USACE 2022a) did not observe seagrass within the proposed study area (Figures 3-5). NMFS (2023) observed scattered patches of seagrass and algae 82 ft away from the Study area including the seagrasses *Enhalus acoroides, Halophila gaudichaudii*, and *Halodule uninervis*; and the macroalgae *Acanthropora spicifera, Avrainvillae spp., Caulerpa filicoides, Caulerpa macrophysa, Caulerpa sertularioides, Dictyota spp., Halimeda opuntia, Padina spp*, and *Sargassum vulgar;* but only sand within the study area.

2.2.2.2 Marine Invertebrates and Associated Habitat

Overall Hagatna Bay had low community diversity and was dominated by stress-resilient *Porites spp.* Scattered colonies of *Acropora muricata* and *A. cf. pulchra* colonies occurred amongst the *Porites spp*. No *Acropora globiceps* (listed as Threatened under ESA) was reported (Raymundo et al. 2022, p.36, NMFS 2023). The PDT (USACE 2022a) did not observe live coral within the proposed study area (Figures 3-5). NMFS (2023) observed bivalve *Pinna* spp. 82 feet from shore and octopus and the corals *Porites australiensis, Porites cylindrica*, and *Pocillopora damnicornis* 164 feet from shore.

2.2.2.3 Shore Birds

Shore birds are commonly seen foraging on the nearshore sand flats at East Hagatna Bay during early morning and late afternoon hours especially around the deltas which formed in front of the storm drains. The Pacific Reef Heron (*Egretta sacra*) is the only observed shore bird considered to be a resident species. The rest are migratory and present in the largest numbers from September to April (Jenkins 1978). The PDT (USACE 2022a) did not observe any birds within the proposed study area (Figures 3-5), though they were not there in the morning. GDAWR has recorded migratory shore birds passing through along the East Hagatna Bay coast between late August and early May (Quitugua 2022). Migratory bird surveys (Table 3) and incidental sightings (Table 4) for migratory seabirds were provided by GDAWR for the East Hagatna area (Duenas 2022).

Table 3: Migratory Shore Bird Survey Results. Source: GDAWR 2022.

Common Name	Species	2019	2020	2021	2022
White Tern	*Gygis alba*	30	No surveys due to covid restrictions		7
Pacific Reef Heron	*Egretta sacra*	1			2
Yellow Bittern	*Ixobrychus sinensis*	1			0
Common Sandpiper	*Actitis hypoleucos*	2			3

Table 4: Incidental Shore Bird Sightings (Collected throughout the year). Source: GDAWR 2022.

Common Name	Species	2019	2020	2021	2022
Pacific Reef Heron	*Egretta sacra*	1	2	0	3
Ruddy Turnstone	*Arenaria interpres*	0	0	6	0
Whimbrel	*Numenius phaeopus*	0	0	1	0
Common Sandpiper	*Actitis hypoleucos*	0	0	2	1

2.2.2.4 Marine Fish

Fish diversity and abundance are reportedly higher in the outer reef flat, decreasing as one moves closer to shore (USACE 1993). The PDT (USACE 2022a) did not observe any fish within the proposed study area (Figures 3-5). NMFS (2023) observed the fish *Canthigaster bennetti, Caranx spp., Chaenopsidae spp., Chromis viridis, Corythoichthys intestinalis, Dascyllus aruanus, Echidna nebulosa, Gerres oyena, Lethrinus harak, Mulloidichthys flavolineatus, Rhinecanthus aculeatus, Scolopsis lineata,* and *Siganus spinus* 82 feet from shore, and *Chlorurus sordidus, Labroides dimidiatus, Myripristis adusta, Myripristis kuntee,* and *Sargocentron* spiniferum were observed 164 feet from shore. No fish were observed in the study area (NMFS 2023).

2.2.2.5 Marine Mammals

Marine Mammals have not been reported in Hagatna Bay (USFWS 1992, USACE 1993, NMFS 2023).

2.2.3 Federal and State Threatened and Endangered Species

Threatened and endangered species which may occur within the Action Area are listed in Table 5. There are no known turtle nesting sites in the Action Area, but turtles may be foraging (Flores 2022). The PDT did not observe any threatened or endangered species in the park during their visit (USACE 2022a). NMFS (2023) did not observe any species that are listed as threatened or endangered (United States Endangered Species Act, ESA 16 U.S Code § 1531 et seq.) during the surveys. There is no designated critical habitat in the Action Area or its vicinity (NMFS 2023).

Table 5: ESA-Listed Species Potentially Affected by the Proposed Action

Species	Distinct Population Segment	ESA Status	Designated Critical Habitat	Agency Jurisdiction
Mariana Fruit Bat *Pteropus mariannus mariannus*		Federally Threatened Territorially Endangered	Not in Action Area	USFWS
Coral *Acropora globiceps*		Threatened	Not in Action Area	NMFS
Green Sea Turtle *Chelonia mydas*	Central West Pacific	Endangered	Not in Action Area	NMFS in water USFWS on shore
Hawksbill sea turtle *Eretmochelys imbricata*		Endangered	Not in Action Area	NMFS in water USFWS on shore

GDAWR has reported Mariana fruit bat (*Pteropus mariannus mariannus*) passing through the area in early morning (dawn) most likely returning to a roost, and at dusk leaving a roost. The roosts are most likely north of East Hagatna along the limestone cliff (Flores 2022). For this specific site on East Hagatna, GDAWR has seen fruit bats on the breadfruit trees along the cliff wall, roosting and foraging during breadfruit season between 2010 and 2013 (Quitugua 2022).

During surveys in 1992 USFWS recorded nine species of coral on the inner reef flat at the proposed project site (Table 4). NMFS (2023) surveys of the Action Area found that coral colonization was scattered and limited, with 12 individual colonies recorded 50m from shore, and none of them were *Acropora globiceps*. The nearest documented observance of *A. globiceps* was in northern part of lagoon (Maynard et al. 2015; Horsley Whitten Group 2017) more than 4 miles from the project area.

On Guam, sea turtle nesting habitat tends to be in areas isolated from human activity and nesting has not been observed in the proposed project/action area. Sea turtles may use the lagoon for foraging habitat. Although green sea turtles nest on Guam beaches, this normally occurs at relatively isolated locations far away from the Action Area (USFWS 1992). Within the Marianas, green turtles are reasonably common and present year-round in the waters, and approximately 22 green sea turtles nest in Guam (Seminoff et al. 2015).

Green sea turtles (*Chelonia mydas*) have previously been observed in the water and on the beach in Hagatna Bay, but they have not been observed to nest on Hagatna Bay beaches (Flores 2022). NMFS sea turtle tagging project from 2014 through 2019 did not tag or observe any hawksbill or green sea turtles in Hagatna Bay (Gaos et al. 2021).

Given the above, it is unlikely that the green sea turtle will enter the Action Area. The green sea turtles enter Hagatna Bay and they have previously been reported using the shoreline for foraging habitat. However, the turtles have not been recently documented to use nearshore habitat in the project area.

In the Mariana Archipelago of Guam and the Commonwealth of the Northern Mariana Islands, less than 10 females nest annually. Hawksbills are uncommon, occurring in much lower numbers than green sea turtles, but foraging hawksbill sea turtles occur in the waters around Guam (NMFS and USFWS 2013). Hawksbill sea turtles have not been reported in the Bay. NMFS sea turtle tagging project from 2014 through 2019 did not tag or observe any hawksbill or green sea turtles in Hagatna Bay (Gaos et al. 2021). Given the above, it is unlikely that the Hawksbill Sea turtle will enter the project area.

2.2.4 Essential Fish Habitat (EFH)

The National Marine Fisheries Service (NMFS) EFH Mapper was accessed on April 19, 2022, for the area within and surrounding East Hagatna Harbor. The study area consists of EFH designated for both the Marianas Bottomfish fishery and the Pelagics fishery (Table 6). No Habitat Areas of Particular Concern (HAPC) were identified in the study area (NMFS 2021). The nearshore region in east Hagatna is designated as level 1 essential fish habitat (i.e., based simply on the "geographic range of a species [or life stage]"; 50 CFR Part 600 Subpart J; WPRFMC, 2009, (NMFS 2023).

Table 6: Mariana Bottom fish EFH management unit species (WPFMC 2018)

Local name	English common name	Scientific name
lehi/maroobw	red snapper, silvermouth	Aphareus rutilans
tarakitu/etam	giant trevally, jack	Caranx ignobilis
tarakiton attelong, orong	Black trevally, jack	Caranx lugubris
bueli, bwele	lunartail grouper	Variola louti
buninas agaga', falaghal, moroobw	red snapper	Etelis carbunculus
abuninas, taighulupegh	red snapper	Etelis coruscans
mafuti, atigh	redgill emperor	Lethrinus rubrioperculatus
funai, saas	blueline snapper	Lutjanus kasmira
buninas, falaghal-maroobw	yellowtail snapper	Pristipomoides auricilla
buninas, pakapaka, falaghal-maroobw, pakapaka	pink snapper	Pristipomoides filamentosus
Buninas, falaghal-maroobw	yelloweye snapper	Pristipomoides flavipinnis
.	pink snapper	Pristipomoides seiboldii
Buninas rayao amariyu, falaghal-maroobw	Flower snapper	Pristipomoides zonatus

While Guam-based management unit (MSA MUS) species were not observed during NMFS surveys in 2022, regional use may occur by the various species and life-stages (NMFS 2023, Attachment 1 Appendix A-3).

2.2.5 Special Aquatic Sites

2.2.5.1 Sanctuaries and Refuges

The Study area is not part of any sanctuary or refuge.

2.2.5.2 Wetlands

The Study area does not include any wetlands (PDT 2022a).

2.2.5.3 Mud Flats

The Study area does not include any mudflats (NMFS 2023).

2.2.5.4 Vegetated Shallows

Scattered patches of seagrass and algae are 82 ft away from the Study area and include the seagrasses *Enhalus acoroides, Halophila gaudichaudii*, and *Halodule uninervis*; and the macroalgae *Acanthropora spicifera, Avrainvillae spp., Caulerpa filicoides, Caulerpa macrophysa, Caulerpa sertularioides, Dictyota spp., Halimeda opuntia, Padina spp*, and *Sargassum vulgare.* There is only sand within the study area (NMFS 2023).

2.2.5.5 Coral Reefs

The coral reef is located 164 ft seaward from the study area and includes *Porites australiensis, Porites cylindrica*, and *Pocillopora damnicornis* (Raymundo et al. 2022, NMFS 2023).

2.2.5.6 Riffle and Pool Complexes

The Study area does not include riffle and pool complexes.

2.2.6 Invasive Species

As per Executive Order 13112 (Section 1. Definitions) an “invasive species” is a species that is non-native (or alien) to the ecosystem under consideration and, whose introduction causes or is likely to cause economic or environmental harm or harm to human health. Invasive species of concern identified for Guam include African tulip tree (*Spathodea campanulate*), Coral Vine (*Antigonon leptopus*), Mile-a-minute Vine (Mikania micrantha), Cycad Aulacaspis Scale (*Aulacaspis yasumatsui*), Tångantångan (*Leucaena leucocephala*), Angel Hair Alga (*Chaetomorpha vieillardii*), cycad blue butterfly (*Chilades pandava*), cycad moth (*Erechthias sp.*), Little fire ant (*Wasmannia auropunctata*), Greater Banded Hornet (*Vespa tropica*), Giant African Land Snail (*Achatina fulica*), New Guinea flatworm (*Platydemus manokwari*), Coconut rhinoceros beetle (*Oryctes rhinoceros*), and Banana Bunchy Top Virus (*Babuvirus*) (University of Guam 2019). None of these species were observed in the study area during the PDT site visit in January 2022 (USACE 2022a).

2.3 Built Environment

2.3.1 Land Use

Designated land use for the Study area is LU2 Parks and Open Spaces (HRRA 2005). The purpose of the park, and Open Spaced Land Use designation is to provide opportunities for public parks and other recreational facilities, such as playgrounds, hike and bike trails, and publicly accessible open space, and to preserve the public’s rights to access the shoreline. Among the goals for this land use are to maintain the character of Hagatna through maintenance and preservation of public access to the natural open spaces, especially the shoreline and regulate the trimming, planting and removal of

trees, shrubs, and other plant matter within the city, on Government land, to include utility easements (HRRA 2005). Specifically, the project study area includes the Veteran's Sunset Beach Park and Trinchera Beach Park, operated by the Guam Department of Parks and Recreation. The 2021 Hagatna Master Plan defines the study area as part of the Padre Jose Palomo Barrio containing the Cormoran Monument, Jose Bernardo Torres Palom, Statue, and US Navy Fortification historic and cultural sites (HRRA 2021).

A variety of businesses are located within the study area including an automotive glass tinting shop, automotive parts store, jewelry shop, bank, and restaurant. There are a total of 19 businesses which, for the most part, are small operations not directly linked to tourism or the military, the two major forces in Guam's economy. On the seaward side of Marine Drive within the study area there is insufficient fast land for commercial or residential development typical of adjacent areas to the east and west. Two small strip parks along the project reach have been constructed recently. The remaining coastal strand is vegetated with coconuts trees and a variety of common shrubs and grasses maintained by the Department of Parks and Recreation (USACE 1993).

The bay recreational areas (the beach, inner reef flat or moat, and the raised outer reef flat) are used regularly by local residents for social or family gatherings, usually picnics, and for cooperative reef flat fishing. Fishing for the family table is a significant cultural tradition in Guam, and is a source of food contributed at fiestas, funerals, marriages, and christening to repay past social debts. During the atulai and manahac fish runs, a hundred or more families camp for several days along Hagatna Bay beach parks to be near to and enjoy the traditional cooperative fishing activity (USACE 1993).

East Hagatna Beach Front Park, a public park situated between the two proposed project reaches was constructed several years ago. Existing facilities include off-road parking, a low CRM wall, three shelters and numerous concrete tables and benches. Popular uses include picnicking, drinking; some swimming and wading, access to reef and shoreline fishing, and launching of jet skis and sail boards. Jet skiing has become an increasingly popular recreation activity for both residents and tourists. A recent proliferation of commercial operations for tourists in East Hagatna Bay and other locations prompted the establishment of the Recreational Water Use Management Plan by the Department of Parks and Recreation. The plan established rules regulating the use and operation of mechanized watercraft and other activities. Specifically designated jet ski courses have already been established for East Hagatna Bay, with eight commercial jet ski operating areas and one public operating area. The 600 ft by 600 ft public jet ski area is located 150 feet directly offshore from the study area (USACE 1993).

2.3.2 Public Infrastructure

In addition to South Marine Corps Drive and the associated public utilities, as described in section 1.6.1, on the seaward side of South Marine Corps Drive within the study area there is insufficient fast land for commercial or residential development typical of adjacent areas to the east and west. The Veteran's Sunset Beach Park and Trinchera Beach Park include a picnic area, with two open pavilions, a parking lot, and stone steps down to the beach. Access to this public park is provided via South Marine Corps

Drive. There is limited off road parking. The parks are used regularly by residents for social gatherings, usually picnics, and for cooperative reef flat fishing. Existing facilities include off-road parking, a low concrete-rubble-masonry seawall, three shelters, and numerous concrete tables and benches (see Figures 3-5).

2.4 Economic Environment

2.4.1 Socioeconomics

The 2020 Census estimates the census-designated place (CDP) Hagatna population as 943. However, since South Marine Corps Drive serves the broader population of the entire island, the unit of analysis for this section is the entire island of Guam. The 2020 Census estimates the population of Guam at approximately 154,000. The 2010 Census showed an increase of 2.9% in population from 2000. However, the 2020 estimates show a decrease of 3.5% from the previous decennial census estimates. The Northern portion of Guam, where the terrain lends itself more easily to development, sees population distributed generally across the landscape, whereas the more mountainous southern half of Guam sees population and development more concentrated near the coastlines.

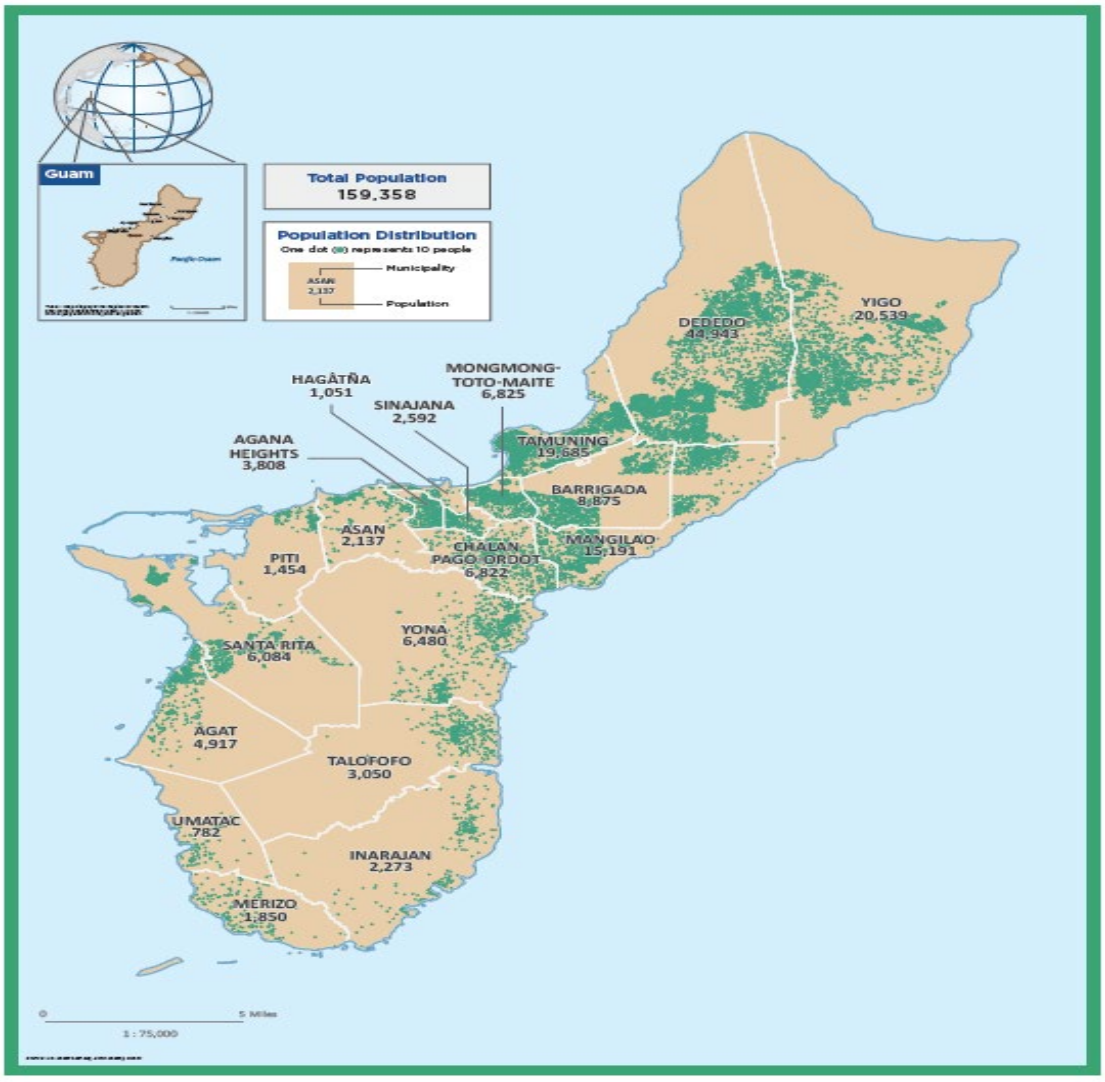

Figure 10: Population Distribution of Guam. Source: U.S. Census Bureau, 2010 Census: Understanding the Population of Guam

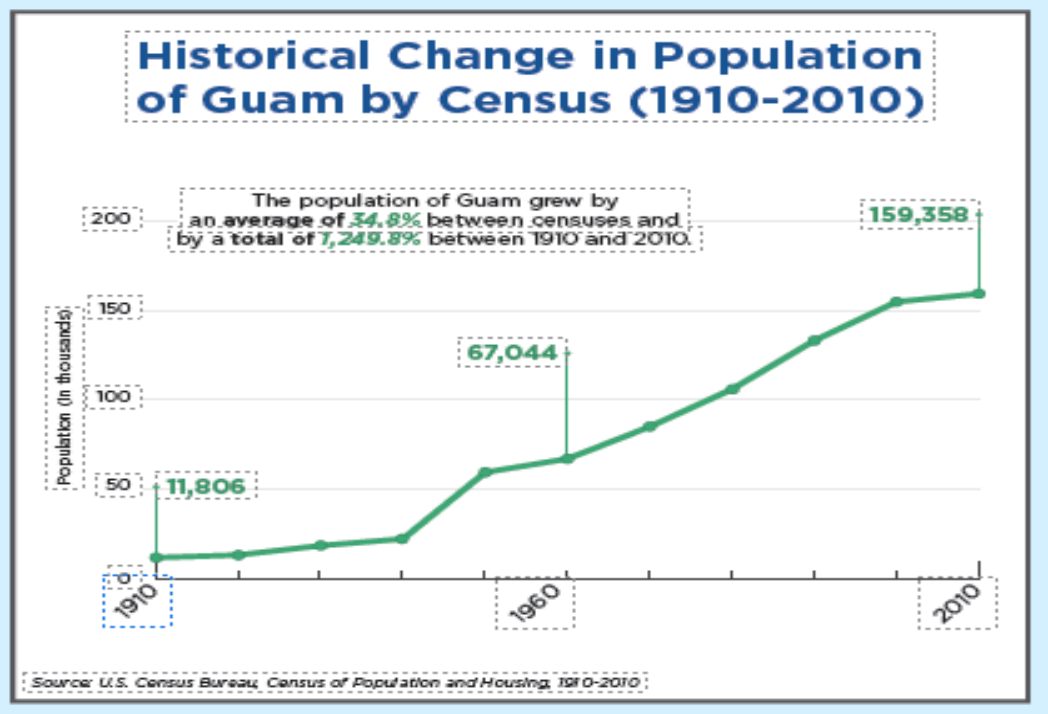

Figure 11: Historical Change in Population of Guam. Source: U.S. Census Bureau, 2010 Census: Understanding the Population of Guam.

Census data from the Guam Bureau of Statistics and Plans and the US Census Bureau indicate that the most prominent race or ethnicity in Guam is Native Hawaiian or Other Pacific Islander (49%), 75% of which are Chamorro. This group is followed by Asian (32%), multi-racial groups (9%), White (7%), Black (1%), and Hispanic or Latino (1%).

The economy of Guam is strongly tied to 2 sectors that predominately contribute to Guam's economic activity: Federal Government, including Military, and Tourism. The Bureau of Economic Analysis (BEA 2022), released the Gross Domestic Product (GDP) for Guam for 2021, showing an increase of 1.1% from 2020 after a decrease of 11.4% from 2019. There was a decrease in exports and consumer spending and increases in private fixed investment, federal government spending, and imports. Spending by tourists increased by 15.6% because of the increased number of Korean and Japanese tourists. Consumer spending increased on goods and services attributable to health care services and retail trade. Guam expected to see an increase in cruise ship activity that would bring ships onto the island to stimulate the economy because of the new Hotel Wharf rehabilitation project.

As of March 2019, there were 65,220 individuals that were employed according to the Current Employment Survey (CES) conducted by the Guam Department of Labor-Bureau of Labor Statistics (BLS 2019). There was also an increase in total employment from 2018 to 2019 of +.52% and an unemployment rate of- 4.3%. The Government of Guam receives most of their revenue from taxes such as Income Tax, Gross Receipts or Business Privilege Tax, Federal Income Taxes, and other taxes. In 2019, there was a decrease in income tax revenue because of the Tax Cut and Jobs Act (UOG 2020).

This policy reduced tax rates dramatically and therefore decreased the amount of revenue received by the Government of Guam.

The military presence in Guam is substantial with plans to further increase its population via relocation of Marines from the U.S. Marine Corps Futenma Air Station on Okinawa to Guam. This relocation is currently delayed due to higher-than-expected relocation costs. There are economic advantages and disadvantages that come with the relocation of the Marines. The advantages are that there may be a chance to create new jobs, new small businesses, new tax revenues, and an increase in spending. Disadvantages include possible social impacts that come with large population shifts such as sufficient housing and public utilities, infrastructure, and resources to facilitate the incoming population of about 35,000 people (GHURA 2009).

2.4.2 Environmental Justice

The CEQ's Climate and Economic Justice Screening Tool, designates 9 out of 57 census tracts in Guam as economically disadvantaged, including two census tracts in close proximity to the study area. However, all US territories, including Guam, are considered economically disadvantaged by the USACE in accordance with the *Implementation Guidance for Section 160 of the Water Resources Development Act of 2020, Definition of Economically Disadvantaged Community* (USACE 2023). Therefore, the study area is considered economically disadvantaged.

2.4.3 Historical and Archeological Resources

The island of Guam was first occupied more than 3,500 years ago by ancestors of the Chamorro people. The history of Guam is broadly divided into six periods: Pre-Latte, Latte, Spanish, First American, Japanese Occupation, and Second American (see Table 7). The dominant archaeological site type associated with the Pre-Latte Period consists of subsurface cultural layers at coastal lowlands and elevated coastal terraces. The principal artifact type associated with these sites is a thin-walled, red-slipped ceramic referred to as Marianas Redware. The Latte Period is characterized by latte architecture; a configuration of two parallel rows of stone shafts (haligi) supporting bowl-shaped capstones (tasa). The foundation of these latte sets supported raised residential structures. Archaeological sites dating to this period are found in both coastal areas and further inland. In addition to latte architecture, the principal artifact type associated with these sites is a thicker style of ceramic known as Marianas Plainware (Watanabe 1994; Hunter-Anderson et al. 2006; Amesbury et al. 2015).

Table 7: General Chronological Historic Context of Guam.

Date Range	GHPI Cultural Periods	Broad Periods
1500 – 1000 BCE	Early Pre-Latte Period	Pre-Latte Period
1000 – 500 BCE	Middle Pre-Latte Period	
500 BCE – 500 CE	Late Pre-Latte Period	
500 – 800 CE	Transitional Period	
800 – 1100 CE	Early Latte Period	Latte Period
1100 – 1350 CE	Middle Latte Period	
1350 – 1521 CE	Late Latte Period	
1521 – 1668 CE	Pre-Colonial European Trade Period	Spanish Period
1668 – 1700 CE	Spanish Missionization Period	
1700 – 1898 CE	Spanish Colonial Period	
1898 – 1941 CE	First American Territorial Period	First American Period
1941 – 1944 CE	WWII Japanese Military Occupation	Japanese Occupation Period
1944 – 1950 CE	Second American Territorial Period	Second American Period
1950 CE – Present	Organic Act / Home Rule Period	

The Spanish Period began with the arrival and departure of Ferdinand Magellan at Guam in 1521 Common Era (CE), although Spain did not formally take possession of Guam until 1565 and did not establish a military or religious presence on the island until the late 1660s. An important cultural event during this period was the immigration of people from the Caroline Islands to the Mariana Islands in the 1800s. The First American Period began when the U. S. acquired Guam from Spain through the terms of the Treaty of Paris in 1898 and ended with the surrender of the American governor to invading Imperial Japanese armed forces on December 10, 1941. The Japanese Occupation Period spans most of World War II, terminating with the cessation of organized Imperial Japanese armed forces resistance on August 15, 1944. The Second American Period began with the reoccupation of Guam by American armed forces and continues to present day. Guam residents were declared citizens of the United States of America in the Organic Act of 1950, and a civilian government was established. In the 1970s, Federal historic preservation laws were found to be applicable to Guam (Watanable 1994; Hunter-Anderson et al. 2006; Amesbury et al. 2015).

When the Spanish first anchored in Hagatna Bay in 1668, Hagatna was one of the principal villages on Guam. Although the Spanish missionaries were initially welcomed by the Chamorro and given land on which to build their church, this relationship did not last. The island's first foreign military installation, thought to have been constructed near the beach in Hagatna, was completed in 1683 (Walth et al. 2016). During the Spanish-Chamorro Wars, the Chamorro built a stone wall from the cliff edge to the water in the vicinity of Trinchera Beach. However, by the early 1700s the East Hagatna Bay area had been abandoned due to population reduction (Moore et al. 1988; Davis 1990). In the early 1800s, immigrant Carolinians were allowed to settle in the area. Occupation of this new community, referred to as Tamuning, began in 1816. In 1884, the Spanish created a settlement in Tamuning called Maria Cristina where they consolidated all the Carolinians dispersed across the island. In 1901, the Carolinians were expelled from Guam by the Americans (Moore et al. 1988).

Previous archaeological investigations in the general vicinity of the study area, including the excavations conducted in the 1920s by Hans Hornbostel on behalf of the Bernice P. Bishop Museum of Hawai'i, have recovered evidence of extensive occupation during the

Latte Period. Cultural materials dating to the Pre-Latte Period have also been identified (Hunter-Anderson et al. 2006; Amesbury et al. 2015). Walth et al. (2016:215) reviewed radiocarbon dates collected from multiple archaeological investigations and determined that 14% of the archaeological sites in Hagatna Bay date to the Pre-Latte Period, 62% date to the Latte Period, and 24% date to the Spanish/First American Period.

Most of the archaeological investigations conducted in the area were undertaken in association with construction projects, including road work (Moore et al. 1988; Amesbury et al. 1991; Walth et al. 2016) and building developments (Brown and Haun 1989; Amesbury et al. 1990; Davis 1990; Haun et al. 1990; Olmo 1997, 1999; Beardsley 2003; Hunter-Anderson et al. 2006; Amesbury et al. 2015). USACE has previously conducted limited archaeological investigations in association with feasibility studies in both the general area (Pangelinan and Price 1986; Cordy and Allen 1988) and along Trinchera Beach (Watanable 1994). More recent archaeological investigations, for which reports have not yet been finalized, include sewer line installations and cell phone tower installations; burials were identified at multiple locations (J. M. Joseph, pers. comm. 2022).

2.4.4 Other Cultural Resources and Subsistence Activities

The study area is an important local talaya (hand-net casting) fishery. Presently, the bay recreational areas (the beach, inner reef flat or moat, and the raised outer reef flat) are used regularly by residents for social gatherings, usually picnics, for talaya fishing, and for cooperative reef flat fishing. Fishing for the family table is an important cultural tradition in Guam, and subsistence fish species provide a culturally significant source of food at fiestas, funerals, marriages, and christenings. During the atulai and manahak fish runs, a hundred or more families camp for several days along Hagatna Bay beach parks to be near to and enjoy the traditional cooperative fishing activity (USACE 1993).

East Hagatna Bay is heavily used by local fishermen during the manahak runs. Community members have indicated the importance of the study area for subsistence use access throughout the year, especially for traditional talaya fishing which is conducted by walking along the shoreline.

2.4.5 Aesthetics

The view of the bay and ocean beyond the fringing reef is presently unobstructed from Marine Drive within the study area. The coastal strand is landscaped with coconut palms and other ornamental coastal trees. Much of the area is grassed or covered with beach morning glory. The overall effect is a natural, pleasing visually aesthetic view.

The view of the bay and ocean beyond the fringing reef is presently unobstructed along the reach of Marine Drive within the study area~ The coastal strand is landscaped with coconut palms and other ornamental coastal trees. Much of the area is grassed or covered with beach morning glory. The overall effect is a very pleasing visually aesthetic view. The public perception of the scenic value of this view plane was clearly demonstrated recently during the construction of the Alupang Beach Tower Condominium on the eastern end of the study area. A concrete seawall built along the 300 feet strip park, which was part of the project, blocked the view ~ of the ocean from

passing motorists. Public reaction was intense enough to cause the developer to shorten the height of the wall so that the view of the ocean would not be obstructed (USACE 1993).

3 PLAN FORMULATION

This chapter presents results of the third step of the six-step planning process: Formulation of alternative plans. This section will outline the evolution of the screening process from identification of management measures to development of an initial array of alternatives, through the initial screening process, and then to the refinement of a final array of alternatives.

3.1 Planning Framework

Plan formulation is the process of building alternative plans that meet planning objectives and avoid planning constraints to the extent practicable. Alternative plans are a set of one or more management measures functioning together to address one or more planning objectives. Alternatives were developed in consideration of study area problems and opportunities as well as study objectives and constraints.

3.2 Management Measures and Screening

3.2.1 Management Measures

As part of the planning process, the PDT, in coordination with the NFS and interested stakeholders, developed a series of measures to consider as potential elements of the study solution. A management measure is a feature or activity that can be implemented at a specific geographic site to address one or more planning objectives. Measures may be structural or non-structural.

The PDT identified structural measures that would either decrease the level of shoreline erosion or reduce coastal risks associated with wave damage and flooding. Traditional shoreline protection and coastal storm risk reduction structural measures include levees, storm surge barrier gates, seawalls, revetments, groins, and nearshore breakwaters. The PDT also identified nonstructural measures that would reduce the consequences of coastal erosion to the threatened facility (South Marine Corps Drive) rather than trying to reduce the probability that facilities are threatened by coastal erosion. Traditional non-structural measures that address shoreline erosion and coastal storm risk at coastal beach fronts include piles, relocation, and acquisition.

Natural and nature-based features (NNBF) are measures that mimic the characteristics of natural features but are created by human design, engineering, and construction. Examples of NNBF that provide coastal risk reduction include dunes and beaches, vegetated offshore islands, oyster and coral reefs, barrier islands, and maritime forests.

The PDT reviewed the above traditionally applied measures and identified the following structural, non-structural and NNBF measures that were most likely to meet the study objectives. Measures consisting of new in-water construction such as breakwaters and groins were not included in the initial list of measures due to the high costs (permitting, design and construction) and substantially greater environmental impacts typically associated with new in-water construction.

Structural Measures:

- Rock revetment – generally consists of a graded slope protected by an underlayer of medium-sized stones and a top layer of heavier armor stones.
- Tri-bar revetment- constructed similarly to the rock revetment but comprised of engineered concrete armor units rather than armor stones. These structures are often considered when locally sourced armor stones are not available.
- Concrete seawall – consists of vertical precast concrete panels set onto bedrock and backfilled.
- Concrete Rubble Masonry (CRM) Wall – involves constructing a concrete rubble masonry wall on top of an engineered foundation
- Secant pile wall - involves drilling overlapping concrete columns to form a barrier.
- Permeation grouting- consists of injecting a flowable grout into granulated soils conditions to fill cracks or voids and form a solid cemented mass.

Non-Structural Measures

- Relocation of South Marine Corps Drive – involves the relocation or retreat of South Marine Corps Drive and buried utilities inland to avoid coastal storm damages.

NNBF Measures

- Beach fill – consists of introducing locally sourced or imported beach sand material to engineer and build up the existing beach to dissipate wave energy. This measure would require periodic beach renourishment to mitigate ongoing erosion and other natural processes.

3.2.2 Screening Management Measures

Screening is the process of eliminating those measures that will not be carried forward for consideration. To meet study objectives, each of the structural and non-structural measures were individually evaluated based on a qualitative assessment of the following criteria:

- Is the measure likely to be effective at providing shoreline protection over the 50-year period of analysis?
- Is the measure likely to be the least cost in comparison to other measures with similar effectiveness?
- Is the measure likely to be environmentally acceptable based on available information?

Parametric cost estimates and initial agency feedback were used to assist with the screening process. Table 8 lists the initial array of alternatives and summarizes the screening of management measures.

Table 8: Screening of Management Measures

Management Measure	Carried Forward (Y/N)	Reason Not Carried Forward
Structural Measures		
Rock Revetment	Y	N/A
Tribar Revetment	Y	N/A
Concrete Seawall	Y	N/A
CRM Wall	Y	N/A
Secant pile wall	Y	N/A
Permeation Grouting	Y	N/A
Natural and Nature-Based Measures		
Beach Fill	N	Renourishment needed for measure performance not feasible under CAP Section 14
Nonstructural Measures		
Relocation of South Marine Corps Drive	N*	Costs too high; *Retained as a reference for plan formulation and selection.

All measures except for road relocation and beach fill were carried forward to the initial array of alternatives. For those measures not carried forward, a summary of the measure's performance under the screening criteria is included below:

- Relocation of South Marine Corps Drive – There is insufficient land area to the east of South Marine Corps Drive to relocate the roadway and associated buried utilities inland to avoid coastal storm damages. The construction contract costs to relocate a 4-lane highway (Marine Corps Drive) inland is approximately $13,000,000 per mile for an anticipated 5-mile road. This cost does not include the additional land acquisition and utility relocation costs. Relocating the road would likely have a higher environmental impact on terrestrial resources due to construction of the new roadway. In addition, relocation would not be considered an acceptable alternative. The non-federal sponsor has indicated that relocation of the road is not a feasible option due to the importance of the highway to not only the locals, but also to the military (see Section 1.6.1). For these reasons, relocation of South Marine Corps Drive was screened out from further evaluation. The estimated cost for road relocation will be used as a point of comparison to identify the least cost alternative and TSP.
- Beach fill – From an engineering standpoint, due to the level of storm surge and wave heights in the study area as well as the topography of the existing bay, beach fill as a stand-alone is considered inadequate and would be considered a temporary fix. Beach fill has the potential to be effective in combination with other structural measures. However, local availability of suitable beach fill material is limited, so this measure would be extremely costly to import and maintain. More importantly, renourishment is not covered under the Section 14 authority, therefore, regular renourishment to maintain the effectiveness of the structure would be a non-Federal responsibility. For these reasons, beach fill was screened from further consideration.

3.3 Initial Array of Alternatives

Alternative plans are a set of one or more management measures functioning together to address one or more planning objectives. An initial array of alternative plans was formulated by combining retained management measures. The initial array of alternatives includes the following:

- Alt 1: No Action
- Alt 2: Revetment (rock or tribar)
- Alt 3: Precast Concrete Seawall
- Alt 4: Concrete Rubble Masonry (CRM) Wall
- Alt 5: Secant Pile Wall
- Alt 6: Permeation Grouting

The initial array of alternatives was screened using the following criteria:

- Is the alternative likely to be cost effective in providing shoreline protection?
- Does the alternative require special equipment, material, or expertise that is not available in Guam?
- Does the alternative meet USACE design life requirements, including the consideration of 100 years of sea level change?
- Is the alternative likely to be environmentally acceptable?

Table 9 summarizes the screening of the initial array of alternative plans. Parametric cost estimates and concept designs were used to screen the initial array of alternatives.

Table 9: Screening of Initial Array of Alternatives

Alternative	Likely to be Cost Effective?	Special Equipment Required?	Meets USACE Design Requirements?	Likely to be Environmentally Acceptable?	Carried Forward
Alternative 1: No Action	N/A	N/A	N/A	N/A	Yes
Alternative 2: Revetment (rock or tribar)	Yes	No	Yes	Yes	Yes
Alternative 3: Precast Concrete Seawall	Yes	No	Yes	Yes	Yes
Alternative 4: Concrete Rubble Masonry (CRM) Wall	Yes	No	Yes	Yes	Yes
Alt 5: Secant Pile Wall	No	Yes	Yes	Yes	No
Alt 6: Permeation Grouting	Yes	Yes	No	Yes	No

Alternative 2 consists of either a rock or tribar revetment. Both measures have similar function and environmental impacts. At this stage in the planning process due to the cost variability, both were carried forward for further analysis. Material sourcing and availability will play a major factor in refinement of cost estimates. Tribar allows for the use of concrete armor units as an optimization if locally sourced armor stone is unavailable or too expensive to meet project budget requirements. Should an optimization be needed based on armor stone availability or cost, it would likely be incorporated during the Design & Implementation (D&I) phase.

The vertical seawall alternatives include Alternative 3: Precast Concrete Seawall, Alternative 4: Concrete Masonry Rubble (CRM) Wall, and Alternative 5: Secant Pile Wall. All three have a similar effectiveness in providing coastal erosion protection. All three also have a similar real estate footprint and wave reflection for environmental considerations. Out of the three alternatives, the secant pile wall has the highest costs because mobilization of specialized equipment and labor are required for the alternative. For this reason, the secant pile wall was screened out from further evaluation.

Alternative 6: Permeation Grouting functions to supplement the existing seawall, so the general footprint is like the other vertical wall options. However, from an engineering standpoint, this alternative is not as effective as the other vertical wall alternatives. Permeation grouting includes injecting chemical grout under pressure to harden granular soils both underneath and behind the existing seawall. For this, specialized equipment and material need to be mobilized, therefore increasing the costs for this alternative. In addition, permeation grouting is typically implemented to provide temporary support, so it has a low likelihood of meeting the USACE 50-year design life requirement. For these reasons, Alternative 6: Permeation Grouting was screened from further consideration.

3.4 Final Array of Alternatives

Based on the rationale and findings noted in Section 3.3, the Final Array of Alternatives were developed. The final array of alternatives include:

- Alternative 1: No Action Alternative
- Alternative 2: Revetment
- Alternative 3: Precast Concrete Seawall
- Alternative 4: Concrete Rubble Masonry (CRM) Wall

3.4.1 No Action Alternative

Under Alternative 1, no federal actions for emergency shoreline protection would be implemented. Conditions in the study area are anticipated to develop as described in the FWOP condition (Section 2). More frequent and severe tropical storms in combination with relative sea level rise would exacerbate shoreline erosion and leave South Marine Corps Drive exposed to severe damage. Without federal intervention, the Government of Guam will be forced to undertake protection of South Marine Corps Drive itself or risk imminent damage to the roadway and associated public utilities.

Without protection, South Marine Corps Drive would eventually need to be relocated or closed at a severe economic cost to the local sponsor.

3.4.2 Alternative 2 Revetment

Alternative 2 involves the removal and replacement of 2,100 ft. of existing seawall from (east end) 13.480339N, 144.768446E to (west end) 13.478478N, 144.762843E along South Marine Corps Drive with a revetment (Figure 12). The base of the revetment extends 17 ft. toward the ocean from the existing seawall toe. The temporary construction footprint of the revetment is approximately 40 to 50 ft. wide to accommodate for construction means and methods.

Based on current hydrological and site control data, the revetment may be inundated under each tidal datum as illustrated in Figure 12.

Figure 12: Temporary staging area and revetment extent

Engineered revetments reduce the erosive power of the waves by dissipating wave energy through the interstices of the stones. A small trench will need to be dug into the underlying limestone to seat the toe of the structure. The rock revetment would be constructed from the toe (approximately -2.5 ft. MSL) up to the crest elevation (approximately +9 ft. MSL), just 1 ft above the existing ground elevation of +8 ft. MSL (Figure 13). The 9-ft height design meets the 50-year design requirement for sea level rise (SLR) and is adaptable to the 100-year SLR under the intermediate scenario.

The revetment design consists of compacted fill as the foundation and base grade, a geotextile filter fabric, a double layer of underlayer stone, a double layer of armor stone, and is anchored by an oversized toe stone. The stone sizing of the underlayer and armor layer was determined to be 35 lbs. stone for the underlayer, 350 lbs. stone for the armor layer, and 525 lbs. stone for the toe. This alternative has the largest footprint of the alternatives included in the final array.

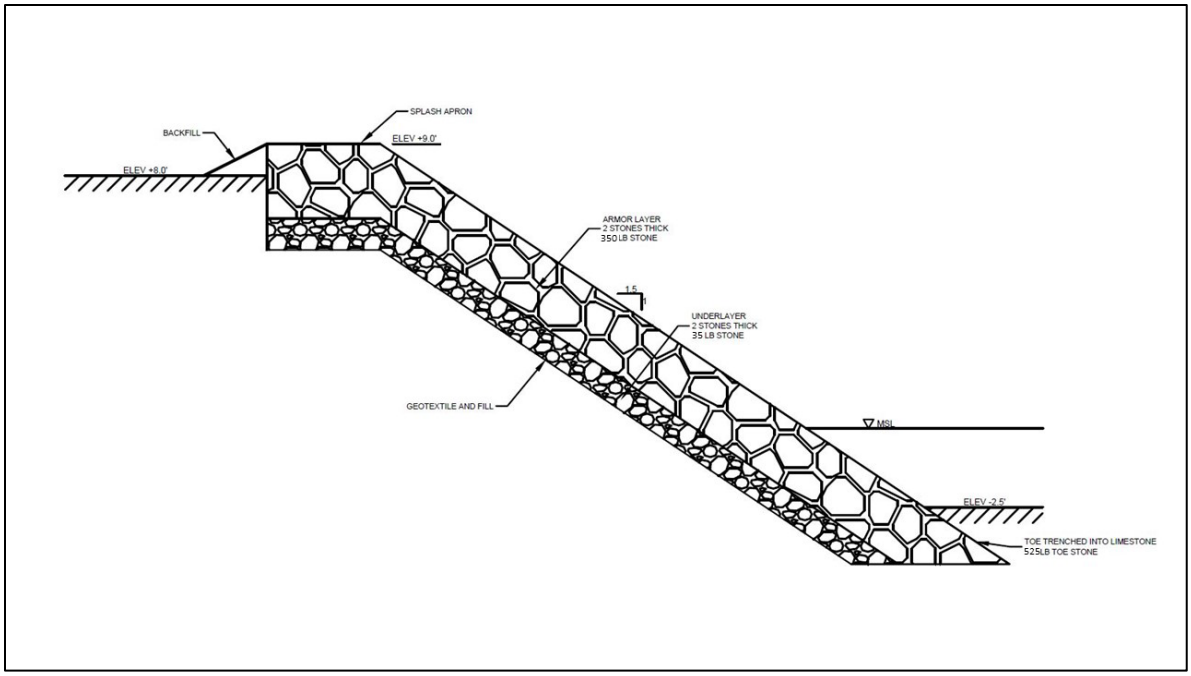

Figure 13: Preliminary revetment schematic

At the time of this study, there is evidence to suggest there is sufficient quantity and quality of stone available in Guam. The armor stone size was determined using the Hudson equation, under the following assumptions: the armor stone will be limestone with a density of 156 pounds per cubic foot (pcf) or 2.11 tons/cubic yard (cy), and the underlayer stone density will be 1.615 tons/cy. Additional assumptions include a specific weight of water of 64 pcf, a KD value of 2.0, and a 1 V:1.5H slope. The design wave height considered for the calculation was the highest observed wave height along the project location under the 2% Annual Exceedance Probability (AEP) +2072 intermediate SLC water level (2.8 ft.).

Depending on the cost and availability of local stone, use of pre-cast concrete armor units such as tribar (Figure 14) may also be considered. Tribar units would be placed in a single layer, uniformly, as is typical for this type of design. The 0.5-ton unit has an individual arm diameter of 1.1 ft., a unit diameter of 3.2 ft., and results in an average layer thickness of 2.2 ft. The 1-ton unit has an individual arm diameter of 1.3 ft., a unit diameter of 4.1 ft., and an average layer thickness of 2.7 ft.

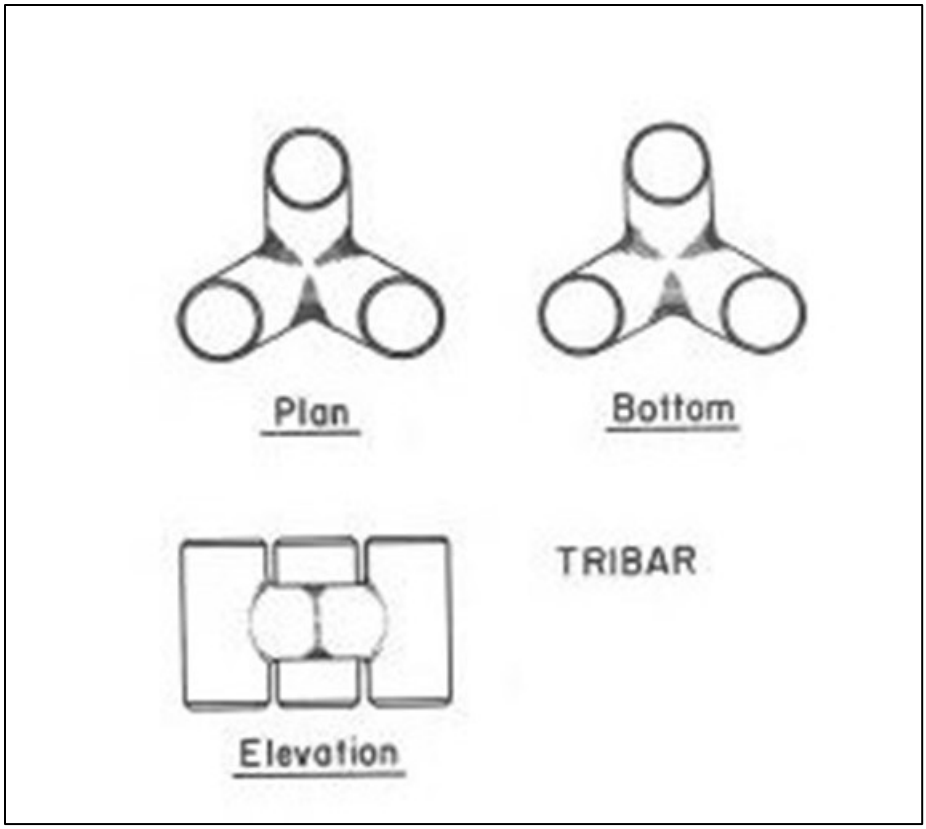

Figure 14: Example of a typical tribar unit

Table 10 summarizes the armor and under layer design criteria as well as the tribar design criteria. The expected design life of this system (assuming proper installation and routine maintenance) is on the order of 50 years.

Table 10: Preliminary Stone Sizing

Description	Median Weight (lbs)	Median Diameter (ft)	Layer Thickness (ft)
Armor Stone	350	1.3	2.6
Underlayer Stone	35	0.6	1.2
Toe Stone	525	2.0	2.0
Description	Tribar arm diameter (ft)	Tribar unit diameter (ft)	Layer Thickness (ft)
Tribar 0.5 ton unit	1.1	3.2	2.2
Tribar 1 ton unit	1.3	4.1	2.7

3.4.3 Alternative 3 Precast Concrete Seawall

Alternative 3 includes a precast concrete seawall which acts as a cantilever retaining wall. This design utilizes the weight of the backfill to provide resistance to the lateral earth pressures (Figure 15). Precast concrete panels would replace approximately 2,100 ft. of existing seawall. Construction of the precast concrete panel wall consists of excavating approximately two to three ft of coastal soils and placing individual wall panels on the limestone shelf. After erecting the wall, the excavated area would be backfilled and regraded to the elevation of the existing ground surface. This design has a top elevation of approximately +9 ft. above MSL and a base that is 7 ft. wide, with the total disturbed area being approximately 20 ft. due to excavation and backfill of the existing soils. Figure 16 illustrates the general footprint of the precast concrete seawall alternative. This design will meet USACE coastal engineering criteria for expected design life. It can meet the adaptability to relative sea level change (RSLC) criteria by increasing the height with concrete rubble masonry (CRM).

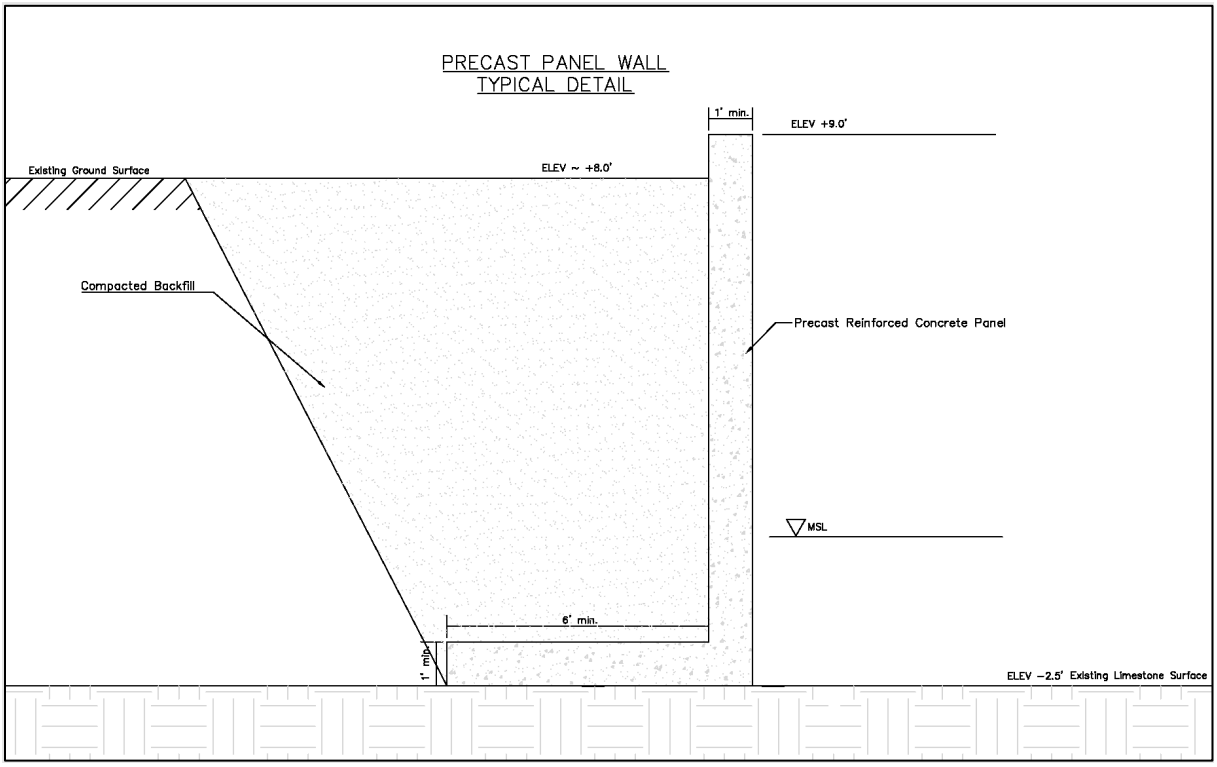

Figure 15: Cross section of a precast concrete wall

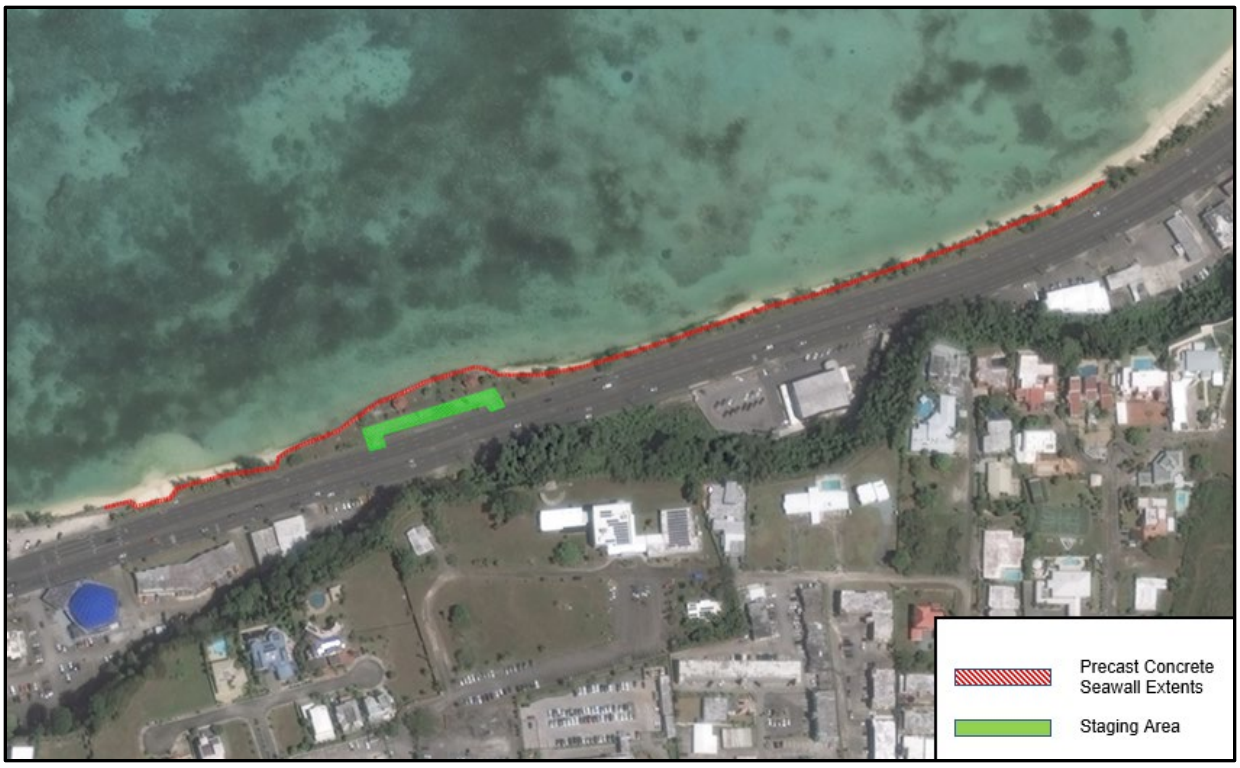

Figure 16: Precast concrete seawall footprint

3.4.4 Alternative 4 CRM Seawall

Alternative 4 includes removal of 2,100 linear ft of existing seawall and construction of a CRM seawall in its place. Figure 17 illustrates the lateral extent of the CRM seawall. The design consists of a precast concrete base secured to the limestone shelf and a CRM seawall constructed on top of the concrete foundation (Figure 18). Following the construction of the CRM seawall, the area would be backfilled and regraded to the elevation of the existing ground surface. The seawall would have an elevation of +9 ft. MSL and a base that is 9 ft. wide, with the total disturbed area being approximately 20 ft due to excavation and backfill of the existing soils. Local material can be used for construction of the CRM seawall. This alternative meets the USACE coastal engineering criteria for expected design life and adaptability to RSLC design. The CRM seawall is the alternative that most closely matches the existing seawall in aesthetics and materials and is engineered to withstand coastal erosion processes through interaction with the limestone shelf.

Figure 17: Footprint of concrete rubble masonry wall.

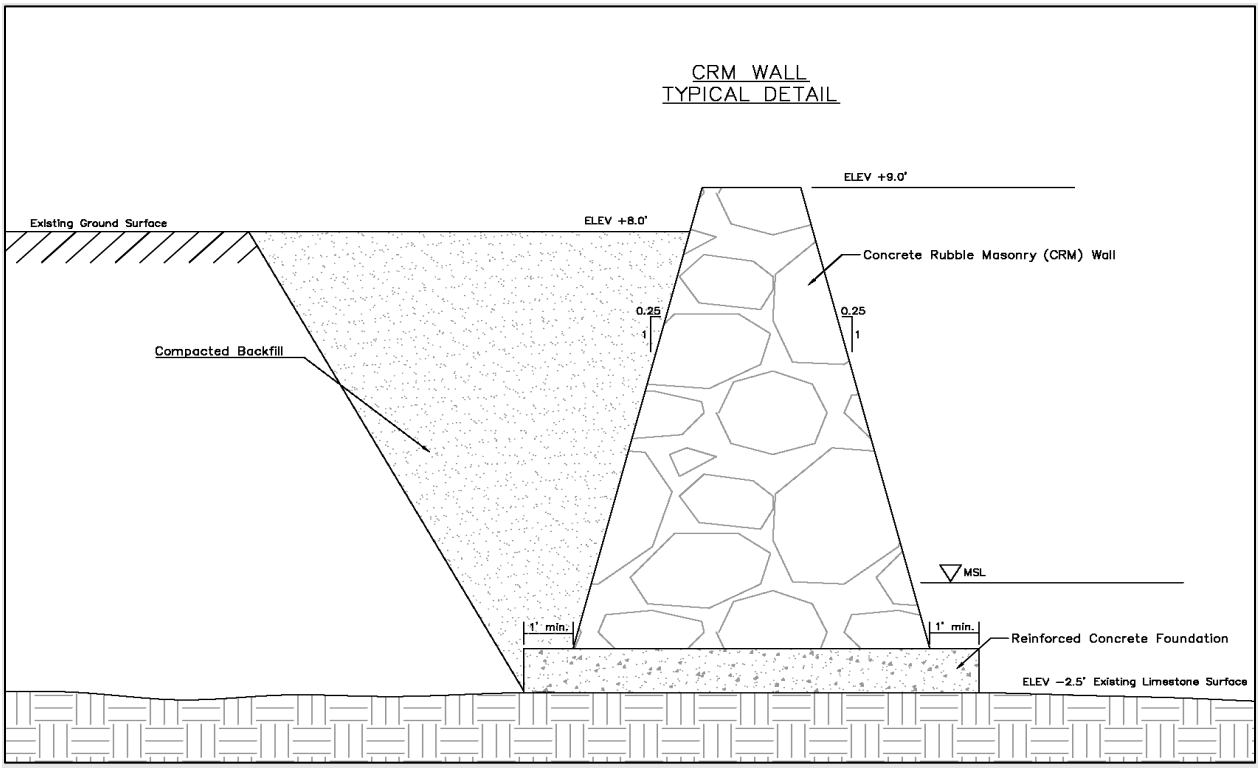

Figure 18: Cross section of concrete rubble masonry wall

4 ENVIRONMENTAL EFFECTS AND CONSEQUENCES

This section provides an analysis of effects and consequences (40 CFR 1502.16) of each alternative plan on the resources present in the study area (Section 2 in comparison to the No Action or (FWOP) conditions i.e., Alternative 1: No Action. For the most part, the Corps anticipates that Alternatives 2, 3 and 4 would cause similar effects to resources listed below and accordingly discusses the impacts of all alternatives together. For resources where the effect differs between alternatives, the effects are discussed independently, per resource. The general setting, natural, physical, and built environments as described in Section 2 are expected to change under the FWOP condition due to the climate change impacts described in Section 2.

Project impacts may be permanent or temporary, adverse, or beneficial, and include both direct and indirect effects. Impacts from the proposed construction will be permanent and temporary in nature. Permanent impacts are those that cause a permanent alteration of the physical, chemical, or biological properties of an area. Temporary impacts occur when fill and/or cut impacts occur that are restored to pre-construction contours or condition when construction activities are complete. (e.g., staging or stockpile area, temporary access construction easements, temporary access routes). Table 11 provides a summary of permanent and temporary impacts by action alternative for the Proposed Project.

Direct effects are caused by the action and occur at the same time and place; indirect effects are caused by the action and are later in time or farther removed in a spatial context (distance from the source of the effect) but are still reasonably foreseeable. Best management practices (BMPs) are used to avoid or minimize direct and indirect impacts. BMPs are policies, practices, procedures, or structures implemented to mitigate the adverse environmental effects resulting from construction activities. BMPs for this project are detailed in Section 6.9 Environmental Commitments and will be included in construction requirements.

Temporary impacted habitat areas include upland staging areas for construction (Figures 11, 15, and 16) and are the same across alternatives. The permanently impacted habitat area is the area that would be disturbed by the placement of each of the alternative plans in the final array (Figures 11, 15, and 16). It is not feasible to calculate the extent of erosion under the No Action Alternative within the constraints of this Feasibility Study.

Table 11: Habitat Area Affected by Alternatives 2, 3, and 4

Impact	**Alternative 1: No Action**	**Alternative 2: Rock Revetment**	**Alternative 3: Precast Concrete Seawall**	**Alternative 4: CRM Wall**
Upland *Temporary Impacts (acres)*	0	0.96	0.96	0.96
Beach/Intertidal *Permanent Impacts (acres)*	unknown	0.82	0	0.48
Slope	0	1.5H/1V	0	0.25H/1V

Criteria based on the definitions of significance and 40 CFR 1508.1 were identified for each resource to assist with evaluation of the potential for significant adverse effects:

- Beneficial. This effect would provide benefit to the environment as defined for that resource.
- No Effect. This effect would cause no discernible change in the environment as measured by the applicable significance criteria; therefore, no mitigation would be required.
- Less than Significant. This effect would cause no substantial adverse change in the environment as measured by the applicable significance criteria; no mitigation would be required, though BMPs may be used to meet other regulatory requirements.
- Significant. This effect would cause a substantial adverse change in the physical conditions of the environment or as otherwise defined based on the significance criteria. Significant effects can be categorized as: (1) those for which there is feasible mitigation available that would avoid or reduce the environmental effects to less-than-significant levels, and (2) those for which there is either no feasible mitigation available or for which, even with implementation of feasible mitigation measures, would remain a significant adverse effect on the environment (significant and unavoidable effects).

Table 12: Summary of Chapter 4 Potential Effects.

Resource	Alternative 1 No Action	Alternative 2 Rock Revetment	Alternative 3 Precast Concrete Seawall	Alternative 4 CRM Seawall
Climate	N	N	N	N
Air Quality*	N	L	L	L
Geology	S	L	L	L
Hydrology	S	L	L	L
Water Resources and Quality*	S	L	L	L
Hazardous, Toxic & Radioactive Wastes	N	N	N	N
Noise*	N	L	L	L
Terrestrial Habitats and Species*	S	L	L	L
Marine Habitats and Species*	S	L	L	L
Threatened/Endangered Species/Critical Habitat	L	L	L	L
Essential Fish Habitat*	L	L	L	L
Special Aquatic Sites*	L	L	L	L
Invasive species*	N	L	L	L
Land use*	S	L	L	L
Public infrastructure*	S	L	L	L
Socioeconomics	S	B	B	B
Environmental justice	S	B	B	B
Historic and Archaeological Resources	S	L	L	L
Other cultural resources*	S	L	L	L
Aesthetics	S	B	B	B
*Effect would cause substantial adverse change in the environment; however, use of standard BMPs would avoid or reduce the environmental effects to less-than-significant or beneficial levels.				
S = Significant, L = Less than Significant, N= No Effect, B = Benefit				

4.1 Physical Environment

4.1.1 Climate

4.1.1.1 Alternative 1 No Action

Without replacement of the wall with a structure having a more stable base, more frequent and severe tropical storms in combination with relative sea level rise would exacerbate shoreline erosion and leave South Marine Corps Drive exposed to severe damage. Without federal intervention, the Government of Guam will be forced to undertake protection of South Marine Corps Drive itself or risk imminent damage to the roadway and associated public utilities. Without protection, South Marine Corps Drive would eventually need to be relocated or closed at a severe economic cost to the local sponsor. For these reasons, USACE has determined this alternative would cause significant impacts to the shoreline from climate change and sea level rise, however the alternatives would have no effect on the climate.

4.1.1.2 Alternatives 2-4

Projected sea level rise within the 50-year study period (2026 to 2076) will be approximately 1.28 ft (Figure 8 Appendix A-1 Engineering). The design water level, based on short-term, storm-driven water level changes superimposed on the astronomical tides (Figure 9 Appendix A-1 Engineering) is approximately 1.4 ft (0.42 m) relative to MHHW or 2.3 ft (0.71 m) relative to MSL.

For these reasons, USACE has determined the alternatives would address effects from climate, and the alternatives would have no effect on the climate.

4.1.2 Air Quality

4.1.2.1 Alternative 1 No Action

Under the No Action Alternative, no federal actions for emergency shoreline protection would be implemented. It is expected that the FWOP air quality conditions would be the same as existing conditions. Air pollution sources within the study area would not be expected to change substantially over the period of analysis. With continuing trade wind patterns, air quality levels are expected to remain relatively constant and would continue to comply with federal and Territory standards. For these reasons, USACE has determined the No Action Alternative would result in no effects to air quality resources.

4.1.2.2 Alternatives 2-4

Alternatives 2-4 have the same potential temporary insignificant effects on air quality. Gases from construction equipment may cause a temporary reduction in air quality at the project site during construction. There may be some temporary generation of dust near the construction area resulting from transport and handling of construction materials. No long-term degradation of air quality would result from implementation of the project. Construction activities involving heavy equipment are minimal and will cease once construction is completed; significant impacts to ambient air quality are not expected and will likely be immeasurable. For these reasons, USACE has determined the alternatives would cause less than significant impacts to air quality.

4.1.3 Geology

4.1.3.1 Alternative 1 No Action

The No Action Alternative would result in collapse of the seawall and erosion of the surrounding land, changing the geology and topography, and shifting the intertidal zone inland. For these reasons, USACE has determined the No Action Alternative would cause significant impacts to geology.

4.1.3.2 Alternatives 2-4

Alternatives 2-4 have slightly different footprints and slopes which would result in minimal changes to the geology and topography of the study area. They all would have the positive effect of protecting the floodplain.

Alternatives 2-4 all have the same temporary less than significant effects on soils. All require the removal of the 2100 ft of existing stonewall requiring excavation and subsequent backfill of 20 ft inland of the wall resulting in a temporarily disturbed area of 0.96 acres. The urban land–ustorthents complex (NRCS 2021) soil in the study area is similar in composition to any fill used in construction.

USACE anticipates the beneficial effects to geology and topography of the shoreline and accordingly preliminarily determined the alternatives would have a less than significant impact on geology and topography in the study area.

4.1.4 Hydrology

4.1.4.1 Alternative 1 No Action

The No Action Alternative would result in changes to hydrology from the collapse of the seawall and erosion of the shoreline. For this reason, USACE has determined the No Action Alternative would cause significant impacts to hydrology.

4.1.4.2 Alternatives 2-4

Alternatives 2-4 would maintain the existing shoreline and protect the existing hydrology. Seawalls are known to disrupt longshore sediment transport, causing erosion and accretion elsewhere. USACE proposes to replace the existing seawall i.e., hardened shoreline, with an engineered structure in the same footprint. Accordingly, the anticipated impacts to longshore sediment transport post-construction would be similar to existing. USACE has determined the proposed action would cause less than significant impact to nearshore hydrology, currents, tide, and circulation.

Effects are positive for the resource; therefore, no environmental commitments are required.

4.1.5 Water Quality

4.1.5.1 Alternative 1 No Action

The No Action Alternative would result in increased sediment and pollution load in the Bay due to collapse of the seawall and erosion of the surrounding land. For these reasons, USACE has determined the No Action Alternative would cause significant impacts to surface water quality.

4.1.5.2 Alternatives 2-4

There may be some localized, transient increases in turbidity created by excavation and setting of stones under all Alternatives, the use of BMPS as described in Section 6.9 will mitigate these impacts. No long-term effects on water quality are anticipated under alternatives 2 through 4. For these reasons, USACE has determined the alternatives would cause less than significant impacts to surface water quality.

4.1.6 Hazardous, Toxic, and Radioactive Wastes

There are no known contaminants in the area therefore the alternatives are anticipated to have no effect on hazardous, toxic, and radioactive wastes. Accordingly, no environmental commitments are required.

4.1.7 Noise

4.1.7.1 Alternative 1 No Action

The No Action Alternative would not affect current noise levels in the study area.

4.1.7.2 Alternatives 2-4

There may be some localized, transient increases in noise created by construction activities under Alternatives 2-4, the use of BMPS as described in Section 6.9 will mitigate these impacts. No long- term effects on noise are anticipated under alternatives 2 through 4. For these reasons, USACE has determined the alternatives would cause less than significant impacts to noise.

4.2 Natural environment

4.2.1 Terrestrial Habitats and Species

4.2.1.1 Alternative 1 No Action

The No Action Alternative would result in the eventual loss of some or all of the terrestrial environment between South Marine Corps Drive and Hagatna Bay, and its associated species as the existing seawall collapses, the shoreline erodes, and sea level rises. Resources in the action area will continue to be vulnerable to inundation and wave damages from elevated sea levels during storm events. Since the shoreline in the study area is generally receding landward, the threat of coastal inundation and storm damage will become more extreme and frequent over time (USACE 2015). For these reasons, USACE has determined the No Action Alternative would cause significant impacts to terrestrial habitat and species.

4.2.1.2 Alternatives 2-4

The Rock Revetment, Precast Concrete Seawall, and Concrete Rubble Masonry Wall all have the same temporary less than significant effects on the terrestrial habitat. All require the removal of the 2100 ft of the existing stonewall requiring excavation and subsequent backfill of 20 ft inland of the wall resulting in a temporarily disturbed area of 0.96 acres. It is estimated that 20 trees would be removed during construction and replaced after construction with appropriate and desirable native species and all bare ground would be revegetated. Impacts to terrestrial animals would be temporary during construction and less than significant due to implementation of Best Management Practices (BMPs) as described in Section 6.9 Construction of the alternatives would beneficially protect existing and restored terrestrial habitat between the wall and the road. Construction may make more nesting sites for Sali to disburse and use (Duenas 2022).

For these reasons, USACE has determined Alternatives 2-4 would cause less than significant impacts to terrestrial habitats and species.

4.2.2 Marine Habitats and Species

4.2.2.1 Alternative 1 No Action

The No Action Alternative would result in increased sediment and pollution load in the Bay due to collapse of the seawall and erosion of the surrounding land contributing material to the bay. Beach and intertidal habitat would be lost. For these reasons, USACE has determined the No Action Alternative would cause significant impacts to marine habitats and species.

4.2.2.2 Alternative 2 Rock Revetment

With a conservatively estimated permanent footprint of 0.82 acres, the rock revetment would replace the greatest area of existing sandy rocky shoreline with coarser rock. During construction, excavation of beach material and some limestone along the shoreline will be necessary prior to installation of the toe and armor stones of the revetment. Benthic invertebrates residing within this zone would be destroyed in the process and are expected to readily re-colonize remaining nearby sandy bottom. The beach and intertidal areas which serve as foraging and loafing habitat for shore birds would be disrupted during construction. After completion of the project the beach would be expected to reestablish and stabilize along the seaward edge of the revetment, followed by the colonization of the supratidal and intertidal zones with organisms typically associated with them. There will be no loss of open water, only intertidal area and beach (Figure 11). For these reasons, USACE has determined Alternative 2 would cause less than significant impacts to marine habitat and species.

4.2.2.3 Alternative 3 Precast Concrete Seawall

The Precast Concrete Seawall has the same permanent footprint as the existing seawall and would not create any additional permanent changes to the shoreline or adjacent marine habitat. Temporary, less than significant impacts, to habitat and fish and wildlife such as increased human presence, elevated noise levels, and elevated turbidity would occur during construction, however adverse impacts would be avoided and/or minimized to the greatest extent practicable through implementation of Best Management Practices (BMPs) as described in Section 6.9. For these reasons, USACE has determined Alternative 3 would cause less than significant impacts to marine habitats and species.

4.2.2.4 Alternative 4 CRM Seawall

The CRM seawall would replace 0.48 acres of the existing sandy rocky shoreline with coarser rock. During construction, excavation of beach material and coral reef rock along the shoreline will be necessary prior to installation of the toe and armor stones of the revetment. Sand bottom invertebrates residing within this zone would be destroyed in the process and are expected to readily re-colonize remaining nearby sandy bottom. Beach and intertidal areas which serve as foraging and loafing habitat for shore birds

would be disrupted during construction of the shore protection structure. With completion of the project, the beach is expected to reestablish and stabilize along the seaward edge of the revetment, minimizing any long-term effects on shore bird habitat. For these reasons, USACE has determined Alternative 4 would cause less than significant impacts to marine habitats and species.

4.2.3 Federal Threatened and Endangered Species

Based on current observations, green sea turtle, hawksbill sea turtle, *Acropora globiceps*, and Mariana Fruit bat would not occur in the study area during the project. Therefore, the proposed alternatives may affect but are not likely to adversely affect threatened or endangered species.

4.2.3.1 Alternative 1 No Action

The No Action Alternative would result in the eventual loss of some or all of the terrestrial environment between South Marine Corps Drive and Hagatna Bay, and its associated species as the existing seawall collapses and the shoreline erodes. Erosion releases terrigenous sediments and pollution into the bay. Beach and intertidal habitat for resting and feeding by sea turtles would be lost. Erosion over time would contribute a chronic input of landside pollutants into the bay which is likely to adversely affect *A. globiceps,* an ESA-listed coral. For these reasons, USACE has determined the No Action Alternative would cause less than significant impacts to, and is likely to adversely affect, federal threatened and endangered species and their habitat.

4.2.3.2 Alternatives 2 -4

The Rock Revetment, Precast Concrete Seawall, and Concrete Rubble Masonry Wall all have the same temporary less than significant effects on green sea turtle foraging in the project area and the less than significant effects on habitat quality of the bay, which would be mitigated with best management practices as detailed in Section 6.9. Given the existing conditions as previously described in Section 2 and in the absence of any shoreline protection measure, the amount of sandy shore habitat that would permanently be lost under the footprint of Alternatives 1 and 2 is still expected to be less than would be lost to natural forces under the No Action Alternative. Mariana Fruit Bat may pass through on their way to foraging areas, but none of their roosting or foraging trees species were observed in the study area. The closest coral is well outside the study area.

For these reasons, USACE has determined Alternatives 2-4 may affect but is not likely to adversely affect federal threatened and endangered species and their habitat and that effect is expected to be less than significant with implementation of BMPs in Section 6.9.

4.2.4 Essential Fish Habitat

Based on current observations, Guam-based management unit (MSA MUS) species would not occur in the study area during the project. Therefore, the proposed

alternatives may affect but are not likely to adversely affect EFH. Effects on the resource will be less than significant with implementation of BMPs in Section 6.9.

4.2.5 Special Aquatic Sites

The only Special Aquatic Sites present in Hagatna Bay are Coral Reefs, which occur 100 yards away from the study area.

4.2.5.1 Alternative 1 No Action

The No Action Alternative would result in increased sediment and pollution load in the Bay due to collapse of the seawall and erosion of the surrounding land contributing material to the bay. Depending on the volume, duration, and composition of terrigenous and anthropogenic pollutants into the bay, water quality may be degraded and adversely impact distant corals over time. For these reasons, USACE has determined the No Action alternative would cause less than significant impacts to coral reefs.

4.2.5.2 Alternatives 2 -4

The Rock Revetment, Precast Concrete Seawall, and Concrete Rubble Masonry Wall all have the same temporary less than significant effects on the habitat quality of the bay due to construction within the intertidal zone at low tide during daylight hours, which would be mitigated with best management practices as detailed in Section 6.9. Construction of each of these alternatives would occur at low tide from land and not require in water work. Construction activities will occur at a far enough distance from known coral reefs that no direct impacts are anticipated. As detailed in Section 6.9 Environmental Commitments, industry-standard BMPs will be employed to curtail spread of construction-generated turbidity that could degrade water quality and indirectly impact distant coral reefs. Such impacts would be avoided and minimized to the greatest extent practicable and also would occur only during the duration of in-water construction. Because of the spatial distance preventing direct impacts and the implementation of BMPs to minimize degradation of water quality and the discrete, temporary in-water construction period, the Corps anticipates less than significant pacts to coral reefs.

4.2.6 Invasive Species

4.2.6.1 Alternative 1 No Action

There are currently no invasive species identified in the study area. Under the No Action Alternative construction activities would not occur and there would be no opportunity for introduction of invasive species. The No Action Alternative would have no effect on invasive species.

4.2.6.2 Alternatives 2-4

All of the Alternatives require mobilization of equipment and materials and will also increase human presence. These all present vectors for introduction of invasive species into the study area if appropriate hygiene practices are not implemented. As

detailed in Section 6.9 Environmental Commitments, USACE will require its construction contractor to ensure equipment and material are clean and free of invasive species. Upon completion of construction USACE will ensure no invasive species are used to re-vegetate disturbed areas. Through implementation of these precautions, USACE anticipates less than significant impacts from invasive species.

4.3 Built Environment

4.3.1 Land Use

4.3.1.1 Alternative 1 No Action

The No Action Alternative would result in loss of the current land use when the seawall collapses and the land erodes. For these reasons, USACE has determined the No Action Alternative would cause significant impacts to land use.

4.3.1.2 Alternatives 2-4

Alternatives 2-4 would result in temporary less than significant impacts to land use during construction. The long-term effect of the alternatives is the protection of the park and recreational land use.

Effects will be temporary, based on inaccessibility of the site during construction. Construction will be phased to allow public access to as much of the study area as possible throughout construction. For these reasons, USACE has determined Alternatives 2-4 would cause less than significant impacts to land use.

4.3.2 Public Infrastructure

4.3.2.1 Alternative 1 No Action

The No Action Alternative would result in collapse of the seawall, erosion of the surrounding land, and loss of existing public infrastructure. For these reasons, USACE has determined the No Action Alternative would cause significant impacts to public infrastructure.

4.3.2.2 Alternatives 2-4

Alternatives 2-4 would result in temporary less than significant impacts to public infrastructure during construction. Long-term positive impacts of protection of the public infrastructure would result from all three alternatives.

Effects will be temporary, based on inaccessibility of the site during construction. Construction will be phased to allow public access to as much of the study area as possible throughout construction. For these reasons, USACE has determined Alternatives 2-4 would cause less than significant impacts to public infrastructure.

4.4 Economic Environment

4.4.1 Socio-Economic Conditions

4.4.1.1 Alternative 1 No Action

The No Action Alternative would result in impacts to socioeconomic conditions from the loss of land, infrastructure, and potentially the road. For these reasons, USACE has determined the No Action Alternative would cause significant impacts to socio-economic conditions.

4.4.1.2 Alternatives 2-4

Alternatives 2-4 would result in short term positive impacts to the socio-economic conditions with employment for construction and purchase of local supplies and services.

Effects are positive for resource; therefore, no environmental commitments are required. For these reasons, USACE has determined Alternatives 2-4 would cause beneficial impacts to socio-economic conditions.

4.4.2 Environmental Justice

4.4.2.1 Alternative 1 No Action

The No Action Alternative would exacerbate the disadvantages of the community in the loss of land and infrastructure. For these reasons, USACE has determined the No Action Alternative would cause significant environmental justice impacts to the community.

4.4.2.2 Alternatives 2-4

Alternatives 2-4 would provide positive impacts by protecting resources and related opportunities for the community.

Effects are positive for resource; therefore, no environmental commitments are required. For these reasons, USACE has determined Alternatives 2-4 have a beneficial impact on environmental justice for the community.

4.5 Cultural Resources

4.5.1 Historical and Archaeological Resources

4.5.1.1 Alternative 1 No Action

The No Action Alternative would result in collapse of the seawall, erosion of the surrounding land, and potential loss of nearby cultural resources. For these reasons, USACE has determined the No Action Alternative would cause significant impacts to historical and archaeological resources.

4.5.1.2 Alternatives 2-4

In accordance with 36 CFR § 800.4(a)(1), USACE has determined that the area of potential effect (APE) is the same for Alternatives 2-4 (Figure 19). A review of published literature, grey literature, and other documentation provided to USACE by the Guam Historic Resources Division in response to Requests for Assistance identified 14 known cultural resources in the general vicinity of the proposed undertaking's area of potential effects (APE). No known historic properties have formally been reported within the APE at this time; however, consultation has identified at least one burial within the APE and there is a likelihood that subsurface cultural resources and/or other burials exist that could be impacted by construction along the shoreline. Consultation with the Guam State Archaeologist identified additional cultural resources and burial locations that have not yet been formally reported (J. M. Joseph, pers. comm. 2022).

The extensive subsurface cultural materials and burials that have been recovered to the east and west of the APE suggest that there is a strong potential that subsurface cultural resources will be affected during revetment construction. Consultation with the Guam State Historic Preservation Office (SHPO) has indicated that the boundaries of the San Antonio Village Site (66-01-261), specifically, are likely to extend into the APE. Due to the inability to determine whether there are subsurface cultural resources or burials within the APE, USACE proposes to conduct a phased identification and evaluation effort in accordance with 36 CFR § 800.4(b)(2), formally documented in a Memorandum of Agreement development in accordance with 36 CFR § 800.6. The Memorandum of Agreement will minimize or resolve any adverse effects on historic properties as appropriate.

In order to minimize or mitigate any adverse effects on inadvertent discoveries of human burials or subsurface archaeological sites that may be eligible for listing in the National Register of Historic Places, the MOA is expected to require, at minimum, that an on-site archaeologist who meets the *Secretary of the Interior's Historic Preservation Professional Qualification Standards* (36 CFR § 61; 48 FR 44716) monitor all ground-disturbing construction activities within the APE. It will also include an appropriate and respectful Human Remains Recovery Plan that meets the requirements of Guam Territorial Executive Order No. 89-24 and adheres to the Guam Department of Parks and Recreation's 2010 Section IV Reburial Guidelines Amendments. USACE has requested concurrence from the Guam SHPO on this assessment of adverse effect in accordance with 36 CFR § 800.3(c); concurrence was received on May 15, 2023 (see Appendix 3, Attachment 6. Execution of the MOA will ensure less than significant impacts to historical and archaeological resources.

Figure 19. Area of potential effect (yellow polygon) and approximate locations of known cultural resources (red points and red polygon)

4.5.2 Other Cultural Resources and Subsistence Activities

4.5.2.1 Alternative 1 No Action

The No Action Alternative would result in collapse of the seawall, erosion of the surrounding land, and potential loss of public access for traditional fishing practices. For these reasons, USACE has determined the No Action Alternative would cause significant impacts to other cultural resources and subsistence activities.

4.5.2.2 Alternatives 2-4

Alternatives 2–4 would temporarily impact access to the water for traditional fishing while construction was active. All three alternatives include the current public access via steps to the beach. The Rock Revetment would replace 0.82 acres of existing sandy rocky shoreline with coarser rock and create a 1.5H/1V slope which is walkable for water access and would have the positive effect of protecting the shoreline and maintain a wadeable depth. The Precast Concrete Seawall has the same permanent footprint as the existing seawall and would not change the slope, width, or depth of the beach. While the upland would be protected, the beach in front of the wall could still erode, which may adversely impact subsistence activities from the shore. The CRM seawall would replace 0.48 acres of the existing sandy rocky shoreline with and would have the positive effect of protecting the shoreline. While the upland would be protected, the beach in front of the wall could still erode, which may adversely impact subsistence activities from the shore.

The study area is absent of Tribal Trust Resources as there are no federally recognized tribes in Guam. Accordingly, the resource is unaffected by the action, therefore no environmental commitments are required. Effects will be temporary, based on

inaccessibility of the site during construction. Construction will be phased to allow public access to as much of the study area as possible throughout construction.

For these reasons, USACE has determined Alternatives 2-4 would cause less than significant impacts to other cultural resources and subsistence activities.

4.5.3 Aesthetics

4.5.3.1 Alternative 1 No Action

The No Action Alternative would result in collapse of the seawall, erosion of the surrounding land, and potential loss of public access for appreciating the visual aesthetics of Hagatna Bay. For these reasons, USACE has determined the No Action Alternative would cause significant impacts to aesthetics.

4.5.3.2 Alternatives 2-4

Alternatives 2 – 4 would add approximately 1 ft of height above the existing wall, which would not affect views from South Marine Corps Drive or the beach parks. The crest elevation of structural improvements should not obstruct the view of the bay. The Revetment would add 17 horizontal ft of rock similar in appearance to the rock already present in the seawall along the shoreline, blending with the current aesthetics. The Precast Concrete Seawall would take the place of the existing seawall with a smoother face. The CRM seawall would look most like the current seawall.

Effects are positive for the resource; therefore, no environmental commitments are required. For these reasons, USACE has determined Alternatives 2-4 would cause beneficial impacts to aesthetics.

5 PLAN COMPARISON AND SELECTION

5.1 Plan Evaluation

5.1.1 Federal Objective

In accordance with Engineering Regulation 1105-2-100, plan formulation and evaluation for CAP Section 14 projects focuses on the least cost alternative. The least cost alternative is considered justified if the total costs of the alternative is less than the costs to relocate the threatened facility.

5.1.2 Contribution to Objectives and Avoidance of Constraints

This section evaluates the alternatives considering the study's objectives (to reduce erosion risks to critical infrastructure in the study area). The following conclusions were drawn from the hydrology and hydraulics analyses and a limited economic analysis:

- All alternatives carried forward to the final array are effective in protecting South Marine Corps drive from storm surge and big wave events, compared to FWOP conditions in Alternative 1: No Action.
- All alternatives conform with USACE requirements for consideration of sea level change over the 50-year period of analysis and are adaptable to 100-year sea level change.
- All alternatives carried forward to the final array have estimated total first costs that are less than the estimated cost of relocating South Marine Corps Drive. The cost of relocating South Marine Corps Drive, without accounting for real estate acquisitions, is estimated at $13 million per mile for a 5-mile length of road, a total cost of $65 million.

5.1.3 P&G Criteria – Completeness, Effectiveness, Efficiency, and Acceptability

Completeness, effectiveness, efficiency, and acceptability are the four evaluation criteria specified in the P&G in the evaluation and screening of alternative plans (USACE ER 1105-2-100). Alternatives considered in any planning study should meet minimum subjective standards of these criteria to qualify for further consideration and comparison with other plans.

Completeness is the extent to which an alternative provides and accounts for all features, investments, and/or other actions necessary to realize the planned effects, including any necessary actions by others. It does not necessarily mean that alternative actions need to be large in scope or scale.

Effectiveness is the extent to which an alternative plan alleviates the specified problems and achieves the specified opportunities.

Efficiency is the extent to which an alternative plan is a cost-effective means of alleviating the specified problems and realizing the specified opportunities, consistent with protecting the nation's environment.

Acceptability is the viability and appropriateness of an alternative from the perspective of the Nation's general public and consistency with existing Federal laws, authorities,

and public policies. It does not include local or regional preferences for particular solutions or political expediency.

Table 13: P&G Criteria Evaluation of Alternatives

Alternative	Completeness	Effectiveness	Efficiency	Acceptability
Alternative 1: No Action	Low	Low	Low	Low
Alternative 2. Revetment	High	High	High	Med
Alternative 3: Precast Concrete Seawall	High	High	Med	High
Alternative 4: Concrete Rubble Masonry (CRM) Wall	High	High	Med	High

Completeness. The No Action alternative has a low rating on completeness, as another project would be required to meet the study objective of providing coastal erosion protection. The three structural alternatives are complete and do not require additional investments or actions to meet the study objectives.

Effectiveness. The No Action alternative rates low on effectiveness since it provides no protection from shoreline erosion. All three structural alternatives are highly effective in protecting South Marine Corps Drive against coastal erosion risks.

Efficiency. The No Action alternative rates low on efficiency because although the alternative would not require immediate funds, it has zero effectiveness in alleviating the specified problems and realizing the specified opportunities. The precast concrete seawall and CRM seawall have higher costs than the revetment, giving the two vertical seawall options a medium rating in efficiency.

Acceptability. The No Action alternative rates low on acceptability as the local government needs immediate assistance of protecting South Marine Corps Drive, which is considered critical to the local economy as well as to national security. The Revetment alternative is rated medium because the relatively wide footprint is likely to reduce the amount available beach for recreational use by locals. The Precast Concrete Seawall and CRM Seawall alternatives are rated high in acceptability as they most closely resemble the existing seawall in terms of aesthetics and general footprint.

5.2 Plan Comparison

The following sections summarize the fifth step in the six-step planning process: comparison of alternative plans. The initial array of alternatives described in Section 3.3 were either screened out or carried forward to the final array of alternatives (Section 3.4). For CAP Section 14 feasibility studies, the TSP is the least cost alternative that is environmentally acceptable, technically feasible, and meets study objectives. In this section, the final array of alternatives will be compared against each other for environmental considerations and cost of implementation.

An evaluation of potential environmental impacts by resource category for each of the alternatives in the final array is included in Section 4. For all resource categories, the

effect determination for the final array of proposed alternatives falls under one of the following: (1) Beneficial; (2) No Effect; (3) Less than Significant; or (4) Significant. Table 14 provides an assessment of environmental acceptability for each proposed alternative included in the final array.

Table 14: Assessment of Environmental Acceptability

Alternative	Significantly Affected Resources	Environmentally Acceptable?
Alternative 1: No Action	Geology, Hydrology, Water Quality, Fish and Wildlife Habitat, Threatened and Endangered Species, Special aquatic sites, Invasive species, Land use, Public infrastructure, Socio-economics, Environmental justice, Historical and archaeological resources, Other cultural resources, Aesthetics	No
Alternative 2: Revetment	None	Yes
Alternative 3: Precast Concrete Seawall	None	Yes
Alternative 4: Concrete Rubble Masonry (CRM) Wall	None	Yes

Alternative 1 is expected to cause significant impacts to the resources listed above. Accordingly, USACE has determined Alternative 1 is not environmentally acceptable. Alternatives 2-4 which propose both measures for shoreline protection and implementation of standard BMPs listed in Section 6.9 that would avoid or minimize environmental effects would result in less than significant or beneficial impacts to the resources considered under Section 4.0. Accordingly, USACE has determined that Alternatives 2, 3 and 4 are all environmentally acceptable.

5.3 Identification of the Least Cost Alternative

Under the CAP Section 14 authority, the least cost, environmentally acceptable alternative that meets study objectives is selected as the TSP. The cost to protect must be less than the cost to relocate the threatened facility. Table 15 compares the estimated Project First Costs at fiscal year (FY) 2022 price levels for each of the final array of alternatives.

Table 15: Project First Costs of Each of the Alternative Plans

Alternative	Project First Cost (FY22 Price Level)	Cost Ranking
Road Relocation	$65,000,000	N/A
Alt. 1 No Action	$0	N/A
Alt. 2 Revetment	$9,968,000	1
Alt. 3 Precast Concrete Seawall	$13,344,000	2
Alt. 4 Concrete Rubble Masonry (CRM) Seawall	$23,690,000	3

The No Action Alternative has the lowest cost estimate of $0, but since this alternative does not provide any protection to South Marine Corps Drive, it does not meet the study objectives.

Alternative 2 revetment ranks the highest of the three structural alternatives with the lowest projected construction costs of $9.97 million. Preliminary analysis indicate locally sourced limestone is of sufficient quality and availability in Guam which makes this alternative highly cost effective.

Alternative 3 precast concrete seawall ranks second highest with the second lowest cost estimate of $13.3 million.

Alternative 4 CRM seawall ranks the lowest out of the three structural alternatives with the highest cost estimate of $23.7 million.

5.4 Plan Selection

Based on the environmental and economic assessment of the final array of alternatives, Alternative 2: Revetment is selected as the TSP. Alternative 2 was assessed as environmentally acceptable (Table 14) and is the least cost alternative (Table 15) that meets study objectives. Alternative 2 is more cost effective than relocating South Marine Corps Drive.

6 THE TENTATIVELY SELECTED PLAN

6.1 Plan Components

The selected plan includes the following components:

- Demolition of approximately 2,100 linear ft of existing seawall
- Construction of a rock revetment to replace the existing seawall. The revetment consists of the following components:
    - A compacted graded fill and geotextile underlayer
    - Installation of an oversized toe stone
    - Installation of double layer of underlayer stone
    - Installation of a double layer of armor stone

6.2 Plan Accomplishments

The construction of a rock revetment to replace the existing seawall will protect South Marine Corps Drive and the associated public utilities from continued and imminent damage due to storm surge and big wave events. The continued viability of South Marine Corps Drive as a major thoroughfare on the western coast of Guam will allow the US military to maintain strategic readiness and facilitate continued commercial activity and the provision of public and emergency services. At the FY23 discount rate of 2.50%, the total construction first cost of the TSP is approximately $10.77 million dollars with a fully funded construction cost estimate of $11.7 million. The TSP accomplishes the project objectives while meeting USACE engineering standards.

6.3 Cost Estimate

The fully funded cost of the TSP (Alternative 2) is $11.7 million. In accordance with the cost share provisions of Section 14 of the Water Resources Development Act (WRDA) of 1986, as amended (33 U.S.C. 2213), the federal share of the fully funded project cost is estimated to be $8.27 million, and the non-federal share is estimated to be $3.43 million.

Table 16 provides the cost breakdown for the fully funded project cost. Detailed information on project costs can be found in the Cost Engineering Appendix. Note that, for the purposes of cost estimating, environmental and cultural mitigation costs are the costs of implementing best management practices to reduce insignificant cultural and environmental effects. These costs are calculated using the upland and in-water footprints for each alternative**.** A detailed description of how these costs were derived is included in the Cost Engineering Appendix.

Table 16: Fully funded Project Cost

Construction Item Cost	Fully Funded Project Cost (FY23 Price Level; $1000s)
Construction	$6,876
LERRDs	$670
Environmental Rectification Mitigation	$305
Section 106 NHPA Mitigation	$743
Preconstruction Engineering & Design	$1,942
Construction Management	$1,171
Total Fully Funded Project Cost ($1000s)	**$11,707**

6.4 Lands, Easements, Rights-of-Way, Relocations, and Disposal

The estimated real estate cost associated with the Tentatively Selected Plan is approximately $670,000 including all recommended lands, easements, rights-of-way, relocations, and disposals (LERRDs), utility and facility relocations, and administrative costs to be carried out by the NFS and Government.

Required estates for the proposed Project include flood protection levee easements totaling 1.5 acres and temporary work area easements totaling 1.2 acres for one (1) year during project construction. Further information is available in the real estate appendix of this report.

6.5 Operations, Maintenance, Repair, Replacement and Rehabilitation (OMRR&R):

Per Engineer Pamphlet (EP) 1105-2-58 (USACE 2019), operations, maintenance, repair, replacement, and rehabilitation (OMRR&R) is a 100% non-Federal responsibility. OMRR&R costs for the TSP are estimated at 10% of project first costs, 20 years following construction.

6.6 Project Risks

The TSP, a revetment, will provide protection to South Marine Corps Drive from storm wave surge and wave attacks. The following high-risk items were identified during the plan formulation process:

The history of bombardment in Guam means that there is a high risk of encountering Unexploded Ordnance (UXO) in the study area. Encountering UXOs could lead to project delays during construction and increased cost for monitoring and mitigation. A literature review has been conducted to find FUDS sites in the study area. Further research into the likelihood of UXOs in the study area will occur during preconstruction,

engineering, and design (PED). The non-Federal sponsor is responsible for providing a clear and safe study area.

Fish and Wildlife Coordination Act (FWCA) survey information is not yet available for the study area. FWCA survey data and the recommendations of a Planning Aid Letter are necessary to know what is in the study area and its vicinity which may be impacted by the project and appropriate avoidance and minimization measures to include in Section 6.9 Environmental Commitments. This information is necessary for the completion of the Environmental Effects and Consequences analysis in Section 4 and the Endangered Species Act Biological Assessment in Appendix A-3 Attachment 5.

Historic properties and human burials may be found in the project area. There is a documented history of burials in sandy beach areas in the Pacific and known historic properties and burials in the immediate vicinity of the project APE. Encountering previously unknown archaeological or burial sites during construction could lead to project delays and increased project costs associated with cultural resources mitigation to resolve adverse effects in accordance with Section 106 of the National Historic Preservation Act (NHPA). Archaeological monitoring and cultural resources mitigation are included in the project first-cost estimate as a construction cost.

Estimated costs are subject to inflation and supply chain risks. Comprehensive documentation of cost-related risks is included in the Cost and Schedule Risk Analysis (CSRM) in Appendix 2.

6.7 Cost Sharing

The Government of Guam qualifies for Section 1156 cost-share waivers in the amount of $511,000 during the feasibility study and $665,000 during design and implementation. The design and implementation cost sharing waiver is based on the FY23 amount authorized by Congress. Because the FCSA was executed in fiscal year 2021, the feasibility study cost sharing waiver is authorized at the FY21 level of $511,000 (USACE, 2021). While CAP 14 studies are normally cost-shared at a federal to nonfederal spending ratio of 65/35, federal spending is limited to $10 million.

Table 17: Estimated Total Project and Cost Share (FY23 Price Level, fully funded)

Alt 2	Fed	Non-Fed	Total
Feasibility Phase			
FID	$100,000	$0	$100,000
Feasibility Study	$561,500	$50,500	$612,000
Total Feasibility Phase	**$661,500**	**$50,500**	**$712,000**
D&I Phase			
Construction (Incl. PED/S&A)	$11,037,000	$0	$11,037,000
LERRD		$670,000	$670,000
	$11,037,000	$670,000	$11,707,000
Adjustments			
5% Min Cash Contribution	($585,350)	$585,350	$0
Additional Cash Contribution	($2,842,100)	$2,842,100	$0
Total Before Waiver	$7,609,550	$4,097,450	$11,707,000
	65%	35%	
Sec 1156 Waiver	$665,000	($665,000)	$0
Total D&I Phase	**$8,274,600**	**$3,432,500**	**$11,707,000**
Feasibility & D&I Phases			
Feasibility Phase	$661,500	$50,500	$712,000
D&I Phase	$8,274,600	$3,432,500	$11,707,000
Total Cost Apportionment	**$8,936,000**	**$3,483,000**	**$12,419,000**

***Note: Numbers may not add up due to rounding*

6.8 Design and Construction

Expected estimated construction quantities are shown in Table 18 below. Additional detailed design will be conducted during the PED phase of the project and quantities are subject to change based on a refined design post-TSP.

Table 18: Estimated Quantities of the TSP

TSP Components:	Quantity	Unit
Existing CRM Wall Demo	933	CY
Backfill Wall	311	CY
Geotextile	5,833	SY
Revetment	2,100	Lf
Reseeding	2,800	SY
Backfill behind revetment	233	CY
Concrete stairs	1	set

The revetment design consists of a graded slope covered in two layers of underlayer and armor stone that is anchored by an oversized toe stone. The 2100 ft revetment will run parallel to the shoreline, extending approximately 22 ft seaward and has a top elevation of +9 ft MSL. A detailed description of the alternative design can be found in Section 3.4.2.

6.8.1 Design Considerations

The lidar determined topography elevations, the AEP curves, SLC curves, and results of the wave modeling were used to inform the crest elevations of the revetment and the other proposed structural alternatives based on computed runup and overtopping. With this information, it can be concluded that a new crest elevation of +9 ft. MSL or a one-ft. increase in elevation from the existing seawall elevation, is sufficient to reduce the risk of overtopping from all but the 2% AEP +2072 SLC high curve water condition.

Considering 100-yr SLR, it is expected that the low curve will still function under the current design criteria, however the intermediate and high curves will likely require additional modification of the structure height. A detailed account of engineering design considerations is included in the Engineering Appendix.

6.8.2 Construction

Construction of the revetment would occur using conventional land-based earth moving equipment. The revetment would be constructed from the toe (-2.5 ft. MSL) up to the crest elevation (+9 ft. MSL). The limestone bench will need to be excavated approximately 1 to 1.5 ft. to seat the toe stone. To accommodate the crest elevation of the structure, the existing ground will need to be excavated approximately 2.3 ft. to accommodate the 1 ft. increase in elevation. Some of the excavated material from seating the crest can be used as backfill both underneath the structure and to tie the structure back to the ground elevation. Construction of the revetment is expected to begin in 2026 and take approximately 12 months.

6.9 Environmental Commitments*

USACE and its contractors commit to avoiding and minimizing adverse environmental effects during construction activities by including the environmental commitments described in Section 4.2 and any other appropriate recommendations that arise in consultation into in the contract specifications. Due to the limited nature of construction disturbance, the activities of the proposed action are not expected to cause any long term adverse environmental effects. Environmental commitments (ECs) and BMPs would be implemented to ensure that potential construction-related effects are avoided and/or minimized to a less than significant level. Impacts to certain resources are not anticipated for the proposed action and therefore no additional minimization measures are proposed for these resources.

6.9.1 Climate Change

The resource is unaffected by the action; therefore, no environmental commitments are required.

6.9.2 Air Quality

- **EC-AQ-1** The project construction contractor shall electrify equipment, where feasible.
- **EC-AQ-2** The project construction contractor shall restrict the idling of construction equipment to ten minutes.
- **EC AQ-3** The project construction contractor shall ensure that equipment will be maintained in proper tune and working order.
- **EC-AQ-4** The project construction contractor shall use catalytic converters on all gasoline equipment (except for small [2-cylinder] generator engines).
- **EC-AQ-5** The project construction contractor shall use only solar powered traffic signs (no gasoline-powered generators shall be used).
- **EC-AQ-6** The project construction contractor shall apply non-toxic soil stabilizers according to manufacturers' specification to all inactive construction areas
- **EC-AQ-7** The project construction contractor shall enclose, cover, water twice daily, or apply non-toxic soil binders according to manufacturers' specifications to exposed stockpiles (i.e., gravel, sand, dirt) with 5% or greater silt content.
- **EC-AQ-8** The project construction contractor shall water active grading/excavation sites at least twice daily.
- **EC-AQ-9** The project construction contractor shall increase dust control watering when wind speeds exceed 15 miles per hour for a sustained period of greater than ten minutes, as measured by an anemometer. The amount of additional watering would depend upon soil moisture content at the time; but no airborne dust should be visible.
- **EC-AQ-10** The project construction contractor shall suspend all excavating and grading operations when wind speeds (as instantaneous gusts) exceed 25 mph (40 kph).
- **EC-AQ-11** The project construction contractor shall ensure that trucks hauling dirt on public roads to and from the site are covered and maintain a 50 mm (2 in)

differential between the maximum height of any hauled material and the top of the haul trailer. Haul truck drivers shall water the load prior to leaving the site to prevent soil loss during transport.

- **EC-AQ-12** The project construction contractor shall ensure that graded surfaces used for off-road parking, materials lay-down, or awaiting future construction are stabilized for dust control, as needed.
- **EC-AQ-13** The project construction contractor shall sweep streets in the project vicinity once a day if visible soil material is carried to adjacent streets.
- **EC-AQ-14** The project construction contractor shall install wheel washers where vehicles enter and exit unpaved roads onto paved roads or wash off trucks and any equipment leaving the site each trip.
- **EC-AQ-15** The project construction contractor shall apply water three times daily or apply non-toxic soil stabilizers according to manufacturers' specifications to all unpaved parking, staging areas, or unpaved road surfaces.
- **EC-AQ-16** The project construction contractor shall ensure that traffic speeds on all unpaved roads to be reduced to 15 mph (25 kph) or less.
- **EC-AQ-17** Prior to the approval of plans and specifications, the USACE shall ensure that plans and specifications specify that all heavy equipment shall be maintained in a proper state of tune as per the manufacturer's specifications.

6.9.3 Geology

The resource benefits from the action, therefore no environmental commitments are required.

6.9.4 Hydrology

The resource benefits from the action, therefore no environmental commitments are required.

6.9.5 Surface Water Quality

- **EC-WQ-1 Construction Stormwater Pollution Prevention Plan (SWPPP)**. A SWPPP shall be developed for the project by the construction contractor and filed with GEPA and Department of Public Works prior to construction. The SWPPP shall be stored at the construction site for reference or inspection review. Implementation of the SWPPP would help stabilize graded areas and waterways and reduce erosion and sedimentation. The SWPPP would define areas where hazardous materials would be stored, where trash would be placed, where rolling equipment would be parked, fueled, and serviced, and where construction materials such as reinforcing bars and structural steel members would be stored. Erosion control during grading of the construction sites and during subsequent construction would be in place and monitored as specified by the SWPPP. Construction contractors shall implement BMPs to prevent erosion and sedimentation to avoid potential release of contaminants into surface waters and groundwater according to the guidelines in the Guam Erosion and Sediment Control Field Guide (2017). These shall be incorporated into a SWPPP.

1. The contractor shall produce and submit the project specific SWPPP to the Contracting Officer for approval prior to the commencement of work. The SWPPP must meet the requirements of 40 CFR 122.26 and the conditions of any permit for stormwater discharges from construction sites.
2. Maintain an approved copy of the SWPPP at the onsite construction office, and continually update as regulations require, reflecting current site conditions.
3. The contractor shall ensure that SWPPP professionals are available to conduct site inspections and maintain BMPs all time and that a crew is available to make repairs as needed to stay in compliance with SWPPP, land use, and National Pollutants Discharge Elimination System (NDPES) permit conditions.
4. The contractor shall ensure that the USACE reviews compliance reports prior to submittal
5. The contractor shall prepare a Notice of Intent (NOI) for NPDES coverage under the general or land use permit for construction activities. Submit to the Contracting Officer for review and approval.
6. The plan would designate BMPs that would be adhered to during construction activities:
    - Erosion minimizing efforts such as straw wattles, water bars, covers, silt fences, and sensitive area access restrictions (for example, flagging) would be installed before clearing and grading begins. Mulching, seeding, or other suitable stabilization measures would be used to protect exposed areas during construction activities. During construction activities, measures would be in place to ensure that contaminates are not discharged from the construction sites. Proper installation and maintenance of equipment diapers, or drip pans.
    - A contingency plan to control and clean spilled petroleum products, hydraulic leaks, and other toxic materials.
    - Appropriate materials to contain and clean potential spills will be stored at the work site and be readily available.
    - All project-related materials and equipment placed in the water will be free of pollutants including silt.
    - Daily pre-work inspections of heavy equipment and vessels for cleanliness and leaks, with all heavy equipment operations and vessel use postponed or halted until leaks are repaired and equipment is cleaned.
    - Fueling of land-based vehicles and equipment shall take place at least 50 ft (15 meters) away from the water, preferably over an impervious surface.
    - All construction discharge water (e.g., concrete washout, pumping for work area isolation, vehicle wash water, drilling fluids) must be treated before discharge.
    - Debris and other wastes will be prevented from entering or remaining in the marine environment during the project.

- **EC-WQ-2 Hazardous Materials Management Plan and Emergency Response Plan**. The construction contractor shall prepare a project- specific hazardous materials management and hazardous waste management plan would be developed prior to initiation of construction. The plan would identify types of hazardous materials to be used during construction and the types of wastes that would be generated. All project personnel would be provided with project-specific training to ensure that all hazardous materials and wastes are handled in a safe and environmentally sound manner.
- **EC-WQ-3** The construction contractor shall prepare a Spill Prevention and Contingency Plan. The Plan shall be implemented prior to and during site disturbance and construction activities. The plan will include measures to prevent or avoid an incidental leak or spill, including identification of materials necessary for containment and clean-up and contact information for management and agency staff. The plan and necessary containment and clean-up materials shall be kept within the construction area during all construction activities. Workers shall be educated on measures included in the plan at the pre-construction meeting or prior to beginning work on the project.
- **EC-WQ-4 Conditional Notifications and Reports of Accidental Discharges of Hazardous Materials**. Following an accidental discharge of a reportable quantity of a hazardous material, sewage, or an unknown material, the contractor shall notify Guam Environmental Protection Agency (GEPA) staff.
- **EC-WQ-5** Fueling, lubrication, maintenance, storage, and staging of vehicles and equipment will not result in a discharge to any waters of the state and will be located outside of waters of the United States in areas where accidental spills will not enter or affect such waters. All fueling of equipment will be done more than 50 ft from open water. All construction equipment will be properly tuned and maintained prior to and for the duration of onsite operations. The equipment will be checked by a certified mechanic and determine to be running in proper condition before it is operated. If construction related materials reach surface waters, appropriate spill response procedures would be initiated as soon as the incident is discovered. In addition, the GEPA will be notified via email and telephone within twenty-four (24) hours of occurrence.
- **EC-WQ-6 Post-Construction**. The contractor shall visually inspect the project site for one season within the project maintenance period to ensure excessive erosion, stream instability, or other water quality pollution is not occurring in or downstream of the project site. If water quality pollution is occurring, the contractor shall notify the Contracting Officer within three working days. The Contracting Office will then notify the GEPA staff member overseeing the Project. The GEPA may require the submission of a Violation of Compliance with Water Quality Standards Report. Additional permits may be required to carry out any necessary site remediation.
- **EC-WQ-7** Cover, or two ft of free board space will be maintained on haul trucks transporting soil, sand, or other loose material on the site. Any haul trucks that will be traveling along freeways or major roadways should be covered.
- **EC-WQ-8** Vehicle speeds on unpaved roads will be limited to 15 miles per hour.

- **EC-WQ-9** Site access will be treated to a distance of 100 ft from the paved road with a 6 to 12-inch layer of wood chips, mulch, or gravel to reduce generation of road dust and road dust carryout onto public roads.
- **EC-WQ10** Idling time will be minimized either by shutting equipment off when not in use or reducing the time of idling to five minutes. Clear signage will be provided that posts this requirement for workers at the entrances to the site.
- **EC-WQ-11** Excavating will be restricted to uncontaminated areas, and any associated waste or spoils must be completely isolated and disposed of in an approved upland disposal location.
- **EC-WQ-12** Construction will incorporate best management practices described in the Guam 2017 Erosion and Sediment Control Field Guide, including a stormwater management plan and an erosion control plan.
- **EC-WQ-13** Appropriate erosion control measures will be incorporated by the construction contractor to prevent sediment from entering waterways and to minimize temporary turbidity impacts. Examples include but are not limited to straw bales/wattles, erosion blankets, silt fencing, silt curtains, mulching, revegetation, and temporary covers. Sediment and erosion control measures will be always maintained by the contractor during construction. Control measures will be inspected periodically by the construction contractor, particularly during and after significant rain events.
- **EC-WQ-14** All deliberately exposed soil or subsoil materials used in the project near water would be protected from erosion and stabilized as soon as possible with geotextile, filter fabric or native or non-invasive vegetation matting, hydro-seeding, etc.
- **EC-WQ-15** Silt curtains or other effective containment devices to help contain silt and other suspended particles placed in the water column because of excavation and construction activities will be used and properly installed to avoid degradation of adjacent coral reefs, and aquatic vegetation.
- **EC-WQ-16** Store all dredge spoil behind maintained berms above the influence of the tides.
- **EC-WQ-17** Temporary access roads and drilling pads must avoid steep slopes, where grade, soil types, or other features suggest a likelihood of excessive erosion or failure; existing access routes must be utilized or improved whenever possible, in lieu of construction of new access routes.
- **EC-WQ-18** The maximum amount of material placed shall not exceed the minimum needed for erosion protection. All material will be placed in a manner that will avoid erosion by normal or expected high flows.
- **EC-WQ-19** Implementation of design and procedural controls will prevent oil, fuel, or other hazardous substances from entering the air or water. All wastes and refuse generated by project construction will be removed and properly disposed. Contractors will implement a spill contingency plan for hazardous, toxic, or petroleum material. Applicable state water quality standards will be met.

6.9.6 HTRW

There are no HTRW in the study area.

6.9.7 Noise and Vibration

- **EC–N-1** The construction contractor shall be required to comply with any municipal noise and vibration ordinances of the Territory of Guam. Activities requiring use of heavy equipment shall be limited to the hours of 7:00 a.m. to 6:00 p.m., Monday through Saturday, except nationally recognized holidays. There shall be no construction permitted on Sunday or nationally recognized holidays unless approval is obtained prior.

6.9.8 Terrestrial & Marine Habitats and Species

- **EC-HS-1** Construction will be staged along the length of the revetment to maintain integrity of the existing wall until fully replaced and timed to avoid operations below tide.
- **EC-HS-2** Standard migratory bird protection protocols will be incorporated into the project plans and specifications. The contractor will be required to abide by those protocols and all monitoring timeframes as specified by all applicable licenses and permits.
- EC-HS-3 All tree felling or limbing will be conducted under the supervision of a licensed arborist or forester.
- EC-HS-4 All disturbed areas will be immediately stabilized following cessation of activities for any break in work longer than 4 days.
- **EC-HS-5** Temporary fills must be removed in their entirety.
- **EC-HS-6** All removed trees will be replaced with appropriate species for the location. Large trees, greater than 2-inch diameter at breast height, will be used as much as possible based nursery on availability. All areas impacted by construction must be stabilized and revegetated with native species as appropriate. Clearing will be confined to the minimal area necessary to facilitate construction activities, while all bare areas will be reseeded and maintained until grass/vegetative cover is established. All areas will be cleaned of any trash and debris and returned, as close as possible, to the condition prior to initiation of project activities.
- **EC-HS-7** Construction activities will be kept under surveillance, management, and control to minimize interference with, disturbance of, and damage to fish and wildlife. Prior to the start of construction, the contractor will submit their Environmental Protection Plan (EPP) that will describe how all relevant fish and wildlife specifications in the contract will be implemented include protective measures for species that require specific attention:
    - limit the placement and use of people and equipment in submerged areas,
    - avoid direct interactions with vegetative habitats and corals,
    - excavation and backfill will be scheduled to avoid coral spawning and recruitment periods, and sea turtle nesting and hatching periods

USACE will also include recommendations from the USFWS July 2023 Planning Aid Letter to conserve fish and wildlife resources to the extent that those recommendations can be practically implemented, are commensurate to anticipated adverse effects and

are not duplicative to other environmental commitments. Attachment 1 Appendix A-3 for the FWCA recommendations.

6.9.9 Threatened / Endangered Species / Critical Habitat

USACE will include recommendations from the 2021 PacSLOPES in the project's plans and specifications. Adverse effects to T&E species will be avoided and/or minimized. T&E species protection criteria will be included in the Contractor's EPP. Attachment 2 Appendix A-3 for the ESA Evaluation.

6.9.10 Special Aquatic Resources

ECs for fish and wildlife and endangered species are protective of other aquatic resources. There are no wetlands in the study area.

6.9.11 Invasive Species

EC IS 1 Source materials to be free of invasive species.

EC IS 2 Clean equipment to avoid moving species between locations.

6.9.12 Cultural, Historic, and Archaeological Resources

USACE will provide for an archaeological monitor who meets the Secretary of the Interior's Historic Preservation Professional Qualification Standards (62 FR 33708) to monitor all ground-disturbing construction activities to minimize potential impacts on inadvertent discoveries. USACE will work with the Guam Historic Resources Division and other stakeholders to develop a Memorandum of Agreement (MOA) pursuant to 36 CFR § 800.6 that will identify appropriate actions to minimize or resolve adverse effects on subsurface historic properties. The MOA will include a Human Remains Recovery Plan in accordance with Guam Territorial Executive Order No. 89-24; the Recovery Plan will adhere to the Guam Department of Parks and Recreation's 2010 Section IV Reburial Guidelines Amendment.

Both a cultural resource finds clause and human remains discovery clause will be included in the project specifications. If any subsurface cultural resources or burials are uncovered during construction activities, all activities will be halted immediately within the area and reported to USACE archaeological staff within 24 hours of discovery. Once reported, USACE archaeological staff will initiate coordination with the appropriate Federal and state agencies. Additional work in the area of the discovery will be suspended at the site until compliance with the executed MOA and all Federal, state, and territorial regulations is successfully completed and USACE archaeological staff provide further directive.

6.10 Environmental Operating Principles (EOP)

The TSP is consistent with the USACE Environmental Operating Principles (EOP) that were developed to ensure USACE's missions include totally integrated and sound environmental practices:

- Foster a culture of sustainability throughout the organization

- Proactively consider environmental consequences of all USACE activities, and act accordingly
- Create mutually supporting economic and environmental solutions
- Continue to meet corporate responsibility and accountability under the law for activities undertaken by USACE, which may impact human and natural environments
- Consider the environment in employing a risk management and systems approach throughout life cycles of projects and programs
- Leverage scientific, economic, and social knowledge to understand the environmental context and effects of USACE actions in a collaborative manner
- Employ an open, transparent process that respects views of individuals and groups interested in USACE activities

The EOPs were considered in the following ways:

- Both environmental and economic considerations were considered in the development of the TSP. Benefits or costs were accounted for in terms of appropriate monetary and non-monetary metrics. These considerations will be carried through the project planning, design, construction, operation, and maintenance phases of the project.
- The study team has, to the maximum extent practicable, attempted to make effective use of transparency in scoping and planning actions in order to elicit new insights from individuals and diverse stakeholder groups. The study team has coordinated with partners and stakeholders early in the process and has made a concerted effort engage the resource agencies.
- The TSP incorporates lessons learned from similar actions (e.g., other Flood Risk Management studies conducted in the region) to ensure activities avoid adverse environmental consequences.
- The study team has identified potential environmental concerns at the conceptual stage and has engaged subject matter experts within the USACE, as appropriate. Outreach to the centers of expertise was conducted (e.g., USACE nonstructural working group, Engineering with Nature). The study team also sought technical assistance from state and federal resource agencies.
- The best available science, practices, analyses, and tools are being investigated and utilized whenever possible. Data and information are being leveraged with partner agencies.
- Development of the TSP (Alternative 2) considered areas of relevant risk and plans to implement mitigation where risks exist.

6.11 Views of the Non-Federal Sponsor

Alignment for the NFS' support was coordinated with the Governor of Guam. The Government of Guam expressed support for Alternative 2 as the TSP at the June 22, 2022 TSP milestone meeting. Concurrent with the draft decision document release, the study team will coordinate a site visit to Guam to complete necessary outreach with the public, local agencies, and specific stakeholders.

7 ENVIRONMENTAL COMPLIANCE

7.1 Environmental Compliance Table

Details of environmental compliance are given by law, regulation, or policy in Section 3 of Appendix A-3

Table 19: Status of Environmental Compliance.

Law, Regulation, Policy	Status
National Environmental Policy Act	Will Comply
Clean Air Act	Not Applicable
Clean Water Act	Will Comply
Rivers and Harbors Act	Not Applicable
Marine Protection, Research, and Sanctuaries Act	Not Applicable
Migratory Bird Treaty and Conservation Acts	Will Comply
Marine Mammal Protection Act	Not Applicable
Anadromous Fish Conservation Act	Not Applicable
Fish and Wildlife Coordination Act	Compliant
Endangered Species Act	Will Comply
Magnuson-Stevens Fishery Conservation and Management Act	Will Comply
Coastal Zone Management Act	Will Comply
Uniform Relocation and Real Property Acquisition Act	Not Applicable
Farmland Protection Policy Act	Not Applicable
National Historic Preservation Act	Will Comply
Federal Water Project Recreation Act	Not Applicable
Wild and Scenic River Act	Not Applicable
Estuary Protection Act	Not Applicable
Coastal Barrier Act and Coastal Barrier Improvement Act	Not Applicable
EO 14008 Justice40	Will Comply
EO 13571 Invasive Species	Will Comply
EO 13690 Floodplain Management	Compliant
EO 13045 Protection of Children from Environmental Health Risks	Will Comply
EO 12898 Environmental Justice	Will Comply
EO 11990 Protection of Wetlands	Compliant

7.2 Public Involvement

7.2.1 Scoping

PDT Members Jeff Herzog, Troy Phan, Rachel Mesko, Chris Floyd, and Kelly Eldridge visited the project Site on January 10, 2022. Mr. Phan and Ms. Eldridge visited the site again on January 12, 2022. Scoping with federal and state agencies was performed during the two agency coordination workshops held on 8 June and 14 June 2022. Agency coordination actions are detailed in Section 7.2.2 and the Environmental Appendix.

7.2.2 Agency Coordination

PDT members Kelly Eldridge, Chris Floyd, and Troy Phan met with Mr. John Mark Joseph and Dr. Megan Edwards Alvarez of the Guam Historic Resources Department-State Historic Preservation Office to informally discuss the project area on January 11, 2022. Formal NHPA Section 106 consultation was initiated on February 25, 2022. Early

coordination and pre-consultation with NMFS and USFWS on threatened, and endangered species was conducted during a series of email conversation on March 16, 2022 (HST) and April 12, 2022 (HST). Coordination workshops were held with Guam State Historic Preservation Office; Guam Preservation Trust; Guam Coastal Management Program; Guam BSP; Socioeconomic Planning Program, and the National Marine Fisheries Service Pacific Islands Regional Office, Intergovernmental Coordination and Conservation Branch of the Protected Resources Division on 8 June 2022 (HST) and with National Marine Fisheries Service, United State Fish and Wildlife Service, United States Environmental Protection Agency; and Guam Division of Aquatic and Wildlife Resources on June 14, 2022 (HST). The purpose of these coordination workshops was to brief coordinating agencies on the preferred alternative for the project and gather their information and concerns regarding the project for incorporation into the IFR/EA.

The entire island of Guam has been designated a “coastal zone” in the context of the CZMA and all offshore islands in their entirety, including Cocos Island, under Section 923.31(a)(7) of the 306 regulations. Most of the submerged lands surrounding Guam to the Territorial Sea limit of three miles were conveyed to Guam in 1974 under Public Law 93-435. USACE evaluated the rock revetment according to the enforceable policies of the Guam Coastal Management Program to make a consistency determination as detailed below and found that the described activities have a range of coastal effects, some of which may include reasonably foreseeable effects on coastal uses or resources or direct or indirect environmental benefits.

7.2.3 Public Comments Received and Responses

As of current, no public comments have been received. A public comment period on the Draft IFR/EA will run for 30 days from release of the report. Comments received during this period will be included in the final report.

8 DISTRICT ENGINEER RECOMMENDATIONS

I have considered all significant aspects of this project, including environmental, social, and economic effects and engineering feasibility. I support Alternative 2, the TSP, for the East Hagatna Emergency Shoreline Protection Study, as generally described in this report, be approved for implementation as a federal project after approval of the final report, with such modifications thereof as in the discretion of the Commander, USACE may be advisable. The estimated total project cost (fully funded) of the TSP is approximately $11,707,000. The federal portion of the estimated total project cost is approximately $8,274,600. The non-federal sponsors' portion of the estimated total project costs is approximately $3,432,500. All amounts are in FY23 price levels.

Federal implementation of the project for emergency shoreline protection includes, but is not limited to, the following required items of local cooperation to be undertaken by the non-federal sponsor in accordance with applicable federal laws, regulations, and policies:

- Provide a minimum of 35%, up to a maximum of 50%, of construction costs, as further specified below:
    - Provide, during design, 35% of design costs in accordance with the terms of a design agreement entered into prior to commencement of design work for the project;
    - Pay, during construction, a contribution of funds equal to 5% of construction costs;
    - Provide all real property interests, including placement area improvements, and perform all relocations determined by the Federal government to be required for the project;
    - Provide, during construction, any additional contribution necessary to make its total contribution equal to at least 35% of construction costs;
- Operate, maintain, repair, rehabilitate, and replace the project or functional portion thereof at no cost to the Federal government, in a manner compatible with the project's authorized purposes and in accordance with applicable Federal laws and regulations and any specific directions prescribed by the Federal government;
- Give the Federal government a right to enter, at reasonable times and in a reasonable manner, upon property that the non-federal sponsor owns or controls for access to the project to inspect the project, and, if necessary, to undertake work necessary to the proper functioning of the project for its authorized purpose;
- Hold and save the Federal government free from all damages arising from design, construction, operation, maintenance, repair, rehabilitation, and replacement of the project, except for damages due to the fault or negligence of the Federal government or its contractors;
- Perform, or ensure performance of, any investigations for hazardous, toxic, and radioactive wastes (HTRW) that are determined necessary to identify the existence and extent of any HTRW regulated under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), 42 U.S.C. 9601-9675, and any other applicable law, that may exist in, on, or under real property interests that

the Federal government determines to be necessary for construction, operation, and maintenance of the project;

- Agree, as between the Federal government and the non-federal sponsor, to be solely responsible for the performance and costs of cleanup and response of any HTRW regulated under applicable law that are located in, on, or under real property interests required for construction, operation, and maintenance of the project, including the costs of any studies and investigations necessary to determine an appropriate response to the contamination, without reimbursement or credit by the Federal government;

- Agree, as between the Federal government and the non-federal sponsor, that the non-federal sponsor shall be considered the owner and operator of the project for the purpose of CERCLA liability or other applicable law, and to the maximum extent practicable shall carry out its responsibilities in a manner that will not cause HTRW liability to arise under applicable law; and

- Comply with the applicable provisions of the Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, PL 91-646, as amended, (42 U.S.C. 4630 and 4655) and the Uniform Regulations contained in 49 C.F.R Part 24, in acquiring real property interests necessary for construction, operation, and maintenance of the project including those necessary for relocations, and placement area improvements; and inform all affected persons of applicable benefits, policies, and procedures in connection with said act.

The recommendations contained herein reflect the information available at this time and current departmental policies governing the formulation of individual projects. They do not reflect program and budgeting priorities inherent in the formulation of the national civil works construction program or the perspective of higher levels within the executive branch. Consequently, the recommendations may be modified before they are approved for implementation funding. However, prior to approval, the Government of Guam, interested Federal agencies, and other parties will be advised of any significant modifications in the recommendations and will be afforded an opportunity to comment further.

If the IFR/EA identifies no significant impacts, the District Engineer will sign a FONSI and recommend the TSP for implementation based on economic justification and environmental acceptability. There is insufficient information at this time to make a formal recommendation.

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CHRISTOPHER RYAN PEVEY

LTC, EN

Commanding

9 PREPARERS OF THE ENVIRONMENTAL ASSESSMENT

The team members listed below provided substantial text to the East Hagatna Emergency Shoreline Protection Study IFR/EA.

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Christopher Floyd	Environmental Resources	CEPOA-PM-C-ER
Kelly Eldridge	Cultural Resources	CEPOA-PM-C-ER
Nickolas Emilio	Plan Formulation	CEPOH-PPC
Cindy Acpal	Plan Formulation/ PM support	CEPOH-PPC
Phillip Ohnstad	Cost Engineering	CENWW-ECE
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